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BRIDGING THE GAP: REAL OPTIONS FOR MEETING CANADA'S 2030 GHG TARGET

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EXECUTIVE SUMMARY

The evidence supporting climate policy is remarkably clear on three points: 1) The climate is changing as a result of human activity, imposing unprecedented risks to Canadians and the world more broadly; 2) Reducing Canada's greenhouse gas (GHG) emissions requires policy; and 3) Well-designed carbon pricing policies are the most cost-effective way to reduce emissions.

Reaching Canada's 2030 emissions target will require more stringent climate policies than those currently implemented. Canada's national price on carbon will rise to $50/tonne by 2022, but this will be insufficient to reach the country's international climate commitments. It is unclear whether policymakers will continue to increase it beyond this level.

Continued increases in Canada's carbon price might prove politically challenging. One factor may be the visibility of the costs of carbon pricing—people can often easily observe or understand the connection between the policy and higher costs (e.g., in the form of increased prices for gasoline). This high visibility could provoke opposition to increasing the carbon price beyond planned levels.

Some have suggested that Canada should adopt an alternative climate policy approach to close the gap to its emissions target—for example, one that relies on regulations with less visible costs or even options that shelter households and businesses from costs altogether. But it is often unclear what these alternatives to carbon pricing would look like in practice. For example, what specific mix of policies would be included? How stringent would they need to be to reach Canada's emissions target? And what would their cost be to the Canadian economy?

Canadians must understand their options if they are to make informed climate policy choices. This report aims to inform the debate with new evidence and new economic modelling. To do so, it answers four main questions:

1. What are the approaches Canada has available for scaling up climate policy to meet its 2030 GHG target?
2. How do the costs of these distinct approaches compare?
3. What kind of design choices would improve their economic performance? And what are the challenges in implementing more efficiently designed policies?
4. In implementing climate policy, how should policymakers weigh the trade-offs that different approaches present?

We explore each of these questions in turn.

What are the approaches Canada has available for scaling up climate policy to meet its 2030 GHG target?

Canada has a limited number of tools available to reach its 2030 target: carbon pricing, regulations, and subsidies. While other policy tools can complement these three, they cannot—on their own—drive the required emissions reductions.

Table ES-1: Three policy approaches to meet Canada's 2030 emissions target		
Available approaches	**Description**	**Policy example(s)**
APPROACH #1: Carbon pricing with dividends	Governments close the gap to Canada's 2030 target by primarily using carbon pricing to reduce emissions.	• Canada's national price on carbon rises year over year. All revenues from the carbon price remain in the province they originate in and are fully recycled back to households in the form of a rebate. • Output-based pricing applies in emissions-intensive and trade-exposed sectors as a way of protecting industry competitiveness and avoiding GHG leakage—where production and emissions relocate to jurisdictions with weaker climate policy.
APPROACH #2: Economy-wide regulations with subsidies	Governments close the gap to Canada's 2030 target using regulations and subsidies (instead of increasing carbon prices).	• As of 2020, all new equipment installed in buildings is required to be zero emissions. • Industry is required to nearly halve the GHG emissions intensity of production by 2030, relative to 2010 levels. • By 2030, governments fund nearly half the purchase costs of electric vehicles, low-emitting heating and cooling equipment, energy-saving lighting, efficient appliances, and carbon capture and storage (CCS). To pay for these subsidies, provinces raise their personal and corporate income taxes.
APPROACH #3: Industry-focused regulations with subsidies	Governments close the gap to Canada's 2030 target using subsidies and industry-focused regulations, leaving households untouched by direct costs.	• The GHG intensity of freight trucks is required to fall by half by 2030, relative to 2010 levels. • Industry is required to reduce the GHG emissions intensity of production by two-thirds by 2030, relative to 2010 levels. • By 2030, governments fund nearly two-thirds of the purchase costs of various low-carbon alternatives. To pay for these subsidies, provinces raise their personal and corporate income taxes.

Each of these tools uses a different mechanism to reduce GHGs. Carbon pricing creates market incentives for reducing GHG emissions. Regulations compel actions that reduce emissions. And subsidies financially reward them.

All three tools have costs, but the visibility of these costs can be very different:

- Carbon pricing attaches an explicit price to emitting GHGs. As a result, households and businesses can often easily connect rising fossil fuel costs to carbon pricing.
- Regulations impose costs on emitters by requiring actions they would not otherwise have taken. But households may not easily connect regulations to increasing costs.
- Subsidies require public funds, but their costs are hidden when they are broadly borne by taxpayers (now or in the future).

In this report, we consider three policy approaches that combine these policy tools in different ways. Each approach scales up policies that have, to varying extents, been implemented or proposed across Canada. Table ES-1 summarizes the three approaches.

Together, these approaches span the spectrum of options available to Canadian policymakers looking to meet Canada's 2030 target. Each represents a distinct approach, although in reality approaches that blend and combine these three approaches are also possible.

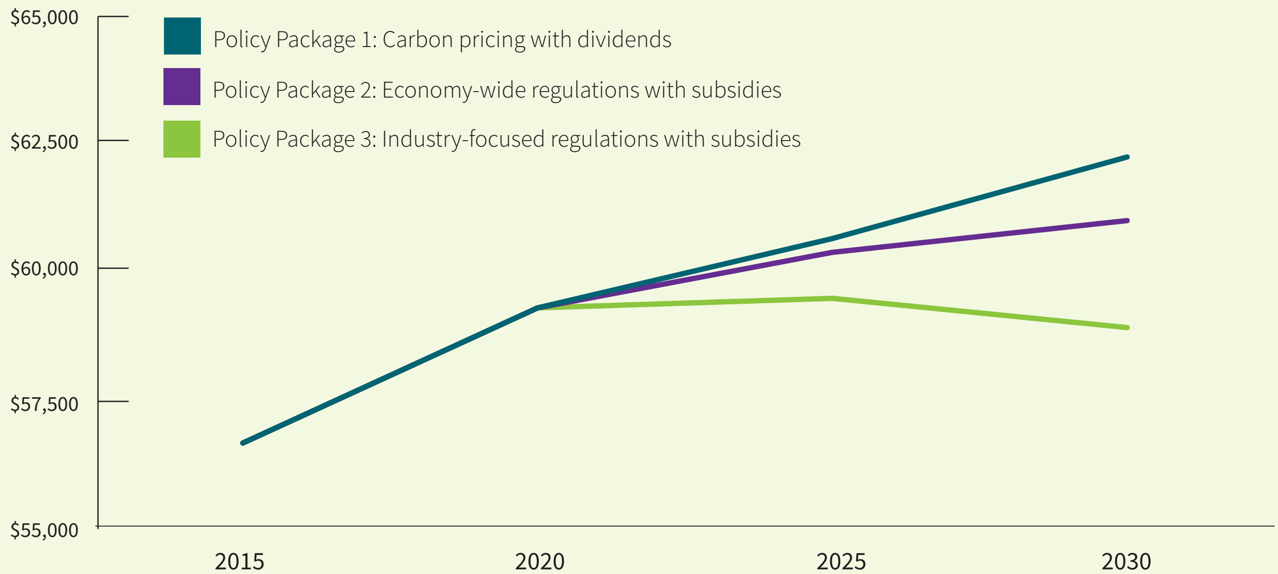
How do the costs of these distinct approaches compare?

Any of the three approaches can meet Canada's 2030 GHG target, provided they are sufficiently stringent. But they do at different costs to the economy.

We estimate the costs of different approaches using Navius Research's GTECH model. GTECH combines a detailed representation of energy-related technologies (from vehicles, to fridges, to crude oil extraction) with a detailed representation of the Canadian economy. Its technological detail and macroeconomic completeness allow us to simulate the impact of climate policies on technology adoption, energy consumption, greenhouse gas emissions, and the broader economy.

Figure ES-1 shows projected gross domestic product (GDP) per capita (i.e., average income per person) between 2015 and 2030 under each approach's policy package.

Figure ES-1: Projected 2030 GDP per capita under each of the three policy packages



This figure illustrates past and projected GDP per capita (GDP divided by population) under the three policy approaches. Projections are developed using the GTECH computable general-equilibrium model.

Three main factors explain the relative performance of the three approaches: flexibility, overlap, and coverage.

First, a policy that provides *flexibility* in terms of how households and businesses reduce their GHG emissions has a lower cost to the economy than a more prescriptive one. Carbon pricing leads to the highest average incomes in part because it is the most flexible of the three approaches. In responding to a carbon price policy, households can, for example, make their driving more efficient, take public transit, switch to a more fuel-efficient vehicle, or—alternatively—make no changes at all. In contrast, the other two policy approaches contain policies that *prescribe* particular actions. This lack of flexibility raises their overall costs to the economy.

Second, a policy approach where policies *overlap* with each other tends to have higher overall costs. The package of economy-wide regulations and subsidies contains a large total number of policies, which sometimes—mirroring policy experience in Canada—overlap in the GHG emissions they cover and the actions that they drive. For example, automakers in this policy package must meet requirements for the total share that electric vehicles comprise of total vehicle sales. But the policy package also offers subsidies toward the purchase of these vehicles. This redundancy raises overall costs.

Third, the broader the *coverage* of a policy the lower its economic costs. A policy approach that avoids imposing direct costs on households requires regulations to be focused only on sectors like industry, commercial buildings, and freight. To compensate for this narrow coverage, policymakers must make their regulatory policies extremely stringent. And they must also make their subsidies more generous. Both of these actions raise the overall costs of meeting Canada's GHG target.

What kind of design choices would improve these approaches' economic performance? And what are the challenges in implementing more efficiently designed policy?

Our modelling analysis finds that policymakers can improve the economic performance of climate policies—relative to the way they have been implemented to date—by:

- recycling the revenues from carbon pricing toward corporate and personal income tax reductions
- incorporating flexibility into their regulations by, for example, focusing on a desired level of performance instead of the means of achieving it or by allowing inter-firm compliance trading
- avoiding the use of subsidies, since using taxes to fund them can reduce investment and result in lower economic growth

Table ES-2: Visibility and cost-effectiveness of available climate policy approaches			
Policy package	**Approach**	**Cost visibility**	**Cost-effectiveness**
Policy packages based on policies already in place in Canada	**Approach #1:** Carbon pricing with revenues recycled toward per-capita dividends and output-based pricing for EITE sectors	High	High
	Approach #2: A range of regulations and subsidies applied across the entire economy	Moderate	Low
	Approach #3: A range of regulations and subsidies, excluding those that would result in direct costs for households	Low	Very Low
Policy packages based on maximizing overall economic efficiency	**Approach #1:** Carbon pricing with revenues recycled toward low-income rebates and tax cuts and carefully calibrated output-based pricing benchmarks	High	Very high
	Approach #2: A select number of flexible regulations with broad coverage across sources of emissions and limited overlap	Moderate	High
	Approach #3: A select number of flexible regulations applied only where they will not increase direct costs for households	Low	N/A (could not achieve target)

- broadening the coverage of climate policies while at the same time avoiding overlap and duplication
- coordinating individual policies to provide a consistent GHG-reduction incentive across the entire economy

Incorporating these features reduces the costs of the three policy approaches we considered—in some cases significantly. Broad, flexible, coordinated regulations, for example, can approach the cost-effectiveness of carbon pricing.

Yet implementing more-efficient policy design also presents policymakers with implementation challenges. Stakeholder influence and pressure may, for example, pull governments toward more carbon pricing rebates for households and support for industry, and away from tax reductions. Similarly, stakeholders may call for flexible regulations with more exemptions, weaker performance standards, or slower increases in stringency. Yielding to this pressure will tend to increase the cost of policy for the economy overall.

These compromises also have implications for the effectiveness of flexible regulations. To offset lost GHG reductions from weakening an individual flexible regulation, the stringency of *other* climate policies must rise accordingly. Where this does not occur, the result can be an overall policy package that does not add up to the total GHG reductions required to reach Canada's targets.

Administrative issues can also pose challenges for the design of efficient regulatory approaches in particular. To provide a consistent incentive for GHG reductions, policymakers must coordinate and calibrate the stringency of individual regulations. Yet insufficient information about the details of industry and the uncertainty of future technological change inherently limit their ability to effectively do so.

In implementing climate policy, how should policymakers weigh the trade-offs that different approaches present?

Elected politicians must balance the need for climate policy to be cost effective with the need for it to be politically viable. Their choice of policy approach can depend on a number of factors: How strong is the societal consensus that climate change is urgent and that governments need to ramp up policy action? What is the public's knowledge of the mechanics and costs of available policy tools? What kind of political coalitions and inter-party consensus exist behind them? How—and how successfully—are proposed or enacted policies communicated to the public? Is the fate of a given policy option tied to that of a political party that may be elected (or not) for unrelated reasons?

The visibility of different policy instruments' costs may also be a key factor. As Table ES-2 illustrates, approaches with lower cost visibility tend to correlate with higher overall costs to the economy. But where households mistakenly link high visibility to high costs, they may prefer alternatives to carbon pricing—even though these alternatives in fact cost more. (The table includes two versions of each approach—one based on policies as they have been implemented to date, the other on a more economically efficient design.)

Policymakers seeking to implement stringent climate policy must balance trade-offs. Where governments believe the perceived costs of carbon pricing are too high for the public to accept, it is their prerogative to explore and pursue alternatives. This report seeks to inform their policy choices by providing analysis of their available options' relative environmental and economic performance. Our recommendations, consistent with our mandate, follow from the desire to make Canadian climate policy both effective *and* cost-effective.

RECOMMENDATION #1: Governments should evaluate whether their policies are stringent enough to meet targets, and close any gaps

Canadian governments should assess how deeply their GHG policies will cut emissions and, where a gap to Canada's target remains, implement climate policy that is stringent enough to close it. If we are serious about meeting the emissions targets that successive Canadian governments have pledged in international forums, we must enact policy commensurate with the scale of the challenge.

Meeting our GHG targets is more than a matter of living up to our commitments. Meaningful action is in Canada's interest. Climate change is a monumental problem; it threatens our economy, our livelihoods, and the ecosystems we depend on for our survival. Its effects on Canada will be significant. Extreme climate events—such as heatwaves, flooding, wildfires, drought, and sea-level rise—are becoming more frequent and are already negatively affecting the health and wellbeing of Canadians. Absent policy action in both Canada and abroad, these effects will only get worse.

RECOMMENDATION #2: If governments wish to meet their climate goals at least cost, they should rely on increasingly stringent carbon pricing

The evidence from this report is consistent with numerous other studies: carbon pricing is the most cost-effective way to reduce GHG emissions. A stringent, rising carbon price can get Canada to its 2030 target at the lowest possible cost to the economy.

To make revenue recycling economically efficient, provincial governments should consider using increasing shares of revenue to reduce corporate and personal income taxes, especially as carbon prices increase over time. Doing so encourages investment and helps bolster economic growth. However, other priorities can also be legitimate, such as rebating households, funding infrastructure, paying down public debt, or investing in emissions-reducing innovation and technology. Revenue-recycling priorities will rightly vary depending on a jurisdiction's unique context and policy goals.

To create an economically efficient overall climate policy package, governments should support carbon pricing by implementing complementary climate policies that do things carbon pricing cannot. However, to be truly complementary, these supporting policies must have a clear rationale, be well designed, and be well integrated into the broader policy package.

RECOMMENDATION #3: If policymakers choose not to close the gap to Canada's emissions target using carbon pricing, they should rely on increasingly stringent flexible regulations instead

If policymakers are unwilling to increase carbon prices in line with the stringency required to reach Canada's emissions target, other, supportive policy measures will be required.

Flexible regulations can be combined with carbon pricing policies so that they collectively achieve Canada's target. To meet Canada's emissions targets using this kind of approach, carbon prices and flexible regulations must together be sufficiently stringent. The stringency required of flexible regulations will depend on how high carbon prices rise. If policymakers keep carbon prices low, flexible regulations will have to drive deeper emission cuts, which will raise the overall cost of meeting Canada's GHG target (since flexible regulations are less cost-effective than carbon pricing). We therefore recommend that policymakers adopting this approach rely on carbon pricing to drive as much GHG mitigation as possible, with flexible regulations playing a supporting role.

If policymakers choose not to use carbon pricing at all, they should use stringent, coordinated, economy-wide flexible regulations. Historically, however, climate policy approaches in Canada have relied on a mix of flexible regulations, prescriptive regulations, and subsidies that commonly overlap in coverage, creating duplication and higher costs. If climate policy is to be cost-effective, policymakers choosing not to use carbon pricing must implement the type of *efficient* flexible regulation policy package we describe in this report.

Doing so will not be easy. Developing efficient flexible regulations presents significant administrative and implementation challenges. Perhaps even more significantly, achieving the 2030 target will require regulations that are much stricter than those seen to date. This will make their costs considerably more visible to households and businesses. It is an open question how regulations' costs will be perceived by households when they are implemented at much higher levels of stringency.

A final word on cost-effectiveness

Policymakers who believe that achieving Canada's GHG targets requires compromise on climate policy cost-effectiveness should proceed with caution. While cost-effectiveness is not the only criterion they should consider, it is far from immaterial. All the approaches we assess in this report impose costs on the economy, so minimizing their costs to households and businesses is a worthwhile goal.

Compromising too much on climate policies' cost-effectiveness also presents its own risks. The more that policymakers do so, the greater the risk that the public will ultimately reject these policies—and even climate policies in general—due to their costs. This is especially significant given that stringency will need to rise under *any* policy approach. While low-visibility, high-cost policies may be easier to implement at the outset, they may prove less durable over time as stringency and costs rise.

Canada's Ecofiscal Commission has long argued for cost-effective policy to achieve environmental objectives. Cost-effectiveness may also prove critical to a politically viable climate policy approach.

We may be more likely to get effective climate policy that is durable over the long term—and consequently, achieve greater GHG reductions—if that policy also minimizes costs. The costs of climate policy are not an abstract concept. They have real implications for jobs, standards of living, and the country's economic prospects. Careful policy design may make households and businesses less resistant to meaningful, increasingly stringent climate policy.

Higher-visibility policies such as carbon pricing may be more difficult to implement at their outset. But in the end, they may be the best way forward.

CONTENTS

1 INTRODUCTION

The evidence on climate policy—from climate science, economic theory, and policy experience—is remarkably clear on three points. First, the climate is changing as a result of human activity, imposing unprecedented risks to Canadians and the world more broadly. Second, reducing Canada's greenhouse gas (GHG) emissions requires policy. Third, well-designed carbon pricing policies can reduce emissions at a lower cost than any other policy option.

Reaching Canada's 2030 emissions target will require more stringent climate policies than those currently implemented. Canada's national price on carbon will rise to $50/tonne by 2022, but this will be insufficient to reach the country's international climate commitments. It is unclear whether the carbon price will continue to increase beyond this level. Will the government rely on carbon pricing to close the gap to its 2030 target? Or will it use other measures?

The Ecofiscal Commission continues to recommend carbon pricing as Canada's climate policy of choice. Carbon pricing is the most cost-effective approach available and, as economists, we believe costs matter. The costs of climate policy have serious implications for the prosperity of households, businesses, and the Canadian economy as a whole—they are not an abstract, distant concept.

What do we mean when we talk about the costs of climate policy? Costs can come in several different forms. Households can experience costs in the form of rising prices for the goods and services they buy, reduced wages or employment, or a lower return on their savings and investments. Businesses can experience costs in the form of rising prices for their production inputs, reduced sales, or lower productivity.[1]

A policy's overall costs to the economy also matters. Looking at costs to the entire economy tells us how the costs described above balance out. It also captures the economic benefits that the policy can have: some sectors may grow while others shrink; some jobs may be created while others disappear. Focusing on a policy's costs to the economy tells us how a policy is likely to affect Canada's overall material prosperity.

How a policy's costs are distributed is also important. Previous research from the Ecofiscal Commission has examined the fairness of carbon pricing for low-income households and how government can recycle carbon pricing revenues to avoid creating disproportionate impacts on them. We have also considered how climate policy can affect emissions-intensive, trade-exposed sectors, and how policymakers can design carbon pricing to both reduce GHGs and keep Canadian companies competitive.

[1] Ultimately, *all* costs are borne by households, since households are the owners of firms. However, in this report, we use "costs to households" to refer to costs that households bear in the form of reduced wages, higher prices and higher personal income taxes. We use "costs to businesses" to refer to reduced firm profits, lost business productivity, and higher corporate income taxes.

