# Exploring the Landscape of Canadian Climate Policy[†]

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*Abstract*

Canadian climate policy is increasingly complex, with numerous mandatory and voluntary policies to reduce greenhouse gas emissions. These policies are national and subnational and involve a variety of policy instruments. Policy interventions range from economy-wide (e.g., emissions pricing) to sector-specific (e.g. clean electricity regulation) to targeting specific actions (e.g. fuel-switching subsidies). Studying the effects of policy changes and interactions is crucial in this active policy space. This paper overviews Canadian climate policy and reviews trends in climate and environmental policy research. Despite the richness of the policy landscape, there is limited academic work evaluating the effectiveness (emissions reductions) and cost-effectiveness (cost per tonne of abatement) of Canadian climate policy, equity and distributional consequences of policy choices, and how policies interact. Additional academic work along these themes can help inform better policy design and help Canada meet its emission-reduction goals.

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# Introduction

Canada has a plethora of federal, provincial, territorial, and even municipal climate policies (Canadian Climate Institute 2023; Scott, Rhodes, and Hoicka 2023; Winter et al. 2023). Despite its many policy levers, Canada has a long history of setting ambitious climate targets and failing to implement sufficiently stringent policies to meet them (Commissioner of the Environment and Sustainable Development 2023b; Leach 2023). Moreover, Canada's institutional and governance structures have led to a policy laboratory (Boyd and Olive 2021) — where even policies developed under the same principle, such as emissions pricing, have vastly different implementation. These three facts speak to the need for robust analysis of the effectiveness and consequences of the current policy environment. We review the current state of Canadian climate policy and extant work evaluating the myriad policy levers to identify areas for future research. Our guiding research question is *what are the gaps in knowledge in existing literature, and what are key questions for evaluating policy and improving policy design?*

Given the high number of current policy instruments — 437 emissions-mitigation federal, provincial, and territorial policies and 151 building-sector policies (Canadian Climate Institute 2023; Winter et al. 2023) — it is outside our scope to examine all, or even to try and find literature evaluating the universe of identified policies. Instead, we use a themed approach to our discussion of policy and policy evaluation, using an assessment of what is currently known to offer avenues for future research. We rely primarily on evidence from Canada, discussing international evidence where it adds relevant content. In all areas, we distinguish between macroeconomic effects — emissions reductions, emissions intensity, output, employment, and productivity — and household effects.

First, we discuss extant work examining the effectiveness (emissions reductions) and cost effectiveness (cost per tonne of emissions reductions) of policy interventions. Here, we review three main policy areas: emissions pricing; industrial policy, trade, and the environment; and energy efficiency and fuel switching programs. Second, we discuss equity issues and distributional concerns with net zero targets and other emissions-reduction policies. Our review focuses on emissions pricing and specific example industrial policies (the federal *Clean Fuel Regulations* and low-emission electrification). Third, we outline the importance of considering policy interactions and exploring these interactions. Ex ante or ex post analysis of a single policy lever is important for understanding its effectiveness and outcomes. However, this approach abstracts from distortions due to other policies or unaddressed market failures, or even simple interaction effects from multiple policies attempting to achieve the same objective. We use the concepts of optimal taxation and policy design for net zero targets to illustrate the importance of considering interactions.

Overall, Canadian climate policy is understudied by the academy, both in terms of the number of policies and the volume of academic work. We find that the majority of climate policy research focuses on pricing, with a mix of ex ante and ex post work. With ex post work, there is a disproportionate emphasis on evaluating BC's carbon tax in determining macroeconomic effects. Industrial policy and abatement subsidy programs receive little attention; the same is the case for evaluating policy interactions. A common theme across the work we review is that much of the analysis is from grey literature — think tanks and the occasional report from government or government agencies — rather than peer-reviewed academic literature. A caveat to our results is that we have not engaged in a systematic review or meta-analysis of specific policy instruments or a specific research area — e.g., Copeland and Taylor (2004), Green (2021b), or Köppl and Schratzenstaller (2023) — or a review of Canadian scholars' contributions (Copeland and Taylor 2017). Comprehensive analysis of this type is needed, but we leave it for future work.

The paper proceeds as follows. The next section reviews the current state of climate policy, to provide context and background for the discussion of existing research. The majority of the paper discusses a threefold research agenda: effectiveness and cost-effectiveness of climate policy design, equity in climate policy, and understanding policy interactions. In each of the three sections

# A Primer on Canadian Climate Policy

This section presents a concise overview of climate policy in Canada, focusing on modern policy developments. This context is important for understanding differences in policy design, the current research gaps and unanswered questions, and how economics as a discipline can contribute to addressing these questions and informing future policy development.

Environmental, energy, and climate policy in Canada is characterised and influenced by three main features. First, the federal system of government, whereby the environment is a joint responsibility and provinces have responsibility for natural resources (subject to some limitations). Second, regional differences in resource endowments, energy systems, and economic activity. Third, the influence of international policy decisions, primarily by the United States and more recently Europe as major trading partners. All three factors have shaped federal and provincial climate policies and determined the scope of ambition and action by different orders of government.

Harrison (1996, 32) notes that "pollution was not a prominent issue in 1867," and so "it is hardly surprising that responsibility for the environment was not explicitly allocated to either the federal or provincial legislatures" in the *British North American Act*. Accordingly, jurisdictional authority to regulate environmental degradation, and more specifically emissions and climate policy, is rooted in other explicit powers given to each order of government (Harrison 1996; Lucas and Cotton 2017). The ambiguity of jurisdiction over the environment results in jurisdictional overlap (founded on different legislative authorities or heads of power), and an outsize role for federalism and the courts in resolving this overlap (Harrison 1996; Olszynski, Bankes, and Wright 2023). Joint jurisdiction alongside evolving political priorities has also led to ebbs and flows in federal and provincial policy action. There are several distinct eras in Canadian climate policy with the majority of policy actions taking place from 2015 onward (Harrison 1996; 2023; Boyd 2015; Winter 2020).

One of the tensions inherent in Canadian climate policy — and to some extent, environmental policy as well — is the international public good aspect of the climate and GHG concentrations. This forces federal action as a participant in international treaties such as the UN Framework Convention on Climate Change, the Kyoto Protocol, the Paris Agreement, and the Kunming-Montreal Global Biodiversity Framework. The Government of Canada makes agreements on behalf of Canada and the provincial and territorial governments, including explicit commitments for emissions reductions. Joint responsibility over the environment means both Canada and its subnational governments are responsible for implementing those commitments. Provincial and territorial jurisdiction over natural resources means it is also possible for provinces to take actions prioritizing economic development and inconsistent with action on climate change, such as Alberta's recent flirtation with expanding coal development (Winter et al. 2021).

Bilateral and multilateral international relationships also substantially influence Canadian energy and environmental policy. Specifically, the US as a major trading partner and a substantially larger economy, means alignment and competition with the US is a major preoccupation for Canadian policymakers, both generally and in policy design (Ljunggren 2018; von Scheel 2022). For example, US withdrawal from the Kyoto Protocol in 2001 contributed to Canada's own withdrawal in 2012 (Harrison 2012; 2023). As a contrast, California's climate policy leadership significantly influenced provincial policy design and action

(Boyd 2015). More recently, the European Union's decision to implement a border carbon adjustment mechanism prompted the Government of Canada to explore border carbon adjustments as an alternative policy mechanism (Department of Finance Canada 2021b; 2021c). Canada is also part of the G7 Climate Club formed in December 2022 (G7 Germany 2022; G7 Leaders 2022), which has the potential to shape Canadian policy moving forward.

## Modern Climate Policy: The Pan-Canadian Framework

From when Canada ratified the United Nations Framework Convention on Climate Change in 1992 to 2015, it produced a series of modest emissions reduction proposals and plans, with little substantive policy development to help it meet its successive targets (Harrison 1996; 2012; 2023; Olewiler 2005). Notable actions include Alberta introducing an emissions-intensity performance standard for industrial emitters in 2007, with a modest price funding emissions reduction technologies (Leach 2012; Dobson and Winter 2015); BC's carbon tax in 2008, starting at $5 per tonne; Quebec's cap and trade system, introduced in 2012; and federal vehicle emissions standards (in line with US standards) and emissions intensity standards for electricity generation (Harrison 2023).

In 2015, due in part to the upcoming Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21)[1], political rhetoric around action on climate change accelerated and focused on interjurisdictional cooperation and dialogue. In April 2015, leading up the to Conference of the Parties (COP21) in Paris, Quebec convened Canada's premiers at a summit on climate change (Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs n.d.). This led to the Quebec Declaration, where the premiers committed to "strengthen[ing] pan-Canadian climate change cooperation," alongside "implement[ing] policies to reduce GHG emissions," and "partner[ing] with the federal government in a concerted effort to develop an ambitious contribution from Canada" at COP21 (The Premiers of Canada 2015). In May 2015, the Government of Canada updated its emissions reduction target to 30 per cent below 2005 levels by 2030 (McDiarmid 2015; Office of the Auditor General of Canada n.d.).

Following the Quebec summit, in June 2015 the Canadian Council of Ministers of the Environment formed a new climate subcommittee (Canadian Intergovernmental Conference Secretariat 2015), though its initial priorities were dialogue-focused rather than action-oriented. Any policy actions were to "reflect [each jurisdiction's] circumstances and priorities," and "be coordinated and complementary" (Canadian Intergovernmental Conference Secretariat 2015). In July 2015, Canada's premiers reaffirmed the Quebec Declaration commitments, and recommitted to "implementing programs and measures to mitigate and address the impacts of climate change," highlighting several policy levers including carbon pricing, "hard caps on emissions from electricity generation, and renewable energy targets" (The Council of the Federation 2015).

After Canada's 2015 federal election, there was a notable shift in the Government of Canada's tone on climate change. Starting with renaming Environment Canada to Environment and Climate Change Canada (CBC News 2015), Prime Minister Trudeau set developing "a plan to combat climate change and reduce greenhouse gas emissions" as the new minister's first priority (Trudeau 2015a). Prime Minister Trudeau emphasized the change in approach and tone with his now-famous speech at COP21[2], stating "Canada is back, my good friends. We are here to help" (Trudeau 2015b). The speech signalled Canada's recommitment to federal climate policy action. Canada, along with almost 200 other countries, negotiated the historic Paris Agreement at COP21 and committed to five-year cycles of policy action and reporting

[1] Canada needed to commit to an updated emissions target at a June 2015 G7 meeting in advance of COP21 (McDiarmid 2015).
[2] The UN Climate Change Conference, or Conference of the Parties.

