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MASTER OF PUBLIC POLICY
CAPSTONE PROJECT

Distributional Effects of Changes in BC's Carbon Tax Revenue-Use

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Abstract

Carbon taxes can impose a disproportionate burden on low-income households, who often spend a greater share of their income on carbon-intensive goods. Policymakers can improve the fairness of a carbon tax through revenue recycling. British Columbia has deviated from its "textbook" 2008 revenue-neutral carbon tax that returned all revenue to taxpayers through income tax cuts and a means-tested tax credit (the climate action tax credit, or CATC). Using Statistic Canada's Social Policy Simulation Database and Model, I estimate the distributional effects of BC's carbon tax and revenue recycling choices on households. I simulate two revenue-recycling schemes in 2022: (1) replicating BC's 2008 policy, directing 35% of revenue toward each of the CATC and personal income tax cuts; and (2) BC's current policy, with 15.7% and 24.3% of revenue funding the CATC and personal income tax cuts, respectively. BC's current carbon tax is regressive, with and without revenue recycling, where regressivity is measured by the carbon tax paid as a share of household disposable income across deciles. The CATC on its own is progressive, and personal income tax cuts are regressive. By increasing the generosity of the CATC, BC's carbon pricing policy becomes progressive and households in the bottom three income deciles receive net benefits (rebates that exceed carbon taxes). British Columbia can meet the goal of achieving a fair carbon tax regime by amending the way it uses its revenue.

1 Introduction

There is evidence from numerous jurisdictions that carbon pricing generates non-uniform distributional consequences (Partnership for Market Readiness 2017; Parliamentary Budget Officer 2020; Klenert et al. 2018). Specifically, lower-income households often spend a larger share of their income on energy-related goods and consequently bear disproportionately higher carbon costs (Lee 2011; Canada's Ecofiscal Commission 2016a). To address this concern, governments can use carbon tax revenue to compensate low-income households for increased costs of emissions-intensive goods (Canada's Ecofiscal Commission 2016a). I explore how revenue-use changes affect the distributional burden of the BC carbon tax and revenue-recycling choices across households.

The province of British Columbia implemented its carbon tax in 2008 — the first broad-based carbon tax in North America. Initially, the government committed to maintaining revenue neutrality (British Columbia Ministry of Finance 2008a) — a policy choice that was especially important for garnering support from the public (Murray and Rivers 2015). A revenue-neutral tax returns all tax revenue to households and businesses (Sawyer et al. 2021). As such, BC's carbon tax garnered the reputation of a "textbook" policy, with a revenue-recycling scheme consisting of low-income tax credits and broad-based tax cuts. Existing taxes can generate market distortions by altering prices and the subsequent behaviour of individuals and businesses (Canada's Ecofiscal Commission 2016b); thus, economists often prefer a revenue-neutral policy to reduce these distortions and enhance economic growth (Murray and Rivers 2015). However, since 2008, BC has changed its carbon tax revenue use, including targeted tax credits for industries and program spending (Murray and Rivers 2015). As a result, the tax has also ceased to be revenue-neutral (Sawyer et al. 2021; Murray and Rivers 2015).

I first describe how BC's use of carbon tax revenue has changed since its implementation in 2008 as a "textbook" revenue-neutral policy. By simulating revenue-recycling scenarios, I determine how changes in revenue use affect the distributional burden of the carbon tax across households. Carbon taxes — net of rebates — as a share of income across households is a measure of a tax's regressivity. A regressive carbon tax constitutes a larger share of income for lower-income households than higher-income households. Contrastingly, progressive taxes ensure higher income households pay more as a share of their income (Ivanova and Klein 2013).

Existing work that examines the distributional impacts of BC's carbon tax on households provides mixed evidence on the progressivity of the tax (Lee 2011; Beck et al. 2015; Winter, Dolter, and Fellows 2021). Others analyze the change in BC's carbon tax revenue-use over time (Murray and Rivers 2015; Metcalf 2015; Lee 2011), and raise concerns that increases in the CATC have been disproportionally smaller than increases in BC's carbon tax rate (Lee 2011, Murray and Rivers 2015). I add to the literature by examining changes in BC's revenue-recycling and the resulting distributional effects following its removal of revenue neutrality in 2017. Like Lee (2011) and Winter, Dolter, and Fellows (2021), I simulate revenue-recycling scenarios using Statistics Canada's Social Policy Simulation Database and Model (SPSD/M)[1]. Specifically, I model BC's "textbook" 2008 revenue recycling scheme as if implemented in 2022 and compare the distributional effects to the current policy. I find that while the CATC is progressive, personal income tax cuts are highly regressive. By increasing the generosity of the CATC, BC's carbon pricing policy can become progressive.

[1] Disclaimer for household revenue recycling analysis: This analysis is based on Statistic's Canada's Social Policy Simulation Database and Model, version 29.0. The assumptions and calculations underlying the simulation were prepared by Lindsey Geier and the responsibility for the use and interpretation of these data is entirely that of the author.

I begin by outlining the characteristics of BC's carbon pricing policy and providing background on relevant legislation. I then provide an overview of BC's carbon tax revenue uses and describe changes in BC's revenue-recycling between 2008/09 and 2020/21. In the third section, I describe my methodology for simulating the revenue-recycling scenarios in SPSD/M, while detailing the assumptions underlying the counterfactual exercises. I then present the results of the revenue-recycling simulations, showing the distributional effects of BC's low-income tax credit and personal income tax cuts as individual and combined policies. By looking at the carbon tax burden across households of different incomes, I analyze each policy action's relative regressivity or progressivity. I conclude by summarizing the results and discussing considerations for policymakers aiming to mitigate the distributional effects of a carbon tax.

2 BC Carbon Tax over Time

In this section, I describe the characteristics of BC's carbon tax — including a legislative background of the tax. I then outline the changes to BC's carbon tax revenue-use between 2008/09 and 2020/21 to determine how the tax has deviated from its 2008 "textbook" policy of income tax cuts and a low-income tax credit.

2.1 Characteristics of BC's Carbon Tax Policy

British Columbia implemented its revenue-neutral carbon tax under the *Carbon Tax Act* (the *Act*), effective July 1, 2008, at $10 per tonne of CO_2 equivalent (tCO_2e), which increased annually by $5/$tCO_2e$ to $30 per tonne in 2012 (British Columbia Ministry of Finance 2008b; 2013). After agreeing to Canada's *Pan-Canadian Framework on Clean Growth and Climate Change*, British Columbia began increasing the carbon tax rate annually by $5 starting April 1, 2018, to meet the federal benchmark of $10/$tCO_2e$ in 2018, reaching $50 per tonne in 2022

(British Columbia Ministry of Finance 2017a). In April 2020, BC did not increase the carbon tax rate as a COVID-19 relief measure (British Columbia Ministry of Finance 2021). Figure 1 displays changes in the established carbon tax rates since 2008, with projections up to 2030.

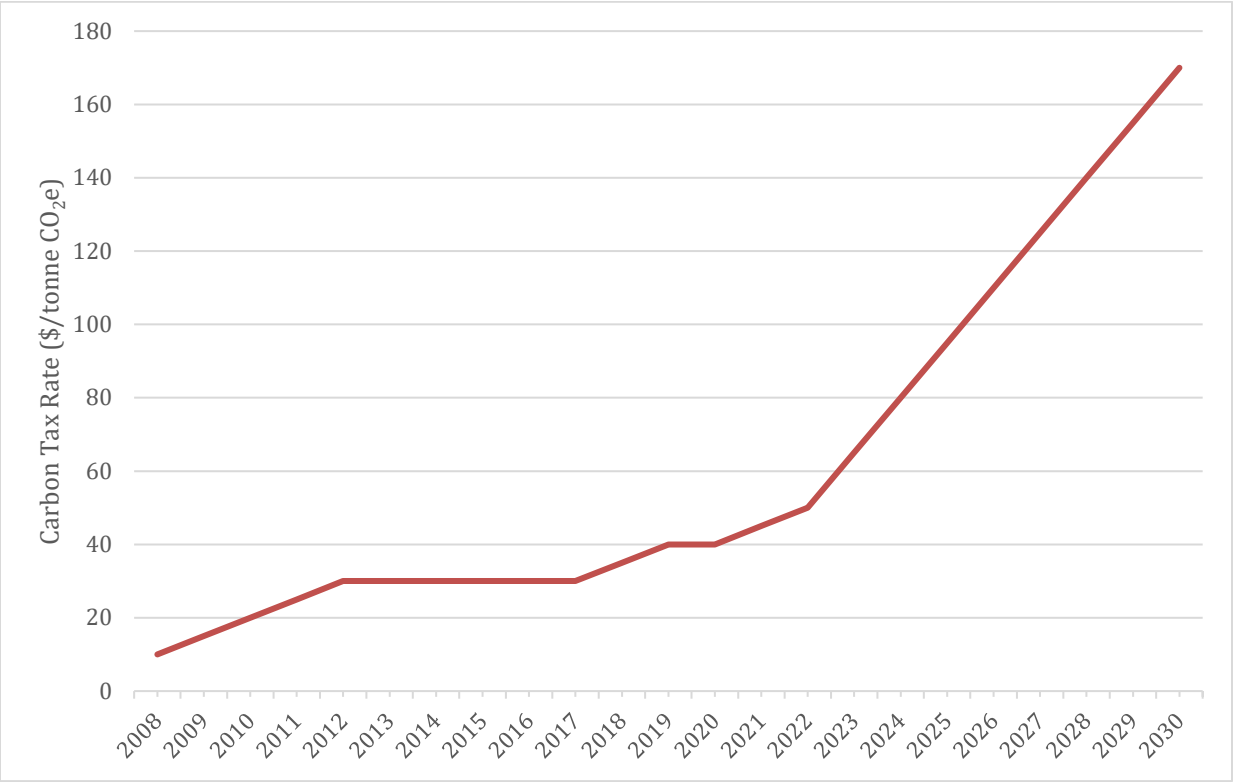

Figure 1: Actual and projected carbon tax rates between 2008 and 2030 (nominal CAD).
Source: Canada (2021a; 2021b)