The visibility of costs can also be an issue. A policy's costs are more visible when households and businesses can easily observe or understand the connection between the policy and higher costs. Carbon pricing, for example, directly translates into higher gasoline prices, making it easier for households to connect those costs to the policy. This high visibility may provoke opposition to increasing the carbon price beyond the planned $50/tonne by 2022. It has led some to suggest that Canada should adopt an alternative climate policy approach to close the gap to its emissions targets—for example, relying on regulations with less visible costs or policies that shelter households and businesses from costs altogether.

But it is not always clear what these alternatives to carbon pricing would look like in practice. For example, what specific mix of policies would be included? How stringent would these policies need to be to close the gap to Canada's GHG target? And what would their costs to the Canadian economy be, including both direct and indirect costs?

Canadians and policymakers must understand their options if they are to make informed climate policy choices. The purpose of this report is to inform Canada's climate policy debate with new evidence and new economic modelling. To do so, it considers four main questions:

1. What are the approaches Canada has available for scaling up climate policy to meet its 2030 GHG target?
2. How do the costs of these distinct approaches compare?
3. What kind of design choices would improve their economic performance? And what are the challenges in implementing more efficiently-designed policy?
4. In implementing climate policy, how should policymakers weigh the tradeoffs that different approaches present?

Our analysis of available climate policy approaches leads us to the following conclusions:

First, there is no free lunch when it comes to climate policy—while the benefits of climate action exceed the costs, there are still costs. The visibility of costs can vary, but all climate policy options have costs.

Second, regulations and subsidies have larger costs to the economy than carbon pricing does. Policies that avoid directly imposing costs on households by focusing on reductions from industry have the highest overall costs for the economy.

Third, economy-wide flexible regulations—if designed optimally—can come close to carbon pricing in function and in environmental and economic performance. However, implementing a package of coherent, coordinated flexible regulations is difficult to accomplish.

Fourth, low-visibility policies do not necessarily stay that way, especially if they are designed to achieve Canada's target. The costs of non-pricing policies such as regulations and subsidies become more noticeable as their stringency rises.

Based on these findings, we make three recommendations to policymakers:

1. First and foremost, we recommend policymakers enact climate policies stringent enough to reach Canada's stated GHG targets. If Canada is serious about meeting the emissions targets that successive Canadian governments have pledged in international forums, we must enact policy commensurate with the scale of the challenge.
2. To close the gap to Canada's emissions targets, we recommend governments rely on carbon pricing, as it can reduce emissions at the lowest cost to the economy. The Ecofiscal Commission stands by its previous recommendations that Canada should nationally price carbon.
3. If, however, policymakers wish to pursue other options, they should combine carbon pricing with flexible regulations. If they choose not to use carbon pricing at all, they should rely entirely on flexible regulations. These alternative approaches will cost the economy more than relying on carbon pricing, but if they are designed and implemented well, they can be much lower cost than packages based on inflexible or poorly targeted regulations and subsidies. Still, policymakers pursuing this approach should proceed with caution: implementing efficient flexible regulations is challenging, and their higher costs will become more and more apparent as their stringency rises.

The remainder of this report is structured as follows. Section 2 assesses the gap between Canada's forecasted emissions and its emissions target. Section 3 lays out the policy tools Canada can use to reduce its emissions and describes how they work. Section 4 presents three alternative approaches to climate policy that combine these policy tools in different ways, and uses new modelling analysis to assess their environmental and economic performance. Section 5 considers how the economic performance of the different approaches could be improved through better policy design and discusses some of the challenges of implementing economically efficient policy. Section 6 offers conclusions and recommendations for policymakers. Finally, Section 7 provides concluding thoughts on the importance of cost-effective climate policy.

2 POLICY CONTEXT

What is the nature of Canada's greenhouse gas (GHG) emissions challenge? To set the stage, this section reviews Canada's GHG emission targets and trends, along with the gap it will need to close with new or more stringent climate policies.

2.1 EMISSION TARGETS AND TRENDS

Policymakers understand the importance of addressing climate change. Successive federal and provincial governments have committed to reducing Canada's GHG emissions. Yet Canada has failed to achieve any of the targets it has set to date. While it has made some progress in recent years, Canada will require significantly more stringent climate policy to hit its targets.

Failing to act on climate change would have significant costs for Canada

The costs of *not* acting to reduce GHG emissions are higher than the costs of policy that addresses them. Average warming from climate change in Canada is approximately double the global average, with even greater levels of warming in the Arctic. Canadians across the country are already feeling the effects on their livelihoods, health, and wellbeing from more frequent and severe wildfires, heatwaves, and flooding. Failing to act will only make these effects worse (Bush & Lemmen, 2019; The Lancet Countdown, 2018).

Canada's contribution matters. We are the tenth largest emitter of GHGs in the world and one of the largest in per capita terms (ECCC, 2018a). In 2016, for example, the average Canadian emitted roughly 15 tonnes of GHGs—three times higher than the global average. Canadians make up 0.5% of the world population yet are responsible for 1.6% of global emissions (OECD, 2018).

Actions taken in Canada can influence global outcomes. Other countries are more likely to implement climate policies of their own when they see that Canada is acting. More critically, if a high-emitting, wealthy country like Canada does not take action to meaningfully reduce its GHG emissions, how can we expect smaller countries with lower GHG emissions or less wealth to act?

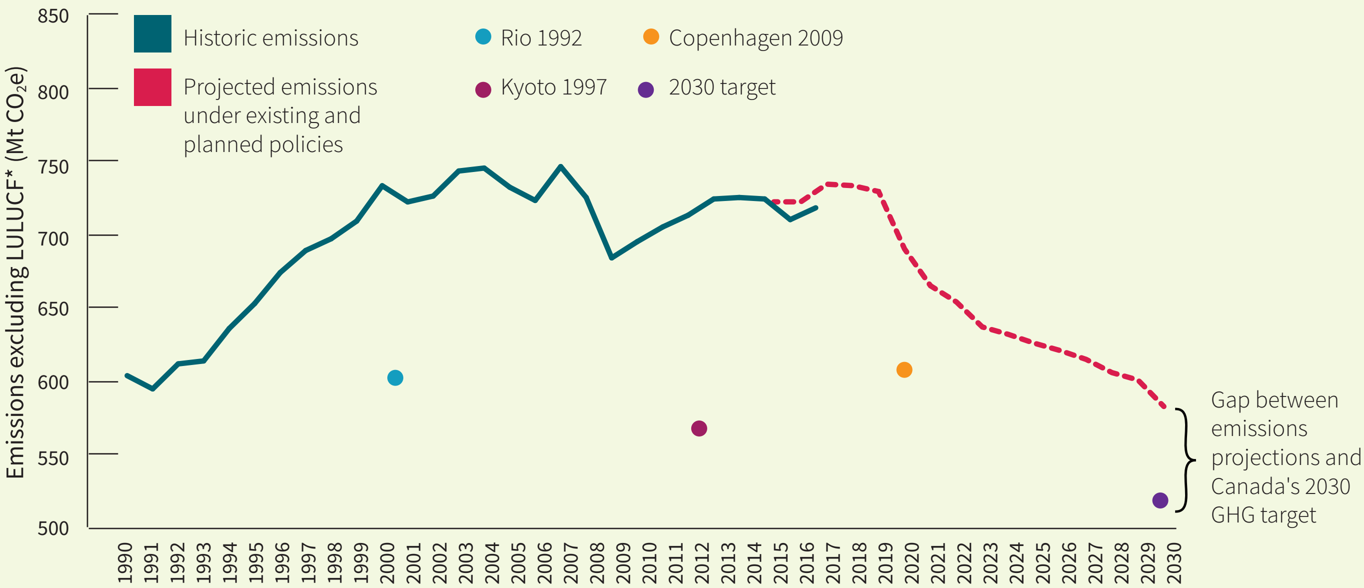
Beyond the costs of climate change, failing to act would also have economic costs for Canada. First, we may lose out on export opportunities as a result of failing to become an innovator in low-carbon technologies. Second, we may find ourselves penalized for our inaction as other countries push ahead with the own climate policies. Other countries could, for example, implement Border Carbon Adjustments (BCAs) against Canada.[2]

Federal and provincial governments have committed to reducing GHG emissions

Recognizing the costs of inaction, Canada's federal government has made successive pledges to reduce Canada's GHG emissions since

[2] BCAs are a policy tool that countries with relatively stringent carbon prices could use to address leakage and competitiveness impacts and encourage countries to adopt more stringency climate policies of their own. BCAs have two main components: import tariffs are a charge applied to imports (ensuring that imported products also have a carbon price applied to them); export rebates are a subsidy to offset relatively higher carbon costs (ensuring that a country's exported products do not face a competitive disadvantage due to domestic climate policies). These components can be combined or used separately. Although BCAs have been thoroughly researched in policy literature, they have not been implemented anywhere in the world to date (Hufbauer et al., 2009; Fischer & Fox, 2012).

Figure 1: Canada's historical and projected GHG emissions



The figure shows Canada's past and future climate targets as well as Canada's historical and projected emissions. Under existing and planned climate policies, Canada is estimated to have a 2030 emissions gap of 79 Mt. Closing this gap will require new or more stringent climate policies. (Data sources: ECCC, 2019; Cleland & Gattinger, 2019)

*LULUCF refers to land use, land use change, and forestry.

1992. But as Figure 1 shows, governments have repeatedly failed to meet these pledges.

Provincial targets tell a similar story. A recent report by Canadian auditors-general found that only two provinces were on track to meet their 2020 targets, and seven provinces did not have a 2020 target at all (Office of the Auditor General of Canada, 2018).

Canada has pledged to reduce its emissions going forward. Under the 2015 Paris Agreement, the country has committed to keeping emissions below 513 megatonnes (Mt) by 2030, representing a 30% reduction below 2005 levels. In addition, Canada has pledged to reduce emissions to 80% below 2005 levels by 2050 (ECCC, 2018b; Government of Canada, 2017a).

Emissions rose over the last several decades, but have decreased slightly since 2005

As a result of Canadian governments' failure to enact climate policies stringent enough to meet their historical GHG targets, Canada's emissions have increased substantially over the last several decades (see Figure 1). Between 1990 and 2005, for example, total emissions increased 25%, from 600 Mt to nearly 750 Mt.

Despite the steady rise in Canada's emissions, federal and provincial climate policies—for example, Ontario's 2014 phase-out of coal-fired electricity—have helped drive modest emission reductions in recent years. Between 2005 and 2016, total emissions fell from 738 Mt to 704 Mt, with some year-to-year fluctuations, including a temporary reduction following the 2008 economic crisis.

2.2 CURRENT CLIMATE POLICIES AND PROJECTED EMISSIONS

In recent years, Canadian governments have taken a number of measures to reduce carbon emissions. But more will be required if Canada is to reach its 2030 target.

All levels of government are implementing climate policy

Prior to 2016, Canada had a patchwork of climate policies. Most jurisdictions had regulations or subsidies of some sort, but the focus and stringency of these policies varied. Four provinces—British Columbia, Alberta, Ontario, and Quebec—had carbon pricing policies.

Federal climate policy ambition increased with the 2016 Pan-Canadian Framework on Clean Growth and Climate Change (PCF).

The PCF established a minimum carbon price across the country, which was implemented by the federal government in 2019. This backstop carbon price applies only in provinces and territories that do not have sufficiently broad and stringent carbon pricing policies of their own, including both Ontario and Alberta. (These provinces repealed their carbon pricing policies in 2018 and 2019, respectively, and have yet to implement any replacement climate policies.) All revenue generated by the federal carbon price is recycled in the province or territory in which it is generated (Government of Canada, 2018a; ECCC, 2016).

The PCF also includes a range of other climate policies. The federal government, for example, established regulations to phase out coal-fired electricity, decrease the use of hydrofluorocarbons (HFCs), and limit methane emissions from the upstream oil and gas sector (Canada Gazette, 2017; Government of Canada, 2017b). It is also developing a national Clean Fuel Standard, which will reduce the carbon intensity of liquid, solid, and gaseous fuels.

Taken together, the new policies under the PCF are expected to significantly reduce Canada's total emissions. As Figure 1 illustrates, ECCC forecasts that Canadian emissions levels will decline steadily through 2030, from 704 Mt in 2016 to 592 Mt (ECCC, 2019; 2018b).

More stringent policies are necessary if Canada is to meet its climate targets

Despite these concerted efforts to ramp up climate policy, Canada is still projected to miss its 2030 target. Even if federal and provincial governments implement the planned policies under the PCF on schedule, modelling by ECCC suggests that Canada will be about 79 Mt short of its 2030 target (exceeding the target by 15%).

Clearly, the stringency of Canadian climate policy will need to rise if Canada is to achieve its target. Yet debate is likely to persist about which policies Canada should use to close the gap.

[3] Provincial and territorial governments are also implementing climate policies of their own. British Columbia, for example, plans to require all new buildings to have a "net-zero ready design" by 2032 (Government of British Columbia, 2019).

[4] This may overestimate of the size of the gap. Not all planned climate policies were included in ECCC's modelling.

3 POLICY TOOLS FOR REACHING CANADA'S 2030 TARGET

This section reviews the three main policy tools that Canada can use to reduce its domestic GHG emissions: carbon pricing, regulations, and subsidies. We first show how each instrument can reduce emissions. Next, we discuss who bears its costs and benefits, and how visible these costs and benefits tend to be.

The visibility of a climate policy instrument's costs can be affected by a range of factors, such as how simple or complex the policy is to understand, how directly or indirectly households and businesses experience its costs, who ultimately ends up bearing them, and how stringent the policy is. Visibility can also be affected by outside factors, such as the broader public narrative around a policy. In this section, we focus on the elements of visibility that are inherent to particular instruments.

The policy instruments we explore in this section are not an exhaustive list. Governments have access to other climate policy tools, such as moral suasion, information campaigns, and procurement policies. They can also buy international mitigation credits. Yet while these other policy tools can complement the three instruments discussed here, they cannot—on their own—drive the required emissions reductions. Information campaigns, for example, can encourage households and businesses to reduce emissions voluntarily and make emitters more aware of their options. However, as Canada learned with its "One-Tonne Challenge" program in 2004, the effect of such measures tends to be limited when they are not backed up with stringent climate policy such as regulations or economic instruments (Government of Canada, 2006). Similarly, funding GHG mitigation abroad may provide Canada with credit toward its GHG reduction goals. However, as we discuss in Box 1, it is does not allow Canada to sidestep the need to reduce its own, domestic GHG emissions. As a result, this section focuses on the three main kinds of climate policy instruments: carbon pricing, regulations, and subsidies.

3.1 CARBON PRICING

Carbon pricing systems include carbon taxes, cap-and-trade systems, output-based pricing systems, and hybrid systems that combine these different elements into a larger scheme.

Carbon pricing policies use economic incentives to reduce GHG emissions

Pricing GHG emissions makes carbon-intensive products and activities more expensive. It gives households and businesses an economic incentive to reduce their emissions. Carbon pricing policies also generate revenue that can be used to help offset increased costs for businesses and households or create other types of benefits. Box 2 provides an example of a Canadian carbon pricing policy in action.

Households and businesses can respond to incentives from carbon pricing in whatever way makes the most sense for them. Some households may, for example, respond to a rising cost of natural gas

Box 1: A fourth option—Paying for GHG mitigation abroad

Article 6 of the 2015 Paris Agreement lays out a framework for developing internationally transferred mitigation outcomes (ITMOs). Essentially, ITMOs would allow a country like Canada to purchase or fund emissions reductions that occur in another country. The intent of ITMOs is to increase the ambition of GHG-mitigation efforts, to allow capital to flow to low-income countries where mitigation opportunities may cost less, and to improve development outcomes in low-income countries.

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) envision ITMOs doing three things: 1) formalizing internationally linked carbon markets (such as Quebec's and California's linked cap-and-trade system) in UNFCCC emissions accounting, 2) forming the basis of a crediting mechanism where governments can purchase GHG mitigation from an inventory of centrally managed projects, and 3) facilitating bilateral agreements that allow one country to claim credit for GHG mitigation that goes on in another. The details of Article 6 are still being worked out.

On their own, ITMOs do not offer a viable way for Canada to reach its emissions targets.

First, Canada's ITMOs would come at a cost. While some ITMOs can be secured though bilateral agreements rather than through the carbon markets or crediting mechanism we discuss above, in practice, bilateral ITMOs would also need to be purchased. Canada's low-carbon exports, for example, are unlikely to generate ITMOs. For Canada to receive an ITMO, the buyer country would have to voluntarily give up some of its own GHG mitigation. It is unlikely to do so unless the exports were subsidized or came with other types of support—actions that would have a cost for Canada.

Second, given the size and scale of emissions reductions that Canada must make, it would be prohibitively expensive to rely solely—or mostly—on buying ITMOs. Other countries will also be interested in buying ITMOs, which will raise their cost. And if demand significantly outstrips supply, the cost advantage that ITMOs might offer over domestic reductions could be significantly reduced or even eliminated.

Third, purchasing ITMOs does nothing to help transition the Canadian economy to a low-carbon future: the investments are happening abroad, not in Canada. As such, the short-term gain may come with the longer-term cost of reduced economic competitiveness.

Fourth, it could be years before formal rules for Article 6 are finalized. Designing and implementing an international crediting system is complicated and administratively complex. Previous systems, such as the Kyoto Protocol's Clean Development Mechanism, faced considerable challenges ensuring that credits were associated with genuine emissions reductions. ITMOs must not only be associated with reductions that are genuine, verifiable, and additional (i.e., in addition to what would have happened in the absence of funding), the system must also be ratified by the international community, which will take time.

Fifth, it's unclear whether Canada will even be able to use ITMOs as a way of meeting its targets. ITMOs were originally intended as a way of increasing ambition, rather than as a way for countries to meet their existing commitments. What will count as a legitimate use of ITMOs is still being debated in UNFCCC processes.

Overall, the opportunity to purchase ITMOs could allow Canada to secure some amount of GHG mitigation at a lower cost than what we can achieve here at home. In that sense, it might *complement* domestic policy action. And we *may* even be able to get credit for it. But ITMOs will play a supporting role at most in closing the gap to Canada's 2030 target.

Box 2: Carbon pricing in action—Quebec's cap-and-trade system

Quebec's cap-and-trade system covers 149 facilities that emit over 25 kilotonnes of CO_2e per year, or 81% of the province's emissions (ICAP, 2019; Dobson et al., 2019). Firms participate in quarterly auctions where they buy allowances to emit GHGs. There is a limited number of allowances, which corresponds to the cap. The number of allowances declines over time, reducing the total emissions that covered entities are allowed to emit (Narassimham et al., 2018). Firms with insufficient allowances to cover their GHG emissions can buy from firms with an excess. Revenues from the system are recycled toward a variety of emissions-reducing projects and initiatives.

In 2014, Quebec linked its system with California's cap-and-trade system. Firms in both jurisdictions participate in the same auctions and can trade allowance with each other. This external linking improves the overall cost-effectiveness of both cap-and-trade systems. If firms in California, for example, can reduce emissions at a lower cost, firms in Quebec benefit from a cheaper supply of allowances. Meanwhile, the firms in California benefit from the higher demand for surplus allowances (Liski, 2001; Kalaitzoglou & Ibrahim, 2015; Purdon et al., 2014).

The price on carbon emissions equals the price that allowances sell for at auctions. At the most recent auction, allowances sold for $21 per tonne (Gouvernement du Québec, 2019). Outside of auctions, the allowances can trade for different prices, but auction and trading prices are usually tightly correlated. As the cap declines over time, the allowance price tends to rise.

Firms that purchase allowances will pass some or all of their costs on to consumers. Fuel distributors, for example, pass their costs on in the form of higher fuel prices (ICAP, 2019). New modelling suggests that fuel distributors in Montreal and Québec are passing on roughly 75% of their allowance costs to consumers (Erutku, 2019). Based on an allowance price of $21/tonne, this equates to approximately 3.5 cents per litre of gasoline.

Consumers can respond to these kinds of price increases by using fuel more efficiently, by seeking alternative transportation options, or by using less fuel overall (Kameyama & Kawamoto, 2016). This lowers emissions by reducing overall fuel consumption and by shifting demand toward lower-carbon fuels (e.g., gasoline and diesel blended with biofuels).

by improving insulation around their doors and windows, others may invest in a more energy-efficient furnace or an electric heat pump, and some may not change their behaviour at all. This flexibility allows the most cost-effective GHG reduction measures to emerge through market forces.