(United Nations n.d.). This set the stage for more ambitious climate action in Canada, the modern era of climate policy. A key component of more ambitious *Canadian* climate action was *Alberta's* new Climate Leadership Plan, announced in November 2015 (Government of Alberta 2015). Released two weeks before the COP21 summit in Paris, the CLP introduced a broad-based carbon tax with means-tested rebates, reforms to the industrial emissions-pricing system, phasing out coal-fired electricity generation, capping oil sands emissions, and new methane-reduction targets in oil and gas operations (Government of Alberta 2015; 2016). A credible climate policy by Canada's largest source of emissions alongside federal resurgence of interest in climate policy enabled new cooperative federalism on this file (Winter 2020).

Canada's first ministers met in March 2016, producing the Vancouver Declaration, a commitment to "a pan-Canadian framework for clean growth and climate change" and achieving Canada's international commitments under the Paris Agreement (Canada's First Ministers 2016; Trudeau 2016). The declaration acknowledged the leadership of provinces, highlighted carbon pricing as an important policy lever in mitigating emissions, and committed to "adopting a broad range of domestic measures, including carbon pricing" to reduce Canada's emissions (Canada's First Ministers 2016). Federal unilateral leadership began to show itself in October 2016, when Prime Minister Trudeau and environment minister McKenna announced a federal backstop system, whereby provinces and territories would need to adopt a pricing system by 2018 or have a federal system imposed (Harris 2016; McDiarmid and Tasker 2016; Harrison 2023).[3]

In December 2016, after a nation-wide consultation process and following COP22 and Canada's ratification of the Paris Agreement, governments in Canada jointly introduced the Pan-Canadian Framework on Clean Growth and Climate Change (Environment and Climate Change Canada 2016). The Pan-Canadian Framework (PCF) is the backbone of recent, or modern, Canadian climate policy. Originally — and primarily — a commitment to emissions pricing, it is an example of cooperative federalism in a contentious policy space (Winter 2020; Harrison 2023).[4] The original PCF had four pillars: pricing emissions; complementary actions where pricing faces market barriers or is insufficient "to reduce emissions in the pre-2030 timeframe"; adapting and building resiliency to climate change; and accelerating innovation and clean technology development. There were two key principles embedded in the pricing commitment: minimize carbon leakage and competitiveness impacts, and a commitment to revenue recycling to mitigate a "disproportionate burden on vulnerable groups and Indigenous Peoples" (Environment and Climate Change Canada 2016, 8). Importantly, the PCF allowed for provincial flexibility in design, with the choice between a price-based system like in BC, a hybrid system like Alberta's, or a cap-and-trade system like Quebec (Environment and Climate Change Canada 2016). Despite the unilateral federal action in October 2016, the pan-Canadian discussion of climate policy and the PCF itself framework was possible because Canada was in an era of cooperative federalism. Alberta had implemented province-wide carbon pricing, not just on large emitters, and BC, Ontario, and Quebec were all willing to move forward on carbon pricing.

In 2017, Ontario also implemented a cap-and-trade system, increasing Canada's priced emissions coverage from roughly 43% to 56%.[5] However, between 2017 and 2019, with additional technical details on the federal pricing system and a series of provincial elections, support for carbon pricing began to decline (Winter 2020; Harrison 2023). In August 2017, Environment and Climate Change Canada released

[3] Importantly, Trudeau announced the federal policy in the House of Commons while McKenna was meeting with provincial and territorial environment ministers, demonstrating his government's resolve in the face of some provincial resistance (Harrison 2023).
[4] The PCF was a joint document produced by the Government of Canada and all provinces and territories, excluding Manitoba and Saskatchewan; Manitoba signed later (Harrison 2023).
[5] We base this calculation on 2015 emissions and coverage estimates from Dobson, Winter and Boyd (2019).

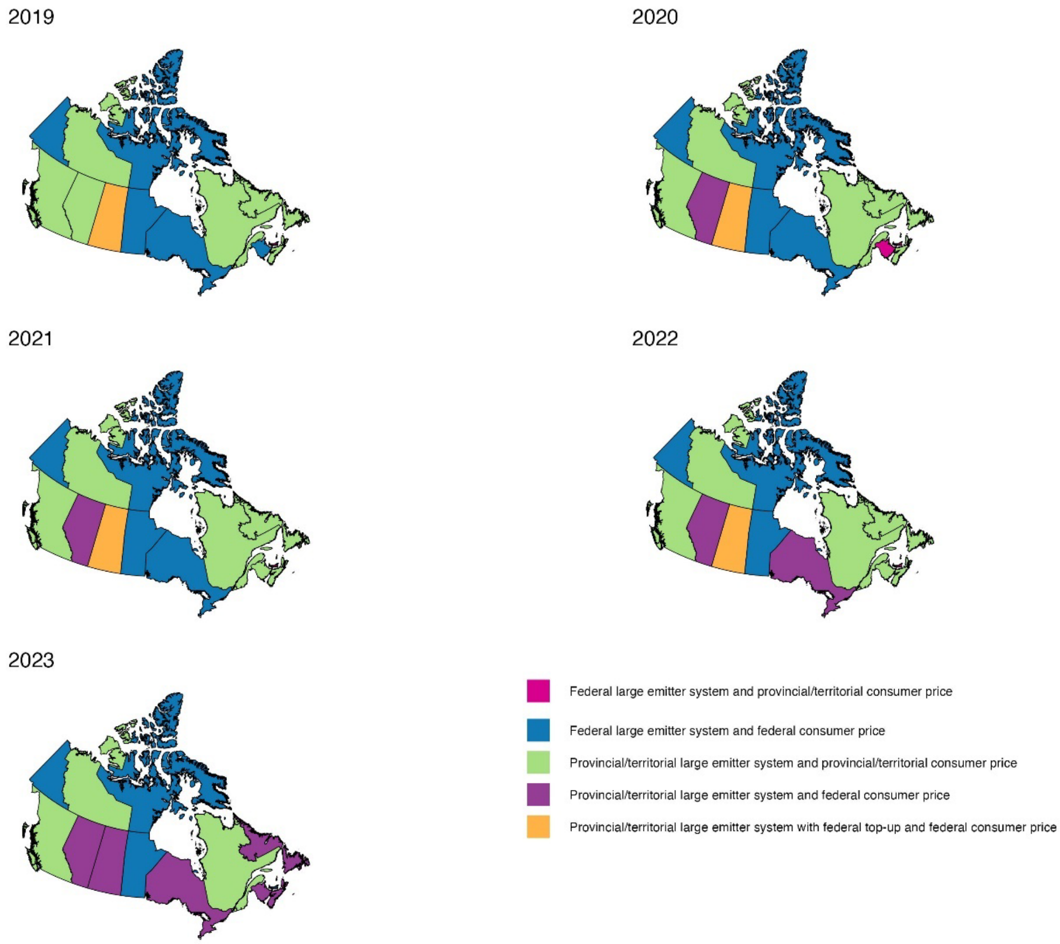
preliminary details of the test subnational systems would face, called the federal benchmark: a minimum increase in stringency (via a price path or declining annual emissions caps), and common scope and coverage similar to BC's carbon tax (Environment and Climate Change Canada 2017; 2023b). As another step in federal unilateralism, at the end of 2017 the federal finance and environment ministers (Morneau and McKenna, respectively) laid out next steps for carbon pricing, including the federal backstop system (for if provincial or territorial plans were deemed insufficient). They would introduce draft legislation for the federal backstop in January 2018, provinces and territories had until the end of March 2018 to opt in, and provincial and territorial pricing system submissions were due by September 1, 2018 (McKenna and Morneau 2017). Ministers McKenna and Morneau warned that provincial systems that did not meet the benchmark would have the backstop imposed. Moreover, backstop jurisdictions would have the system in place until 2022 to "minimize uncertainty for residents, businesses and investors" (McKenna and Morneau 2017).

The federal backstop policy — the *Greenhouse Gas Pollution Pricing Act* (GHGPPA) — came into force in June 2018. The *GHGPPA* set out a two-part system similar to Alberta's, with a fuel charge[6] combustion emissions and an output-based pricing system (OBPS)[7] for large industrial emitters (annual emissions over 50,000 tonnes $CO_2$e in 2014 or later) designated as emissions intensive and trade exposed. Revenue from the fuel charge is returned to households via lump-sum transfers (called the Climate Action Incentive Payment), using 90% of the fuel charge revenue in the jurisdiction where the revenue is raised (Environment and Climate Change Canada 2018). The remaining 10% of revenue was targeted to direct support of specific sectors.

In 2019, by the time Canada-wide emissions pricing was actually in place, the climate policy landscape was fragmented and complex (Winter 2020; Harrison 2023).[8] (Provincial resistance had also solidified, with Alberta, Ontario and Saskatchewan challenging the constitutionality of the GHGPPA.) A few provinces adopted their own systems, some adopted the federal backstop voluntarily, and others had a mix of provincial systems with a federal top-up (Figure 1). Moreover, provinces and territories that voluntarily implemented their own pricing systems secured specific exemptions to priced emissions (Dobson, Winter, and Boyd 2019). Rather than a uniform system, flexibility and exemptions created a system with differential treatment, policy instruments, emissions coverage, and marginal and average prices, altogether eroding the initial principles and ambition (Dobson, Winter, and Boyd 2019; Sawyer et al. 2021; Harrison 2023). Moreover, political changes combined with federal actions to close gaps in the original benchmark have led to provinces switching in and out of the backstop on a regular basis. The most notable example is in 2023 when the four Atlantic provinces switched to the federal consumer price.[9]