The province announced the carbon tax and the government's commitment to maintaining revenue-neutrality in its 2008 Budget Speech (British Columbia Ministry of Finance 2008a). The budget introduced several ways BC would return all carbon tax revenue: reducing personal income tax rates on each of the bottom two tax brackets by five percent by 2009[2]; lowering the general corporate and small business income tax rates by one percentage point each; and introducing a low-income Climate Action Tax Credit (CATC). The province introduced the credit to compensate low-income British Columbians for the tax, ensuring they were "no worse

[2] This is a five percent reduction in the marginal tax rates on each tax bracket up to $70,000 of income, not a reduction of five percentage points.

off" (British Columbia Ministry of Finance 2008b). In June 2008, the province also provided a one-time Climate Action Dividend as a direct payment of $100 per adult and child; the rationale was to help British Columbians further reduce their greenhouse gas emissions (British Columbia Ministry of Finance 2008a). By ensuring these payments were visible and made up-front, the province hoped to encourage British Columbians to make cleaner choices to offset impending higher energy costs and reap a larger net benefit (British Columbia Ministry of Finance 2008a). The Climate Action Dividend was funded from BC's 2007/08 surplus and cost $440 million (British Columbia Ministry of Finance 2008b).

The Carbon Tax Act (the *Act*) initially mandated a revenue-neutral tax (*Carbon Tax Act, SBC, c 40* 2008). The *Act* required the amount of carbon tax collected to be offset by an equivalent — or higher — reduction in provincial revenues through specified "revenue measures": tax reductions, exemptions, or tax credits (Duff 2008; *Carbon Tax Act, SBC, c 40* 2008). The revenue-neutrality provisions were repealed in late 2017, following the 2017 election and the New Democratic Party (NDP) forming government. Until 2017, the *Act* required the Minister of Finance to prepare a carbon tax plan and report each year, with a three-year forecast of the estimated tax revenues and designated tax expenditures (*Carbon Tax Act, SBC, c 40* 2008). Annual reports had to specify an "adjustment amount" if estimated carbon tax revenue exceeded estimated carbon tax expenditures in a given fiscal year (section 3(3)). If the Minister of Finance failed to maintain revenue neutrality of the tax in any given fiscal year, the legislation imposed a penalty of a 15% reduction in the Minister's salary (section 5(3)). However, there is no evidence of the use of this penalty. These provisions within the legislation allowed accountability for full revenue recycling and ensured transparency in the mechanisms used for returning revenue to taxpayers (British Columbia Ministry of Finance 2008b).

2.2 Evolution of Carbon Tax Revenue and Expenditures

Table 1 shows carbon tax revenue and expenditures by fiscal year between 2008/09 and 2020/21. Carbon tax revenue has risen from $306 million in 2008/09 to $1,683 million in 2020/21. Between 2008/09 and 2016/17, actual tax expenditures allocated against carbon tax revenue have exceeded revenue. Tax expenditures exceeded revenue by $7 million in 2008/09, reaching as much as $539 million in 2015/16 (Table 1). For each fiscal year, BC bases its revenue recycling plan on estimates of carbon tax revenue (British Columbia Ministry of Finance 2009). Revenue projections were higher than actual revenues in each fiscal year except for 2010/11, 2011/12, and 2017/18. Moreover, tax expenditure projections were lower than actual expenditures in 2010/11, 2012/13, 2014/15 and 2016/17. These results may explain why tax expenditures have surpassed revenues raised in most fiscal years. Alternatively, Lee (2011) suggests that between 2009/10 and 2012/13, carbon tax expenditures exceeded revenue due to corporate income tax cuts. In 2013 there was a partial reversal of the corporate income tax cut (from 10% to 11%), which explains the 125% drop from $450 to $200 million in corporate income tax cut expenditures and the net-revenue increase from -$260 to -$10 million – between 2012/13 and 2013/14 (Table 1).

Table 1: Actual and projected carbon tax revenue and expenditures in millions of nominal dollars by fiscal year.

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Projected Carbon Tax Revenue	**338**	**546**	**727**	**950**	**1,172**	**1,236**	**1,228**	**1,261**	**1,234**	**1,228**	**1,488**	**1,713**	**1,954**
Actual Carbon Tax Revenue	**306**	**542**	**741**	**959**	**1,120**	**1,222**	**1,198**	**1,190**	**1,220**	**1,255**	**1,465**	**1,682**	**1,683**
Climate Action Tax Credit (CATC)	106	153	165	184	195	194	193	192	195	195	235	252	783
Personal income tax cut	107	206	207	220	235	237	269	283	309	322*	**	**	**
Northern and rural homeowner benefit			19	66	67	69	83	83	84	85*	**	**	**
Seniors' home renovation tax credit					27	0	0	1	2	2*	2	2	4
Children's fitness and children's arts tax credit					9	8	8	8	8				
Small business venture capital tax credit					3	3	3	3	5	9*	24	26	29
Training tax credit					10	11	9	9	4	15*	14	11	12
Medical Services Plan premiums										311*	**	**	**
Total personal tax benefits	**213**	**359**	**391**	**470**	**546**	**522**	**565**	**579**	**607**	**939**	**275**	**291**	**828**
Corporate income tax cut	65	152	271	381	450	200	216	218	232				
Small business corporate tax cut	35	164	144	220	281	240	250	247	251	404*	1429	1394	1445
Industrial property tax credit		54	58	68	68	43	23	23	23	23*	**	**	**
Farmland tax credit			1	2	2	2	2	2	2	2*	**	**	**
Interactive digital media tax credit					26	63	37	33	65				
Scientific research & experimental development tax credit							82	131	148	165*	149	179	198
Film incentive tax credit						88	78	106	51				

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Production services tax credit						66	265	385	340				
Other tax credits					7	8	6	5	8	10*	8	10	12
Sales tax exemption on electricity										21*	84*	172*	198*
Total business tax benefits	**100**	**370**	**474**	**671**	**834**	**710**	**959**	**1150**	**1120**	**625***	**241**	**361**	**408**
Actual total tax expenditures	**313**	**729**	**865**	**1141**	**1380**	**1232**	**1524**	**1729**	**1727**	**1564***	**1945**	**2046**	**2681**
Projected total tax expenditures	**338**	**735**	**796**	**1141**	**1275**	**1236**	**1436**	**1621**	**1733**				
Net Revenue	**-7**	**-187**	**-124**	**-182**	**-260**	**-10**	**-326**	**-539**	**-507**	**-309**	**-480**	**-364**	**-998**

Note: In the 2020/21 fiscal year, the CATC includes a one-time enhanced payment in July 2020 made as part of BC's Covid-19 Action Plan. The Home Renovation Tax Credit for Seniors and Persons with Disabilities was originally introduced as the Seniors' Home Renovation Tax Credit in 2012/13. The Scientific Research and Experimental Development Tax Credit includes both a refundable and non-refundable component.

*Estimated values.

**I was unable to acquire these values in BC budget documents.

Source: BC Budget and Fiscal Plans (British Columbia Ministry of Finance 2008b; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017a; 2017b; 2018; 2019; 2020; 2021; 2022)

2.2.1 Changes in Carbon Tax Expenditures since 2008/09

In 2008/09, BC returned all carbon tax revenue to households and businesses through corporate and personal income tax cuts and the CATC (Table 1). Between 2008/09 and 2017/18, BC made several changes to income tax rates as designated carbon tax revenue measures. Effective January 1, 2008, there was a two percent reduction in the marginal tax rates for each of the first two personal income tax brackets (Table 2). In addition, there was a one percentage point reduction in each of the general (12% to 11%) and small business (4.5% to 3.5%) corporate income tax rates, effective July 1, 2008 (Table 3).

In 2009, the marginal tax rates for each of the first two personal income tax brackets were further reduced by three percent, to 5.06% (Table 2), resulting in a total cut of 5% each. The general corporate income tax rate was reduced by 0.5 percentage points per year to 10% in 2011. The province then raised the general corporate income tax rate to 11% in 2013 and back up to 12% in 2018 (Table 3). Between 2008 and 2017, BC reduced the small business corporate income tax rate to 2% (Table 3) and increased the small business threshold from $400,000 to $500,000.

Table 2: Marginal BC personal income tax rate changes as part of carbon tax expenditures.

		Tax Rates (%)		
Tax Bracket	Taxable Income Range for 2008 Tax Year	Prior to Changes	Effective January 1, 2008	Effective January 1, 2008
1	$0 - $35,016	5.35	5.24	5.06
2	$35,016.01 to $70,033	8.15	7.98	7.7
3	$70,033.01 to $80,406	10.5	10.5	10.5
4	$80,604.01 to $97,636	12.29	12.29	12.29
5	Over $97,636	14.7	14.7	14.7

Note: The two percent tax cut (5.35% to 5.24%) was announced in Budget 2008 and the three percent tax cut (5.24% to 5.06%) was announced on October 22, 2008. The three percent tax cut for 2009 was made retroactive to January 2008. The basic personal amount is indexed to inflation. In 2008 the basic personal amount was $9,189 and has risen to $11,302 as of 2022.
Source: British Columbia Ministry of Finance (2008b)

Table 3: Changes to the small business and general corporate income tax rate.