We have ample evidence that carbon pricing works. Places that have implemented it see an increase in the uptake of low-carbon goods and services. For example, a study that isolated for the effects of British Columbia's carbon tax as it rose to $30 per tonne found that the average vehicle's fuel economy would have been four per cent lower without the carbon tax (Antweiler & Gulati, 2016).

Households and businesses can easily connect rising fossil fuel costs and carbon pricing

Because carbon pricing attaches an explicit price to emitting GHGs, its effect on the costs of fossil fuels can be highly visible to households and businesses. Drivers can, for example, often easily understand the connection between the policy and the resulting increase in gas prices when they fill up their vehicles (Harrison, 2012; Stadelmann-Steffen & Dermont, 2018; Kirchgässner & Schneider, 2003; Dijkstra, 1999).[5]

Carbon pricing's costs tend to be less visible to households when they are embedded in the products and services they buy. Generally, businesses that incur costs from carbon pricing and that sell and operate in domestic markets can pass on most of the additional costs by increasing the prices of their products.[6] Costs passed through in this way ultimately fall on households, but their connection to carbon pricing may not always be obvious.

Recycling the revenues from carbon pricing provides benefits, but households and businesses may not always be aware of them

Governments can recycle revenues generated by carbon pricing in a number of ways. For example, they can choose to return the revenues directly to households, lower existing personal or corporate tax rates, subsidize emissions-reducing innovation and technology, invest in climate change adaptation or critical public infrastructure, reduce government debt, or fund other projects and priorities (World Bank, 2016; Canada's Ecofiscal Commission, 2016a).

The visibility of these benefits depends on how carbon pricing revenues are recycled. A tax cut for example, may be visible at first; however, its visibility can diminish over time as households and businesses grow accustomed to the lower tax rate. The benefits from transferring revenues directly to households, on the other hand, are highly visible throughout time. Cheques distributed yearly or quarterly regularly remind citizens of the benefit they are receiving (Stadelmann-Steffen & Dermont, 2018). Other options tend to be less visible.

3.2 REGULATIONS

Regulations provide an alternative approach to reducing GHG emissions. Regulations require households or businesses to take GHG-reducing actions.

Regulations require businesses or households to take actions they would not have otherwise taken

Regulations can work in different ways. Some may prohibit (or alternatively, require) the use of certain technologies. For example, Canada bans most kinds of incandescent light bulbs, requiring consumers to use alternatives (e.g., CFL, LED bulbs). Others may require a certain level of environmental performance but remain neutral on how that performance is achieved. For example, Canada's Corporate Average Fuel Economy standards specify a level of average fuel efficiency required for new vehicles, but do not prescribe how auto manufacturers should meet the standards. For a discussion of prescriptive versus flexible regulations, see Box 3.

Who bears the cost of regulations will depend on what they specifically require and which sectors, activities, or technologies they target.

Businesses' awareness of the cost of regulations can vary

The cost of regulations for businesses depend on several factors. The coverage and stringency of a regulation, for example, determines how many sectors or businesses must comply with it and how difficult it is for them to do so. A regulation with higher coverage and stringency will generally lead to a larger cost increase for businesses. Costs also hinge on the extent to which businesses can pass costs on to their consumers.[7]

In general, regulatory costs tend to be less visible to firms than the costs of carbon pricing. Regulations are typically more complex than carbon pricing policies, making the link between a regulation and the resulting increase in costs less direct and more opaque (Stadelmann-Steffen & Dermont, 2018; Dijkstra, 1999). Of course, some highly regulated and emissions-intensive sectors (e.g., oil and gas production, chemical manufacturing) will be keenly aware of regulatory costs no matter how complex or indirect their effects. For example, a higher emission-intensity standard for electricity generators will increase costs for aluminum producers; manufacturers that are large consumers of aluminum will likely be

[5] The costs of a cap-and-trade scheme may be less visible to households than a carbon tax, both because the trading price for emissions allowances tends to fluctuate and because the mechanics of a cap-and-trade system are more complex than a simple dollar-per-tonne carbon tax. Still, both types of carbon pricing tend to have more visible costs relative to other instruments. We explore Quebec's cap-and-trade system as an example of a carbon pricing policy in Box 2.

[6] Not all businesses, however, can pass on their costs through higher prices. Many businesses sell their goods on international markets (e.g., steel, oil and gas, cement) and compete against foreign companies that might face weaker climate policies at home and thereby have lower carbon costs. Prices for these goods and services are determined by regional and world markets, so passing on carbon costs to consumers would put Canadian companies at a competitive disadvantage. In light of these competitiveness concerns, climate policies commonly make special provisions for sectors that are both emissions intensive and trade exposed. See Box 8 for more information.

[7] The degree to which costs are passed through from businesses to households depends on a number of factors. Goods that trade internationally may see lower pass-through, since domestic producers must compete with foreign producers that don't have the same regulatory cost burden. In these cases, domestic firms may absorb the cost in the form of reduced profitability. Market structure can also play a role. Less-competitive markets where there are a limited number of producers may see greater costs being passed through to consumers.

Box 3: Flexible versus prescriptive regulations

Climate regulations can be designed in different ways. Some regulations, for example, are performance based and require firms within a sector to meet a benchmark standard for the emissions intensity of their production (i.e., the GHG emissions associated with producing one unit of output). Benchmarks are typically set below the sector's average emissions intensity, ensuring the sector as a whole reduces emissions intensity by a designated amount. Performance-based regulations are considered *flexible* when they are technology neutral (i.e., where emitters can make use of any technologies or processes that improve their performance) and when they allow some form of compliance trading between firms.

Under a flexible regulation, emitters (e.g., fuel distributors) that have an emissions intensity above the benchmark have a choice in how they respond. One option is to reduce their emissions directly, by becoming more efficient. Another is to choose to purchase excess permits from higher-performing firms that fall below the benchmark. If the cost to buy and install a low-carbon technology is less than the market price for permits, firms will choose to reduce their emissions.

British Columbia, for example, implemented a performance-based regulation for transportation fuels in 2013 (called a low-carbon fuel standard, or LCFS). It requires fuel distributors to reduce the average carbon intensity of their fuels by 10% by 2020. The LCFS is *flexible*, in that it allows fuel distributors to meet the standard in whatever way is most economical for them and includes a market for firms to buy and sell compliance permits.

Other regulations—including command and control regulations or technology standards—*prescribe* certain technologies, practices, or outcomes that emitters must adopt. These also increase costs for emitters, as they must take actions that they would not have otherwise taken. However, because prescriptive regulations are less flexible than performance standards, the GHG mitigation they deliver tends to come at a higher overall cost. Prescriptive regulations can also reduce the incentive to innovate beyond the regulation's specific requirements (Lanoie et al., 2011; Wittrup & Murphy, 2012).

Prescriptive regulations are less common, but there are still a few examples in Canada. The federal government, along with six provinces, uses renewable fuel mandates to drive emission reductions in transportation fuels. The mandates require fuel distributors to blend minimum levels of ethanol and biodiesel with gasoline and diesel fuels. Unlike low-carbon fuel standards, however, renewable fuels mandates prescribe a specific technology (i.e., ethanol and biodiesel), which means fuel distributors have fewer compliance options. An LCFS is broader in scope and lets fuel distributors choose the most cost-effective compliance options to reduce emissions from a wider selection of fuel types (e.g., electricity, hydrogen) (Canada's Ecofiscal Commission, 2016b).

Box 4: An example of a flexible regulation: renewable electricity standards

Renewable electricity standards (RES) require power producers to generate a certain percentage of their electricity from renewable sources. Producers can either generate this power themselves or buy renewable energy credits (RECs). Producers receive RECs for every additional unit of renewable power they generate above the benchmark defined by the policy, which they can sell to producers that cannot meet the benchmark on their own (Cox & Esterly, 2016).

Utilities pass on the costs of RES to consumers through higher electricity rates (Palmer & Burtraw, 2005; Young & Bistline, 2018). Electricity prices in the 29 U.S. states with operational RES increased by an average of 11% seven years after implementation and reduced GHG emissions at a cost of between $115 and $530 per tonne (Greenstone et al., 2019).

The largest RES in Canada is in Nova Scotia. The Nova Scotia RES's target of 25% renewables by 2015 achieved meaningful emissions reductions from producers. This policy effectiveness helped the province negotiate an equivalency agreement to keep its coal plants open past 2030 (i.e., the policy sufficiently cut emissions to be deemed equivalent to the federal coal policy) (Canada Gazette, 2018).

It is difficult to estimate the degree to which the costs of the Nova Scotia RES are passed on to consumers. The sector is a regulated monopoly, and several other regulations are layered on top of the RES, including enhanced net metering, feed-in tariffs, and a commercial renewables program (NEB, 2017; ECCC, 2017; Government of Nova Scotia, 2019). In addition, annual increases in electricity rates are capped, which may be forcing producers to internalize a portion of the policy costs they would otherwise pass on (NS Power, 2017). As a result, its cost to consumers is not especially visible.

aware of the regulation's cost implications—even though they are not the target of the policy.

Households may not connect regulations with higher costs

The costs of regulations may not often be visible to the average household. Regulations that apply to upstream sectors (e.g., heavy industry) initially increase costs for those sectors. Industry can often pass some or all of these costs onto households in the form of higher prices, but households may not be aware of the connection between the regulation and the price increase (Jenkins, 2014; Ganapati et al., 2016; Fabra & Reguant., 2014).

Even when regulations target households' GHG emissions, households still may not connect the regulations to rising costs. A coal phase-out, for example, reduces the GHG emissions associated with households' electricity consumption by requiring electricity generators to stop producing coal-fired electricity. In response, generators will either retrofit their coal-fired plants to run on gas or construct new gas-fired or renewable generation capacity. The costs of these actions are recovered from ratepayers in the form of higher electricity prices; however, the link between increasing electricity prices and the coal phase-out may be difficult for households to detect and distinguish from other factors that affect prices. (We discuss the mechanics, effects, and visibility of renewable electricity standards—an alternative type of electricity sector-regulation—in Box 4.)

3.3 SUBSIDIES

Subsidies offer an alternative way to reduce GHG emissions. While regulations require GHG-reducing activities or investments, subsidies financially reward them.

Box 5: The distribution and visibility of costs under the federal public transit tax credit

The Government of Canada introduced a non-refundable tax credit for public transit in 2006. Canadians could deduct 15% of the cost of monthly transit passes from their taxable income. For example, spending $1,000 on public transit would translate to a $150 credit. The policy objective was to increase public transit ridership and reduce the number of cars on the road (Chandler, 2014). Both outcomes would reduce GHGs, although this was not the primary policy objective.

The policy was not particularly cost effective. It was found to have reduced emissions at a cost of $1,000 per tonne of GHGs (Jaccard & Rivers, 2007; Chandler, 2014). *Free ridership*—where recipients of the benefit are paid to do something they would have done anyway—was a significant problem in that many commuters already taking public transit claimed the credit. And while the tax credit did increase the number of transit passes sold, there is limited evidence that it significantly increased ridership: analysis suggests that ridership across Canada increased by only 0.25 to 1% (Chandler, 2014; Rivers & Plumptre, 2018). Moreover, its benefits were not spread equally: middle- and higher-income households were likelier than lower-income households to claim the credit (Chandler, 2014).

The tax credit cost the federal government over $100 million annually in lost tax revenues. The government ran deficits for all but one year of the program, so these costs mostly took the form of government debt—which will require future repayment plus interest. The costs of the program were therefore spread across the future tax base—a particularly low-visibility type of cost.

Subsidies drive emissions reductions by rewarding the adoption of low-carbon alternatives

Subsidies provide monetary support to households and businesses that purchase or adopt low-carbon alternatives, which helps increase their uptake. Subsidies for energy efficiency retrofits, for example, reduce the financial barriers to adopting low-carbon technologies such as heat pumps and better-insulated windows. Lowering these financial barriers results in more energy retrofits, which reduces GHGs.

Subsidies can vary in type. Direct subsidies transfer funds from government to individual recipients for specific purchases (e.g., an electric car). Governments can also use tax reductions, rebates, or credits to make low-carbon goods and services more affordable. They can also make direct investments, for example, funding research and development (R&D) or demonstration projects.

Subsidies provide tangible benefits to those that receive them

Subsidies provide material benefits to those that receive them. Often, these benefits are concentrated on a relatively narrow segment of the economy (i.e., those individuals or businesses that apply for and receive the subsidy).[8] As a result, beneficiaries of subsidies tend to be aware of the policy and the resulting financial benefit. In some cases, governments will also promote the benefits of subsidy programs, to increase public awareness and uptake.

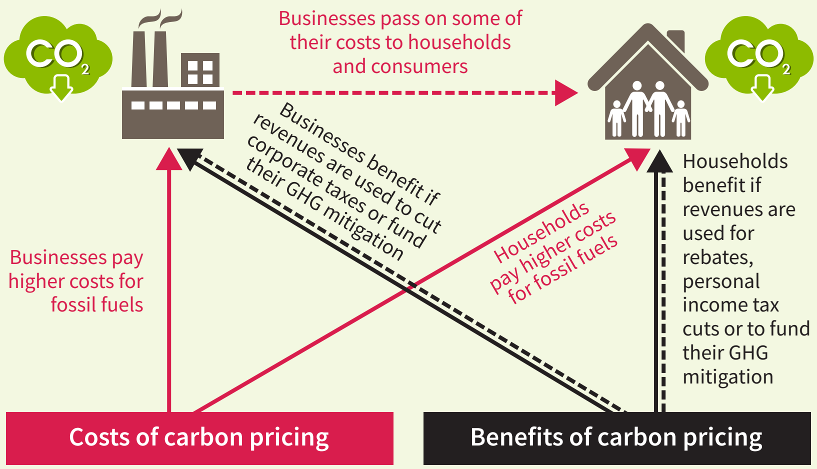
Electric vehicle subsidies are a notable example. British Columbia, Quebec, and the federal government all provide subsidies toward the purchase of electric vehicles (with federal subsidies added to provincial ones). The subsidies are substantial—up to $5,000 federally, $3,000 in British Columbia, and $8,000 in Quebec (CAA, 2019). Buyers of electric vehicles benefit substantially from these subsidies and are keenly aware of them, since they can defray a significant portion of the retail price.

Yet, while the total cost of these subsidies can be large for governments, the number of beneficiaries may be small. Phase 1 of British Columbia's electric vehicle program, for example, ran from 2011 to 2014 and subsidized 950 vehicle purchases. The program also included funding for charging stations, research and training, and outreach. The government of British Columbia estimates the program's GHG abatement at 57 kilotonnes over 15 years, giving

[8] Subsidies that provide broader, more indirect benefits (e.g., funding R&D) tend to be less visible to the public.

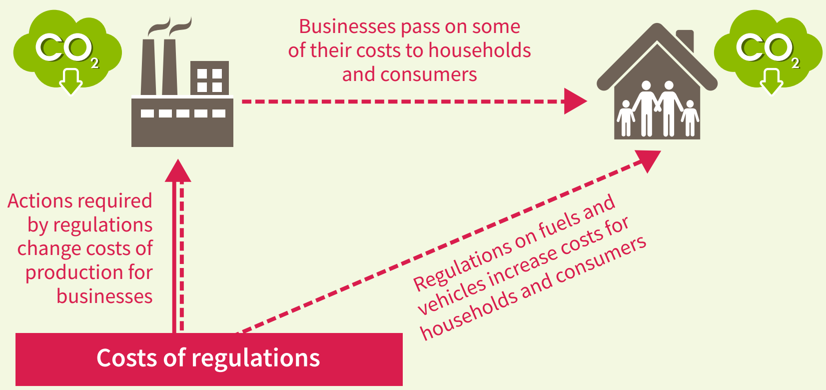
Figure 2: Visibility of financial costs and benefits of available climate policy instruments

Carbon pricing



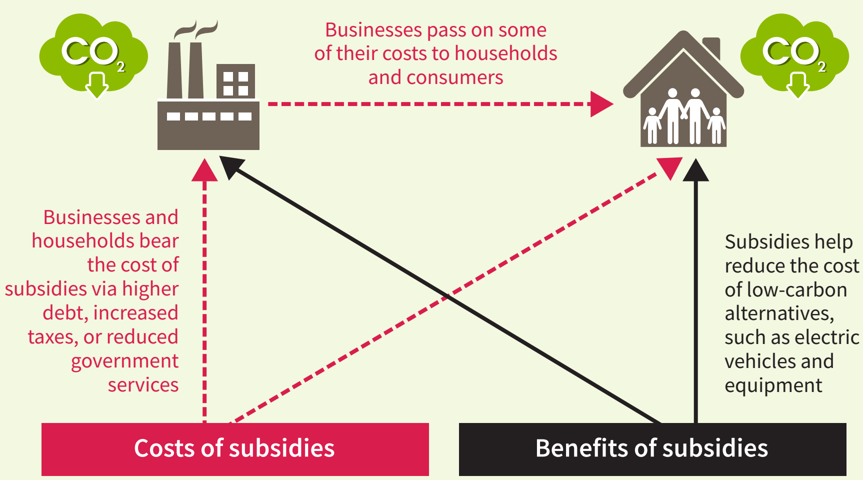
By design, carbon pricing policies make consuming carbon-intensive fuels more expensive. Some of these additional costs can be highly visible to households and businesses (e.g., increases in gasoline and diesel prices). Other costs are less visible, as businesses pass some of their higher costs on to households through higher prices for goods and services (e.g., food, building materials). The visibility of benefits from revenue recycling depends on how governments recycle revenue.

Regulations

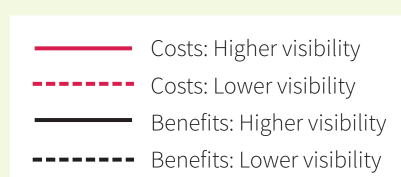


Regulations impose direct costs on households and businesses by requiring them to take actions they would not have otherwise taken. Part of businesses' costs are ultimately passed on to and borne by households; however, the link between the regulation and higher costs may not be apparent. Some regulations, such as a low-carbon fuel standard, will have a more direct and immediate impact on households. Still, costs from these regulations may not be especially visible to households, due to the opaque link between the regulation and price increases.

Subsidies



Governments can offer subsidies that encourage people to invest in low-carbon alternatives. The costs they impose tend to be less visible.



an average cost of $250/tonne for the entire program—a figure well above the mitigation costs of the province's $40/tonne carbon tax (Government of British Columbia, 2015). Moreover, electric vehicle subsidy programs tend to be regressive, since the subsidies disproportionally benefit wealthier households (Irvine, 2017a).

Subsidies have hidden costs

One way or another, the cost of providing subsidies ultimately falls on taxpayers. Governments can finance subsidies by increasing taxes, cutting spending, or taking on more debt. Taxpayers therefore bear the costs of subsidies in the form of reduced services, higher taxes, or both.

Raising taxes to pay for subsidies also has a broader economic cost: raising an additional dollar through higher taxes distorts the economy in ways that reduce investment, employment, and economic growth (Dahlby, 2008). This broader economic cost is a key determinant of the total cost of the subsidy.

Subsidies are unique among climate policy tools in that they tend to have highly visible benefits, but at the same time, costs that may not be obvious—either to their beneficiaries or the public. The costs of subsidies tend to have especially low visibility when they are broadly spread across the entire tax base (Harrison, 2012). For an example of the cost that subsidy policies can have as well as how visible those costs tend to be, see Box 5.

How governments choose to pay for subsidies can also have important implications for the fairness of a policy—i.e., whether low-income households are left better or worse off. (For a discussion of climate policy and household fairness, see Box 10.)

3.4 COMPARING INSTRUMENTS

All three main types of climate policy instruments—carbon pricing, regulations, and subsidies—can reduce GHG emissions. But they do so via different mechanisms. Carbon pricing creates market incentives for reducing GHG emissions. Regulations compel actions that reduce emissions. And subsidies financially reward them.

Notably, the lines between the instruments are sometimes blurry: regulations can include market mechanisms that create flexibility. Carbon pricing can generate revenue to fund subsidies.

While all three policy instruments create costs, the visibility of their costs to households and businesses vary. The visibility of their benefits vary as well, depending on how they are provided and to whom. Figure 2 illustrates costs and benefits from the three available climate policy instruments, who bears these costs and benefits, and their relative visibility.