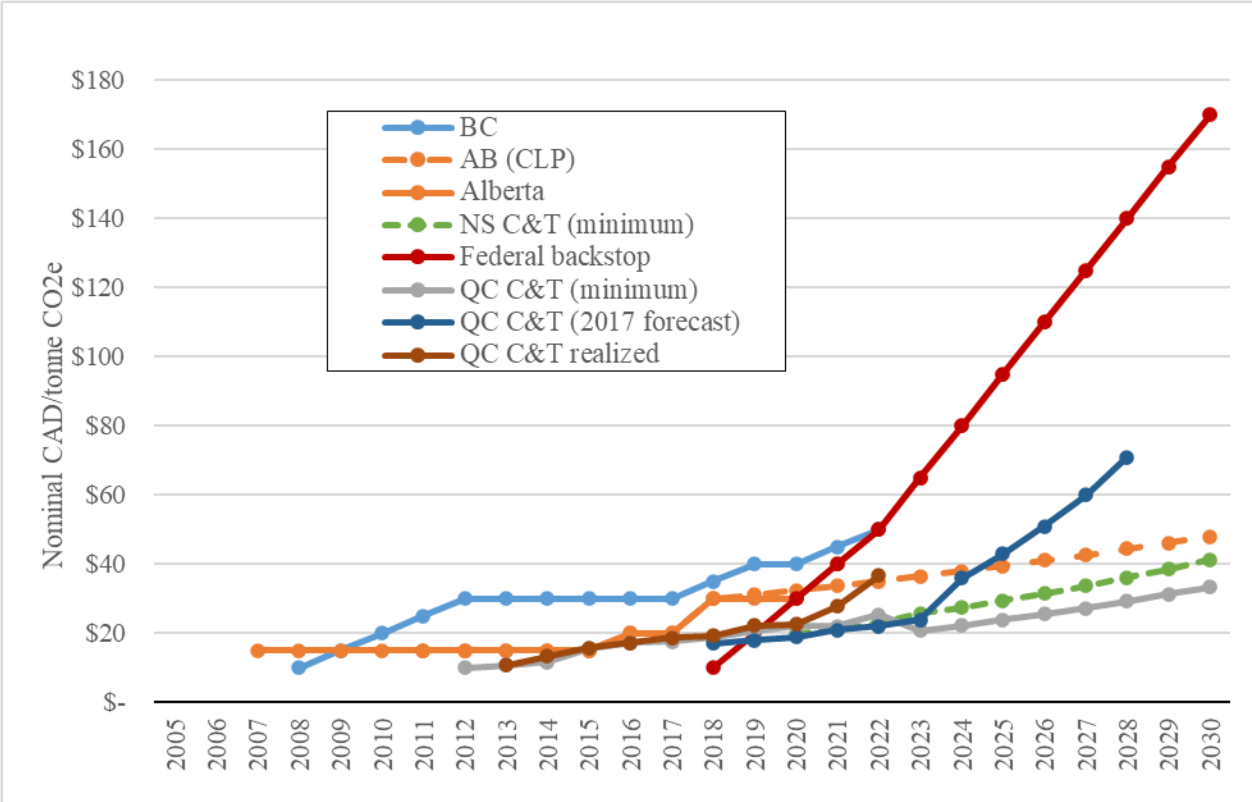
*Figure 1: Canada's Emissions Pricing Systems, 2019 to 2023*

[6] By quirk of Canadian jurisprudence, the federal price on emissions is a regulatory charge, not a tax (L. Tedds 2017).
[7] Output-based pricing combines emissions pricing with an output subsidy tied to an emissions performance standard. For details, see Fischer and Fox (2012) and Dobson and Winter (2018).
[8] Elections in Ontario and New Brunswick in 2018, and Alberta in 2019, meant these provinces removed their support for emissions pricing and action independent of federal unilateralism.
[9] This was due to the removal of the heating oil exemption these provinces originally received and a desire by the provincial governments to avoid increasing the stringency of their provincial systems (Poitras 2023).




As Harrison (2023) notes, the PCF, the federal benchmark and the federal backstop were inconsistent with Canada's Paris Agreement target. Specifically, a price well above the initial \$50 per tonne $CO_2e$ in 2022 would be necessary. Moreover, the choice between the cap and trade system and an explicit price also created inconsistency — the cap-and-trade system required declining annual caps consistent with the Paris target (Environment and Climate Change Canada 2017), more stringent than the initial price path. In practice, however, the cap-and-trade price in Quebec was substantially lower than the prevailing federal backstop price and forecast to remain low (Figure 2), likely contributing to regional tensions. The PCF also included language that Canada's "overall approach will be reviewed by 2022 to confirm the path forward" (Environment and Climate Change Canada 2016, 8), a nod to both the need to revisit the PCF in order to meet the Paris target and an acknowledgment of the tensions between flexibility and climate ambition.

*Figure 2: Emissions Pricing Paths in Canada, 2005 to 2030*




Note: Alberta's price for large industrial emitters deviated briefly from its consumer price, with an increase to $30 per tonne in 2017 (Government of Alberta 2020).

In late 2020, the pattern of federal unilateralism on climate policy continued. November 2020 saw the introduction of the *Canadian Net Zero Climate Accountability Act*, enshrining and "mandating *federal* accountability for meeting national emission targets" (Harrison 2023, 79). In December 2020, the Government of Canada released its updated climate plan, *A Healthy Environment and a Healthy Economy* (HEHE). The plan involved a unilateral increase to the backstop carbon price (Harrison 2023), alongside 63 other "strengthened or new" policy initiatives (Environment and Climate Change Canada 2020a, 9) and a budget allocation of $15 billion (Department of Finance Canada 2021a). HEHE would set Canada to exceed its Paris target, with a 31% reduction in emissions by 2030 relative to 2005 (Environment and Climate Change Canada 2020a; 2020b). More ambitious actions followed. First, Budget 2021 allocated an additional $17.6 billion to complimentary policies for climate action and low-emissions technology development (Department of Finance Canada 2021a). Second, in April 2021, Trudeau announced a new emissions reduction target of 40-45% below 2005 emissions by 2030 (Environment and Climate Change Canada 2021a). Third, in August 2021, the federal benchmark was updated and strengthened, closing some of the gaps in the original benchmark test. Finally, at COP26 in Glasgow, Trudeau advocated for global emissions pricing and announced a commitment to cap oil and gas emissions (Trudeau 2021), with implementation of the cap targeted over 2023 and 2024 (Environment and Climate Change Canada 2022c; Varadhan 2023).

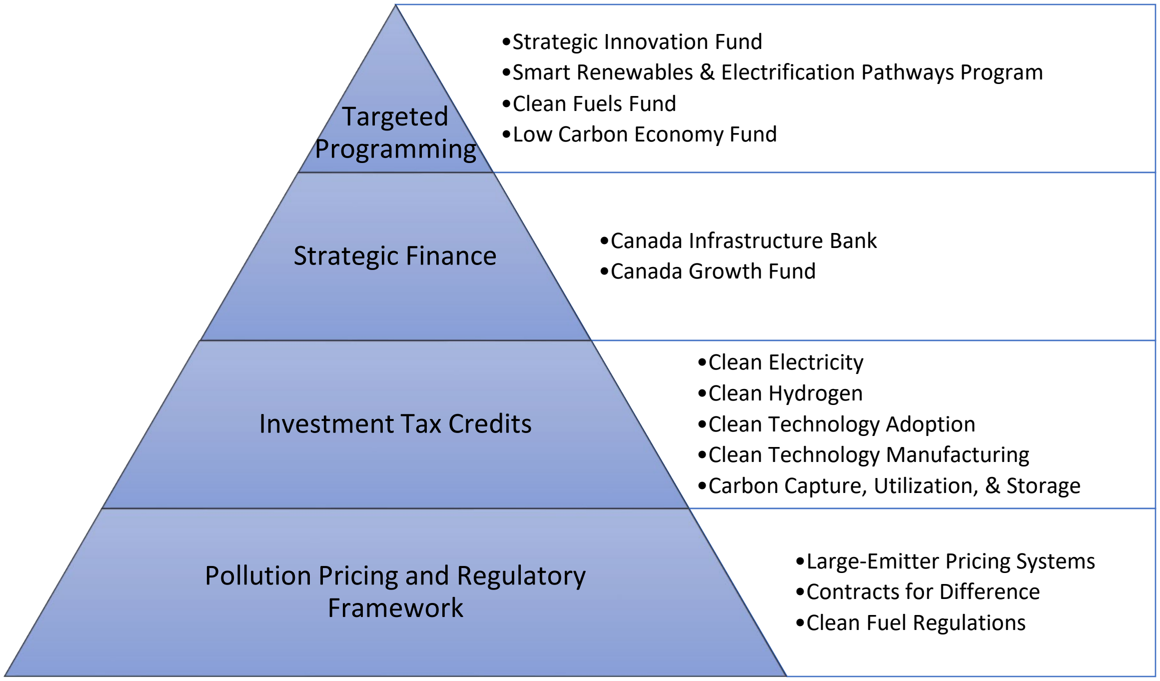
The updated benchmark set a course for renewed federal-provincial tensions over pricing, exacerbated by exceptionally high inflation in 2022 and 2023. Key changes were an updated price path, rising by $15 per tonne per year to $170 in 20230; a requirement for a provincial or territorial system to fully replace[10] the fuel charge or OBPS; emissions pricing coverage equivalent to the backstop; elimination of fuel exemptions; maintaining a marginal price signal at the minimum price; ensuring protections against carbon leakage are restricted to sectors at risk; high quality offset credits; moving to a multi-year assessment period; and public reporting on "key features, outcomes, and impacts" (Environment and Climate Change Canada 2021b). In principle, these changes would bring Canadian emissions pricing closer to uniformity, improving both the efficiency of the policy and the overall incentive to reduce emissions.

The revised federal target and the accompanying changes to the benchmark test prompted renewed provincial resistance (Government of Alberta 2022; Poitras 2023). The Atlantic premiers in particular pushed for exemptions and pauses, in part due to high inflation (Government of Nova Scotia 2022; Tombe and Winter 2023). Carbon pricing also became even more politically unpopular (Ipsos 2022), a marked contrast from past public opinion (Angus Reid Institute 2015; Anderson 2018). Rising inflation in 2022 and 2023, particularly on energy prices (Y. Chen and Tombe 2023), prompted calls for pausing or removal of the tax by provincial and federal politicians (Levesque 2022; Tombe and Winter 2023). In fall 2023, following pressure within the Liberal Party from Atlantic MPs, the Government of Canada reversed course, announcing a three-year pause on the fuel charge on heating oil and an increase in the rural Climate Action Incentive Payment (Department of Finance Canada 2023b; Stefanovich 2023). The majority of provinces and federal opposition politicians responded by calling for additional exemptions (Major 2023a; 2023b). Emissions pricing on households and non-industrial emitters remains controversial and politically fraught.

Although much of the political focus was and is on carbon pricing, all orders of government engaged in significant complimentary policy action, with some more active than others (Scott, Rhodes, and Hoicka 2022; Canadian Climate Institute 2023; Winter et al. 2023). However, the Government of Canada again had a major leadership role, with successive budgets implementing programs and policies designed to subsidize emissions reductions across the economy. By 2023, while pricing was the base of its climate policy framework, it was eclipsed by other actions (Figure 3). Major federal complementary actions, signalled by HEHE, include clean fuel regulations, clean electricity regulations, regulation of methane from oil and gas and landfills, energy-switching and energy-efficiency incentives, offset markets, tax credits, research and development funding, and infrastructure funding. The policies represent a mix between mandatory levers (pricing and regulatory initiatives), abatement support and other voluntary options, and information-provision. Many of these, including the *Clean Fuel Regulations* and the *Clean Electricity Regulations*, are controversial and opposed by the provinces (Government of Alberta 2023a; 2023b; Graney and Jones 2023).

*Figure 3: 2023 Federal Climate Policy Framework*

[10] Between 2019 and 2022, Saskatchewan had an OBPS system excluding electricity generation and natural gas pipeline transmission, with federal top-up (Government of Saskatchewan 2022).




Source: Replication of figure on page 74 in Budget 2023 (Department of Finance Canada 2023a).