	Before July 1, 2008	Effective July 1, 2008		Effective December 1, 2008		Effective April 1, 2017
Small business corporate income tax rate (%)	4.50	3.50		2.50		2.00
		Effective July 1, 2008	Effective January 1, 2010	Effective January 1, 2011	Effective April 1, 2013	Effective January 1, 2018
General corporate income tax rate (%)	12.00	11.00	10.50	10.00	11.00	12.00

Source: British Columbia (n.d.b.)

As British Columbia saw increases in carbon tax revenue with the rising carbon tax rate, the province began using tax revenue to finance additional tax credits (Harrison 2013). Starting in 2009/10, carbon tax expenditures included an industrial property tax credit for businesses of 50% of school property taxes payable by light and major industrial properties, which increased to 60% in 2011. In 2010/11, the province introduced a credit of 50% of school property taxes for businesses with property classified as Farm. Following the introduction of the carbon tax, rural households in Northern BC began voicing concern over their limited ability to substitute consumption of heating fuels and gasoline (Harrison 2013; Beck, Rivers, and Yonezawa 2015). In response to the emerging backlash over the perceived unfairness of the tax, the province introduced a Northern and Rural Homeowner Benefit (NRHB) for individuals in 2010/11. As of 2022/23, homeowners are still eligible to receive up to $200 if they reside in areas outside the Capital, Greater Vancouver and Fraser Valley regional districts.

In 2012/13, the province introduced new offsetting tax measures for individuals, which included the Home Renovation Tax Credit for Seniors and Persons with Disabilities, the

Children's Fitness Credit and Children's Arts Credit, and an increase in the Small Business Venture Capital Credit. The Home Renovation Tax Credit cost decreased from $27 million in 2012/13 to $4 million in 2020/21. Contrastingly, the Small Business Venture Capital Credit cost increased between 2012/13 and 2020/21 from $3 million to $29 million. *BC Budget 2017* announced that the children's fitness and arts tax credits were no longer available after the 2017 taxation year, following the elimination of the federal children's fitness and arts credits in 2017.

In 2012/13, the province began "accounting" pre-existing tax measures targeted at specific industries to carbon tax revenues. Specifically, the Interactive Digital Media Credit, introduced in 2010, was added as a revenue-use measure in 2012/13. Its cost increased from $26 million in 2012/13 to $65 million in 2016/17 (Table 1). The Film Incentive BC tax credit and Production Services Tax Credit — introduced in 1998 — were extended past their end date in 2009, and the credit rate increased in 2010. Both credits first appeared as a carbon tax revenue measure in 2013/14. The government designated $66 million to the Production Services Tax Credit in 2013/14, a portion of its total cost of $79 million (British Columbia Ministry of Finance 2015). The government included its entire cost in 2014/15 and subsequent fiscal years, which increased from $265 million to $340 million in 2016/17 (Table 1). BC first introduced the Scientific Research and Experimental Development Tax Credit in 1999. However, the province extended the credit past its end date in 2014, and first included it as a carbon tax expenditure in 2014/15. Between 2014/15 and 2020/21, the cost of the Scientific Research and Experimental Development Tax Credit increased from $82 million to $198 million (Table 1). Figure 2 shows actual carbon tax revenue and expenditures between 2008/09 and 2016/17 without assigning these pre-existing revenue measures to carbon tax revenue. The figure shows that tax expenditures exceed revenue up until 2012/13. In 2017/18, the province ceased to "account" the

Interactive Digital Media Tax Credit, Production Services Tax Credit and Film Incentive Tax Credit to carbon tax revenues (British Columbia Ministry of Finance 2017a).

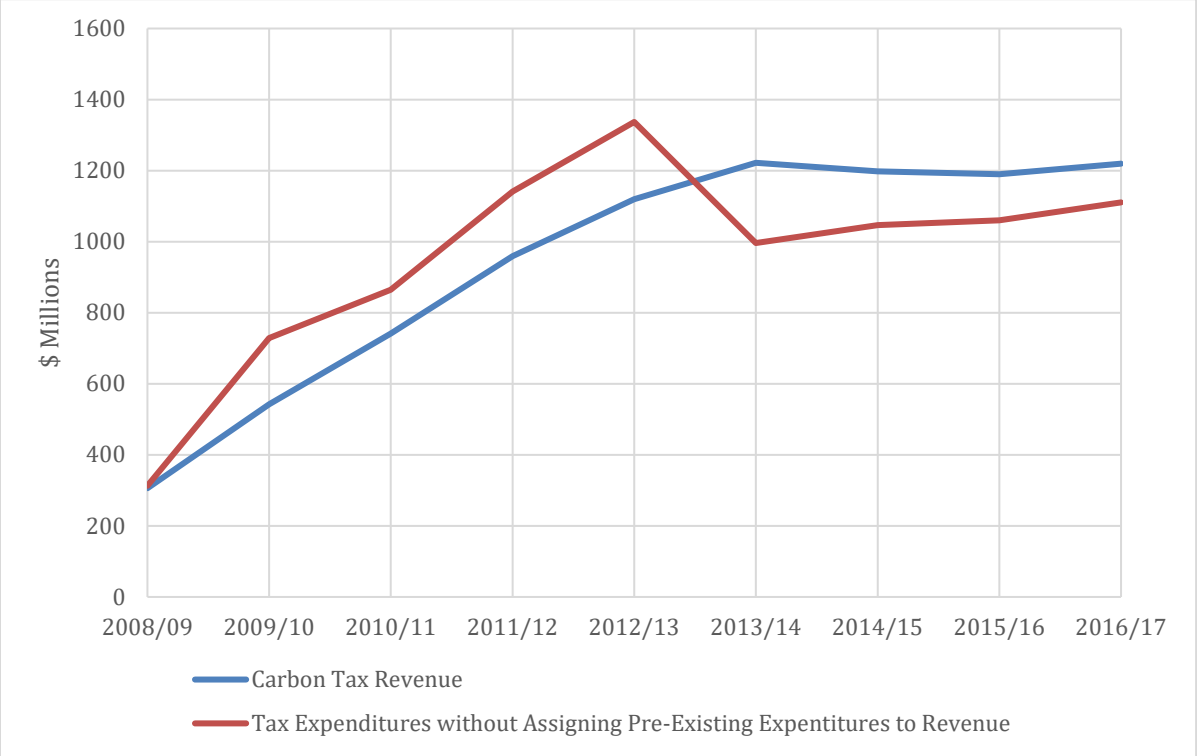

Figure 2: Actual carbon tax revenue and tax expenditures less pre-existing revenue measures in millions of nominal dollars by fiscal year.
Source: BC Budget and Fiscal Plans (British Columbia Ministry of Finance 2008b; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017b)

In BC's 2017/18 – 2019/20 Budget and Fiscal Plan, the province introduced new offsetting measures, including a 50% reduction in Medical Services Plan (MSP) premiums for all British Columbians, effective January 1, 2018 (British Columbia Ministry of Finance 2017a). The government eliminated the MSP premiums on January 1, 2020, due to their regressive nature and administrative complexity (British Columbia Ministry of Finance 2020). In addition, the province phased out the provincial sales tax on electricity purchases to improve business competitiveness and spur growth and investment (British Columbia Ministry of Finance 2017a). In January 2018, the province reduced the provincial sales tax rate on electricity from 7% to 3.5% of the purchase price for businesses. At the time, the purchase of electricity for residential

use was already exempt (British Columbia Ministry of Finance 2017a). BC eliminated the sales tax on electricity effective April 1, 2019 (British Columbia Ministry of Finance 2020).

Figure 3 shows changes in actual carbon tax revenue and expenditures between 2008/09 and 2020/21. Notably, personal and corporate income tax cuts as proportions of carbon tax expenditures decreased between 2008/09 and 2016/17. In 2008/09, approximately two-thirds of carbon tax expenditures constitute tax credits for individuals, decreasing to just over one-third in 2016/17. As a result, the share of tax expenditures targeted at businesses has increased over time to almost two-thirds.