Critically, the high visibility of carbon pricing's costs can be a useful feature. When consumers are aware of the connection between a climate policy and the rising cost of their GHG emissions, the policy is more noticeable. This greater salience, combined with the expectation of an increasing price, allows businesses and consumers to make more informed purchasing and investment decisions, which helps reduce the cost of emissions reductions (Rivers and Schaufele, 2012).

But visibility can also be a challenge. If individuals are keenly aware of the costs of a policy, they may be less willing to support it, especially as it increases in stringency. In fact, the costs of a highly visible policy may be perceived as being higher than the costs of a less visible alternative—independent of actual costs. Policies with highly visible costs may tend to receive less public support as a result.

At the same time, visibility and perceived costs are only two of the myriad factors that can affect a climate policy's political viability and implementation. (We return to these topics in Section 6, where we discuss visibility's broader implications for policy implementation.)

4 ASSESSING THREE CLIMATE POLICY APPROACHES

To help Canadian policymakers weigh their options for achieving Canada's 2030 GHG target, this section considers three potential approaches to climate policy. Each combines the individual policy tools we presented in Section 3 in different ways. The three approaches are representative of the policy approaches that have been implemented or proposed across Canada.

- **Approach #1:** Governments close the gap to Canada's 2030 target by primarily using **carbon pricing** to reduce emissions.
- **Approach #2:** Governments close the gap to Canada's 2030 target using **regulations and subsidies** (instead of increasing carbon prices).
- **Approach #3:** Governments close the gap to Canada's 2030 target using **subsidies and industry-focused regulations,** leaving households untouched by direct costs.

These options span the spectrum of climate policy approaches—that can deliver the required emissions reductions—available to Canadian governments. Each represents a distinct approach, although in reality approaches that blend and combine these three approaches are also possible.

We use economic modelling in this section to 1) identify and detail specific policy packages for each of these approaches and 2) evaluate the performance of each approach, in terms of its impact on Canada's GHG emissions and economy.

To do so, we use Navius Research's GTECH model. GTECH is a dynamic computable general-equilibrium model. It combines a detailed representation of energy-related technologies (from vehicles, to fridges, to crude-oil extraction) with a detailed representation of the Canadian economy. Its technological detail and macroeconomic completeness allow us to simulate the impact of climate policies on technology adoption, energy consumption, GHG emissions, and the broader economy.

To evaluate the costs of different policy approaches, the model estimates their costs to the economy, measured in terms of GDP. The model's macroeconomic perspective allows us to estimate overall economic costs in a way that aggregates both direct and indirect costs and benefits (as shown in Figure 3). In this way, it provides a useful approximation of a policy approach's expected *net* costs to the economy.

We use GDP as estimated by GTECH as a proxy for overall material living standards in Canada. Of course, GDP is not a perfect measure of overall welfare. For example, it does not include the benefits of greater leisure time or a healthier environment. But as the sum of incomes, GDP provides a useful measure of overall Canadian prosperity.

Like all models, GTECH is not perfect. For example, its results are sensitive to the choice of exogenous (i.e., external) inputs, such as how consumers respond to price changes for particular technologies and fuels.[9] The model also does not capture the benefits of reducing GHG emissions or the effect of policy-driven innovation. (For a discussion of the difficulty of modelling innovation and the complexity of prediction in general see Box 9.)

Results from the model (discussed below) are not precise predictions of the future; rather, they indicate the expected effects of different policies. The modelling helps us understand the expected *relative* performance of different policy choices better than it does their expected *absolute* performance. For more details on the modelling analysis, see Navius Research (2019).

4.1 POLICY DESIGN AND STRINGENCY

We define specific policy packages for the three approaches considered in this section by drawing on actual policies that Canadian governments have implemented to date.[10] We present the policy packages that we use to model each approach in detail below. For each approach, we provide a high-level discussion of the policy instruments it uses, followed by a detailed table presenting its individual policies as well as the stringency required to meet Canada's 2030 GHG target using them, as estimated by the GTECH model.

Approach #1: Economy-wide carbon pricing

This policy package uses carbon pricing as the primary tool for meeting Canada's 2030 emissions target.

The carbon pricing policy broadly applies to 89% of Canadian emissions. It is a two part-policy: a levy on fossil fuels and an *output-based pricing system* for large industrial emitters. All carbon pricing revenues raised under the fossil fuel levy remain in the province they originate in and are fully returned to households in that province in the form of a rebate. This approach follows the model of the federal government's backstop carbon pricing policy, but goes beyond the current plan to increase prices to $50/tonne in 2022. In this policy package, the price of carbon rises to $210 per tonne by 2030, which GTECH estimates as the price level needed for Canada to reach its Paris Agreement target in 2030.[11]

Also consistent with the federal backstop, the package uses output-based carbon pricing for large industrial emitters. It applies output-based pricing in emissions-intensive, trade-exposed (EITE) sectors to protect competitiveness and reduce GHG leakage while still maintaining incentives to reduce emissions (see Box 8). Revenues from output-based systems are recycled into a fund that goes toward R&D for GHG-mitigation technologies in EITE sectors (Beale et al., 2015; Fischer & Fox, 2004, 2011; Government of Canada, 2018a, 2018b).

The policy package also includes a number of gap-filling regulatory policies that cover emissions that carbon pricing cannot easily address. For example, the package includes requirements for landfills to capture methane emissions, a policy already in place in a number of provinces, but extended nation-wide for the purpose of this analysis. Emissions from methane leaks are diffuse, making them hard to measure. As a result, they are difficult to include within a carbon pricing policy (Canada's Ecofiscal Commission, 2017).

The package also assumes that a number of existing, non-pricing climate policies remain in place across Canada. This includes, for example, the federal government's national energy-efficiency standards for appliances and its corporate average fuel economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard (see Navius Research, 2019 for more information). A number of these policies overlap in coverage with the carbon price policy we model. These existing policies can have a role to play when they provide offsetting co-benefits or when they cost-effectively address market problems that impede carbon pricing's efficient operation. Failing that, existing policies will raise the overall costs to the economy.

Table 1 summarizes the details of the policies in this package, including the policy stringency required of each policy for the overall package to achieve Canada's 2030 target.

9 As much as possible, the model incorporates peer-reviewed empirical estimates of these variables. And we subject the modelling results to sensitivity analysis, to test their resilience to alternative assumptions.

10 To help define these policy packages, we convened a group of climate policy experts, including both Ecofiscal Commissioners and external experts. The policy packages in this report are the result of discussion and debate between these experts. Experts included Sara Hastings-Simon, Senior Fellow at the Pembina Institute; Mark Jaccard, Professor at Simon Fraser's School of Resource and Environmental Management; Dave Sawyer of EnviroEconomics; and Trevor Tombe, Associate Professor at the University of Calgary's Department of Economics; as well as several Ecofiscal Commissioners.

11 All cost figures are in 2019 Canadian dollars. See Box 6 for a discussion of the implications of a stringent, rising price on carbon.

Table 1: Policy package for Approach #1: Economy-wide carbon pricing			
Policy	**Description**	**Real-world examples**	**Details and required stringency**
Carbon pricing	A national, uniform, rising price on carbon. The price is applied to all heating, cooking, and transport fuels.	British Columbia's carbon tax; Quebec's cap-and-trade system; the federal government's carbon pricing backstop	Carbon price rises to $210/tonne in 2030[12] (see Box 6 for a discussion of the implications of a stringent, rising price on carbon)
Revenue recycling	All carbon pricing revenues are recycled in the form of per-capita dividends. All the revenues raised by the tax remain in the province they originate in.	Federal government's Climate Action Incentive payments	All revenues raised in a province are distributed equally across that province's residents. Dividends vary across provinces, from an estimated low of $268/person in Quebec in 2030 to an estimated high of $4,030 in Saskatchewan. (See Annex 1 for a breakdown of estimated dividends across provinces.)
Output-based pricing	Provinces implement output-based pricing for emissions-intensive, trade-exposed (EITE) sectors to address competitiveness pressures and avoid GHG leakage (see Box 8). Firms receive emissions credits based on a sector-average emissions intensity and pay a carbon price on any emissions that exceed this benchmark.	Federal government's output-based pricing system; Alberta's output-based pricing system; free permit allocations in Quebec's cap-and-trade system[13]	Benchmarks are set at 90% of sector-average combustion GHG emissions per unit of output. The carbon price firms pay on emissions above the benchmark is set in line with the national price. Output-based pricing system revenues are recycled into a R&D fund for EITE sector mitigation technology.
Gap-filling policies	A regulation for the agricultural sector that requires methane to be captured from manure and used to make renewable natural gas	Alberta regulations on how manure should be managed	By 2030, 50% of feedlots with proximity to a pipeline are required to capture methane.
	A regulation requiring solid waste disposal facilities to flare methane or capture it for the production of electricity or renewable natural gas	Ontario's Landfill Gas Regulations; Manitoba's Prescribed Landfills Regulation	50% of landfills not currently flaring or capturing methane must do so by 2030
Other existing policies	Existing policies include the federal government's national energy efficiency standards for appliances and Corporate Average Fuel Economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard. See Navius Research (2019) for more details.		

12 As we discuss above, modelling results should be interpreted as indicative of expected costs and impacts, rather than being precise estimates. Indeed, a $210/tonne carbon price may be an overestimate, since it does not account for new low-carbon innovation that can help lower costs. We discuss the complexity of modelling innovation in Box 9.

13 Alberta in fact has had three iterations of an output-based pricing system for large emitters: the Specified Gas Emitters Regulation (SGER), the Carbon Competitiveness Incentive Regulation (CCIR), and the planned Technology Innovation and Emissions Reduction (TIER) regime.

Box 6: The effects of a rising carbon price

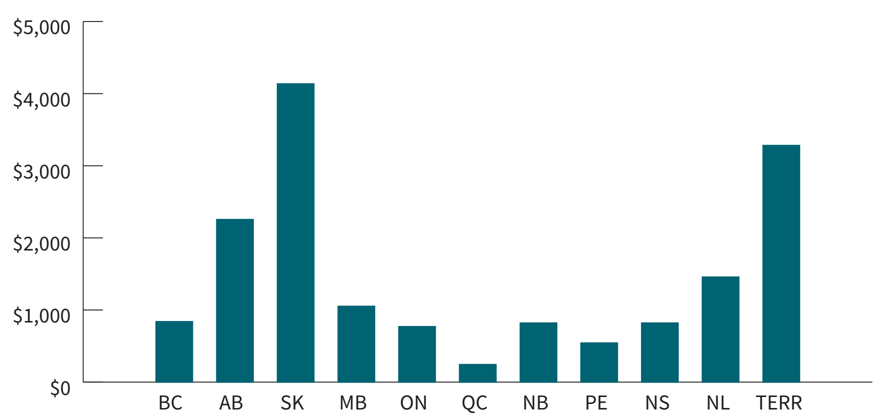
Several factors will offset the effects of gradually rising carbon prices, including behavioural change, technological change, and rebates that will rise over time alongside the carbon price. Our modelling finds that a carbon price that rises from $30 per tonne in 2020 to $210 per tonne in 2030 can meet Canada's Paris target. This translates into a 3.8 cents per year average annual increase the price of gas. This gradual increase gives businesses and households time to respond and prepare, which helps reduce the overall costs of the policy.

Rising carbon prices will prompt behavioural changes. For example, a carbon price will make alternative forms of transportation (carpooling, cycling, public transit, etc.) more attractive for many Canadians. Some may adopt or mix in these alternative modes almost immediately, while others may change their behaviour only over time. Others may not modify their behaviour at all. Carbon pricing drives substantial changes in behaviour and emissions in the aggregate. Evidence shows this has been the case in British Columbia, which has had a carbon tax since 2008 (Murray & Rivers, 2015; Rivers & Schaufele, 2015; Lawley & Thivierge, 2016; Antweiler & Gulati, 2016; Bernard & Kichian, 2018; Xiang & Lawley, 2019).

Over time, households will have more and more options in how they can respond to carbon pricing. Rising carbon prices will accelerate low-carbon innovation throughout the economy. These innovations will drive technology costs down and lead to the development of altogether new technologies, making lower-carbon alternatives increasingly accessible. Households and businesses that do not respond to carbon prices right away will have more incentives to respond over time, and more choice in how they do so. For example, several analyses suggest that upfront costs for electric vehicles will reach parity with internal combustion engines within the next five years (Popp, 2016; Soulopolous, 2017; Bullard, 2019).

Critically, as carbon prices rise, carbon rebates will rise as well. Rebates help defray the cost of carbon pricing policies and give households greater capacity to invest in low-carbon alternatives. Our modelling indicates that the per-capita dividends from a national carbon price of $210/tonne would be substantial, particularly in more emissions-intensive regions like Alberta, Saskatchewan, and Canada's territories, as shown in Figure A. Because the size of the rebate is unrelated to personal GHG emissions, households have an ongoing and growing incentive to reduce emissions. Crucially, regulatory approaches and subsidies cannot generate revenues that can offset policy costs for households; this policy feature is unique to carbon pricing.

Figure A: Per-capita dividends in 2030 resulting from recycling carbon pricing revenues back to households under Approach #1: Economy-wide carbon pricing



Approach #2: Economy-wide regulations and subsidies

This policy package relies on a mix of regulations and subsidies to close the gap to Canada's 2030 target.[14] The package's *non-pricing policies* cover the full range of emissions in the economy. As Table 2 illustrates, the policies include a cross-section of regulations and subsidies, many of which replicate policies already implemented by various governments in Canada.

While the types of policies in this package are familiar, their stringency is dramatically higher than the policies that inspired them. Aggressive regulations and subsidies are required to achieve the 2030 target. (For a discussion of the policy stringency required to meet Canada's emissions target using regulations and subsidies, see Box 7.)

The policy package includes both flexible and prescriptive regulations (see Box 3), reflecting real choices that governments have made in Canada. For example, Quebec's zero-emissions vehicle (ZEV) regulation requires manufacturers to sell a specific share of ZEVs in their new vehicle sales each year. The policy offers flexibility to automakers in how they comply: they can, for example, increase their investment in ZEV production and sales capacity, cross-subsidize ZEVs by raising the price of other vehicles that they sell, or purchase compliance credits from automakers that can more easily meet the policy's requirements. While the ZEV mandate we model drives only a narrow subset of emissions reductions (i.e., those generated by switching to ZEVs), it is very stringent—the policy requires that by 2025 nearly one in four of new vehicles sold must be ZEVs.

Some of the regulations in the policy package are less flexible because Canadian governments continue to implement regulations that are prescriptive in terms of how emitters reduce GHG emissions. For example, the federal government—and six provinces—require that fuel distributors blend minimum levels of biofuels with gasoline and diesel. In the policy package we model, the stringency of these existing regulations increases significantly over time.

To reflect the current policy context in Canada, the policy package also includes a range of subsidies for investment in low-carbon products and technologies, such as more efficient heating/cooling systems, appliances, lighting, etc.; public transit; and carbon capture and storage (CCS). Subsidies in the package are funded in-province, by increasing the province's personal and corporate income taxes.

Also reflecting the current policy landscape, some of the policy measures in this package overlap in terms of the GHG emissions to which they apply and the actions they drive. For example, vehicle emissions in Quebec are targeted using both a ZEV mandate and electric vehicle subsidies. As a result, there is also overlap in the emissions reductions that they both drive.[15]

Table 2 summarizes the details of the policies in this package, including the policy stringency required of each policy for the overall package to achieve Canada's 2030 target.

[14] Canada's current national price on carbon (along with a number of other existing climate policies) is included in this policy package; however, it does not increase beyond the planned $50/tonne by 2022 laid out in the PCF; therefore, additional policies are needed to close the gap to Canada's 2030 target.

[15] The total GHG reductions that the GTECH model estimates for a given policy approach account for this kind of overlap. GHG reductions are not double-counted.

Table 2: Policy package for Approach #2: Economy-wide regulations and subsidies			
Policy	**Description**	**Real-world examples**	**Details and required stringency**
Tax increases	To fund the various subsidies used in this policy package, provinces raise taxes.	British Columbia partly funds its GHG-reducing subsidies out of its general revenues.	Provinces raise their existing mix of personal and corporate income taxes to the degree necessary to support the additional expenditure associated with the subsidy programs described below. The increase in tax rates varies across provinces.[16] For example, combined average 2030 provincial and federal personal income tax rates rise 1.9 percentage points in Ontario, versus 3.6 in New Brunswick.
Agriculture sector regulation	A regulation requiring methane to be captured from manure, used to make renewable natural gas	Alberta's regulation for manure management	By 2030, 50% of feedlots with proximity to a pipeline are required to capture methane.
Buildings sector regulations and subsidies	A regulation on heating and cooling equipment used in buildings	BC's Energy Efficiency Standards Regulation	All new equipment installed after 2020 must be zero emissions. For space and water heating, heat pumps must be used.
	Rebates and other incentives for the adoption of GHG-reducing building technologies	NS government rebates households for upgrades to energy efficient heating systems	Rebates on the purchase of low-emitting heating and cooling equipment, energy-saving lighting, efficient appliances, etc. return 28% of purchase costs between 2020 and 2025 and 47% between 2025 and 2030.
Electricity sector regulations and subsidies	Standards for the share of electricity generated from renewable sources	SaskPower requirements to make 50% of generation capacity renewable by 2030; NS's Renewable Electricity Standard	Standards differ by province, ranging from 30–40% by 2030 for coal-dependent provinces to 99% for hydro-dependent provinces.
	Public investment in renewable electricity generation capacity and carbon capture and storage (CCS) technology	SaskPower investment of over $1 billion in carbon capture and storage	Subsidies are 28% of capital costs between 2020 and 2025 and 47% between 2025 and 2030.
Industry sector regulations	Provincial standards for the emissions intensity of production in the industry sector	Saskatchewan's output-based performance standard	The standards require a 28% reduction in a province's GHG intensity of industrial production by 2025 and a 47% reduction by 2030 (relative to 2010 levels), with compliance obligations tradable across industrial sub-sectors but not across provinces.

[16] Rather than using individual marginal rates at different income brackets, the GTECH model uses an effective overall average tax rate. Provincial and federal taxes are combined in the model. As a result, the tax rates in this report refer to an individual province's combined federal and provincial effective corporate or personal income taxes.

Policy	Description	Real-world examples	Details and required stringency
Transport sector regulations and subsidies	Requirements for the share that partial or zero-emissions vehicles (ZEVs) comprise of total new vehicle sales	Quebec's Zero Emission Vehicle Standard; BC's proposed Zero Emission Vehicle Standard	The mandate requires 28% of new vehicles sold between 2020 and 2025 to be ZEVs and 19% to be fully electric, rising to 47% and 34% (respectively) between 2025 and 2030.
	Emissions standards for new vehicles sold in Canada	Government of Canada's Corporate Average Fuel Economy standards	The standard requires grams of CO_2e per vehicle kilometre travelled by heavy-duty vehicles to fall to 108 by 2025 and to 92 by 2030. It also tightens the existing standard for light-duty vehicles, requiring 96 grams of CO_2e per vehicle kilometre travelled by 2025 and 63 by 2030.
	A tightening of the standard for minimum renewable fuel content in gasoline and diesel	Manitoba Renewable Fuel Standard; Ontario Greener Diesel Regulation	The regulation requires 28% renewable fuel content by 2025 and 50% by 2030.
	A regulation on the average carbon intensity of new freight trucks sold	Federal government's Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations	The standard requires the average carbon intensity of new freight trucks sold to be 34% lower than their 2010 level by 2025 and 44% lower by 2030, with compliance trading permitted.
	Investment in public transit	Over $1.5 billion in revenues from Quebec's cap-and-trade system invested in public transit	Subsidies of 28% of investment costs are provided between 2020 and 2025, rising to 47% between 2025 and 2030.
	Per-vehicle subsidies for the buyers of partial or zero-emissions vehicles	BC's CEVforBC program; QC's Roulez Electrique program	Subsidies of 28% of purchase costs are provided between 2020 and 2025, rising to 47% between 2025 and 2030.
Waste sector regulation	A regulation requiring flaring of methane or capture for the production of electricity or renewable natural gas	Ontario Landfill Gas Regulations; Manitoba Prescribed Landfills Regulation	50% of landfills not currently flaring or capturing methane must do so by 2030
Other existing policies	Existing policies include the federal government's national energy-efficiency standards for appliances and Corporate Average Fuel Economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard. They also include a federal price on carbon that rises to $50/tonne by 2022. See Navius Research (2019) for more details.		