Canada, across the federal, provincial and territorial governments, has 472 climate-related policies and 309 specifically targeting emissions mitigation (Scott et al. 2023). These policies range in scope from covering multiple sectors (e.g., Quebec's cap and trade system) or a single sector, to funding a project (e.g., New Brunswick's Total Home Energy Savings Program), to targeting a specific technology (e.g., appliance energy efficiency standards or tax credits for carbon capture and storage). Winter et al. (2023) find 151 policies that are relevant for the building sector alone. This breadth of policy levers and complexity of the policy landscape creates three problems for governments: potential duplication, scope for policy interactions, and running out of actions to regulate or affect through policy levers. All together, this means Canadian governments will likely need to turn to increasing the stringency of existing instruments and evaluating their effectiveness (alone and in combination) in order to meet Canada's 2030 and 2050 emissions reduction goals. We turn to this problem next, discussing extant research and where there are gaps that can inform and help improve climate policy development.

# Research Gaps and Key Questions

In this section, we review and discuss existing research on Canadian climate policy, and relevant international work. We use the lens of existing research and the current state of knowledge to identify and describe research gaps. We offer three avenues for future research, focusing on policy interventions to reduce emissions. First, we discuss a research agenda examining the effectiveness (emissions reductions) and cost effectiveness (cost per tonne of emissions reductions) of policy interventions. Second, we discuss equity issues and distributional concerns with net zero targets and other emissions-reduction policies. Third, we outline the importance of considering policy interactions and exploring these interactions as an avenue of research. A common theme across all three agendas is that much of the analysis is from grey literature — think tanks and the occasional report from government or government agencies — rather than peer-reviewed academic literature. While both sources have their place in advancing robust policy analysis, Canadian climate policy is under-studied by the academy.

## Effectiveness and Cost-Effectiveness of Policy Interventions

Here, we focus on policy design — outstanding questions, research gaps, and avenues for future work. Economists have a diverse toolkit for assessing both the effectiveness and cost effectiveness of policy interventions. This can take the form of ex ante assessment of policy options, and ex post analysis of the causal effect of a policy on metrics of interest (e.g., GDP, employment, productivity). In the realm of mitigation-focused climate policy, we typically define effectiveness as emissions reductions. In the case of behavioural interventions (e.g., electric vehicle subsidies) a metric of effectiveness may be program uptake. We generally measure cost effectiveness as the cost per tonne of emissions reductions, where the cost is the total economic burden, not just the cost borne by the emitter. In some cases, cost may also include changes to GDP, productivity, or the returns to labour.

Despite this diverse toolkit, there is relatively little analysis of the effectiveness and cost effectiveness of Canadian climate policy (or Canadian climate policy in general). While this is an academic research gap, there is a more fundamental problem: governments in Canada also do not conduct ex post analysis (Commissioner of the Environment and Sustainable Development 2023a).[11] For example, Canada's Commissioner of the Environment and Sustainable Development audited five federal regulations targeting greenhouse gases in Canada — *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*, *Heavy-Duty Vehicle and Engine Greenhouse Gas Emission Regulations*, *Reduction of Carbon Dioxide Emissions From Coal-Fired Generation of Electricity Regulations*, *Regulations Limiting Carbon Dioxide Emissions From Natural Gas-Fired Generation of Electricity*, and *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector* — concluding the Government of Canada is not effectively evaluating the causal effect of policy on emissions. Specifically, the Government of Canada is unable to attribute quantities of emissions reductions to the individual regulations. In practice, this means the Government of Canada is unable to determine whether its regulations are "working" or need to be tightened to meet policy goals. This example highlights how economists can contribute to policy analysis in Canada, and, perhaps more importantly, enhance the quality of policy development.

One of the potential reasons for limited within-government analysis of the consequences of emissions-mitigation policy is the complexity of the Canadian climate policy environment (Sawyer et al. 2021; Canadian Climate Institute 2023; Winter et al. 2023). This complexity can result in policy overlap between orders of government (Scott, Rhodes, and Hoicka 2023), or multiple policies from one or multiple ministries targeting the same actions (Sawyer et al. 2021; Winter et al. 2023). We discuss assessing policy interactions as a research agenda further below; with the remainder of this section, we highlight specific examples of analysis of individual Canadian climate policies and where gaps in understanding remain.

### Emissions Pricing

Emissions pricing is broadly seen, by economists, as the most efficient and effective way to reduce combustion emissions via pricing the externality, filling in the missing demand curve (Keohane and Olmstead 2016).[12] For firms, emissions pricing raises the cost of emissions-intensive inputs and increases costs of production. Potential responses are lowering output, changing the input mix, and investing in abatement activities (e.g., improving combustion efficiency, emissions control equipment, etc.) or

[11] There are some exceptions to this statement. Federal, provincial, and territorial auditors general offer ex post analysis, as does the Parliamentary Budget Officer, but these do not always rely on formal economic models. Within government departments, the regulatory impact analysis statements underpinning regulatory modifications also include assessments of the impacts, but these are generally more forward-looking as they outline the expected effects of regulatory changes.

[12] Others argue that pricing is ineffective and insufficient for reaching net zero goals (Green 2021a; 2021b).

alternative production technologies (e.g., fuel switching). For households. pricing reduces emissions by changing relative prices, prompting some combination of reduced consumption and a reallocation of consumption to less emissions-intensive goods. There is a growing literature on the effects of emissions (carbon) pricing on Canadian households, industrial activity, and the economy more broadly. However, Canadian governments' emissions pricing differs in practice from a textbook Pigouvian tax with a double-dividend from revenue return to households (Goulder 1995). This opens the door for additional work to understand the effectiveness and cost effectiveness of pricing as a policy.

***Macroeconomic Effects***

An important tool in evaluating the expected effects of emissions pricing is ex ante analysis, generally relying on computable general equilibrium (CGE) models and hypothetical policy counterfactuals. This is the approach taken by Environment and Climate Change Canada, in both its regulatory impact assessment statements[13] for federal pricing policies (Government of Canada 2018), and its modelling and reporting on Canada's emissions reduction plan (Environment and Climate Change Canada 2020b). However, Government of Canada modelling exercises and the models themselves are not subject to the same rigour of review and transparency of assumptions as academic work (Bailey et al. 2022; Rhodes et al. 2022). Academic work is important for providing alternative — and complementary — analysis.

The benefit of CGE models is their flexibility in designing and examining counterfactual outcomes, subject only to data limitations and the modellers' imaginations. The downside, on the other hand, is the outcomes are only predicted or projected effects, and are sensitive to model assumptions. This flexibility means there is already a rich literature examining the effects of emissions pricing in Canada. Example topics include optimal carbon tariffs in enforcing Paris Agreement targets (Munzur 2022a; Y.-H. H. Chen et al. 2023); policy design trade-offs (Dissou 2005; Tombe and Winter 2013; Withey et al. 2022); general equilibrium effects of meeting emissions-reduction targets with trade (Peters et al. 2010; Munzur 2022b; Gilmore et al. 2023); the distribution of effects across provinces (Snoddon and Wigle 2007; Peters et al. 2010; Böhringer et al. 2015; Munzur 2022b); and province-specific analysis, e.g., of BC (Carbone et al. 2020), Saskatchewan (Liu et al. 2018), and New Brunswick (Withey et al. 2022).

There is little ex post work examining how emissions pricing affects Canadian emissions (either economy-wide or sector- or fuel-specific), or other effects. In a survey of the empirical evidence on carbon pricing, Köppl and Schratzenstaller (2023) identify only seven papers presenting evidence on Canada, all studying BC's carbon tax.[14] These articles suggest BC's carbon tax decreased transportation (Rivers and Schaufele 2015; Lawley and Thivierge 2018; Pretis 2022), fossil fuel (Elgie and McClay 2013; Xiang and Lawley 2019), and aggregate emissions (Elgie and McClay 2013; Murray and Rivers 2015; Metcalf 2019). Pretis (2022) examines both transportation and aggregate emissions and only finds an effect for transportation emissions. In contrast, Arcila and Baker (2022) find emissions and gasoline consumption rise, alongside reduced energy-sector employment. Specific to manufacturing, Ahmadi, Yamazaki and Kabore (2022) find BC's carbon tax reduced plants' emissions, increased their output and decreased their emissions intensity. Other work examines the effect of BC's carbon tax on manufacturing productivity (Yamazaki 2022), employment (Yamazaki 2017; Yip 2018; Azevedo, Wolff, and Yamazaki 2023), and farm income (Olale et al. 2019; Slade, Lloyd-Smith, and Skolrud 2020). We are also starting to see the beginnings of a literature examining Quebec's cap and trade system. Hanoteau and Talbot (2019), with perhaps the first analysis of

[13] These are required evaluations of the positive and negative effects of proposed regulations, including formal benefit-cost analysis (Treasury Board of Canada Secretariat 2018a; 2018b; 2023).

[14] Köppl and Schratzenstaller (2023) also identify one additional paper, Kohlscheen, Moessner and Takats (2021) examining the effect of emissions pricing on 121 countries, but it is not clear if this article includes Canada.

Quebec's cap and trade system, examine the effects on industrial facilities. They find negative effects on output, employment and emissions intensity relative to non-regulated plants in the rest of Canada.

What is clear from the paragraph above is that what little literature there is places a disproportionate emphasis on evaluating BC's carbon tax, in part because it is one of the few provinces with a long-enough time series of data for ex post analysis. Though Alberta started pricing industrial emissions in 2007 through its *Specified Gas Emitters Regulation*, the majority of extant work is descriptive — e.g., Leach (2012) or Tarnoczi (2018) — with only a few articles discussing emissions reductions (Auditor General of Alberta 2015; Dobson and Winter 2015; Kebede 2015), and without any causal inference. Similarly, Barrington-Leigh, Tucker, and Kritz Lara (2014; 2015) offer analysis of the short-run effects on Quebec industrial GDP, assuming no response to emissions pricing, though they do explore bookend scenarios of limited versus full cost pass-through to consumers. Canada is also excluded from recent analysis using panels of countries to evaluate the effect of pricing on emissions (Rafaty, Dolphin, and Pretis 2020; Kohlscheen, Moessner, and Takats 2021), likely due to the subnational nature of pricing systems and its late entry to country-wide pricing.

This points to significant gaps in knowledge and the importance of expanding ex post work examining the effect of Canadian federal, provincial and territorial pricing policies on emissions reductions (whether economy-wide or specific sectors), emissions intensity, output, employment, and productivity. Moreover, given the differences in policy coverage and design (Mascher 2018; Dobson, Winter, and Boyd 2019; Dobson, Goodday, and Winter 2023; Harrison 2023), understanding the productivity and input allocation consequences of non-uniform policy, sector-specific exemptions, and the benefits of harmonization is crucially important (Tombe and Winter 2013; Snoddon 2015; Restuccia 2019).[15] These latter topics will be served by counterfactual modelling exercises and empirical ex post work. There is also scope for investigation of specific sectors, whether by partial-equilibrium models (Arjmand and McPherson 2022), hybrid bottom-up models (Rivers and Jaccard 2005), or ex post empirics using firm-level microdata (Azevedo, Wolff, and Yamazaki 2023).