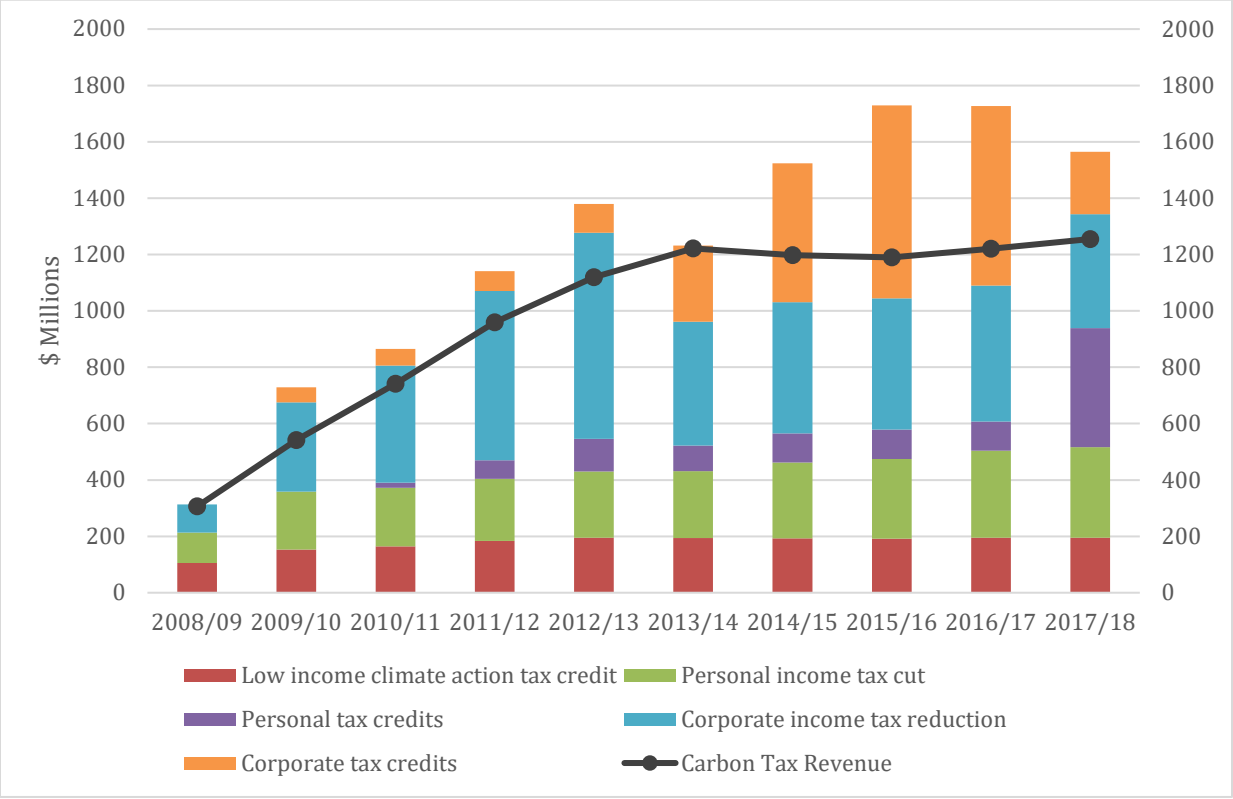

Figure 3: Carbon tax revenue and expenditures between 2008/09 and 2020/21
Source: BC Budget and Fiscal Plans (British Columbia Ministry of Finance 2008b; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017b)

In July 2017, the BC New Democratic Party (NDP) came into power and released the *Budget 2017 Update,* announcing that the carbon tax would no longer be revenue neutral. By repealing Part 2 of the *Carbon Tax Act*, the NDP government could direct a portion of carbon tax

revenue towards green program spending (British Columbia Ministry of Finance 2017a). The province continues to provide carbon tax relief to British Columbians through CATC rate increases and personal income tax cuts. However, some carbon tax revenue now supports programs that reduce GHG emissions. Specifically, the province directs a portion of BC's carbon tax paid by industry into the *CleanBC Program for Industry*, which was announced in Budget 2018 and implemented in 2019/2020. As of June 2020, a portion of carbon tax revenue from industry is directed into the CleanBC Industry Fund (CIF) and the CleanBC Industrial Incentive Program (CIIP) (British Columbia Ministry of Environment and Climate Change Strategy (MECCS) n.d.b.). Under these programs, facilities that emit greater than 10,000 tCO_2e and report their emissions under the *Greenhouse Gas Industrial Reporting and Control Act* are eligible to receive tax relief (British Columbia MECCS n.d.b.).

Through the CIF, the province directs carbon tax revenue into funding emissions-reduction projects for industry. To receive funding, operators of eligible industrial operations apply to the CIF with an emissions-reduction project for the given funding year. Proposals are for funding to invest in commercially available technologies that reduce greenhouse gas emissions, or innovation in clean technology (British Columbia MECCS 2022a; 2022b). Project proposals receive a score and ranking based on certain criteria, including the project's ability to reduce emissions cost-effectively (British Columbia MECCS 2022). The highest-ranking project proponents enter funding agreements with the province, which depend on available funds within a given fiscal year (British Columbia MECCS 2022b). The 2019 CIF provides $10 million in funding to project proponents over three years. In 2020 and 2021, funding increased to $33 million and $70 million, respectively (British Columbia MECCS n.d.c.).

CIIP reduces carbon-tax costs for industries that meet or exceed emission intensity benchmarks in their operations. Specifically, facilities that meet these emission intensity benchmarks receive rebates of 100% of their incremental carbon tax (above \$30/tCO_2e) payments in the previous year (British Columbia MECCS 2021b). In 2019, the program provided \$33.4 million in grants to industrial facilities, rising to \$81.7 million in 2020 and \$65.5 million in 2021 (British Columbia MECCS n.d.a.).

BC's *2020/21 to 2021/22 Budget and Fiscal Plan* announced that funding to support these two CleanBC programs increased from \$56 million in 2019/2020 to \$105 million in 2020/21. For the 2022/23 fiscal year, BC committed \$171 million to the CleanBC Program for Industry (British Columbia MECCS 2022).

2.2.2 British Columbia Climate Action Tax Credit

The province provides lump-sum payments through its refundable Climate Action Tax Credit (CATC) to mitigate cost increases from the carbon tax for lower-income households. The CATC is subject to a claw-back rate of 2% per dollar of additional income for an adjusted family net income above a specified threshold amount (British Columbia n.d.a.), which is indexed annually to provincial inflation (Figure 5). The tax credit was introduced at \$100 per adult and \$30 per child in July 2008, increasing to \$105 per adult and \$34.50 per child in 2009, and \$115.50 per adult and \$34.50 per child in 2011, with the first child in a single parent family receiving the adult amount (*Low-Income Climate Action Tax Credit Regulation, BC Reg 135* 2008). Figure 4 displays the changes in the CATC amounts between the 2008 and 2022 benefit years. Between 2008/09 and 2011/12, the carbon tax rate increased 150% from \$10 to \$25, while the CATC increased by only 15.5%, evoking criticism for raising the tax rate without corresponding increases in the low-income tax credit (Lee 2011). However, beginning in 2018, the government

tied the CATC to increases in the carbon tax rate (British Columbia MECCS 2021a). Table 4 shows corresponding increases in the CATC and carbon tax rates between 2008 and 2022.

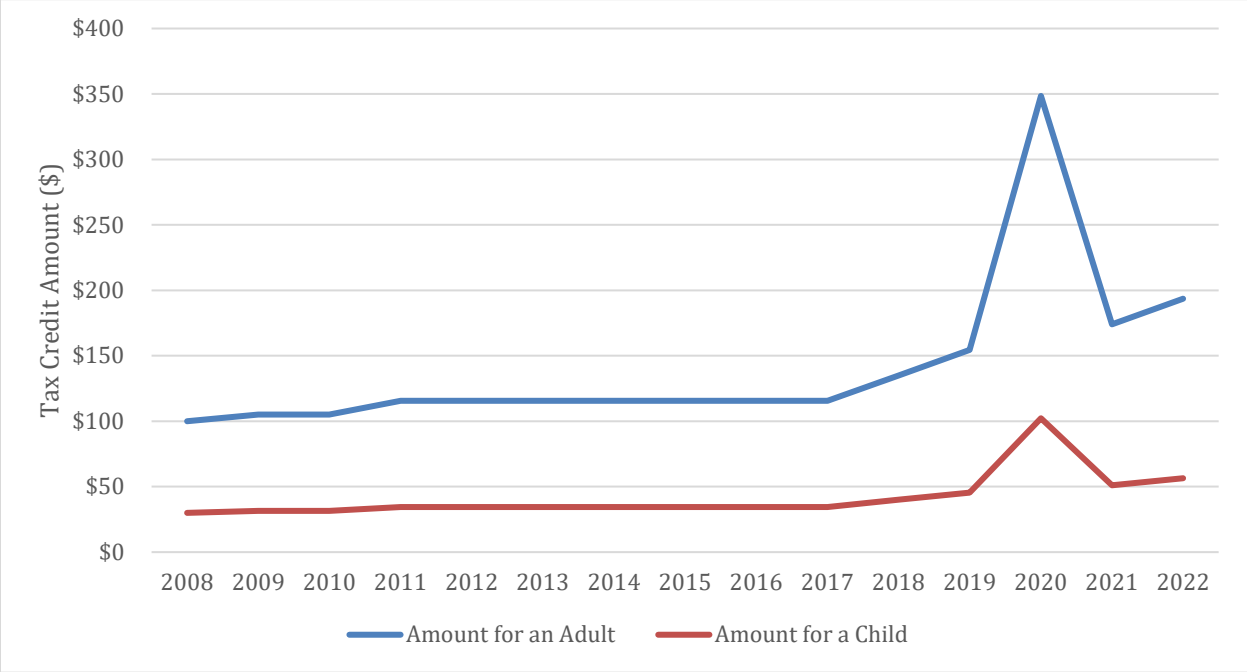

Figure 4: BC's Climate Action Tax Credit between the 2008 and 2022 benefit years.
Note: As part of BC's COVID-19 Action Plan, the province provided a one-time increase in the CATC in July 2020. Adults received up to $348.50 plus $102.25 per child – an increase from the regular CATC amount by $174.50 and $51.25, respectively (British Columbia n.d.a.). This is reflected in the figure.
Source: BC Budget and Fiscal Plans (British Columbia Ministry of Finance 2008b; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017b; 2018; 2019; 2020; 2021; 2022)

Table 4: Year-over-year percent increases in the CATC and carbon tax rates, 2009 and 2022.