Box 7: Meeting Canada's 2030 target using regulations and subsidies requires very stringent policy

Using regulations and subsidies to close the gap to Canada's 2030 GHG target will require much more stringent policy than any climate policies implemented in Canada to date. Regulatory policies will require deep changes in Canada's buildings, electricity, and transport sectors (to name a few). And subsidies for things like electric vehicles, energy-efficient products, and carbon capture and storage (CCS) technologies will require significant amounts of public funds raised via taxes.

Under the policy package in Approach #2, for example, subsidies will cover nearly half the purchase costs of electric vehicles, low-emitting heating and cooling equipment, energy-saving lighting, efficient appliances, and CCS technologies. Funding these subsidies will require significant tax increases. Our modelling estimates that combined effective average 2030 provincial and federal personal income tax rates would, for example, have to rise 2.5 percentage points in Nova Scotia to fund these subsidies. (See Figure 4 and Figure 5 in the Annex for a summary of tax rate changes across provinces.)

Regulations in the policy package would have significant implications for Canadians' lives and businesses. For example, starting in 2020, all new equipment installed in buildings would have to be zero-emissions. As a result, only electric heat pumps could be installed for home heating; gas furnaces would no longer be permitted. Canada's industrial sectors (e.g., oil and gas, cement, chemical manufacturing) would be required to complete a near-halving of their emissions intensity of production (relative to 2010 levels) by 2030.

Even though Approach #2 does not rely on carbon pricing, the emissions reductions it would drive have clear costs for the Canadian economy. The package would require significant additional investment. In some cases, the regulations would require the retirement of capital stock before the end of its useful life. This level of capital stock turnover and GHG-abatement technology investment will inevitably lead to increased costs.

The price that compliance obligations trade at under the regulatory policy for industry—its implicit carbon price—is telling. In Newfoundland and Labrador, for example, our modelling estimates the price of tradable compliance credits would cost $350 per tonne in 2030—well above the carbon price level needed to reach Canada's target under Approach #1.

Approach #3: Industry-focused regulations and subsidies

This policy package relies on a range of non-pricing policies to close the gap to Canada's 2030 target.[17] In contrast to Approach #2, however, it excludes all regulatory policies that would impose direct costs on households. Regulations in the policy package raise costs for households *indirectly*; for example, industry sector regulation results in higher prices for goods and services that use industrial output.[18] However, the policy package contains no regulations that would directly increase the costs of driving, home heating, or electricity. To address these sources of emissions, this approach relies strictly on subsidies.

Focusing regulations only on sources of emissions that do not raise direct costs for households results in much narrower regulatory coverage than the package seen in Approach #2. In order to achieve Canada's 2030 target using this narrower coverage, regulations must be significantly more stringent. For example, industry-sector regulations in this package require a 68% reduction in the emissions intensity of industrial production by 2030, compared to only a 47% reduction in Approach #2.[19]

While households are not subject to regulation in this policy package, they benefit from the same set of subsidies outlined in Approach #2. These subsidies include, for example, rebates for purchasing GHG-reducing building technologies, subsidies for ZEVs, and investment in public transit. Also similar to Approach #2, subsidies in this policy package are funded by raising a province's personal and corporate income taxes.

To make up for the narrower emissions coverage in this policy package, however, subsidies are more generous than those in Approach #2. For example, subsidies for renewable electricity and carbon capture and storage technologies rise to 48% and 59% of capital costs by 2025 and 2030, respectively, compared to the 24% and 47% provided under Approach #2. Funding this policy package's subsidies in-province requires significant tax increases. For example, in Alberta, combined average provincial and federal average 2030 personal income tax rates must rise 11 percentage points.[20]

Table 3 summarizes the details of the policies in this package, including the policy stringency required of each policy for the overall package to achieve Canada's 2030 target.

Table 3: Policy package for Approach #3: Targeted industry regulations with subsidies

Policy	Description	Real-world examples	Details and required stringency
Tax increases	To fund the various subsidies in this policy package, provinces raise taxes	See Table 2	Provinces raise existing personal and corporate income taxes to the degree necessary to support the additional expenditure associated with subsidy programs. The increase in tax rates varies across provinces. For example, combined effective 2030 provincial and federal average corporate income tax rates rise from 3.1 percentage points in Manitoba versus 3.7 in British Columba (see the Annex's Figure 7 and Figure 8 for a breakdown of tax increases by province).
Agricultural sector regulation	A regulation that requires methane to be captured from manure, used to make renewable natural gas	See Table 2	By 2030, 50% of feedlots with proximity to a pipeline are required to capture methane.

[17] Canada's current national price on carbon (along with a number of other existing climate policies) is included in this policy package; however, it does not increase beyond the planned $50/tonne by 2022 laid out in the PCF. Therefore, additional policies are needed to close the gap to Canada's 2030 target.

[18] Another example of a regulatory policy that results only in indirect costs is the regulation requiring commercial vehicle fleets to meet tougher fuel efficiency standards. Such a policy would increase trucking costs, which freight companies would pass onto shippers throughout the economy who rely on ground transportation to buy and sell their goods. Eventually, shippers would pass a portion of these regulatory costs onto households through higher prices for groceries, clothes, electronics, and any good or service transported by truck. However, households cannot readily observe the link between these increased costs and the regulatory policies.

[19] This higher stringency makes Approach #3's industrial regulation less effective at addressing leakage and competitiveness issues (see Box 8).

[20] See the Annex's Figure 8 and Figure 9 for a breakdown of tax increases by province.

Policy	Description	Real-world examples	Details and required stringency
Buildings sector policies	Rebates and other incentives for the adoption of GHG-reducing building technologies	See Table 2	Rebates on the purchase of low-emitting heating and cooling equipment, energy-saving lighting, efficient appliances, etc. return 53% of purchase costs between 2020 and 2025 and 68% between 2025 and 2030.
	A regulation on heating and cooling equipment used in commercial buildings	See Table 2	All new equipment installed after 2020 must be zero emissions. For space and water heating, heat pumps must be used.
Electricity sector subsidies	Public investment in renewable electricity generation capacity and carbon capture and storage (CCS) technology	See Table 2	Subsidies are 53% of capital costs between 2020 and 2025 and 68% between 2025 and 2030.
Flexible regulations for industrial sectors	Provincial standards for the emissions intensity of production in the industry sector	See Table 2	The standards require a 53% reduction in a province's GHG intensity of industrial production by 2025 and a 68% reduction by 2030 (relative to 2010 levels), with compliance obligations tradable across industrial sub-sectors but not across provinces.
Transport sector policies	Investment in public transit	See Table 2	Subsidies of 53% of investment costs are provided between 2020 and 2025, rising to 68% between 2025 and 2030.
	A regulation on the average carbon intensity of new freight trucks sold	See Table 2	The standard requires the average carbon intensity of new freight trucks sold to be 44% lower than their 2010 level by 2025 and 52% lower by 2030, with compliance trading permitted.
	Per-vehicle subsidies for buyers of partial or zero-emissions vehicles	See Table 2	Subsidies of 53% of purchase costs are provided between 2020 and 2025, rising to 68% between 2025 and 2030.
Waste sector regulation	A regulation requiring flaring of methane or capture for the production of electricity or renewable natural gas	See Table 2	50% of landfills not currently flaring or capturing methane must do so by 2030
Flexible regulations for industrial sectors	Existing policies include the federal government's national energy-efficiency standards for appliances and Corporate Average Fuel Economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard. They also include a federal price on carbon that rises to $50/tonne by 2022. See Navius Research (2019) for more details.		

Box 8: Managing competitiveness impacts and leakage in the three policy packages

Stringent climate policies increase costs for emissions-intensive firms and sectors. Yet firms that export their goods on international markets are unable to pass on these additional costs to their customers. Prices are determined by regional and world markets, so passing on carbon costs would put these firms at a competitive disadvantage, risking a loss in jobs and income. Some sectors, such as oil and gas, steel, cement, and fertilizer are particularly vulnerable to these kinds of competitiveness pressures (Beale et al., 2015; Carbone & Rivers, 2017; Wood, 2018).

Emissions leakage is the other side of the competitiveness issue. If stringent climate policy in Canada causes production or investment to relocate to jurisdictions with weaker policy, an increase in global emissions may offset (or even exceed) the reduction in domestic GHG emissions.

The sectors exposed to competitiveness pressures in Canada is small relative to the size of the economy (about 5% of GDP). However, the risks are both real and significant for firms in those sectors. In some provinces—such as Alberta and Saskatchewan—EITE sectors make up a larger share of the economy (around 18% of provincial GDP).

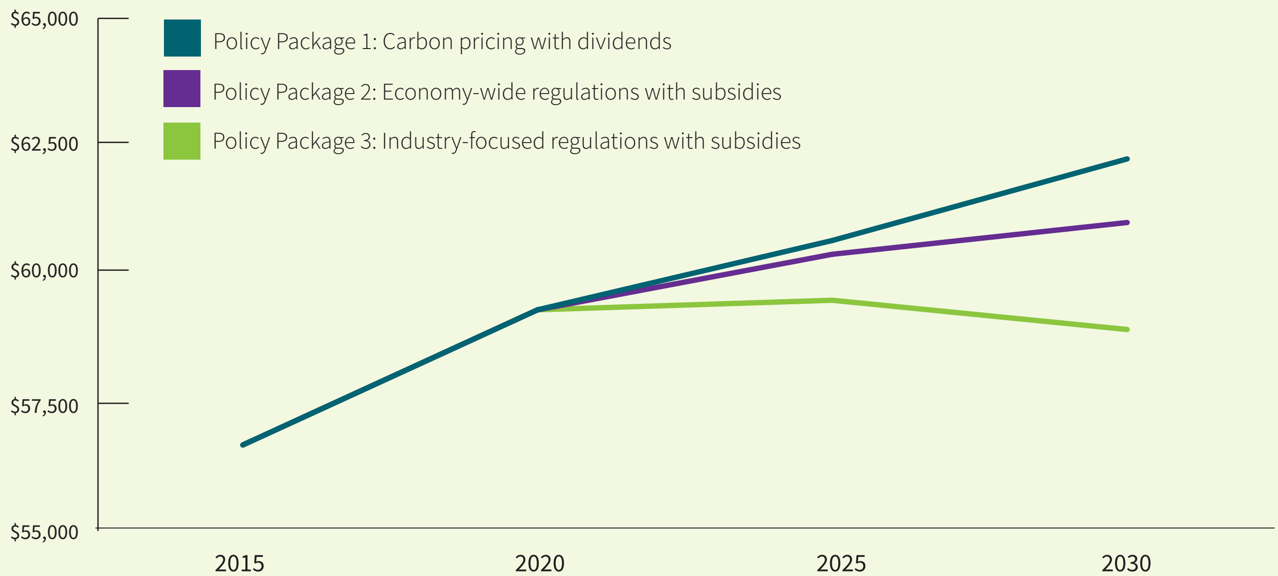
The three approaches in this report all directly address competitiveness and leakage in EITE sectors.

Approach #1 includes a special type of carbon pricing for EITE sectors. The policy, known as output-based pricing, requires firms to pay only for emissions that exceed an established sector benchmark. Because the benchmark is based on the emissions intensity of production (rather than on total emissions), firms have an incentive to reduce emissions by reducing their emissions per unit of output, rather than by reducing their overall output. Output-based pricing helps protect EITE sectors' competitiveness while reducing leakage. The federal government and several provinces have implemented this type of policy (Government of Canada, 2018b).

Approach #2 and #3 also include policies that address competitiveness and leakage. Each approach includes a flexible, performance-based regulation for the industrial sector that works in a similar manner to output-based pricing. The regulations require firms to reduce emissions only when their emissions intensity of production exceeds a sector-wide benchmark. Firms whose emissions exceed the standard can buy excess credits from firms whose emissions intensity is beneath it. This flexibility provides a strong incentive to reduce emissions by reducing emissions intensity rather than by reducing output, helping protect competitiveness and reduce leakage.

However, while the industrial-sector regulations operate using the same mechanics in Approaches #2 and #3, they have differing degrees of stringency. Greater stringency in Approach #3—necessitated by the package's narrow regulatory coverage—makes the policy less effective at mitigating competitiveness and leakage effects. Since small emitters do not face regulations or carbon pricing, large industrial emitters must make up the difference to achieve the required overall emissions reductions by 2030.

Figure 3: Projected 2030 GDP per capita under the three policy packages



This figure illustrates past and projected GDP per capita (GDP divided by population) under the three policy approaches. Projections are developed using the GTECH computable general-equilibrium model.

4.2 ECONOMIC PERFORMANCE

While each approach is designed to meet Canada's 2030 emissions target, they do so at different costs to households and the economy more broadly. Figure 3 shows projected GDP per capita (i.e., average income per person) between 2015 and 2030 under each approach.

There are multiple ways to achieve our target and grow the economy

Under two of the three policy approaches (#1 and #2), average income per person grows between now and 2030 in the projections. That is, regardless of whether Canada adopts a carbon pricing policy approach or an economy-wide regulatory and subsidy approach, average household income will be higher in 2030 than it is today. This finding is consistent with other major analyses that assess the costs of reaching Canada's emissions targets (Canada's Ecofiscal Commission, 2015; Bataille & Sawyer, 2016; Matier et al., 2019).

The economy—and with it, the average income of Canadians—continues to grow in most of our modelling projections, all of which include stringent climate policy, for several reasons.

First, Canada has a dynamic market economy that responds to changes in policy. Climate policy tilts incentives and outcomes toward economic behaviour that generates fewer emissions. Employment, production, and investment patterns shift in response, but capital continues to flow toward its most productive use—whatever it may be. This dynamic market response grows the Canadian economy while emissions fall.

Second, the stringency of policy in each approach ramps up over time. Such an incremental approach gives the economy time to adjust gradually and avoids dramatic shocks.

Finally, innovation—which we do not explicitly model—stands to improve projected average income in *all three* policy packages, by giving households and firms less expensive ways to reduce their emissions. In fact, these positive benefits from innovation are likely to be biggest for carbon pricing, as it provides a broader incentive to find new and cheaper ways of reducing emissions. While the model includes a range of technologies and efficiency improvements, it does not model innovation and technological change, given the challenges with predicting the discovery and deployment of new technologies—including both emissions-reducing and emissions-increasing technologies. See Box 9 for more discussion.[21]

On the other hand, poorly designed climate policy can also undermine Canada's economic prosperity. Income per capita declines under Approach #3, underscoring the shortcomings of an approach that relies only on subsidies and targeted industry regulations.[22] We unpack the reasons for these impacts below.

Box 9: Innovation and the complexity of prediction

Policymakers can use economic models to better understand how changes in policy today may affect the economy in the future. These models effectively construct a simplified version of the economy, which modellers use to test and compare the impacts of different policies, trends, or economic shocks. While models can never perfectly predict the future given the complexity of the economy in the real world, they are useful in simulating and forecasting different tradeoffs associated with different policy choices (Zenghelis, 2014).

When modelling the impacts of climate policy, modellers must make key assumptions about the economy. These assumptions include long-term trends (e.g., GDP growth, employment, and inflation) and the nature of policy changes, such as the extent to which policies are reversible or create path dependencies. Importantly, modelling results tend to decrease in accuracy as the time horizon of analysis increases. Because reducing emissions requires significant structural changes to the economy over long time horizons, all climate policy models grapple with similar shortcomings (Zenghelis, 2014; Pindyck, 2016).

Innovation is particularly challenging to model. In the long run, low-carbon innovation induced by climate policy can create economic benefits, but what this innovation will look like—and critically, when and how it will occur—is highly uncertain. A new advancement in battery storage, for example, could make renewable energy (e.g., wind, solar) cheaper and more deployable. In turn, this new technology could make the transition to a low-carbon economy faster and less costly for the economy. An innovation in battery storage could also have spillover benefits, inducing innovations in other areas of the economy.

At the same time, innovation that *increases* GHG emissions may also be a factor. Innovation could decrease the costs of fossil fuel extraction. It could drive development of technologies that cost less or deliver new functionality, but are more emissions-intensive.

Predicting technological innovation is a persistent challenge in economic models. While our modelling does not quantify the effects of innovation, evidence suggests that comprehensive, stringent, flexible, and well-designed climate policies can have a significant effect on inducing technological innovation (Johnstone et al., 2012; Ambec et al., 2013; Zenghelis, 2014; Aghion et al., 2016; Calel & Dechezleprêtre, 2016).

Despite the limitations inherent with economic models, they provide a powerful and instructive tool for policymaking. For our analysis, economic modelling helps us to compare tradeoffs between and within the different policy approaches.

Relying on carbon pricing produces the strongest economic outcomes

Of the three approaches, Approach #1—which primarily relies on a rising carbon price to close the gap to Canada's 2030 GHG target—leads to the highest growth in average income per person. Three main factors underpin this outcome:

- **Carbon pricing is flexible.** Carbon pricing allows emitters and those who consume their products to decide for themselves how best to reduce emissions. This flexibility helps reduce the overall cost of GHG mitigation (Aldy & Stavins, 2011; Baranzini et al., 2017).
- **Carbon pricing drives economy-wide emissions reductions.** Carbon pricing provides incentives to reduce emissions across the entire economy, regardless of their source. For example, in the transport sector, a price on carbon encourages better vehicle fuel economy, the purchase of ZEVs, and greater use of public transit. This broad coverage across modes of GHG reductions allows the most cost-effective GHG mitigation actions across these options to emerge.[23] In contrast, Approaches #2 and #3 require a range of individual policies to provide the same incentives, which results in costlier emissions reductions and higher overall costs (Chen & Hafstead, 2016; Williams, 2016).
- **Carbon pricing does not require raising other taxes.** Approaches #2 and #3 partly rely on subsidies to achieve Canada's 2030 target, funded by raising provincial corporate and personal income taxes. This taxation carries a significant cost to the broader economy that carbon pricing does not.[24]

Two factors *not* included in the modelling suggest that the relative benefits of carbon pricing might be even greater than shown in Figure 3:

- **Carbon pricing has lower administrative costs.** Compared to carbon pricing, Approaches #2 and #3 are significantly more complex to design, implement, and administer. Not only do they include a much larger number of total policies, but many of these policies also have more design variables for governments to manage. This raises administration costs, which are not modelled (Aldy & Stavins, 2011; Stavins, 2008).[25]
- **Carbon pricing will drive more low-carbon innovation.** While our modelling does not quantify the effects of innovation, research suggests that innovation gains will make carbon pricing, in particular, more cost effective than our results indicate. While all comprehensive, flexible, and stringent environmental policies generally drive more technological innovation and lower costs (provided policies are designed well), carbon pricing can provide stronger incentives for innovation than other approaches. It sends a clear signal to companies, investors, and innovators that there will be a market for low-carbon alternatives (Johnstone et al, 2012; Ambec et al, 2013; Aghion et al., 2016; Popp, 2016; Calel & Dechezleprêtre, 2016; Stavins, 2008; Nordhaus, 2008).

Narrower, targeted policy costs more than broader, economy-wide policy

Approach #3, which relies on subsidies and industry-focused regulations, is the costliest of the three climate policy approaches.

Exempting households from regulations increases costs to the economy. Approach #3 excludes any regulations that directly increase costs for households, and thus forgoes significant emissions-reductions opportunities in the residential buildings, personal transportation, and electricity sectors. To achieve the 2030 climate target, policymakers must compensate with more stringent—and costlier—regulations for industry as well as more generous subsidies, which must be funded by increasing taxes.

As illustrated in Figure 3, approaches that avoid imposing direct costs on households ultimately cost them more by reducing growth in average income. Households will often not be aware of these costs.

[21] Similarly, the model does not capture the value of co-benefits. Climate policies can sometimes drive environmental benefits beyond reducing GHG emissions (Gale et al., 2015; Canada's Ecofiscal Commission, 2017). For example, policies that reduce or phase out coal-fired electricity or that drive greater uptake of electric vehicles can reduce air pollution and improve health outcomes. These benefits are not reflected in Figure 3, but would likely be similar across each policy package (as they all reduce GHGs by the same amount). Co-benefits would be offset by an additional driver that we do not model—the costs of climate change. More frequent and extreme temperatures, severe weather events, and poorer air quality will affect Canadians' health and wellbeing, environment, and economy. Including these costs would likely reduce the 2030 per capita income seen Figure 3 (McMichael et al., 2006; NRTEE, 2011; Wang et al., 2015).