***Households***

A separate strand of literature focuses on effects on households, focusing mainly on distributional consequences (which we discuss further below). Importantly, the majority of the work focusing on households examines the mechanical, short-run effects of pricing and does not incorporate behavioural change by households (Barrington-Leigh, Tucker, and Kritz Lara 2015; Cameron 2018; Parry and Mylonas 2018; Ammar 2019; 2020; Moffatt, McNally, and Shaban 2020; Winter, Dolter, and Fellows 2023). The majority of these papers rely on micro-simulation analysis using Statistics Canada's Social Policy Simulation Database and Model (SPSD/M), using synthetic microdata rather than 'true' microdata.

A second shortcoming of these analyses is that they make simplifying assumptions about pass-through (bookends of incomplete and full passthrough, and uniform across household purchases) and do not incorporate general equilibrium effects. Moreover, many of these analyses don't address the specific nuances of provincial pricing systems, by making simplifying assumptions about exemptions and the role of large-emitter pricing systems. Of the works we identify, only Barrington-Leigh, Tucker, and Kritz Lara (2015), Sawyer (2018), and Winter, Dolter and Fellows (2023) incorporate the mitigating effects of large-emitter systems on households' indirect costs. These mitigating effects come from either free allocation of emissions permits or output subsidies lowering the average cost of emissions for firms. The mitigating effect on households' indirect costs relies on firms passing the cost reductions on to households, for which

[15] Specifically, factor market misallocation can occur from both the emissions externality and non-uniform policy treatment of firms (Tombe and Winter 2015).

evidence (in either direction) is scant. Similarly, about half model the effect of actual policies in place (Barrington-Leigh, Tucker, and Kritz Lara 2015; Beck et al. 2015; Ammar 2019; 2020), instead of hypothetical policy changes.

Ammar et al. (2022; 2023) update previous analysis from the Office of the Parliamentary Budget Officer, adding the dynamic effect of emissions pricing on income growth and returns to capital for Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.[16] They find the combined effect is negative, making households worse off even with lump-sum rebates. Crucially, however, their analysis is not fully general equilibrium. Instead, they take general equilibrium effects of price changes and apply this to household consumption shares given by the SPSD/M synthetic microdata. This means they also abstract from changes to household consumption bundles as a result of pricing. Dissou and Siddiqui (2014) take the same approach to simulate a $50 per tonne carbon tax across Canada, using static analysis, and calibrate to Canada's economy in 2004. Sawyer (2018) offers another quasi-GE model with improvements, allowing for behavioural change by households in response to pricing via modelled transportation and residential abatement curves, and incorporating the federal OBPS. Sawyer analyses the effect of the federal backstop on households in Alberta, Saskatchewan and Ontario, finding lump-sum revenue recycling significantly reduces the cost incidence.

Beck et al. (2015) perform static and fully general equilibrium analysis of BC's carbon tax at $30 per tonne, finding a small decline in welfare (-0.53% without revenue recycling and -0.01% with). They incorporate detailed household consumption, expenditure and income microdata in calibrating the model, allowing for changes in wages, capital income, and government transfers. However, they calibrate their analysis to 2006 data, for both households and the economy's input-output matrix. Moreover, they make several simplifying assumptions, including consumption elasticities, whereby households consume energy (electricity, oil, and natural gas), non-energy goods and leisure. Finally, they assume only BC has emissions pricing.

These articles present a good start, but much more work is necessary. Updating this type of analysis, with more recent data and modelling a greater number of consumption goods, alongside the nuances of each jurisdiction's policy, is necessary for a true understanding of the direct, indirect, and income effects of pricing on households. Computationally and conceptually, there is a trade-off between using rich microdata to understand the effects on households and keeping the models tractable. More precise evidence on cost pass-through (to inform direct and indirect costs, and GE effects) and consumption elasticities will grant deeper understanding of the true effects on households. More information on consumption elasticities, particularly dynamic effects, is also helpful. For example, Antweiler and Gulati (2016) find higher taxes prompt decreased vehicle use and increased sales of more fuel-efficient vehicles. Perhaps more importantly, Rivers and Schaufele (2015) find BC's carbon tax is more salient than equivalent market-caused price movements. This is important to include in modelling behavioural changes given the persistence of discussions about emissions pricing in Canadian media. Moreover, this additional precision is helpful in understanding the trade-offs inherent in different revenue recycling choices. Finally, the extant literature implicitly has as a baseline business-as-usual economic activity without climate damages. While a simplifying assumption, this is clearly incorrect and is an important avenue for exploration in determining the net effect on households. One option would be to incorporate the negative cognitive effects of pollution (Archsmith, Heyes, and Saberian 2018; Heyes, Rivers, and Schaufele 2019), perhaps via decreasing incomes, into BAU welfare.

[16] Ammar et al. (2023) drop New Brunswick and add Nova Scotia, Prince Edward Island, and Newfoundland and Labrador, due to changes in the provinces subject to the federal fuel charge.

## Industrial Policy, Trade, and the Environment

Industrial policy has an important role in Canadian federal, provincial and territorial emissions mitigation. Moreover, industrial policy design and implementation is closely linked with international competitiveness and trade. Recently, tying environmental policy to industrial policy and trade has moved to the forefront of domestic and international policy discussions. Domestically, when implementing pricing for large industrial emitters, policy design explicitly integrated international competitiveness concerns and leakage mitigation. Internationally, climate clubs are gaining traction as a mechanism to build cooperation on emissions mitigation (Nordhaus 2015; Bierbrauer et al. 2021; Mathieu (ed.) et al. 2021), and work "against zero-sum competition" (G7 2023, 1). The G7 has committed to implement a climate club, focusing on "effective implementation of the Paris Agreement," reducing industrial emissions, information-sharing, and "comparative analysis of the effectiveness and economic impact" of pricing and non-pricing policies (G7 Germany 2022).

Competitiveness concerns arise from unilateral policy action in Canada — whether pricing or non-pricing regulatory action to constrain emissions — causing economic activity to leave for other jurisdictions with less stringent environmental policy. Economic activity "leaks," reducing domestic GDP and likely has no net effect on global emissions, penalizing the country engaging in unilateral action. Cosbey et al. (2019) identify four channels for leakage: competitiveness (increased domestic production costs from pricing); energy market (changes in between-country relative prices of fossil fuels affects the location of consumption and emissions); income (changes in relative prices and abatement costs shift countries' terms of trade); and technology spillovers (negative leakage via green innovation uptake elsewhere).

### *Industrial Emissions Pricing*

Large variation in the level of countries' emissions prices and the emissions subject to those prices sets the stage for leakage (Winter 2022b). Accordingly, some policy development, such as in Alberta, was quite weak to protect against perceived negative economic outcomes (Boyd 2019). In other instances, a policy's effect on industrial competitiveness was explicitly accounted for and addressed in policy design (e.g., the *Greenhouse Gas Pollution Pricing Act* or the *Clean Fuel Regulations*). For a fulsome discussion of options to address leakage, see Cosbey et al. (2019), Winter (2022b), and Böhringer, Fischer, and Rivers (2023).

In implementing industrial emissions pricing, Canadian policymakers have included leakage mitigation from the competitiveness channel in policy design (Dobson and Winter 2018). Importantly, there are two effects policymakers are concerned about: domestic competitiveness against international imports, and international competitiveness.[17] The Canadian approach is to lower average costs while (generally) maintaining the marginal price incentive, protecting both domestic and international competitiveness (Dobson and Winter 2018). In cap-and-trade systems (Quebec and Nova Scotia), free allocation of emissions permits lowers the average cost of compliance while keeping the marginal price signal. The emissions permits' free allocation given to firms or facilities as a share of the total cap defines the generosity of the support. In other large-emitter systems (e.g., Alberta and the federal OBPS), emissions are fully priced at the prevailing rate, and facilities are granted output subsidies tied to a sector- or product-specific emissions intensity standard. Again, this lowers average costs while maintaining the marginal price signal. This also mutes the price signal to end consumers lessening the burden of pricing but muting the incentive to reduce emissions-intensive consumption (Fischer 2015). Output-based rebating also signals to firms that emissions reductions should be through emissions-intensity improvements, not output reductions. While

[17] Border carbon adjustments only protect domestic competitiveness, by increasing importers' costs, whereas output- or emissions-based rebating protects domestic and international competitiveness by lowering compliance costs regardless of the buyer (Winter 2022b; Böhringer, Fischer, and Rivers 2023).

preventing leakage, both approaches result in emissions that are higher compared to a full-pricing counterfactual.

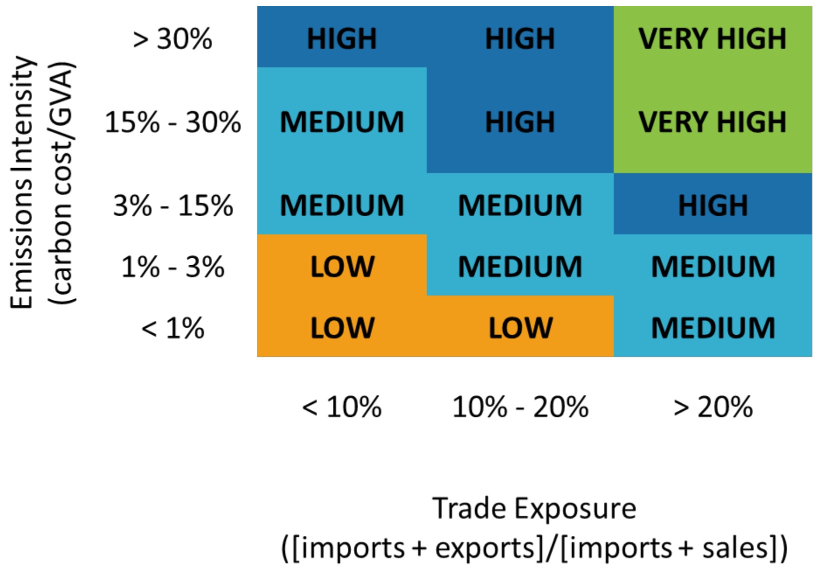
There are numerous imperfections and challenges with the Canadian approach to industrial emissions pricing. First, major competitiveness effects are taken as given, though the evidence on leakage in the literature is mixed (Condon and Ignaciuk 2013; Branger and Quirion 2014; Böhringer et al. 2022). Ex ante modelling suggests 5% to 30% of domestic GHG reductions are offset by increases elsewhere, with estimates for emissions-intensive and trade-exposed sectors between 20% and 70% (Demailly and Quirion 2006; Ponssard and Walker 2008; Böhringer, Balistreri, and Rutherford 2012; Condon and Ignaciuk 2013; Branger and Quirion 2014; Carbone and Rivers 2017; Fowlie and Reguant 2022). By contrast, ex post empirical analysis of the EU ETS finds little evidence of leakage (Renaud 2008; Branger, Quirion, and Chevallier 2017; Healy, Schumacher, and Eichhammer 2018; Naegele and Zaklan 2019; Dechezleprêtre et al. 2021), though this may be due to a combination of low permit prices and free allocations of permits. Evidence from the Kyoto Protocol, on the other hand, suggests signatories' domestic emissions decrease and imports of embodied emissions increase (Aichele and Felbermayr 2012; Kanemoto et al. 2014; Aichele and Felbermayr 2015). Misch and Wingender (2021) use trade flows and reduced-form estimates to determine leakage rates, finding evidence of significant leakage and cross-country variation.