	Percent Increase in the Adult CATC	Percent Increase in the Child CATC	Percent Increase in the Carbon Tax
2009	5%	5%	50%
2010	0%	0%	33%
2011	10%	10%	25%
2012	0%	0%	20%
2013	0%	0%	0%
2014	0%	0%	0%
2015	0%	0%	0%
2016	0%	0%	0%
2017	0%	0%	0%
2018	17%	16%	17%
2019	14%	14%	14%

	Percent Increase in the Adult CATC	Percent Increase in the Child CATC	Percent Increase in the Carbon Tax
2020	13%	12%	0%
2021	0%	0%	13%
2022	11%	11%	11%

Note: The percentages do not reflect the one-time increase in the CATC in July 2020 as part of BC's COVID-19 Action Plan.
Source: Author's calculations based on BC carbon tax rates and CATC amounts in BC Budget and Fiscal Plans (British Columbia Ministry of Finance 2008b; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017b; 2018; 2019; 2020; 2021; 2022)

Figure 5 displays changes in the CATC rebate value for a single person between the 2008 and 2022 benefit years, as a function of their net family income. The figure shows the increasing generosity of the CATC with time. In 2008, adults received the maximum benefit of $100 where family net income is below $30,000 and a reduced credit for incomes below $30,000 and $35,000. In 2022, adults receive a maximum benefit of $193.50 when family net income is below $36,901 and a reduced credit for incomes between $36,501 and $46,576.

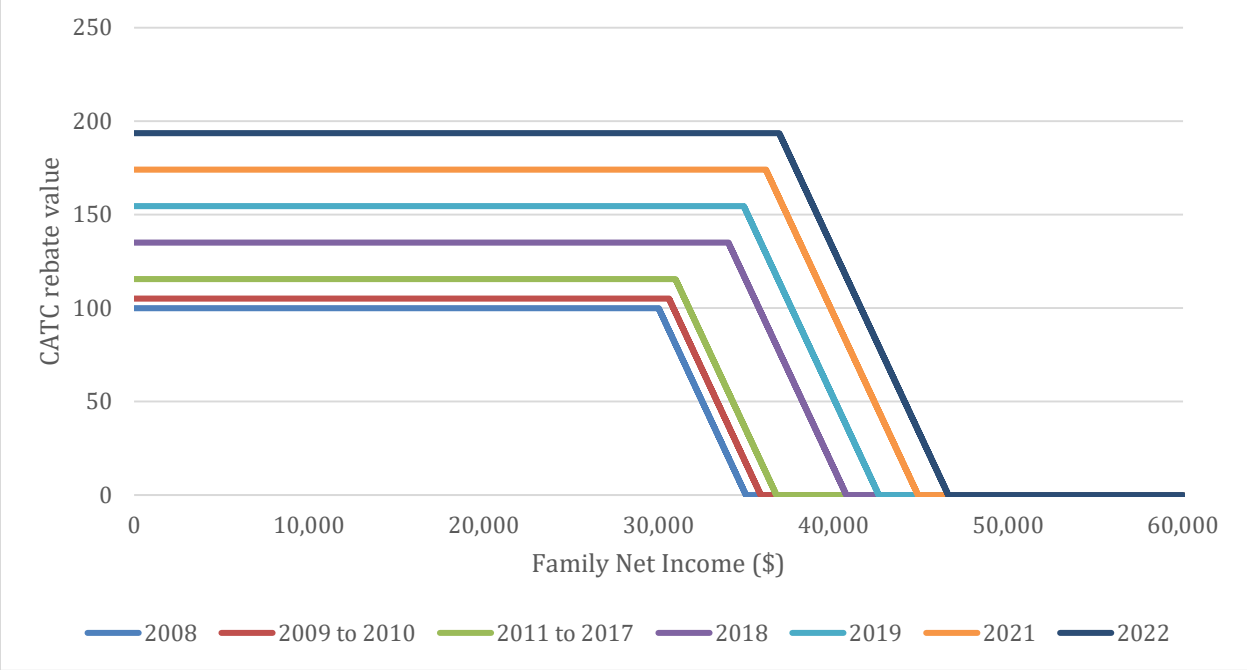

Figure 5: Climate Action Tax Credit (CATC) amounts for a single person between the 2008 and 2022 benefit years.
Note: The value of the CATC was constant between 2009 and 2010, and 2011 and 2017. This figure does not reflect the one-time increase in the CATC in July 2020 as part of BC's COVID-19 Action Plan.
Source: Author's calculations based on CATC amounts and family net income thresholds in British Columbia (n.d.a.) and SPSD/M v. 29.

Figure 6 displays the CATC rebate value as a function of family net income for different family types. While the family net income threshold for a single person is $36,901, this rises to $43,051 for married or common-law and single-parent families. In addition, the maximum rebate value rises from $139.50 for a single person to $555 for a family consisting of a couple with three children.

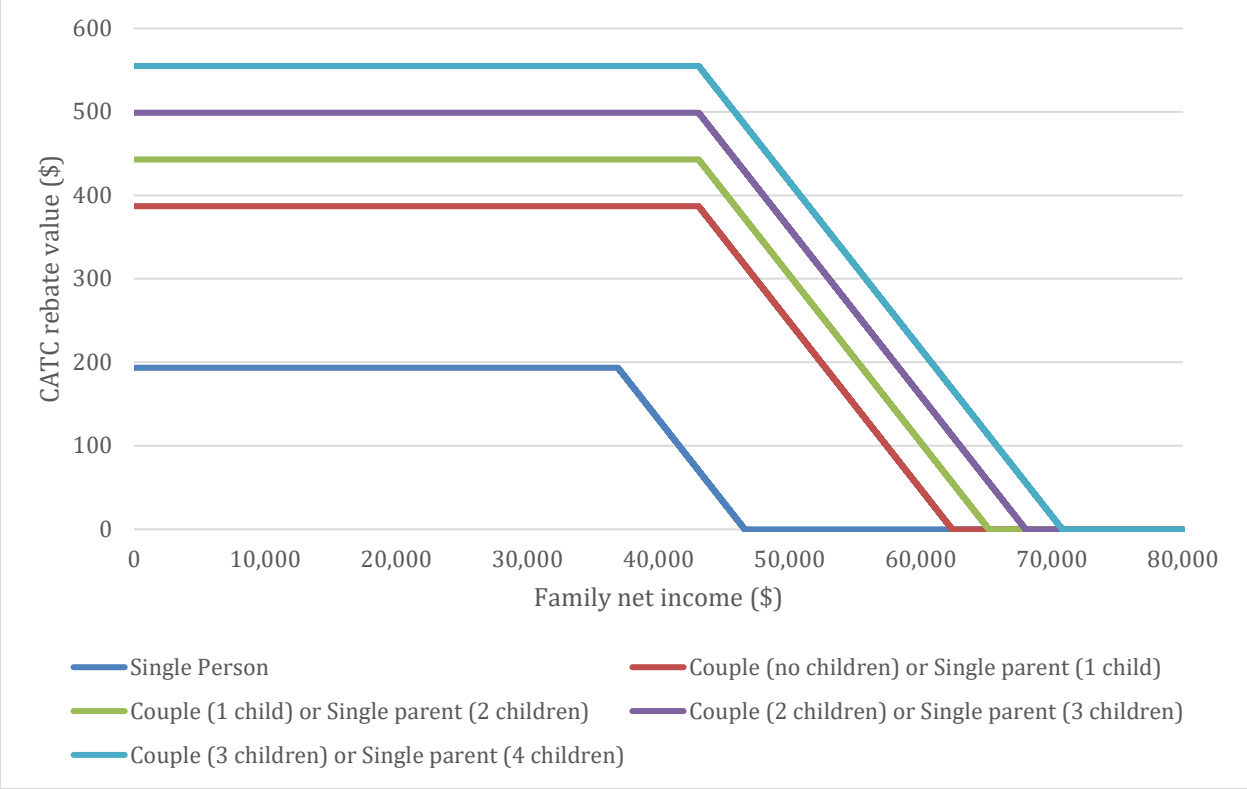

Figure 6: Climate Action Tax Credit (CATC) amounts for the 2022 benefit year for different family types.
Source: Author's calculations based on CATC amounts and family net income thresholds in British Columbia (n.d.a.).

3 Modelling BC's Textbook Revenue Recycling Policy

To investigate how changes in BC's revenue-recycling design between 2008 and 2022 affect the distributional burden of the tax on households, I simulate counterfactual revenue-recycling scenarios. The first scenario increases the 2022 adult and child CATC amounts by 104%, and the second reduces the marginal personal income tax rates by 2.60% in each of the

first two income tax brackets[3]. I analyze the distributional consequences of BC's carbon tax under different revenue recycling scenarios using Statistic Canada's Social Policy Simulation Database and Model (SPSD/M) version 29.0.[4] The SPSD/M is a microsimulation model and statistically representative database that provides the ability to calculate taxes and transfers. While the SPSD/M uses data from 2017 — the base year — it can simulate tax/transfer systems for all years between 1997 and 2026 (Statistics Canada 2022a). By modelling BC's 2008 revenue-recycling scheme as if implemented in 2022, I compare the distributional effects of a "textbook" policy to the status-quo, the carbon tax revenue-use policy currently in place. The "textbook" carbon tax policy returns all revenue to British Columbians through income tax cuts and BC's low-income climate action tax credit (CATC). I simulate counterfactual scenarios that use the same proportion of carbon tax revenue for personal income tax cuts and the CATC in 2022/23 as in 2008/09. Using net carbon tax as a share of income across households, I analyze the progressivity or regressivity of each revenue measure together and individually. Comparing the outcomes of the counterfactuals to the status-quo scenario illustrates how the distributional effects of a carbon pricing policy change with its revenue-recycling design.