[22] In *absolute* terms, however, the economy grows. Average annual GDP growth between 2020 and 2030 is 0.81% under Approach #3 (compared to 1.37% under Approach #1 and 1.16% under Approach #2). Income *per capita* falls during this period because the Canadian population is projected to grow faster than GDP.

[23] A carbon price does not always works best when it is a stand-alone policy. As we detail in Canada's Ecofiscal Commission (2017), other climate policies can complement carbon pricing in specific circumstances; for example, to address sources of emissions that are too difficult or costly to measure, a strategy employed in Approach #1.

[24] The revenues raised from carbon pricing also have a distortionary effect on the economy. However, its distortionary effect can be mitigated or completely offset when revenues are recycled back to households and businesses (McKitrick, 1997).

[25] For example, regulating heating and cooling equipment requires setting standards across a vast array of products, as well as testing and evaluating products to determine their compliance with the regulation.

Box 10: Climate policy and household fairness

Climate policies have important fairness implications, particularly for low-income households. Whether governments use carbon pricing or regulations to reduce emissions, either one ultimately increases the prices of fuel, energy, and other consumer goods. Because low-income households spend a larger portion of their budgets on heating and transportation, these climate policies can be regressive—that is, they can have a disproportionate impact on low-income households (Rivers, 2012). (Subsidies can be regressive as well, since low-income families may not drive or own their homes. They may therefore not benefit from, for example, subsidies for electric vehicles, home retrofits, or energy-efficient appliances.)

Different policy choices can, however, address this regressivity.

Climate policies with broader coverage and high flexibility, for example, can reduce the total cost of policy across all households, including those that are low income. In contrast, policies with narrower coverage need to be more stringent to achieve the same level of GHG reduction, which imposes higher costs on the economy (and therefore on low-income households).

To offset regressive impacts, policies can also provide relief to low-income households. Carbon pricing, for example, generates revenue that governments can recycle back to low-income households in the form of tax cuts or cash dividends. These transfers can offset the costs of carbon pricing for low-income households and can even make them better off (Rausch et al, 2011; Rivers, 2012; Canada's Ecofiscal Commission, 2016c).

For climate policies that do not generate revenues (i.e., regulations), governments could provide targeted support to low-income households. They could, for example, help low-income households invest in home retrofits. Such programs could help low-income households reduce their home heating costs, as well as lead to additional GHG reductions. But at the same time, such supports must themselves be funded through raising taxes, deficit spending, or cutting services in other areas, which can negatively affect low-income households.

For a discussion of how the costs of climate policy—as well as the costs of alternative climate policy approaches—tend to break down across households of different income levels, see Box 10.

Subsidies have high costs

Approach #3 has higher costs than other approaches not only because its regulations have narrower coverage across sources of emissions, but also because it uses subsidies to broaden this coverage. In general, subsidies tend to be a costly way to reduce GHG emissions.

First, subsidies are prone to free ridership where a firm or individual receives a financial benefit for doing something they would have done anyway. At the limit, this can constitute a significant share of the recipients of a given subsidy (as was the case with federal transit pass tax credits, which we discuss in Box 5).

Second, subsidies typically require government to pick winners by allocating subsidies toward particular technologies. This can distort the market for different types of low-carbon technologies and reduce the cost-effectiveness of GHG mitigation.

Third, raising money to pay for subsidies—either through higher taxes or greater public debt—can reduce investment and economic growth. As a result, the same GHG mitigation can often be delivered at a lower economic cost using carbon pricing or regulations.[26]

Figure 3 shows that although households may benefit *directly* from a subsidy-heavy approach, they ultimately bear its costs indirectly in the form of higher prices, higher taxes, and reduced incomes (Jaffe et al., 2005). Indeed, Canada's Ecofiscal Commission (2017) has estimated that GHG reductions from ZEV subsidies provided by the Quebec government come at an economic cost of $395/tonne—well above mitigation costs under the province's cap-and-trade system. These costs will ultimately be borne by Quebec residents.

4.3 COMPARING THE PERFORMANCE OF THE THREE APPROACHES

The analysis we present in this section yields the following findings:

- Any of the three climate policy approaches can reach Canada's 2030 GHG target.
- In terms of economic impacts, an approach that relies on carbon pricing outperforms the alternatives. Annual per capita income is approximately $1,200 higher by 2030 under carbon pricing relative to an economy-wide regulatory approach, and approximately $3,300 higher relative to an approach that relies on subsidies and industry-only regulations.
- The economy still grows under an approach that relies on economy-wide subsidies and regulations, but less quickly than under an approach that relies on carbon pricing.
- A narrow approach that tries to avoid imposing direct costs on households by focusing on subsidies and industry-only regulations actually results in the highest overall cost to households. It causes average per-capita income to *fall* between now and 2030.

Our findings have clear implications for the relative merits of the three approaches. But are our results simply a function of the specific policy packages we have used to model the three approaches? How would *better-designed* policies in each of the three policy approaches affect the key tradeoffs? The next section explores these questions in detail.

[26] Targeted subsidies can play a role in cost-effective policy though. In particular, addressing specific market problems can make sense. The private sector, for example, tends to fund less research and development than is optimal. In this case, subsidizing it can accelerate low-carbon innovation and provide positive spillover effects. See Canada's Ecofiscal Commission (2017) for more on what constitutes a cost-effective subsidy.

5 ASSESSING MORE ECONOMICALLY EFFICIENT POLICY ALTERNATIVES

In the previous section, we assessed three policy approaches for meeting Canada's 2030 GHG target. To do so, we defined representative policy packages that draw on specific climate policies already implemented across Canada.

But can we do better than existing policies? Can we improve the design of the three approaches to further reduce costs? Can we optimize the packages of policies by more carefully designing and coordinating their individual policies? What are the implications of doing so?

This section develops alternative policy packages for the three approaches. For each approach, we propose a modified package of policies designed to reduce costs by improving economic efficiency. We discuss the implications of these alternative designs for GHG emissions and the economy. And we consider the practical barriers to implementing more economically efficient policies.

5.1 IMPROVING THE EFFICIENCY OF ECONOMY-WIDE CARBON PRICING

What design choices can make carbon pricing more efficient? How large are those gains? And what barriers might exist to implementing economically efficient carbon pricing?

Design choices—especially revenue recycling—can further lower the costs of carbon pricing

The more economically efficient approach to carbon pricing we present in this section differs from the package we presented in Section 4 in two ways.[27]

First, it recycles revenues differently. Low-income households still receive rebates to ensure fairness (15% of total revenues are used toward this purpose). But the majority of revenues (85%) go toward lowering corporate and personal income taxes. These tax cuts facilitate employment and investment, which supports economic growth (Goulder, 2013; Williams & Wichman, 2015; Klenert et al., 2018).

Second, the policy package uses output-based pricing in a way that more carefully targets competitiveness and leakage. Emissions-intensity benchmarks for the EITE sectors are set more stringently here than they are in Section 4 (specifically, benchmarks in this policy package are set at 80% of sector-average emissions intensity and tighten to 70% by 2030, versus remaining at 90% until 2030). Calibrating stringent benchmarks that drive emissions reductions while still protecting EITE sector competitiveness generates more

[27] See Annex 2 for a detailed breakdown of the policy package we model in this section.

revenue that can be invested in R&D for EITE sector mitigation technology (Böhringer et al., 2017). This in turn helps to improve the overall cost-effectiveness of GHG mitigation.

The policy package contains the same set of existing, non-pricing climate policies already in place across Canada that were included in the package we presented in Section 4. It also includes the same gap-filling policies, which drive GHG mitigation from sources not easily covered by a carbon price, such as methane emissions in the agricultural sector.

Under this more efficient carbon pricing package, Canadians' 2030 average per-capita income is approximately $1,500 higher than under the less-efficient policy package we model in Section 4.[28] Of all the policy packages we model in this report, 2030 income per capita grows highest when carbon price revenues are recycled toward tax reductions and output-based pricing benchmarks are carefully calibrated.

Implementing efficient output-based pricing presents administrative challenges

Recycling revenues toward provincial tax reductions is simple and straightforward from an administrative perspective. British Columbia has been doing it since 2008, with annual reports that show revenue allocations and magnitudes.

Efficient calibration of output-based pricing policies, however, is challenging in practice. It requires policymakers to understand the economics of production in each individual sector, the GHG-mitigation opportunities available, the associated costs of reducing emissions, and, ideally, the expected pace of technological change. Both imperfect information and information *asymmetries* make this challenging in practice. Companies have deep knowledge of their own production techniques and cost structures, while governments must rely on publicly available or second-hand information. As a result, it can be difficult for policymakers to be confident that their output-based pricing policies are efficiently calibrated. This can especially be the case in early implementation phases, when compliance and GHG performance data are not yet available.

The consequences of miscalibration can be significant. If policymakers set their benchmarks too aggressively, they can undermine the industry's competitiveness and risk driving leakage. On the other hand, if they set benchmarks too laxly, the system over-protects firms, forgoing revenue recycling opportunities. And at the extreme, it may even undermine the incentive that firms have to mitigate GHGs (if doing so creates an excess supply of emissions permits that drives down their trading price).

Stakeholder interests and pressure may pull governments toward more rebates for households and more support for industry

Stakeholder consultation is a necessary and important part of any policy-making process, including climate policy. However, stakeholder interests and pressure can affect how policymakers choose to recycle carbon pricing's revenues.[29] Where stakeholders' interests—however understandable—end up trumping economically efficient policy design, the result will be higher economic costs.

As we discuss in our report on revenue recycling (Canada's Ecofiscal Commission, 2016c), governments have a range of options for recycling revenues (e.g., investing in infrastructure, providing dividends, reducing taxes). While tax reductions have the greatest effect on improving economic growth, revenue recycling priorities will rightly vary with the unique social and economic context in each jurisdiction. Alternative priorities might also have other, non-economic benefits (for example, per capita dividends might dampen political opposition to continuing carbon price increases). Nevertheless, choosing to recycle carbon pricing revenues toward other priorities can represent a missed opportunity from the perspective of economic growth.

Stakeholder interests and pressure can also affect how policymakers choose to design output-based pricing systems (Markussen & Svendsen, 2005; Sawyer & Beugin, 2012). Lower-cost policy is in many companies' economic interest, so they may emphasize compliance costs or competitiveness challenges to justify weaker performance standards and slower increases in stringency. Sectors may call for inclusion in the output-based pricing system despite not meeting the definition of EITE, or call for a less-stringent definition. These types of stakeholder interests and pressure can cause policymakers to err on the side of weaker standards and greater concessions, particularly when coupled with the information asymmetries we discuss above.

5.2 IMPROVING THE EFFICIENCY OF ECONOMY-WIDE REGULATIONS

What design choices can make a package of economy-wide regulations and subsidies more efficient? How does greater efficiency affect their economic performance? And what are the

[28] In GDP growth terms, average annual growth between 2020 and 2030 is 1.61% under this policy package, compared to 1.37% under the policy package we model in Section 4.

[29] Stakeholder interest and pressure may also affect how policymakers choose to set the stringency of carbon pricing policies. As we discuss in Section 3, the costs of carbon pricing tend to be highly visible. As a result, stakeholders may respond by pushing for a less-stringent carbon price, slower increases in the carbon price level, or no increases at all. When policymakers respond to this pressure by implementing less-stringent carbon pricing, they must rely on higher-cost policy alternatives to drive the lost emissions reductions. This raises the overall cost of meeting Canada's GHG targets.

challenges of implementing this kind of economically efficient policy package?

Making regulations flexible and coordinated dramatically improves their performance

An economically efficient climate policy package that does not use carbon pricing instead relies on a limited number of performance-based, flexible regulations that collectively cover Canada's entire emissions inventory (Jaccard, 2016).

The regulations in the policy package that we model in this section are more economically efficient than those described in Section 4—which were based on regulations already implemented in Canada—in several ways.[30] First, regulations in this package maximize flexibility, allowing compliance trading both between firms and across provinces, which helps to reduce costs (de Miranda Ribeiro & Kruglianskas, 2015). Second, the regulations collectively cover a broad set of GHG emissions in the economy. Providing broad coverage while avoiding overlap and duplication helps keep the costs of GHG reductions low (Canada's Ecofiscal Commission, 2017). Third, the stringency of each regulation is calibrated to provide a relatively consistent incentive to reduce GHG emissions across the entire economy. Harmonizing the regulations helps realize the lowest-cost GHG mitigation opportunities available across the regulations' collective coverage (see Box 8).[31]

This package does not include subsidy policies, given their challenges around cost-effectiveness (i.e., free-ridership, problems with picking winners, and the efficiency cost of funding subsidies through taxation).

When regulations are flexible and well coordinated, their economic performance improves substantially. Our modelling estimates that under an economy-wide flexible regulation approach, average 2030 per-capita income will be approximately $2,300 higher than under the less-efficient regulatory package we model in Section 4.[32]

A flexible regulation approach can deliver a level of economic performance similar to carbon pricing because it shares some of carbon pricing's core features:

- **Flexible regulations focus on ends instead of means.** Flexible regulations focus on a desired level of performance rather than the specific way(s) that companies achieve it. This is economically efficient because it allows emitters to identify for themselves the most cost-effective ways of reducing emissions (Lade & Lawell, 2015).
- **By allowing compliance trading, flexible regulations leverage market forces.** Relative to prescriptive regulations that require a specific action from all regulated entities, compliance trading allows those with the lowest mitigation costs to mitigate more and benefit by selling their excess credits. This helps minimize the overall cost of GHG reductions (Chen et al., 2014; Holland et al., 2011).
- **Flexible regulations put a price on GHG emissions.** Compliance trading among firms establishes a market price for compliance obligations, providing firms with valuable information. Firms can easily identify the point at which it becomes cheaper to pay for emissions reductions (i.e., by buying other firms' excess compliance obligations) rather than invest in their own. This improves the overall cost-effectiveness of GHG mitigation (Yeh & Sperling, 2010).

Even optimally designed flexible regulations will cost more than carbon pricing

Nevertheless, flexible regulations have limitations that make them a higher-cost policy approach compared to carbon pricing. In particular, they can leave gaps in the incentives to reduce emissions across the economy, raising the overall cost of GHG mitigation.

Despite its broad coverage across sources of emissions, the economically efficient regulatory package we model in this section fails to create incentives for some modes of GHG reductions. These incentive gaps stem from the fact that flexible regulations incent reductions in emissions intensity, rather than reductions in emissions directly. For example, the flexible regulation for the transport sector focuses on the emissions intensity of fuels. As a result, it does not encourage other ways of reducing transportation emissions—for example, taking public transit—as strongly. Incentive gaps raise the overall cost of GHG mitigation by prioritizing certain types of GHG reduction over others—even when the actions have the same cost-per-tonne of GHGs reduced.[33]

Over the long term, incentive gaps can impede Canada's transition to a low-carbon economy. For example, under a flexible regulation in the electricity sector, electricity producers have a clear incentive to develop more renewable generation capacity. This

30 See Annex 2 for a detailed breakdown of the policy package we model in this section.

31 Economists will recognize this as an effort to equate marginal costs across policies and thereby reduce overall costs.

32 In GDP growth terms, average annual growth between 2020 and 2030 is 1.54% under this policy package, compared to 1.16% under the policy package we model in Section 4.

32 In contrast, because firms and individuals bear the full cost of their GHG emissions under carbon pricing, they have a comprehensive incentive across all available modes of GHG reduction.

Box 11: A consistent incentive for GHG reductions reduces total costs

The three policy approaches we discuss in this report drive emissions reductions from multiple parts of the economy, including large industry, small- and medium-sized businesses, commercial buildings, transportation, and households. For each of the economic actors within these categories, reducing emissions increases costs. That is, to comply with policy, households and firms take actions that they would not have taken otherwise.

Yet the costs of reducing emissions varies widely across the economy. The cost of reducing one additional tonne of GHGs for a large industrial emitter, for example, will be different than reducing one tonne of GHGs from commercial freight. Reducing emissions will be relatively inexpensive for some emitters and expensive for others. The same is true for individual actions that reduce emissions.

Taking more high-cost actions and fewer low-cost actions increases the total costs of a policy. So how can climate policies be designed to ensure they prioritize low-cost GHG reductions? The key is to align the marginal costs of policy (i.e., the cost of reducing one more tonne of GHG emissions from a given region, sector, or firm). Aligning these incentives drives emitters with low abatement costs to reduce more emissions than emitters with high costs, minimizing the total cost of mitigation across the economy (Field and Olewiler, 2015).

Carbon pricing policies do this automatically. Whether governments use a cap-and-trade system or a carbon tax, carbon pricing provides all agents in the economy with the same incentive to reduce GHGs. It then allows them to decide for themselves how best to respond, based on their unique abatement costs. A carbon tax of $30 per tonne, for example, sets the marginal price for emitting GHGs across the entire economy. Emitters will reduce their emissions up to and until the point where it costs them $30 per tonne to do so. Before this point, it is cheaper to reduce their own emissions and avoid paying the $30 per tonne tax (i.e., each tonne of emissions reduced is a tonne not taxed).

Flexible regulations, on the other hand, provide similar incentives but use a different mechanism. Regulated entities trade compliance obligations among themselves, establishing a market price for them. When GHG mitigation costs less than the price of a compliance obligation, emitters undertake it; when it does not, they purchase obligations from others instead.

However, while carbon pricing provides a consistent emissions-reduction incentive across the entire economy, each individual flexible regulation provides *its own* incentive. If the incentives provided by different flexible regulations do not closely align, then some low-cost mitigation opportunities go unrealized, raising the overall cost of GHG mitigation. Governments can try to overcome this by coordinating flexible regulations; however, as we discuss in Section 5.4, there are limits to how effectively they can do so in practice.

helps drive structural transformation in the electricity sector. But electricity *consumers* bear a cost for the GHG emissions associated with their electricity consumption only if its GHG emissions exceed the performance standard defined by the flexible regulation. This shields them from the full carbon costs of their consumption, reducing their incentive to conserve electricity and to switch to more energy-efficient products. This incentive gap impedes the development of markets for energy-efficient goods and services. Over the long term, such effects can inhibit Canada's structural transformation to a low-carbon economy. They also risk making Canada less competitive as other countries undertake their own low-carbon transitions.

A package of coordinated flexible regulations is challenging to implement

A package of flexible regulations can be simpler for policymakers to administer than the regulatory approach we model in Section 4 in the sense that it involves fewer total policies. However, the level of coordination required to make flexible regulations economically efficient raises considerable administrative challenges.

For a policy package to be truly efficient, it must provide consistent GHG-reduction incentives across the entire economy, as we discuss in Box 11. Under an approach that uses multiple flexible regulations, compliance obligations for each regulation trade at different prices. Therefore, to ensure economic efficiency, policymakers must coordinate the stringency of individual regulations such that the trading prices for their compliance obligations are closely aligned.

There are limits on how effectively governments can coordinate flexible regulations in this way. Policymakers do not have access to the information required to precisely calibrate incentives across individual regulations. Even if they had access to this information, ongoing and uneven technological improvement and innovation across sectors mean that any one policy's effective stringency is constantly changing relative to other policies. Information asymmetries and the uncertainty of future technological change create inherent limits on policymakers' ability to efficiently administer a package of flexible regulations.[34]

Stakeholder interests and pressure compound these administrative challenges. Firms and households may call for exemptions, weaker performance standards, or slower increases in the stringency of flexible regulations. Where policymakers make these kinds of accommodations, divergent incentives across regulations become more likely, since the stringency of *other* flexible regulations must rise to offset the lost GHG reductions.

Such accommodations also create risks for the overall effectiveness of a climate policy package that relies on flexible regulations. When policymakers reduce the stringency of an individual regulation as a result of stakeholder influence, it reduces fewer GHGs. Where stakeholder pressures on *other* flexible regulations make it difficult for policymakers to increase these regulations' stringency in response, the result can be an overall policy package that does not add up to the total amount of GHG reductions necessary to reach Canada's targets.