There is little direct Canadian evidence of leakage, other than a few ex ante analyses (Böhringer et al. 2017; Holladay, Mohsin, and Pradhan 2018; McKitrick, Aliakbari, and Stedman 2019; Bistline, Merrick, and Niemeyer 2020; Carbone et al. 2020; Munzur 2022b), ex post analysis of BC (Ahmadi, Yamazaki, and Kabore 2022; Yamazaki 2022), and aggregate country-level estimates (Misch and Wingender 2021). There is also some evidence of leakage from other environmental regulations (Najjar and Cherniwchan 2021; Cherniwchan and Najjar 2022). Using Canadian manufacturing data, Cherniwchan and Najjar estimate the effect of air quality standards on firms' output, emissions intensity, exports, and entry and exit. Knowing the potential for leakage, and how it differs across provinces, is crucial for effective design of competitiveness supports. Moreover, ex post analysis of the evidence for or against leakage, given existing policy supports, is important for informing adjustments to increase stringency (particularly as policy to address emissions becomes more widespread globally). Finally, analysis is also helpful to explore the pros and cons of border carbon adjustments versus the current output-based pricing systems (and free allocations in Quebec) as mechanisms for addressing leakage, building on existing work (Munzur 2022a; Y.-H. H. Chen et al. 2023).

Second, and relatedly, the definition of leakage risk is defined by whether a firm is emissions-intensive and trade-exposed (EITE). Figure 4 shows the federal OBPS EITE criteria, where the EITE assessment relies on calculation of industry-level emissions intensity and trade exposure, as a proxy for leakage risk. The federal definition — and that of other provinces — relies on rules of thumb and proxies rather than an assessment of the risk of leakage and the economic consequences (Dobson and Winter 2018). For example, electricity is included as an EITE sector in several systems — namely, Alberta, the federal OBPS, and the Atlantic provinces — despite its lack of trade exposure.

Fowlie and Reguant (2018) and Cosbey et al. (2019) argue that economists' understanding of the appropriateness of these rules of thumb is incomplete, and an important avenue for future research. Sato et al. (2015), in an ex post analysis of the EU ETS, evaluate whether the emissions intensity and trade exposure rules of thumb correctly identify leakage risk. They find the cost increase as a share of gross value added is appropriate, but the trade intensity (the ratio of non-EU exports plus imports to EU market size) metric is not. Fischer and Fox (2018) and Fowlie and Reguant (2018) articulate the importance of industry-specific trade elasticities and differentiating sensitivity to import and export shocks for evaluating leakage risk. An important flaw in existing policy approaches is that theory-grounded leakage risk depends more on foreign emissions intensities rather than domestic emissions intensities (Fowlie and Reguant 2018; 2022). A starting point for Canadian EITE policy analysis is replicating these works for Canadian industries to confirm the generalizability of their conclusions for Canada, and then proposing and evaluating alternative leakage-risk criteria.

*Figure 4: Federal EITE Criteria*




Source: Author's interpretation of the Regulatory Impact Assessment Statement in Government of Canada (2022).

Third, current design of EITE policy supports is non-uniform (even within a jurisdiction), threshold-based and creates bright-line rules (Sawyer et al. 2021; Dobson, Goodday, and Winter 2023). There is a mix of sector-, product- and facility-specific performance standards, there are differences in covered sectors and covered emissions, differences in marginal and average costs, and substantial free allocations of emissions permits. These differences have potential effects on output, factor allocations, productivity, and emissions relative to uniform treatment. For example, BC's previous industrial pricing system — it is transitioning to an OBPS in 2024 — gave a full rebate of the emissions price above $30 per tonne for facilities meeting an emissions-intensity performance standard (Dobson, Goodday, and Winter 2023; BC Ministry of Environment and Climate Change Strategy 2023). In Nova Scotia's cap and trade system, auctions occurred in the years following production (and emissions) decisions, e.g., 2019 emissions permits were purchased in auctions in 2020 (Government of Nova Scotia n.d.a). Both these examples illustrate the inefficiency of the system design choices relative to a theoretical first best system, with accompanying consequences for emissions reduction incentives.

Moreover, it introduces the potential for intra-Canada leakage and distortions. This presents a rich area for future research, examining the consequences of different system designs for individual provinces and territories, as well as the consequences of non-uniformity. For example, Böhringer, Fischer, and Rivers (2023) compare rebating options on incentives to abate and output protection in EITE sectors. Replicating their analysis with Canadian data, for each province and territory, can help improve policy design. This type of analysis, modelling different systems and the economic outcomes of interest, also helps determine the equivalency of the different industrial pricing systems, improving transparency of policy development and design. Modifying existing CGE models to incorporate the nuance of large-emitter pricing systems is well-suited to these questions.

***Regulatory Interventions and Industrial Policy***

Though emissions pricing absorbs much political and academic focus, there are several regulatory interventions and other industrial policy mechanisms worthy of detailed analysis. We highlight just two here, as a sample of where additional academic thought (and rigour) can inform policy analysis and development. Other policy areas worth exploring but not discussed here are methane regulations — see Dobson, Goodday and Winter (2023) for a review of the state of policy — tax credits for large industrial emitters, and electricity emissions performance standards (including the federal *Clean Electricity Regulations*), to name a few.

*Clean Fuel Regulations*

Several provinces in Canada have clean fuel standards, requiring renewable content (Environment and Climate Change Canada 2022b). Canada introduced its *Clean Fuel Regulations* in 2022, and compliance under the regulation became effective July 2023 (Environment and Climate Change Canada 2023a). The CFR introduces an emissions intensity performance standard for transportation fuels. The regulation was projected to reduce emissions by 204 million tonnes between 2022 and 2040, at a net cost of $30.8 billion or $151 per tonne (Canada 2022). There is very little alternative analysis of the expected emissions reductions or the efficiency trade-off relative to an alternative approach; what exists is ex ante (Rivers and Wigle 2018a; 2018b; Hoyle 2020).

Its implementation became controversial after an Office of the Parliamentary Budget Officer report on the distributional effects, despite the analysis relying on estimates of diesel and gasoline price increases from the CFR's Regulatory Impact Analysis Statement (Ammar et al. 2023). One of the key areas of concern was the pass-through of cost increases to households, prompting joint complaints by the Atlantic premiers (Council of Atlantic Premiers 2023a; 2023b). An important factor is that regulators in the Atlantic provinces determine transportation fuel prices, and incorporating CFR compliance costs was less straightforward than with direct emissions pricing (Grant Thornton 2023). Further complicating the situation is that Minister of Environment and Climate Change Guilbeault suggested industry profits were sufficient to absorb the compliance costs without increasing costs to consumers (Grant Thornton 2023; Withers 2023), despite the Government of Canada considering Canadian refineries to be price-takers and emissions-intensive and trade-exposed (Natural Resources Canada 2018; Government of Canada 2022). Together, this emphasizes the need for economists to empirically quantify cost pass-through, and examine pass-through in a competitive market versus a regulated one, to fully determine the regional effects of federal and provincial clean fuel regulations. Other research avenues for informing policy include modelling the trade-offs from the CFR vis a vis a more stringent industrial emitters pricing regime, or full emissions pricing.

*Oil Sands Emissions Cap*

The discussion document proposing options to "cap and cut emissions" from the oil and gas sector identifies two options: a new, sector-specific cap-and-trade system, or modifying and increasing the stringency of existing pricing systems (Environment and Climate Change Canada 2022c). The rationale for the additional policy lever was creating "milestones set at a pace that aligns with achieving Canada's 2030 and net-zero by 2050 climate change objectives", and sending "a clear, long-term policy signal" (Environment and Climate Change Canada 2022c, 6–7). An obvious departure from first-best, sector-specific environmental policy introducing non-uniformity in price signals *for the same externality* will misallocate factor inputs, and have consequences for output, productivity, and firm entry and exit (Tombe and Winter 2013; 2015). Specifics of the design and analysis of the effects of the cap from Environment and Climate Change Canada are forthcoming. In the interim, arguments for and against the cap are primarily descriptive (Bataille 2022; Canadian Climate Institute and Net-Zero Advisory Body 2022; CAPP 2022; Leach 2022; McKenzie et al. 2022; Standing Committee on Natural Resources 2022; Winter 2022a). Several argue the regulation is unnecessary given current policy levers and would have excessive costs (CAPP 2022; Leach 2022; Winter 2022a; Ragan, Rochon, and Jaccard 2023). The sole modelling exercise compares an oil and gas production phase-out to two alternatives: announced policy and announced policy plus a net-zero economy-wide cap on emissions in 2050 (Navius Research Inc. 2023). While a useful tool for bookending policy options, it does not address the trade-offs inherent in the policy proposal at hand, for either of the proposed options or an alternative grounded in existing policy levers. The academic community can make important contributions here, both in modelling policy options themselves and exploring the effects of the scope of the policy (e.g., different definitions of an oil and gas sector).

### Energy Efficiency and Fuel Switching Programs

All orders of government in Canada, including municipalities, have numerous programs to subsidise or otherwise encourage the uptake of energy-efficiency and energy-switching activities by households and businesses (Canadian Climate Institute 2023; Scott, Rhodes, and Hoicka 2023; Winter et al. 2023). Governments generally assume these programs have both private benefits (energy savings leading to lower bills) and social benefits (avoided energy use and avoided emissions). However, there is growing evidence that these programs under-perform — engineering estimates of energy savings overestimate actual savings in all cases (Giandomenico, Papineau, and Rivers 2022). Moreover, the type and timing of information provision appears to matter for households' responses (Martin and Rivers 2018; Giandomenico, Papineau, and Rivers 2022; Papineau and Rivers 2022). Recent evidence also suggests changes to Canada's building energy codes do not prompt changes in energy use or air leakage, again contrary to ex ante engineering estimates.

The majority of evidence on the effectiveness of energy-efficiency and energy-switching programs is from the United States (Giandomenico, Papineau, and Rivers 2022), with a few more recent Canadian articles (Papineau and Rivers 2022; Papineau, Rivers, and Yassin 2023). Given Canada's many, many programs addressing energy efficiency and energy switching, there is significant scope for work evaluating the effectiveness and cost effectiveness of these programs.