3.1 Methodology and Assumptions

This section describes the counterfactual scenarios and underlying assumptions. Firstly, simulations do not use all available carbon tax revenue, as SPSD/M does not allow for modelling of corporate income taxes. As a result, I ignore revenue directed toward corporate income tax cuts and only focus on personal tax expenditures — namely, the CATC and personal income tax

[3] This is a 2.60 percent reduction in the marginal tax rates on each bracket up to $86,599 of income – not a reduction of 2.60 percentage points.
[4] Disclaimer for household revenue recycling analysis: This analysis is based on Statistic's Canada's Social Policy Simulation Database and Model, version 29.0. The assumptions and calculations underlying the simulation were prepared by Lindsey Geier and the responsibility for the use and interpretation of these data is entirely that of the author.

cuts. This is a potential limitation of this research. Many studies argue that reducing corporate income taxes disproportionately benefits high-income households (Lee 2011; Canada's Ecofiscal Commission 2016b; Ivanova and Klein 2013). Thus, I do not consider the potential regressive effects of corporate income tax cuts. Secondly, I model changes to BC's personal tax and transfer system, which directly impacts a tax family consisting of a tax-filer, their spouse and tax dependents. As such, I use "economic families" as my unit of analysis. An economic family is "a group of individuals living together who are all related by blood, marriage, or adoption and share the same dwelling," including unattached individuals (Statistics Canada 2022b). However, this means an economic family is not necessarily synonymous with a tax family. Specifically, a low-income individual — in their own tax family — may be included in a higher-income economic family. The value of the CATC depends on tax family characteristics. As a result, CATC values for an economic family will be greater than — or equal to — that of a tax family, which is another limitation of this research. "Economic family" also differs from "household" in SPSD/M, which "consists of all individuals sharing the same dwelling" (Statistics Canada 2022b). However, this paper treats the term "economic family" as synonymous with "household." Lastly, I use disposable income in my distributional analysis to divide households into deciles. SPSD/M defines disposable income as "total income minus total taxes, excluding federal and provincial commodity taxes" (Statistics Canada 2022b). This income definition has been used in past work analyzing the distributional impacts of carbon taxes across households (Metcalf 2007; Wier et al. 2005; Andersson and Atkinson 2020; Parliamentary Budget Officer 2020). Disposable income is a useful measure for gauging one's potential to consume (Rosen, Wen, and Snoddon 2016).

To analyze the distributional effects of the carbon tax on households of different incomes, I use SPSD/M to divide BC households into disposable income deciles[5]. In creating the income ranges, each observation is weighted in SPSD/M to form a representative population sample. Table 5 shows each income band, along with the number of observations, average income, and the average number of people and children, in each decile.

Table 5: Household characteristics.

Decile	Disposable Income Range for 2022 Tax Year ($)	Average Disposable Income ($)	Number of Observations	Number of Weighted Observations	Average Household Size	Average Number of Children
Bottom Decile	0 – 23,695	16,914	542	180,846	1	0
2nd	23,696 – 33,796	28,160	695	180,846	1	0
3rd	33,797 – 44,760	39,676	661	180,846	2	0
4th	44,761 – 57,590	50,806	711	180,846	2	0
5th	57,591 – 69,422	63,500	686	180,846	2	0
6th	69,423 – 82,856	76,085	1,432	180,846	2	0
7th	82,857 – 97,242	89,629	6,046	180,846	2	0
8th	97,243 – 117,783	106,850	10,509	180,846	3	1
9th	117,784 – 154,360	134,201	18,221	180,846	3	1
Top Decile	154,361 and above	263,686	30,452	180,846	3	1
Average		**87,075**			**2**	**0**

Note: Disposable income is "total income minus total taxes, excluding federal and provincial commodity taxes" (Statistics Canada 2022b). Each observation is weighted in SPSD/M to be representative of the population.
Source: Author's calculations using SPSD/M v. 29.

3.2 CATC Counterfactual Assumptions

To replicate BC's "textbook" carbon tax policy in 2022, I target the CATC's 2008/09 share of carbon tax revenue in 2022/23 and inflate the adult and child CATC values equally to meet that target. BC estimates that in 2022/23, the province will generate $2,311 million in carbon tax revenue, and the CATC will cost $363.0 million, or 15.7% of projected carbon tax

[5] A decile represents 10 percent of the population. BC households are divided into ten equal sized groups. This means the lowest decile contains the poorest 10 percent of BC households and the highest decile contains the richest 10 percent.

revenue (British Columbia Ministry of Finance 2022). In 2008/09, the CATC constituted 34.6% of carbon tax revenue of $306 million. The counterfactual scenario increases the adult and child CATC amounts by 104% to $394.74 and $115.26, respectively. Using SPSD/M, I estimate the cost of the counterfactual CATC to be $806.7 million — or 34.9% of carbon tax revenue — in 2022. Table 6 outlines the amounts for the CATC and associated costs in both the status-quo and modelled "textbook" revenue recycling scenarios.

Table 6: Actual and modelled Climate Action Tax Credit (CATC) amounts per adult and child in the 2022 tax year.

	Status-Quo Policy	Modelled Policy
Adult CATC Amount (2022 dollars)	193.50	394.74
Child CATC Amount (2022 dollars)	56.50	115.26
Cost (million 2022 dollars)	$363.0	$806.7

Note: The modelled CATC amounts are 104% higher than the actual CATC amounts. The CATC is a July to June program. In SPSD/M simulations the tax credit is based on the value set for July 2022.
Source: Authors' calculations using SPSD/M v. 29 and British Columbia Ministry of Finance (2022).

3.3 Personal Income Tax Cut Counterfactual Assumptions

Like the counterfactual scenario for the CATC, I target the 2008/09 share of carbon tax revenue in 2022/23 and introduce personal income tax rate decreases in the first two brackets to match that share. In 2008/09, personal income tax cuts constituted 35.0% of carbon tax revenue of $306 million. In SPSD/M, I estimate that in 2022, the 5% reduction in personal income taxes in each of the first two income tax brackets (5.35% to 5.06% and 8.15% to 7.70%) will cost $560.7 million. This is 24.3% of the projected carbon tax revenue of $2.311 billion. Using SPSD/M, I simulate a further 2.60% reduction in each of the first two personal income tax brackets, costing an additional $246.7 million. In total, I estimate that personal income tax cuts in the counterfactual scenario cost $807.4 million or 34.9% of carbon tax revenue. Table 7 displays the income tax brackets with associated marginal income tax rates used in SPSD/M to estimate household tax savings across income deciles.

Table 7: BC's marginal personal income tax rates prior to its tax reductions in 2008 and 2009, current tax rates, and tax rates used in the SPSD/M simulation, with corresponding 2022 income tax brackets.

Tax Bracket	Taxable Income Range for 2022 Tax Year (SPSD/M)	Tax Rates Prior to 5 Percent Cut (2008)	Current Personal Income Tax Rates (2009-2022)	Modelled Personal Income Tax Rates
1	$0 - $43,299	5.35%	5.06%	4.93%
2	$43,299 - $86,599	8.15%	7.70%	7.50%
3	$86,599 - $99,426	10.50%	10.50%	10.50%
4	$99,426 - $120,732	12.29%	12.29%	12.29%
5	$120,732 - $163,698	14.70%	14.70%	14.70%
6	$163,698 - $228,299	N/A	16.80%	16.80%
7	Over $228,299	N/A	20.50%	20.50%

Note: In SPSD/M income tax brackets for 2022 vary slightly from those reported by the BC Ministry of Finance. Tax brackets are indexed each year to the Consumer Price Index for B.C. For the 2022 tax year, tax brackets were increased by a CPI rate of 2.1%. SPSD/M uses a BC CPI rate of 2.6% to inflate from 2021. The sixth and seventh tax brackets were introduced in 2018 and 2020, respectively.
Source: Author's calculations using SPSD/M v. 29.

4 Results of the Distributional Analysis

In this section, I present within-decile averages of households' carbon tax payments and CATC and tax savings under the status-quo and modelled revenue-recycling scenarios. Using these averages, I assess whether households in each decile are made better off from the tax changes by comparing rebates to carbon taxes. I analyze the distributional effects of each revenue-recycling choice, using average net carbon taxes as a share of disposable income across deciles, where net carbon taxes are equal to carbon taxes paid less CATC rebates and tax savings. I then discuss how revenue-recycling design can help policymakers improve the distributional equity of the carbon tax.

4.1 Distributional Effects of a CATC Increase

Table 8 displays the average carbon tax paid, and CATC received per household across income groups for the modelled and status-quo revenue recycling scenarios. The average carbon tax paid per household is $617 (Table 8). Households in the bottom decile pay an average of $262 in carbon taxes, rising to $1,068 in the top decile (Table 8). Thus, in terms of absolute value, higher-income households pay higher carbon taxes, likely resulting from higher consumption (Lee 2011).

Under the status-quo scenario, households in the bottom three deciles receive an average CATC payment of between $209 and $226. The CATC decreases to $49 for the top decile, showing a progressive pattern. Under the modelled revenue-recycling scenario, households in the bottom three deciles receive an average CATC of between $429 and $510 which decreases to $114 for the top decile. As a result, rebates from the CATC exceed carbon taxes for the bottom 30% of households.

In 2022, the CATC becomes zero between $46,576 and $70,876 of net family income, depending on household characteristics; however, the results show that some higher-income households receive the CATC. A limitation of this analysis is that the data capture economic families with high disposable incomes but contain multiple adults, one of which is low income. Because this adult is low-income and files taxes, the economic family receives the CATC.

Table 8: Estimated carbon taxes paid, and climate action tax credits received per household, by income decile in the 2022 tax year (2022 dollars).