5.3 IMPROVING THE EFFICIENCY OF INDUSTRY-FOCUSED REGULATIONS

Can an industry-focused approach also be improved through design choices? What are the benefits and challenges of implementing a more-efficient policy package that avoids imposing direct costs on households?

Relying on flexible regulations is the most efficient way to pursue an industry-focused policy package

This policy package we model in this section improves on the industry-focused policy package we modelled in Section 4 in two key ways:[35]

- First, it relies on flexible—rather than prescriptive—regulations. By building in flexibility mechanisms such as compliance trading, these policies can more closely resemble carbon pricing, relying on market forces to drive low-cost actions to reduce GHG emissions. Flexible regulations are implemented in the freight, commercial buildings and industry sectors in this policy package. Regulated entities must decrease emissions intensity to correspond with a standard that tightens over time, with compliance trading permitted.
- Second, the policy package avoids subsidies altogether, given challenges around free-ridership, picking winners, and the economic cost of funding subsidies with increased taxes. To avoid imposing direct and visible costs on households, several sectors—including residential buildings, electricity, and personal transportation—end up exempted from climate policy altogether in this policy package.

[34] In our modelling analysis, we had the benefit of an economic model that allows us to calibrate the package of policies, to view the effects, and then to recalibrate accordingly. Yet even with this advantage, calibrating the modelling scenarios to achieve the target *and* align the marginal costs of each policy proved challenging. Even if policymakers also have access to such a model, all models are imperfect, and the actual alignment of policies is unlikely to be perfectly accurate in reality.

[35] See Annex 2 for a detailed breakdown of the policy package we model in this section.

If policy coverage is too narrow, Canada will not reach its GHG target

This policy package is unable to meet Canada's emissions target. Its coverage across sources of GHG emissions is too narrow to deliver sufficient emissions reductions.

Narrow coverage forces policymakers to compensate by making policy extremely stringent. For example, this policy package's flexible regulation of the industry sector (which includes a range of sub-sectors such as oil and gas, steel, and cement) requires deeper cuts in emissions intensity than any other policy that we model in this report—68% by 2030.[36] Even with this high level of stringency, however, Canada cannot reach its 2030 target.

While we do not estimate this policy package's costs (since it cannot reach Canada's 2030 GHG target), they are likely to be high. The stringency of its flexible regulations is unrivaled across any of the policies we model under other approaches. These regulations would impose considerable costs to regulated sectors and the Canadian economy as a whole.

5.4 COMPARING MORE ECONOMICALLY EFFICIENT ALTERNATIVES

For two of the three climate policy approaches we examine, a more-efficient design improves economic performance. Projected future income per capita improves when policymakers recycle carbon pricing revenues toward tax reductions and calibrate output-based pricing system benchmarks carefully. And it also improves when policymakers implement a package of coordinated economy-wide flexible regulations.

The package of efficient industry-focused regulations, however, cannot deliver GHG reductions in line with Canada's 2030 target. Meeting Canada's targets requires climate policy that has broad coverage across sources of emissions.

With respect to the approaches that *can* meet Canada's GHG target, the findings presented in this section are consistent with those in Section 4: a climate policy approach that relies on carbon pricing outperforms its alternatives. However, a package of coordinated flexible regulations can approach carbon pricing's cost-effectiveness by mimicking some of its core features.

Critically though, a package of efficient flexible regulations is likely to face more administrative challenges than efficient carbon pricing. First, compared to carbon pricing, flexible regulations have more design variables that policymakers must manage. Second, an approach that relies on flexible regulations requires policymakers to design and manage a greater total number of policies, each with its own implementation processes. Third, to provide a consistent GHG-reduction incentive, policymakers must coordinate and calibrate their flexible regulations while contending with information asymmetries and policy coordination challenges (in contrast, carbon pricing delivers this consistent incentive automatically). Fourth, carbon pricing's lesser administrative burden makes it more straightforward to implement in a federation; having to coordinate flexible regulations across Canada's provinces and territories would significantly exacerbate the administrative challenges inherent to a flexible regulation approach.

Whether governments implement carbon pricing or flexible regulations, stakeholder influence and pressure can complicate the creation of cost-effective policy. It can also create risks for the overall *effectiveness* of flexible regulations. When policymakers decrease the stringency of one flexible regulation, the stringency of others must rise correspondingly. Carbon pricing avoids this sort of piecemeal approach to climate policy. Exemptions to a carbon price or reductions in its stringency have unambiguous implications for overall climate policy effectiveness that can make them more difficult for policymakers to justify.

The challenges we describe here do not make economically efficient climate policy impossible to implement. But they do help explain why governments have implemented less-efficient policies such as those in Section 4. They also suggest that even governments that prioritize economic growth may be more likely to ultimately implement less-efficient versions of each approach.

[36] This is the maximum depth of emissions intensity reductions that are possible for the Canadian industrial sector in Navius Research's GTECH model.

6 CONCLUSIONS AND RECOMMENDATIONS

To explore Canada's options for closing the gap to its 2030 GHG target, this report focused on answering four key questions:

1. What are the approaches Canada has available for scaling up climate policy to meet its 2030 GHG target?
2. How do the costs of these distinct approaches compare?
3. What kind of design choices would improve their economic performance? And what are the challenges in implementing more efficiently-designed policy?
4. In implementing climate policy, how should policymakers weigh the tradeoffs that different approaches present?

The analysis in the preceding sections provides insights that help answer these questions. Answers to the first three questions form our main conclusions. Answers to the fourth form our recommendations for Canadian policymakers.

6.1 CONCLUSIONS

Four overarching conclusions emerge from our analysis.

All climate policies have costs

The list of credible and effective policy tools for reaching Canada's GHG emission reduction targets is short. Pricing GHG emissions is one option. Regulating the activities of emitters is another. Subsidizing low-carbon technologies and activities is a third. Other instruments—moral suasion, information campaigns, procurement programs, buying GHG mitigation from abroad—might have a role to play as complementary measures, but cannot on their own drive sufficient emissions reductions.

While the benefits of climate action exceed the costs, *all* credible climate policies have costs. Carbon pricing makes it more costly to emit GHGs, prompting households and businesses to spend more on GHG-reducing activities and technologies. Regulations impose costs by requiring households and businesses to take GHG-reducing actions they would not otherwise take. And subsidies require public dollars, in turn requiring new taxes, reduced government programs, or public debt.

But as we discussed in Section 3, the costs of these policy tools are not equally visible to businesses and, in particular, to households:

- Carbon pricing attaches an explicit price to emitting GHGs. As a result, households and businesses can often easily connect rising fossil fuel costs and carbon pricing.
- Regulations impose costs on emitters by requiring actions they would not otherwise have taken. But households may not easily connect regulations to increasing costs.
- Subsidies require public funds, but their costs are hidden when they are broadly borne by taxpayers (now or in the future).

An approach that relies on carbon pricing costs the economy less than approaches that rely on regulations and subsidies

Of the three approaches we evaluate, an approach that relies on a rising carbon price to close the gap to Canada's 2030 GHG target is associated with the highest growth in average Canadian incomes. This is the case for a number of reasons. First, carbon pricing

Table 4: Visibility and cost-effectiveness of available climate policy approaches			
Policy Package	**Approach**	**Cost Visibility**	**Cost-Effectiveness**
Policy packages based on policies already in place in Canada	**Approach #1:** Carbon pricing with revenues recycled toward per-capita dividends and output-based pricing for EITE sectors	High	High
	Approach #2: A range of regulations and subsidies applied across the entire economy	Moderate	Low
	Approach #3: A range of regulations and subsidies, excluding those that would result in direct costs for households	Low	Very Low
Policy packages based on maximizing overall economic efficiency	**Approach #1:** Carbon pricing with revenues recycled toward low-income rebates and tax cuts and carefully calibrated output-based pricing benchmarks	High	Very high
	Approach #2: A select number of flexible regulations with broad coverage across sources of emissions and limited overlap	Moderate	High
	Approach #3: A select number of flexible regulations applied only where they will not increase direct costs for households	Low	N/A (could not achieve target)

allows emitters and those who consume their products to decide for themselves how best to reduce emissions, which helps reduce costs. It provides incentives to reduce emissions across the entire economy, regardless of their source. It has lower administration costs than other approaches due to its comparative simplicity. It drives more low-carbon innovation by sending a clear signal to companies, investors and innovators that there will be a market for low-carbon alternatives. And unlike subsidies, carbon pricing does not require raising other taxes.

Ironically, an approach that avoids imposing direct costs on households by offering generous subsidies and focusing regulations on industry ultimately results in the highest overall costs to households. Exempting households from regulations forgoes significant emissions reductions opportunities. To compensate, policymakers must implement more stringent—and more expensive—industry-focused regulations. And they must offer more-generous subsidies that are prone to free-ridership and require government to pick winners—subsidies which must be funded through either higher taxes, greater public debt, or reduced government services. While households may benefit directly from an approach that extends them subsidies and exempts them from regulations, they ultimately bear its costs in the form of higher prices, higher taxes, and reduced income. However, these costs may not be particularly visible to them.

Notably, as illustrated in Table 4, approaches with lower cost visibility tend to correlate with higher overall costs to the economy.

An economy-wide flexible regulation approach can—if designed optimally—approach carbon pricing's performance, but presents implementation challenges

A harmonized, economy-wide package of stringent flexible regulations could close the gap to Canada's 2030 target at relatively low cost. While the costs of such an approach would still be higher than carbon pricing, they would tend to be less visible to households, which might make it easier to implement in some contexts. However, implementing the kind of efficient policy package that we model in this report would be a significant challenge.

As we discuss in Section 5, flexible regulations are administratively complex. They present significant coordination difficulties for governments. And pressure from stakeholders can cause policymakers to weaken individual flexible regulations, which can undermine the effectiveness of the overall policy package, its cost-effectiveness, or both.

These implementation realities pose significant challenges for policymakers. Despite their best efforts, they may end up with flexible regulations that are high cost or that cannot reduce emissions in line with Canada's 2030 target. Policymakers need to take great care to ensure that a flexible regulatory approach can meet Canada's targets both effectively and cost-effectively.

As the stringency of flexible regulations rises, costs become more noticeable

Regardless of the climate policy approach that policymakers adopt, meeting Canada's emissions targets will require stringent policy. As the stringency of a climate policy rises, its costs grow more and more apparent—whatever the policy instrument. The effect that carbon pricing has on the costs of fossil fuels gets more significant as the carbon price rises. The impact of regulations on costs become more pronounced as they reach deeper and deeper into the transportation, electricity and buildings sectors (to name a few). And the effect that subsidies have on public finances becomes more pronounced as they become more generous.

As stringency rises, the cost of regulations and subsidies become much more visible. Unlike carbon pricing, the costs of regulations and subsidies may not be apparent at low levels of stringency. But as stringency rises, so too do costs—and their visibility. For example, a regulation requiring 50% renewable fuel content in gasoline and diesel by 2030 (as found under the policy package for Approach #2 that we present in Section 4) is likely to have a significant effect on the price of gasoline—a rising cost that households will have a hard time missing. When policy stringency rises, low-visibility policies do not necessarily stay that way.

6.2 RECOMMENDATIONS

Given these conclusions, what climate policy approach should Canadian governments take? The answer is not clear-cut.

The Ecofiscal Commission's mandate is to identify practical, cost-effective policies to achieve Canada's environmental objectives. Our expertise is in economics, and that expertise has been the foundation of our policy advice. From this perspective, carbon pricing is unambiguously the most cost-effective approach to reducing Canada's emissions. However, we recognize that policymakers may not make decisions based on costs alone.

Elected politicians must balance the need for climate policy to be cost-effective with the need for it to be politically viable. Their choice of policy approach can depend on a number of factors: How strong is the societal consensus that climate change is urgent and that governments need to ramp up policy action? What is the public's knowledge of the mechanics and costs of available policy tools? What kind of political coalitions and inter-party consensus exist behind them? How—and how successfully—are proposed or enacted policies communicated to the public? Is the fate of a given policy option tied to that of a political party that may be elected (or not) for unrelated reasons?

The visibility of costs for different policy instrument may also be a key factor. Where households mistakenly link high visibility to high costs, they may prefer alternatives to carbon pricing—even though these alternatives in fact cost more.

Where governments seeking to implement stringent climate policy believe the perceived costs of carbon pricing are too high for the public to accept, it is their prerogative to explore and pursue alternatives. Our report seeks to inform their policy choices by providing analysis of their available options' relative environmental and economic performance.

RECOMMENDATION #1: Governments should evaluate whether their policies are stringent enough to meet targets, and close any gaps

Canadian governments should assess how deeply their GHG policies will cut emissions and, where a gap to Canada's target remains, implement climate policy that is stringent enough to close it. If Canada is serious about meeting the emissions targets that successive Canadian governments have pledged in international forums, we must enact policy commensurate with the scale of the challenge.

Meeting our GHG targets is more than a matter of living up to our commitments. Meaningful action is in Canada's interest. Climate change is a monumental problem; it threatens our economy, our livelihoods, and the ecosystems we depend on for our survival. Its effects on Canada are likely to be significant. Hotter temperatures, more extreme weather events, poorer air quality, wildfires, and increased water scarcity already negatively affect the health and well-being of Canadians. Absent policy action in both Canada and abroad, these effects will only get worse.

RECOMMENDATION #2: If governments wish to meet their climate goals at least cost, they should rely on increasingly stringent carbon pricing

The evidence from this report is consistent with numerous other studies: carbon pricing is the most cost-effective way to reduce GHG emissions. A stringent, rising carbon price can get Canada to its 2030 target at the lowest possible cost to the economy.

For Canada to reach its 2030 target, carbon prices must increase significantly from current levels. Our analysis suggests that a pan-Canadian price that rises to approximately $210 per tonne by 2030 will achieve the 2030 target. Our results likely over-estimate the required price, given rapid advancements in low-carbon technology that are likely to occur, including both innovations from abroad and those induced by Canadian policy. (These advancements in technology and innovation were not included in our modelling analysis.)

Carbon pricing generates revenues that can be recycled back into the economy. These revenues can be used to offset impacts on low-income households. Previous research by Canada's Ecofiscal Commission shows that less than 15% of revenues are needed to fully offset the costs of carbon pricing for the bottom 40% of households. Remaining revenues can go toward any number of priorities.

To make revenue recycling economically efficient, provincial governments should consider using increasing shares of revenue to reduce corporate and personal income taxes, especially as carbon prices increase over time. Doing so encourages investment and helps bolster economic growth. However, as we outline in Canada's Ecofiscal Commission (2016a), other priorities are also legitimate (e.g., funding infrastructure, paying down public debt, or investing in emissions-reducing innovation and technology). Revenue recycling priorities will rightly vary depending on a jurisdiction's unique context and policy goals.

Finally, to create an economically efficient climate policy package, governments should support carbon pricing by implementing complementary climate policies. As we detail in Canada's Ecofiscal Commission (2017), complementary policies do things carbon pricing cannot. To be truly complementary, these supporting policies must have a clear rationale and be well designed. And they must be well integrated into the broader policy package.

RECOMMENDATION #3:
If policymakers choose not to close the gap to Canada's emissions target using carbon pricing, they should rely on increasingly stringent flexible regulations instead

If policymakers are unwilling to increase carbon prices in line with the stringency required to reach Canada's emissions target, other, supportive measures will be required.

Flexible regulations can be combined with carbon pricing policies so that they collectively achieve Canada's target. Flexible regulations mimic key features of carbon pricing, such as compliance flexibility. By leveraging market forces, they can approach the efficiency of carbon pricing and deliver GHG mitigation more cost-effectively than other alternatives like subsidies or prescriptive regulations.[35]

To meet Canada's emissions targets using this kind of approach, carbon prices and flexible regulations must together be sufficiently stringent. The stringency required of flexible regulations will depend on how high carbon prices rise. If policymakers keep carbon prices low, flexible regulations will have to drive deeper emission cuts, which will raise the overall cost of meeting Canada's GHG target (since flexible regulations are less cost-effective than carbon pricing). We therefore recommend that policymakers adopting this approach rely on carbon pricing to drive as much GHG mitigation as possible, with flexible regulations playing a supporting role.

If policymakers choose not to use carbon pricing *at all*, they should use stringent, coordinated, economy-wide flexible regulations. Historically, this has not been the case. Regulatory climate policy approaches in Canada have relied on a mix of flexible regulations, prescriptive regulations and subsidies that commonly overlap in coverage, creating duplication and increasing costs. If climate policy is to be cost-effective, policymakers choosing not to use carbon pricing must implement the type of *efficient* flexible regulation policy package that we detail in Section 5.

But policymakers pursuing an economy-wide flexible regulation approach should proceed with caution. Developing efficient flexible regulations presents significant administrative and implementation challenges. Perhaps even more importantly, achieving the 2030 target will require regulations that are much stricter than those seen to date. The flexible regulation policy package outlined in Section 5 goes far beyond any policies have been implemented in Canada so far. A regulation that, for example, cuts the GHG intensity of transport by more than 40% by 2030 will require costly, far-reaching changes in Canada's transportation sector. At these high levels of stringency, the costs of flexible regulations become more visible.

The kind of flexible regulations necessary to reach Canada's target will be much more noticeable to businesses and households than those that have been implemented to date. It is an open question how their costs will be perceived by households when they are implemented at these kind of stringency levels.

[35] In some cases, these other instruments may still have a role to play. As we discuss in Canada's Ecofiscal Commission (2017), such policies are complementary when they fill gaps in emissions coverage that other instruments cannot, address market problems that impede cost-effective GHG mitigation, or deliver valuable co-benefits.

7 A FINAL WORD ON COST-EFFECTIVENESS

Meeting Canada's emissions targets will not be easy. All the climate policy options available to Canadian policymakers will create costs for households, businesses, and the economy as a whole. And every option will present its own implementation challenges. However, the costs of not acting are greater. Climate change is by far the biggest and most consequential risk humankind faces; to reduce this risk—and to meet our international commitments—we must act.

Elected (and prospective) politicians are in the best position to assess which policy approach stands the best chance of being acceptable to Canadians. A wide range of factors may be relevant in making that determination.

In some cases, they may believe that making climate policy effective requires compromise on cost-effectiveness. But they should proceed with caution. While cost-effectiveness is not the only criterion they should consider, it is far from immaterial. Indeed, compromising too much on cost-effectiveness presents its own risks.

In particular, we may be more likely to get effective climate policy that is durable over the long term—and consequently, achieve greater GHG reductions—if that policy also minimizes costs.

To illustrate, we need look no further than Ontario's feed-in-tariff program for its electricity sector. The policy achieved its aim of greater renewable electricity investment and deployment in the province. But the subsidies that it provided to producers were more generous than necessary. Paired with concern over rising electricity prices in Ontario (which were only due in part to the program) the policy's high costs fuelled a strong public backlash against what many would have assumed would be a low-visibility climate policy. Moreover, its example helped drive opposition to renewable energy policies in Alberta despite the fact that its policies were better designed, and later, to carbon pricing in Ontario—a much more cost-effective type of climate policy.

There is a risk that the more that policymakers compromise on climate policies' cost-effectiveness, the more the public will ultimately reject these policies—and even climate policies in general—due to their costs. This is especially significant given that stringency will need to rise under any policy approach. While low-visibility, high-cost policies may be easier to implement at their outset, they may prove less durable over time as stringency and costs rise.

Ecofiscal has long argued for cost-effective policy to achieve environmental objectives. Cost-effectiveness may also prove critical to a politically viable climate policy approach. The costs of climate policy are not an abstract concept. They have real implications for jobs, standards of living, and the country's economic prospects. Careful policy design may make households and businesses less resistant to meaningful, increasingly stringent climate policy.

Policies with higher costs but lower visibility may be easier to implement in the short-term, but they represent a false promise. By ultimately costing households and businesses more, they risk causing a backlash that undermines their own long-term political viability.

Higher-visibility policies such as carbon pricing may be more difficult to implement at their outset. But in the end, they may be the only way forward.

Annex 1: Additional modelling results

All projections and modelling results described below are developed using the GTECH computable general equilibrium model.

Rather than using individual marginal rates for different income brackets, the GTECH model uses an effective overall average tax rate. The tax rates we discuss in this annex therefore refer to an individual province's average (combined federal and provincial) corporate or personal income taxes.