### Summary and Key Questions

In summary, there is scope for both ex ante and ex post work to expand and enhance analysis of Canadian climate policy options, using the lens of efficiency and cost-effectiveness.

Key questions include:

- What are emissions reductions from a given policy? (Does carbon pricing work?!?)
- What are the general equilibrium effects of carbon pricing on households and firms? Does this differ across provinces and territories in Canada?
- What are the relative magnitudes of the different channels for general equilibrium effects? Are some more influential than others for the provinces and territories?
- How does incorporating climate damages into the BAU estimates of economic activity affect the results for impacts on households and firms?
- What are the trade-offs from different emissions-mitigation policies?
- What are the costs and benefits of energy-efficiency and energy-use interventions?
- What are the relative effects on output, emissions and productivity from different federal, provincial, and territorial EITE policies?
- How will trade change as a result of increasingly stringent emission-reduction policies in Canada?
- What is the expected effect of the EU carbon border adjustment mechanism on Canada?
- Is there a better way to measure leakage exposure?

- Is there a better way to target competitiveness supports?

## Equity in Climate Policy

An issue of increasing importance in Canadian policy discussions is equity and affordability of the energy transition, particularly given high post-COVID inflation and energy prices (Y. Chen and Tombe 2023), exacerbated by Russia's invasion of Ukraine in early 2022. A major, near universal, concern with climate policies is the effect they will have on energy affordability, particularly for lower-income households. This led to several affordability-focused interventions by governments, such as Alberta eliminating its gasoline tax or Canada exempting home heating oil from the federal fuel charge. We do not discuss these type of policy interventions below, as they are not climate policies per se, but they are also worthy of attention.

In this section, we discuss equity issues inherent in policy design of climate policies, focusing on pricing and industrial policy as examples of where economics as a discipline can contribute. As with academic work on Canadian climate policy more broadly, extant research on equity and affordability issues in climate policy has only just scratched the surface despite being an area of key policy concern. Of note, as well, is that economics as a discipline may unintentionally further inequality, via prioritizing efficiency over equity; abstracting from important institutional, historical, and social factors; neglecting procedural justice in policy evaluation; and a narrow focus on "tractable" problems (Ando et al. 2023). Policy frameworks tend to reflect the same biases, ignoring intersectionality (L. M. Tedds 2023). Any analysis of equity in climate policy should work to mitigate these biases.

### Emissions Pricing

As a useful frame for understanding the literature, Shang (2023) identifies four channels whereby carbon pricing affects households, and poverty and income inequality in particular. First, consumption effects including pass-through of costs to consumers, production response by firms, leakage affecting economic activity, and demand response by consumers. Second, income effects via destruction of brown jobs, creation of green jobs, and structural changes such as factor incomes and demand for skills. Third, improved health outcomes. Fourth, revenue recycling changing incomes.

As we note above, the literature examining effects on households in Canada is in an early stage, with many simplifying assumptions, and so evidence on these specific channels is incomplete. That said, most articles on the effect of pricing on households cover the distributional consequences of pricing. Subject to the caveats above regarding the methodological drawbacks, the evidence is still useful. The focus with this literature is generally on evaluating the combined effects of emissions pricing plus revenue-recycling, rather that pricing on its own.

Winter, Dolter and Fellows (2023) provide the most up-to-date and comprehensive analysis of the distributional burden of emissions pricing in Canada by province and corresponding offsetting effects from revenue recycling. They examine the mechanical effects of carbon pricing, assuming full cost-passthrough and abstract from consumer demand responses, presenting an estimate of the higher bound of costs to households and economic incidence and the potential distributional effects. They find the carbon tax is generally progressive, on its own as a share of income is regressive in the lower half of the income distribution, and different revenue recycling options — a means-tested sales tax credit and lump-sum rebate — make it fully progressive. However, Winter, Dolter and Fellows present a hypothetical carbon tax, modelled after the federal backstop. While they incorporate the effects of the industrial large-emitter system, their revenue-recycling assumptions are more generous. And, as we note above, they assume both full cost pass-through and no behavioural change. All these factors are important avenues for improving understanding of the distributional consequences of pricing.

Others perform similar analysis of the distributional outcomes, also relying on first-order incidence (Cameron 2018; Parry and Mylonas 2018; Ammar 2019; 2020; Moffatt, McNally, and Shaban 2020). The evidence on the regressivity or progressivity is relatively consistent, with the majority finding pricing is progressive after revenue recycling (Cameron 2018; Ammar 2019; 2020; Moffatt, McNally, and Shaban 2020). Moffatt, McNally, and Shaban also find progressivity depends on the revenue-recycling method, with a sales tax reduction, lump sum rebates and means-tested tax credit all progressive and personal income tax changes regressive. Parry and Mylonas find the effect of pricing is uniform, though they evaluate progressivity with costs as a share of consumption, rather than costs as a share of income. Winter, Dolter and Fellows (2023) have a similar result. While cost as a share of consumption is more representative of lifetime effects (Poterba 1989), cost as a share of income is standard for expressing the average tax burden and the distributional consequences of a new tax. The latter is also likely more relevant in assessing short-term effects and distributional consequences.

The general equilibrium (Beck et al. 2015) and quasi-GE (Dissou and Siddiqui 2014; Ammar et al. 2022; Ammar, Laurin, and Sourang 2023) analyses find emissions pricing is progressive. Beck et al. find heterogeneity in income sources is the source of the progressive nature of the tax. Specifically, even without revenue recycling, declines in real wages and returns on capital combined with increased government transfers reduces inequality. Coupled with revenue recycling, the BC policy is highly progressive. Similarly, Dissou and Siddiqui find a U-shaped relationship, where a Canada-wide carbon tax reduces inequality via changes in factor prices and increases inequality through changes in commodity prices. Ammar et al. (2022) and Ammar, Laurin, and Sourang (2023) find the carbon price plus revenue recycling is progressive for both first-order effects and with quasi-GE analysis. Other quasi-GE analysis only considers net effects after revenue recycling, finding the federal lump-sum rebate is progressive (Sawyer 2018).

Importantly, however, these analyses define regressive and progressive relative to a baseline without an emissions price, which abstracts from pre-existing equity issues. While this literature allows consumption bundles to differ across the income distribution (calibrated to household expenditure data), it maintains assumptions of uniform income and price elasticities. Behavioural responses, and in particular long-term consumption choices to avoid emissions-intensive household capital stocks (e.g., houses, vehicles) are likely to differ across the income distribution. For example, lower-income households are more likely to rent (Randle, Thurston, and Kubwimana 2022). This may limit their ability to respond to emissions pricing via energy-efficiency (e.g., more efficient appliances) or energy-shifting improvements (e.g., moving to a heat pump from natural gas). Allowing for elasticities of substitution to vary by income will be important for a more nuanced understanding of the distributional consequences of emissions pricing. Relatedly, the amount of cost pass-through by firms is likely to differ across consumption goods, which may also affect distributional incidence. Large variation can occur within income groups, and so assessing the full distributional consequences are important, far more so than relying on in-group averages (Fischer and Pizer 2019; Shang 2023). Expanding the types of representative households in economic models to include groups at increased risk of poverty or other sources of inequity, such as Indigenous Peoples or single-parent families (Statistics Canada 2022b), is another important factor in considering distributional effects.

The issue of pre-existing equity issues is particularly important when exploring the effect of revenue-recycling policies, predominantly delivered as refundable tax credits. Robson and Schwartz (2020) identify the characteristics of non-tax-filers in Canada, finding between 10 and 12% of Canadians do not file a return. This statistic is almost 20% for some socio-economic groups: renters, single individuals, and family income below the market basket measure[18]. While this is an issue not specific to revenue recycling from emissions pricing, it is relevant context for the conclusions regarding progressivity. While Beck et al. (2015) find BC's carbon tax is progressive independent of revenue-recycling, it does decrease welfare and their analysis does not include socioeconomic status beyond income. Moreover, their conclusions may not be generalizable outside of BC, given the low emissions-intensity of electricity in BC. More concerning, Winter, Dolter and Fellows (2023) find the mechanical effect of pricing is regressive in the lower half of the income distribution in all provinces. Exploring the effects of emissions pricing on low-income and vulnerable populations is an imperative area for research to address climate justice concerns. It also supports required Government of Canada analysis (Commissioner of the Environment and Sustainable Development 2022).

The evidence above suggests economists studying Canada's emissions pricing systems have a good handle on a small sliver of the necessary evidence to understand the distributional consequences. The literature has started to explore the consumption and revenue-recycling channels. However, fully exploring the consumption channel requires linking to other, more macro-based ex post work, to include pass-through of costs to consumers, production response by firms, leakage, and consumers' demand response. Second, including more precise estimates of the income effects via evidence from ex post analysis of structural changes. For example, destruction of brown jobs, green jobs creation, and factor incomes and demand for skills. Some of this information we already have, at least for BC (Yamazaki 2017; Yip 2018; Azevedo, Wolff, and Yamazaki 2023). Third, rethinking the baseline to include health outcomes and avoided climate damages. Lastly, returning to the revenue-recycling channel once the other three channels are better understood. As Shang (2023) notes, "[m]any of the channels that are complex and difficult to model tend to lower the poverty and inequality impacts of carbon pricing," meaning that exploring the broader macro effects of emissions pricing are imperative for improving estimates of the distributional consequences. For Canada, this is particularly relevant given the regional variation in economic activity, energy systems, and concomitant exposure to carbon risk.

## Industrial Climate Policy and Equity

Similar to pricing, industrial policy — both explicit pricing and non-pricing regulatory policies — affects equity through consumption channels and income channels, and health outcomes in the case of environmental policy affecting industry emissions. Accordingly, policy design matters for mitigating or exacerbating the effects of these channels. For example, Fischer and Pizer (2019) compare the effects of two stylized emissions-reduction policies in the electricity sector on household welfare. The policies are a cap-and-trade system with full pass-through and household lump-sum rebates and a tradeable performance standard (equivalent to a tax on emissions plus an output subsidy); the latter policy has smaller electricity price increases. Large within-income-group variation in electricity use translates into large within-group distributional consequences, and the policy with a lower price effect has a lower effect on equity and distributional consequences. Fischer and Pizer conclude by arguing that economic analysis of equity should consider both vertical equity (variation between income groups) and horizontal equity (variation within income groups).

Canadian evidence on the distributional consequences of industrial policy is scant and focuses on vertical equity. The Office of the Parliamentary Budget Officer presents a quasi-GE distributional analysis of the *Clean Fuel Regulations* and find it is regressive on net, though the income channel is progressive (Ammar et al. 2023). Their method relies on using the macroeconomic impacts and expected fuel price increases from the Environment and Climate Change Canada modelling underlying Regulatory Impact Assessment

[18] The market basket measure (MBM) is Canada's official poverty measure, and is "the cost of a specific basket of goods and services representing a modest, basic standard of living" (Statistics Canada 2022a).