			Average CATC		Average Net Carbon Tax	
Decile	**Disposable Income Range**	**Average Carbon Tax Paid**	**Status-Quo Scenario**	**Modelled Scenario**	**Status-Quo Scenario**	**Modelled Scenario**
Bottom Decile	0 - 23,695	262	209	429	53	-167
D2	23,696 - 33,796	363	224	462	139	-99
D3	33,797 - 44,760	420	226	510	194	-90
D4	44,761 - 57,590	478	182	447	296	30
D5	57,591 - 69,422	588	106	350	482	238
D6	69,423 - 82,856	662	117	333	545	330
D7	82,857 - 97,242	699	72	207	627	492
D8	97,243 - 117,783	760	48	139	712	621
D9	117,784 - 154,360	863	52	135	811	727
Top Decile	154,361 - Max	1068	49	114	1019	954
Average		**617**	**128**	**312**	**488**	**304**

Note: A positive net carbon tax implies cost greater than rebate; negative value implies rebate greater than costs. Results are weighted averages. Observations are weighted in SPSD/M to represent the population.
Source: Authors' calculations using SPSD/M v. 29.

Figure 7 displays the distributional effect of the carbon tax, using net carbon taxes as a share of disposable income across deciles. Net carbon taxes are equal to carbon taxes paid less rebates. Average carbon taxes paid as a share of disposable income are highest among low-income households, at 5.15% for the bottom decile and decreasing to 0.49% for the top decile, showing a regressive pattern (Figure 7). Under BC's current revenue recycling scheme, the average carbon tax paid exceeds the low-income tax credits received by households — resulting in net losses — across all income deciles (Table 9). In contrast, a 104% increase in the CATC results in net benefits — rebates that exceed carbon taxes — for households on average in the first three deciles (Table 9). Figure 7 shows that under the current revenue recycling regime, the net carbon tax as a share of disposable income decreases from 1.59% in the bottom decile to 0.47% in the top decile. This suggests that the progressivity of the CATC helps reduce the carbon tax burden

for low-income households. The modelled revenue recycling regime shows a progressive pattern across the distribution, with the CATC more than offsetting carbon tax costs for low-income households on average in the first three deciles. Specifically, low-income households in the first three deciles experience net benefits from 0.23% to 2.13% of household disposable income.

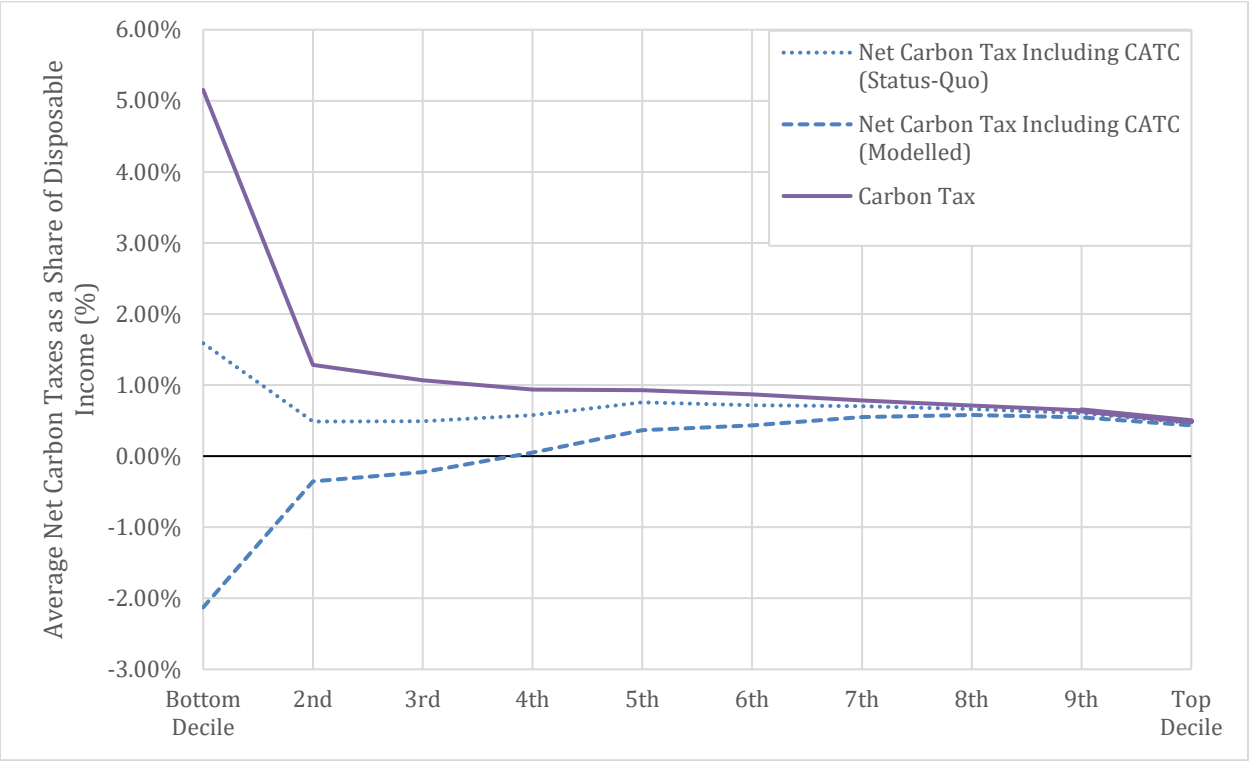

Figure 7: Net carbon tax — carbon tax costs less CATC rebates — as a share of household disposable income across deciles.
Note: Results are weighted averages. Observations are weighted in SPSD/M to represent the population.
Source: Author's calculations using SPSD/M v. 29.

4.2 Distributional Effects of Personal Income Tax Cuts

Table 9 displays the estimated carbon tax paid and tax savings per household across income groups for the modelled and status-quo revenue recycling scenarios. Tax savings under the status-quo revenue recycling scenario are equal to the difference between taxes payable before the five percent tax cut — using tax rates in 2008 — and after — using the prevailing tax rates in 2022. Under the status-quo scenario, households in the bottom decile receive the lowest tax savings of $7 on average. Tax savings rise with each consecutive decile, reaching an average of

$509 for the top 10% of households. With additional tax cuts, households in the bottom decile receive $10 on average, rising to $737 in the top decile. In both revenue recycling scenarios, each successive decile receives higher tax savings than the previous, showing a regressive pattern. Lee (2011) finds similar results: the highest personal income tax cuts accrue to the richest 10% of households. Alone, tax cuts fail to offset carbon tax costs for low-income households. More specifically, carbon taxes exceed tax savings in both revenue-recycling scenarios, leading to positive net carbon taxes across all households.

Table 9: Estimated carbon taxes paid, and tax cuts received per household, by income decile in the 2022 tax year (2022 dollars).

			Tax Cuts		Net Carbon Tax	
Decile	**Disposable Income Range**	**Average Carbon Tax**	**Status-Quo Scenario**	**Modelled Scenario**	**Status-Quo Scenario**	**Modelled Scenario**
Bottom Decile	0 - 23,695	262	7	10	255	252
2nd	23,696 - 33,796	363	44	63	319	300
3rd	33,797 - 44,760	420	88	126	333	294
4th	44,761 - 57,590	478	136	196	341	281
5th	57,591 - 69,422	588	205	295	383	292
6th	69,423 - 82,856	662	242	350	420	312
7th	82,857 - 97,242	699	294	425	405	274
8th	97,243 - 117,783	760	351	507	409	253
9th	117,784 - 154,360	863	432	624	430	238
Top Decile	154,361 - Max	1068	509	737	559	332
Average		**617**	**231**	**334**	**385**	**283**

Note: Income taxes payable are calculated for economic families using 2022 tax bracket thresholds. Tax cuts mean tax savings. Results are weighted averages. Observations are weighted in SPSD/M to represent the population.
Source: Author's calculations using SPSD/M v. 29.

Figure 8 displays the average net carbon tax as a share of disposable income across deciles, with and without the additional tax cuts. The figure shows that the modelled revenue recycling regime is slightly more regressive than the current one. With the current tax cuts, the net carbon tax as a share of disposable income decreases from 5.11% in the bottom decile to 0.25% in the top decile.

With additional tax cuts, the net carbon tax as a share of disposable income is lower across all deciles, ranging between 5.10% for households in the bottom decile and 0.14% in the top decile.

While personal income tax cuts benefit low-income households very little, they provide high-income households with significant tax savings. Existing literature finds that lower-income households pay less in income taxes and thus, receive less from income tax cuts (Lee 2011; Goulder 2013; Canada's Ecofiscal Commission 2016a). The resulting effect is that revenue-recycling using personal income taxes is regressive.