Figure 4: Percentage point change in combined average provincial and federal 2030 personal income tax rates that results from recycling carbon pricing revenues under *Approach #1* using the more-efficient approach described in Section 5

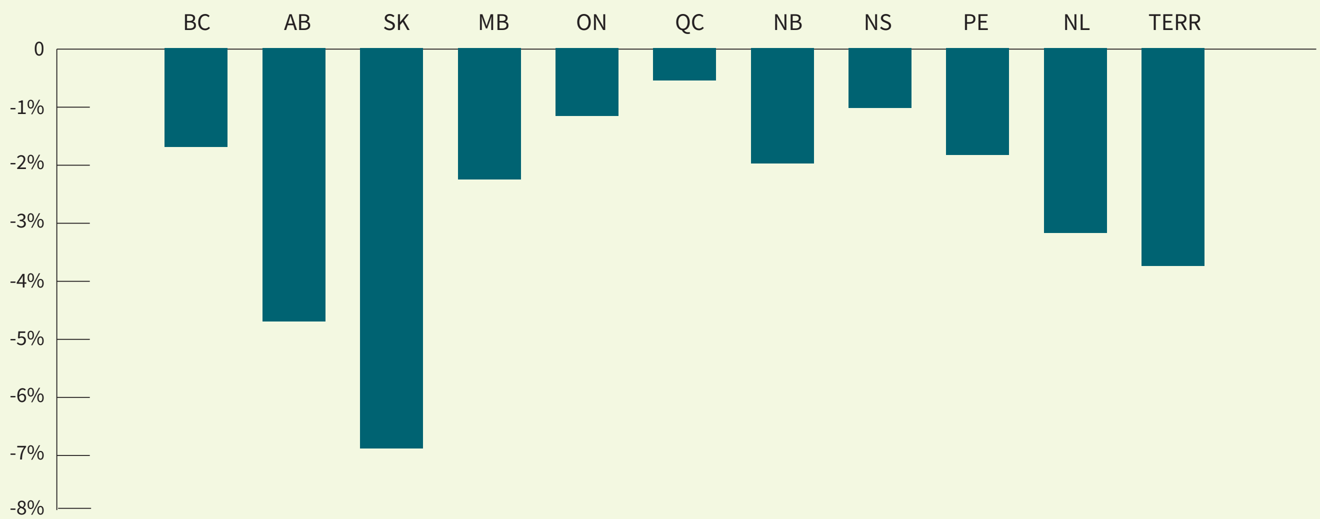


Figure 5: Percentage point change in combined average provincial and federal 2030 corporate income tax rates that results from recycling carbon pricing revenues under *Approach #1* using the more-efficient approach described in Section 5

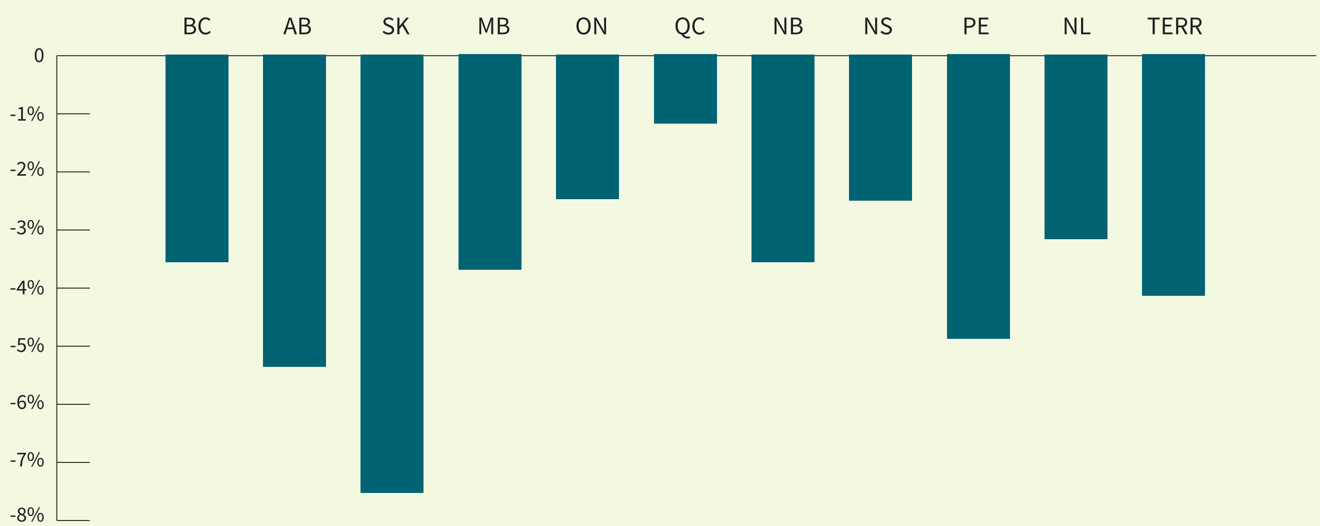


Figure 6: Percentage point change in combined average provincial and federal 2030 personal income tax rates resulting from having to raise taxes to fund subsidies under *Approach #2: Economy-wide regulations and subsidies*

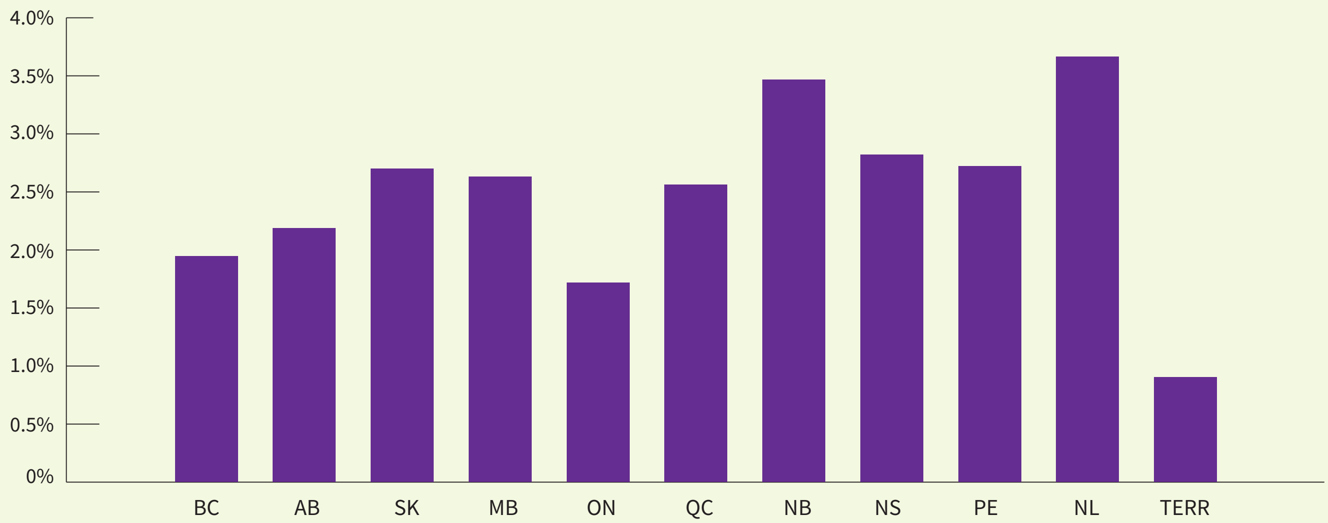


Figure 7: Percentage point change in combined average provincial and federal 2030 corporate income tax rates resulting from having to raise taxes to fund subsidies under *Approach #2: Economy-wide regulations and subsidies*

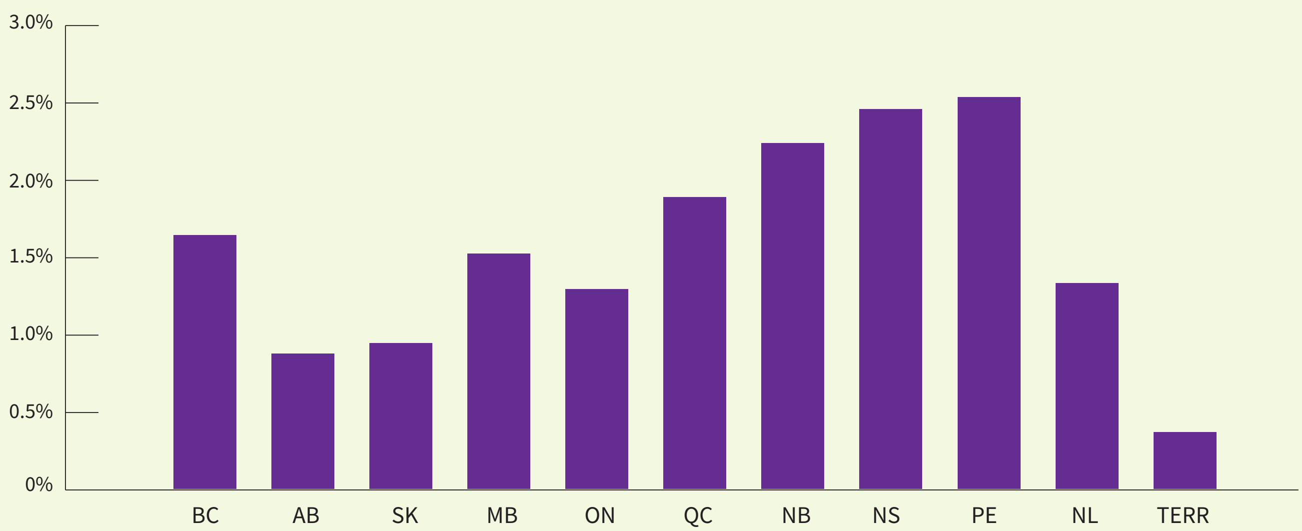


Figure 8: Percentage point change in combined average provincial and federal 2030 personal income tax rates resulting from having to raise taxes to fund subsidies under *Approach #3: Industry-focused regulations and broad subsidies*

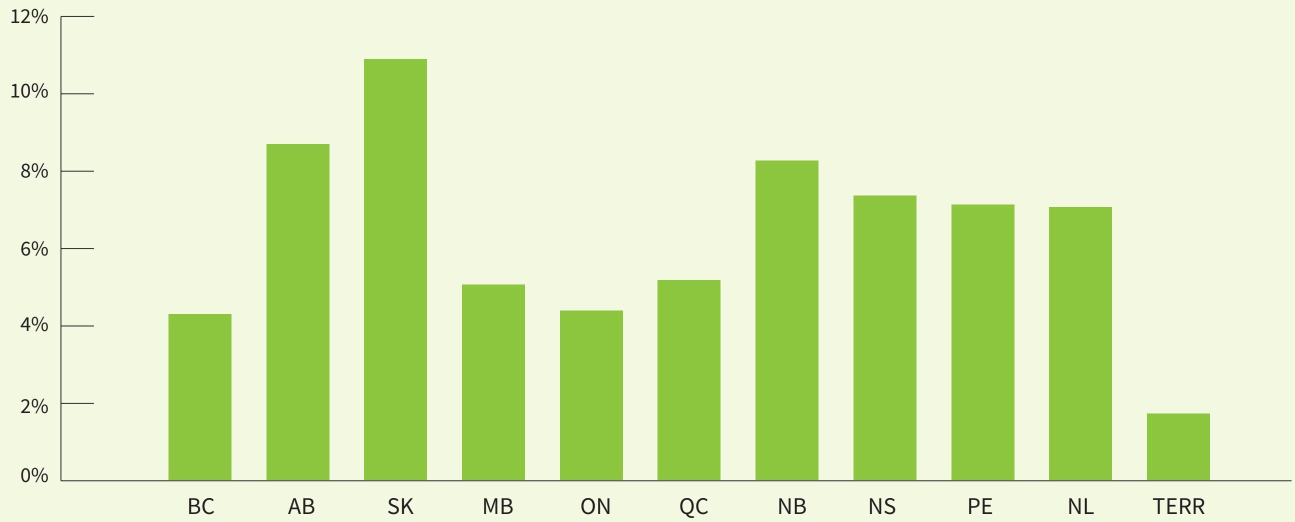
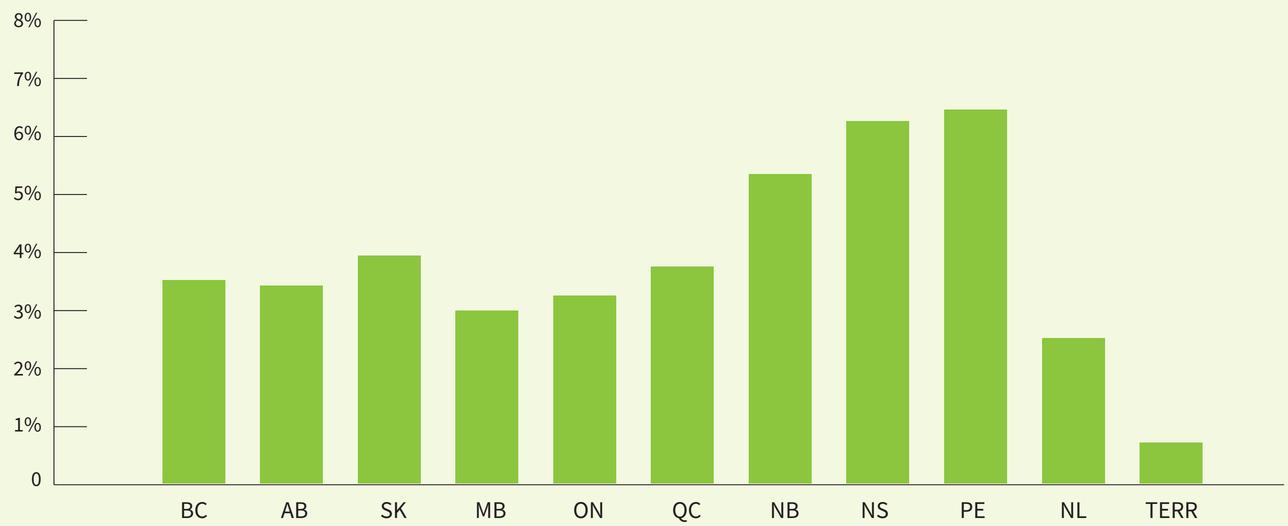


Figure 9: Percentage point change in combined average provincial and federal 2030 corporate income tax rates resulting from having to raise taxes to fund subsidies under *Approach #3: Industry-focused regulations and broad subsidies*



Annex 2: Policy packages for improving the economic efficiency of Approaches 1 to 3

Table 5: An alternative policy package for Approach #1: Carbon pricing with tax reductions and targeted support for industry

Policy	Description	Details and required stringency
Carbon pricing	A national, uniform, rising price on carbon. All of the revenues raised by the tax remain in the province they originate in	Carbon price rises to $229/tonne by 2030[36]
Output-based pricing	Provinces implement output-based pricing for emissions-intensive, trade-exposed (EITE) sectors to address competitiveness pressures and avoid GHG leakage. Firms receive emissions credits based on a sector-average emissions intensity and pay a carbon price on any emissions that exceed this benchmark.	Benchmarks are set at 80% of sector-average combustion GHG emissions per unit of output, tightening to 90% by 2030. The carbon price firms pay on emissions above the benchmark is aligned with the national price.
Revenue recycling	Carbon pricing revenues are recycled toward protecting low-income households and reducing taxes. All of the revenues raised by the tax remain in the province they originate in. Output-based pricing system revenues are recycled into a technology R&D fund.	Requires 15% of revenues to go toward protecting low-income households. The balance is used to reduce provinces' corporate and personal income taxes. The decrease in tax rates varies across provinces. For example, combined 2030 provincial and federal average personal income tax rates fall 1.9 percentage points in Nova Scotia versus 9.6 in Saskatchewan (see Figure 4 and Figure 5 in the Annex for a breakdown of tax rate changes across provinces). For output-pricing, 100% of revenues go into provincial R&D funds for EITE sector mitigation technology.
Gap-filling policies	A regulation for the agricultural sector that requires methane to be captured from manure, used to make renewable natural gas	By 2030, 50% of feedlots with proximity to a pipeline are required to capture methane.
	A regulation requiring waste management facilities to flare methane or capture it for the production of electricity or renewable natural gas	Requires 50% of landfills not currently flaring or capturing methane must do so by 2030
Other existing policies	Existing policies include the federal government's national energy-efficiency standards for appliances and Corporate Average Fuel Economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard. See Navius Research (2019) for more details.	

[36] Modelling results indicate that the carbon price needed to reach Canada's 2030 target is higher under the more economically efficient version of this approach. This is due to the positive effect of tax reductions on economic growth: carbon prices need to be higher to constrain the emissions increases that would otherwise come with increased economic growth. However, again, modelling results should be seen as indicative rather than precise estimates. And carbon prices may be overestimated because our modelling analysis does not include the cost-reducing effects of policy-driven low-carbon innovation.

Table 6: An alternative policy package for Approach #2: Economy-wide flexible, harmonized regulations		
Policy	**Description**	**Details and required stringency**
Agriculture sector regulation	A regulation for the agricultural sector that requires methane to be captured from manure, used to make renewable natural gas	By 2030, 50% of feedlots with proximity to a pipeline are required to capture methane
Flexible regulation of the buildings sector	A clean fuel standard for buildings' energy use, with compliance trading among regulated entities permitted	The standard requires a 5% reduction in the direct GHG intensity of the fuels used by buildings between 2020 and 2025 and a 27% reduction between 2025 and 2030. By 2030, compliance obligations for this regulation are estimated to trade at a price of $301/tonne.
Flexible regulation of the electricity sector	An emissions-intensity standard for electricity generation, with compliance trading among regulated entities permitted	The standard requires a 37% reduction in the GHG intensity of electricity generated and sold in Canada between 2020 and 2025 and a 50% reduction between 2025 and 2030. By 2030, compliance obligations for this regulation are estimated to trade at a price of $271/tonne.
Flexible regulation for the industrial sector	A standard for the emissions intensity of production in the industry sector, with compliance trading among regulated entities permitted	The standard requires a 16% reduction in the GHG intensity of production between 2020 and 2025 and a 32% reduction between 2025 and 2030. By 2030, compliance obligations for this regulation are estimated to trade at a price of $268/tonne.
Flexible regulation for the transport sector	A low-carbon fuel standard for transportation, with compliance trading among regulated entities permitted	The standard requires a 16% reduction in the direct GHG intensity of transportation fuels sold in Canada between 2020 and 2025 and a 42% reduction between 2025 and 2030. By 2030, compliance obligations for this regulation are estimated to trade at a price of $211/tonne.
Solid waste sector regulation	A regulation requiring flaring of methane or capture for the production of electricity or renewable natural gas	Requires 50% of landfills not currently flaring or capturing methane to do so by 2030
Other existing policies	Existing policies include the federal government's national energy-efficiency standards for appliances and Corporate Average Fuel Economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard. They also include a federal price on carbon that rises to $50/tonne by 2022. See Navius Research (2019) for more details.	

Table 7: An alternative policy package for Approach #3: Targeted flexible regulations

Policy	Description	Details and required stringency
Flexible regulation of the industry sector	A standard for the emissions intensity of production in the industry sector, with permits tradable across industrial sub-sectors (e.g., steel, fertilizer, cement, oil and gas), with compliance trading among regulated entities permitted	The standard requires a 60% reduction in the GHG intensity of production between 2020 and 2025 and a 68% reduction between 2025 and 2030. By 2030, compliance obligations for this regulation are estimated to trade at a price of $532/tonne.
Flexible regulation of the freight sector	A regulation on the average carbon intensity of new freight trucks sold, with compliance trading among regulated entities permitted	The standard requires the average carbon intensity of new freight trucks between 2026 and 2030 to be 49% lower than the average intensity of trucks sold in 2010. By 2030, compliance obligations for this regulation are estimated to trade at a price of $559/tonne.
Flexible regulation of commercial buildings	A regulation on heating and cooling equipment used in commercial buildings	All new equipment installed after 2020 must be zero emissions. For space and water heating, heat pumps must be used.
Waste sector regulation	A regulation requiring flaring of methane or capture for the production of electricity or renewable natural gas	Requires 50% of landfills not currently flaring or capturing methane to do so by 2030
Other existing policies	Existing policies include the federal government's national energy efficiency standards for appliances and Corporate Average Fuel Economy regulations for automakers, as well as provincial policies like Nova Scotia's Renewable Electricity Standard and British Columbia's Low-Carbon Fuel Standard. They also include a federal price on carbon that rises to $50/tonne by 2022. See Navius Research (2019) for more details.	

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