Statement, and applying them to household consumption shares given by the SPSD/M synthetic microdata. Winter, Dolter and Fellows (2023) include the federal OBPS in their analysis of the distributional effects of emissions pricing, and compare the OBPS to full pricing. They find the OBPS significantly reduces households' indirect costs, and its absence flattens the distribution of total household costs. The latter effect is most pronounced for provinces with more emissions-intensive energy systems. Due to modelling limitations, both approaches likely overstate the policy cost.

Industrial policy in the electricity sector — to increase electrification of energy systems and reduce the emissions intensity of electricity — is also expected to have distributional consequences. While increased electricity use will reduce households' consumption of fossil fuels, increased electrification requires home retrofits and electricity system investment (these costs are borne by consumers, or ratepayers). While the nuances of provincial and territorial electricity rate design are beyond our scope, bills are usually split into fixed charges reflecting some portion of system costs and volumetric charges per kWh of electricity households consume. Changing electricity generation sources is likely to affect the mix of fixed system costs and volumetric costs on households' bills, as renewables have low marginal costs (Borenstein, Fowlie, and Sallee 2021; Dolter and Winter 2022; Levinson and Silva 2022). There are numerous equity issues in current rate design structures, as fixed charges are regressive and there is cross-subsidization between the fixed charges and volumetric rates (Dolter and Winter 2022; Levinson and Silva 2022).

Dolter and Winter (2022) examine the distributional consequences of increased electrification, abstracting from changes to total household energy use.[19] They find current electricity costs are regressive, in that the electricity-expenditure-to-income ratio declines with income. Increased electrification could exacerbate this existing inequality, as could rate design to improve the efficiency of pricing (moving volumetric charges closer to marginal costs and fixed charges closer to the true fixed costs). Harland and Dion (2023) find that overall decreases in households' consumption of other energy sources will make households better on net, but do not examine the distribution of costs. An important caveat to these results is that they are based on modelled hypothetical energy system transitions, rather than actual policy (whether announced or in place).

This discussion demonstrates that links between climate-oriented industrial policy and household outcomes, particularly equity, are tenuous. Economy-wide evidence, while relevant for understanding employment effects, is not yet translated into household impacts. There is, like with most Canadian climate policies, vast scope for improvements in analysis with more realistic assumptions, modelling proposed or in place policy, explicitly exploring macroeconomic channels of interest, and focusing the lens of analysis on both vertical and horizontal equity.

## Summary and Key Questions

In summary, equity and affordability issues in climate policy is an area of key concern, but not yet well-understood.

Some key questions are:

- What are the general equilibrium effects of carbon pricing on households, and how does that change the distributional effects?
- What are the distributional effects of other key emissions-mitigation policies like the *Clean Fuel Regulations* or the *Clean Electricity Regulations*?
- What is the burden of emissions-reduction policies on vulnerable populations (e.g., non-tax-filers)?

[19] Total household energy use is expected to decline overall due to increases in energy efficiency (Dion et al. 2022; Harland and Dion 2023).

- What are the distributional consequences of targeted energy-shifting or energy efficiency subsidy programs?
- Are current government energy affordability programs effective or meeting their stated goals? What are the distributional consequences?
- Can we better assess energy affordability and equity issues with techniques rooted in the economics of inequality?

## Understanding Policy Interactions

Much of the work by economists is ex ante or ex post analysis of the effect of a single policy lever. This type of analysis is important for understanding the effectiveness of a given instrument in achieving its objective (e.g., emissions pricing and reducing emissions) and broader effects (e.g., macroeconomic or distributional effects). However, it often abstracts from distortions due to other policies or unaddressed market failures, or even simple interaction effects from multiple policies attempting to achieve the same objective. This presents a large and significant gap in the literature and our understanding of the *net effects* of the mix of climate policies.

As we allude to above, Canada has a very complex climate policy landscape. This is in part due to shared jurisdiction over emissions and the role of all four orders of government — federal, provincial and territorial, municipal, and Indigenous — in determining households' and businesses' energy use. In practice, multiple orders of government can implement policies with similar objectives and outcomes; for example, both Canada and BC have heat pump subsidy programs (Canadian Climate Institute 2023). These policies mixes can reinforce each other and "signal boost," counteract each other, attenuate the effects, be redundant, have unknown interactions, or no effect on each other (Ragan et al. 2017; Scott, Rhodes, and Hoicka 2023). There are roughly 437 mitigation-focused policies in Canada, and 151 policies that interact with the building sector (Canadian Climate Institute 2023; Winter et al. 2023). This generally reflects ad hoc policy layering (Scott, Rhodes, and Hoicka 2023), rather than cohesive and structured policy development that minimizes efficiency and maximizes overlap. For researchers, the complex policy environment presents an opportunity to assess interactions, and specifically where and how policies reinforce each other, counteract each other, or have an unknown interaction. Research on policy interactions has several benefits, including demonstrating efficiency gains. In what follows, we discuss several examples of where additional work can inform our understanding of these interactions.

### Optimal Taxation

The issue of optimal taxation is an easy example of how researchers can approach policy interactions, given its rich and deep literature. A straightforward, and perhaps obvious initial area for research is an optimal *national* carbon tax given pre-existing distortionary income taxes and other taxes (e.g., sales and excise taxes) that differ by jurisdiction. Another interesting problem is what is an optimal gasoline tax, given the additional externalities — accidents, congestion, and local air pollution — that accompany the combustion externality from driving. Wood (2015) and Dorval and Barla (2017) offer evidence for Canada, examining Ontario and Quebec, respectively. Wood finds the optimal gasoline tax is significantly higher than excise taxes at the time of analysis, though he includes distortionary income taxes. Dorval and Barla only consider driving externalities and find the Quebec's excise tax rate is close to the optimal tax, conditional on congestion charges internalizing the congestion externality. With economy-wide emissions pricing now in place, optimal gasoline taxes are worth revisiting. This is true particularly in light of multiple Canadian governments eliminating or reducing gasoline excise taxes due to affordability concerns or in response to the federal fuel charge. Moreover, Wood (2015) and Dorval and Barla (2017) do not account for industrial large emitter pricing systems. An important and, as far as we are aware, unstudied question is how does the presence of an OBPS or a cap-and-trade system with free allocations influence or affect what the optimal gasoline tax would be?

An equally important issue, and one uniquely Canadian, is treatment of emissions in the tax base (Snoddon and Tombe 2019; Snoddon 2022). The uneven distribution of emissions across provinces and territories means disparity in revenue potential. Snoddon and Tombe (2019) and Snoddon (2022) explore some of the interactions between the equalization program — Canada's system for redistributing revenue to maintain comparable levels of public services — and emissions pricing. Currently, emissions are not treated as a separate tax base and the revenues are included with consumption taxes, though the effect is currently quantitatively small (Snoddon and Tombe 2019). If emissions were a tax base and as the price level increases, it would significantly change provinces' and territories' fiscal capacity, with consequences for Canada's equalization program. Snoddon and Tombe (2019) note that there is differential treatment of revenues from large versus small emitters: net, not gross, revenues are booked, and so output subsidies or free permit allocations lower net revenues compared to full pricing. Moreover, emissions pricing revenues are excluded from the formula for backstop provinces. Future research should address the incentives the current design rules create for emissions pricing design and emissions reductions, and how changes to the equalization program might affect these incentives.

## Net Zero Targets and Policy Design

Canada has emissions quantity targets — 40-45% below 2005 levels by 2030 and net zero by 2050 — and has a variety of national and subnational instruments in place or announced to meet that target (Environment and Climate Change Canada 2022a). An open question is what is the contribution of each of these levers to on-target emissions reductions (Commissioner of the Environment and Sustainable Development 2023a), or whether these policies are in fact sufficient to meet Canada's targets (Sawyer et al. 2022; Commissioner of the Environment and Sustainable Development 2023b). Similarly, is there an optimal emissions price path for Canada to meet its targets that differs from the current price path, given the presence of other policies? Lastly, and perhaps most importantly, what are the gains from policy harmonization, given the vast differences in system design, covered emissions, and stringency for the suite of climate policies across Canada?

A more substantive caveat to the discussion throughout this article is that there is growing evidence that Canada's emissions quantification processes underestimate the national emissions inventory (Talbot and Boiral 2013; Vollrath 2022; Dobson, Goodday, and Winter 2023). This poses several challenges for policy design. First, the uncertainty in emissions differs by type (e.g., $CO_2$ vs $CH_4$) and sector (Dobson, Goodday, and Winter 2023), which may prompt desired differences in policy stringency. Second, it introduces uncertainty in the position and slope of sector-specific and Canada-wide abatement supply curves, with concomitant consequences for the most effective policy choice. Third, it risks misallocation of policy attention and regulatory resources away from or to specific sectors or activities as a result of incorrect assessment of the relative contribution of these activities to Canada's emissions total. This speaks to the importance of economists revisiting uncertainty in their evaluations of policy design.

## Summary and Key Questions

In summary, the research community knows far too little about how different policies interact, and whether they compliment or counteract each other.

Some key questions include:

- How do specific policies interact, and what are the consequences for GDP, emissions, productivity, and welfare?

- What are optimal taxes with broad-based carbon pricing?
- Does an OBPS or free permit allocations effect optimal taxes?
- What are the consequences of emissions pricing as a (growing) tax base?
- What are the gains from harmonizing pricing policies, and specifically large-emitter systems?
- What is the contribution of a given policy to Canada's expected emissions reductions?
- What is Canada's optimal carbon tax, given the presence of other emissions-reducing policies?

# Concluding Thoughts

Canadian climate policy is complex, multi-faceted, constantly in flux, and very politicized. Vast differences in policy design and policy choices across jurisdictions creates quasi-natural experiments, and there is significant scope for future work examining the effects of different policy instruments. Moreover, regional variation in incomes, population, economic structure, and energy systems means conclusions for one province do not necessarily generalize to others. Currently, the effects of different policy interventions are under-studied and poorly understood, though there is a growing literature on the macroeconomic effects of specific policies (mainly BC's carbon tax) and the first-order equity effects of emissions pricing.

There are many interesting and important questions in Canadian climate policy research; future areas for both ex ante and ex post work are threefold. First, the effectiveness and cost effectiveness of policy interventions. Specifically, macroeconomic and household-level effects of emissions pricing beyond BC; industrial policy, both regulatory interventions and pricing, and including leakage; and energy efficiency and fuel switching programs. Second, the equity implications of climate policy and the role of complementary interventions. Work in this area should focus on both within and between income-group equity, and the role of pre-existing inequalities. Much of the work has focused on first-order effects from emissions pricing, with little attention to the equity effects of other policy interventions (e.g., industrial policy or abatement subsidy programs). Third, how different policy levers interact and whether they are complementary or counteractive.

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