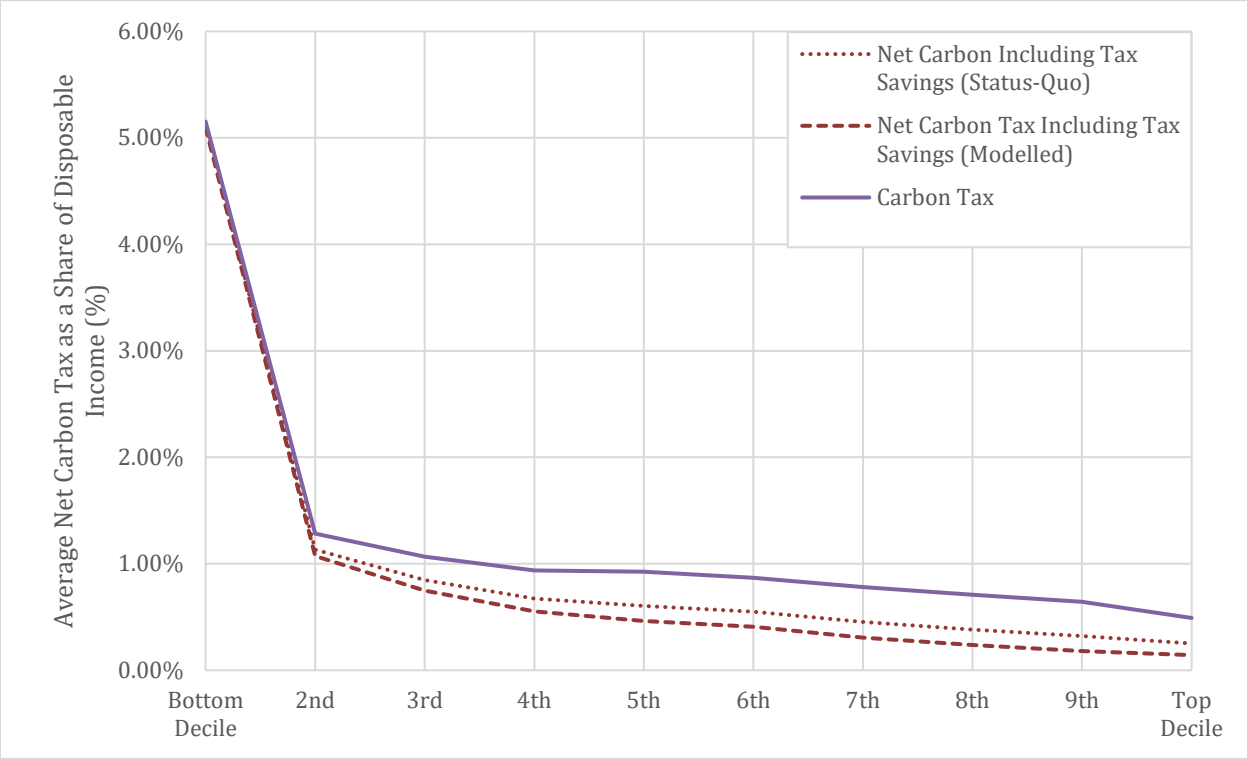

Figure 8: Net carbon tax — carbon tax costs less tax savings — as a share of household disposable income across deciles.
Note: Results are weighted averages. Observations are weighted in SPSD/M to represent the population.
Source: Author's calculations using SPSD/M v. 29.

4.3 Comparison of CATC and Tax Cuts

Figure 9 displays the average CATC, tax cut savings, and carbon tax costs accruing to households in each revenue recycling scenario across the first five deciles (up to $69,422 of household disposable income). The CATC rebates benefit low-income households more than

personal income tax cuts. Under the status-quo revenue-recycling scenario, households in the bottom decile receive benefits from the CATC that are approximately 29 times larger than tax savings from the 2008 personal income tax cut. In the modelled revenue-recycling scenario, this rises to 43 times. Alone, CATC rebates under the "textbook" revenue recycling scenario are large enough to more-than-offset the carbon tax costs for the lowest-earning 30% of households. Lee (2011) finds similar results, concluding that BC's low-income tax credits provide the best compensation to low-income households compared to personal income tax cuts, which disproportionately benefit high-income households. Thus, a carbon tax policy aiming to minimize the adverse distributional effects of the tax through revenue measures may better target low-income households through a low-income tax credit rather than tax cuts.

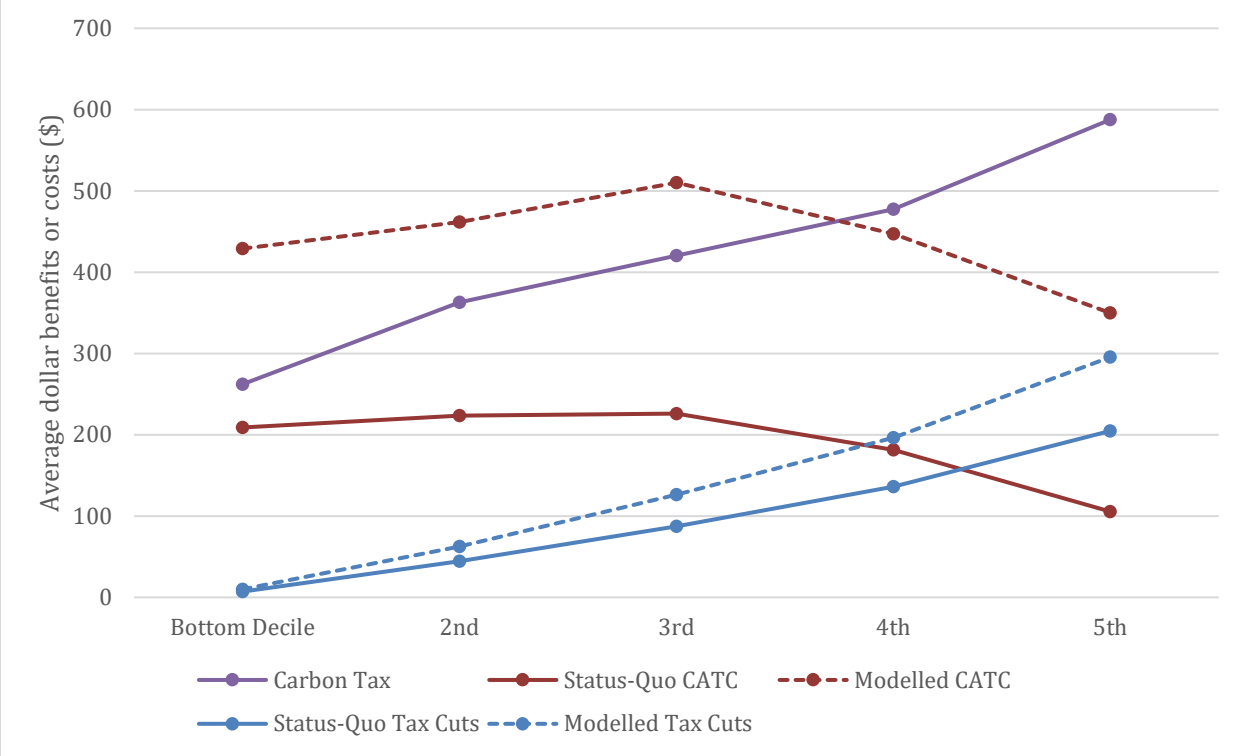

Figure 9: Average benefits from tax savings and the CATC under the status-quo and modelled revenue recycling scenarios and carbon tax costs across income deciles.
Note: Results are weighted averages. Observations are weighted in SPSD/M to represent the population.
Source: Author's calculations using SPSD/M v. 29.

Table 10 displays the total net carbon tax across income deciles, combining both revenue-recycling tools. Under BC's current revenue recycling scenario, households experience a net loss of $257, on average. The bottom 10% of households pay an estimated $46 in net carbon taxes on average, rising to $510 per household in the top decile. Contrastingly, an increase in the CATC and higher tax cuts result in net benefits — or negative net carbon taxes — for households in the first six deciles. This means, under the "textbook" revenue recycling scenario, adding the impact of tax cuts now provides net benefits to households in the fourth, fifth and sixth deciles. Specifically, the bottom 60% of households will receive average benefits of between $20 and $216. This results in a progressive pattern, with the second half of the distribution experiencing increasing net losses — with rising income — of up to $217 per household in the top decile. Overall, on average households will receive an estimated net benefit of $30 under the modelled revenue recycling scenario.

Table 10: Total net carbon tax— carbon tax costs less tax savings and CATC rebates — across income deciles (2022 dollars).

			Total Net Carbon Tax Including Tax Cuts and the CATC	
Decile	**Disposable Income Range**	**Average Carbon Tax Paid**	**Status-Quo Scenario**	**Modelled Scenario**
Bottom Decile	0 - 23,695	262	46	-177
2nd	23,696 - 33,796	363	95	-161
3rd	33,797 - 44,760	420	107	-216
4th	44,761 - 57,590	478	160	-166
5th	57,591 - 69,422	588	277	-58
6th	69,423 - 82,856	662	303	-20
7th	82,857 - 97,242	699	333	67
8th	97,243 - 117,783	760	360	114
9th	117,784 - 154,360	863	378	103
Top Decile	154,361 - Max	1068	510	217
Average		**617**	**257**	**-30**

Note: A positive net carbon tax implies cost greater than benefits from tax savings and the CATC rebate; negative value implies benefits greater than costs. Results are weighted averages. Observations are weighted in SPSD/M to represent the population.
Source: Author's calculations using SPSD/M v. 29.

Figures 10 and 11 display the net carbon tax — including the CATC and tax cuts — as a share of household disposable income across deciles in each revenue-recycling scenario. BC's carbon pricing policy is regressive without revenue recycling, with lower-income households bearing a greater tax burden. The steep slope between the first and second deciles illustrates the dramatic increase in the average tax burden as household disposable income falls below $23,696. Under the status-quo scenario, BC's carbon pricing policy becomes relatively less regressive when adding in the progressive effect of the CATC (Figure 10). Households in the first decile experience the greatest decrease in their average tax burden from the CATC, decreasing the slope between the first and second deciles (Figure 10). When including the effect of the 2008 personal income tax cut, BC's carbon pricing policy becomes more regressive than a policy consisting of only the CATC (Figure 10). When combining the two policy actions, the bottom decile pays 1.55% of household disposable income on average, while the top 10% of households pay only 0.23% (Figure 10). The combined effect of the CATC and personal income tax cuts is relatively neutral across the income distribution except for the bottom decile, shown by the flatter curve between the second and tenth deciles (Figure 10).

Figure 11 shows that by increasing the generosity of the CATC, the carbon tax regime becomes progressive, with higher-income households bearing a greater tax burden than low-income households. Adding in the effect of the additional personal income tax cuts makes the carbon pricing policy relatively more regressive, reducing the tax burden for high-income households (Figure 11). Despite this, the CATC sufficiently counteracts the regressive nature of the personal income tax cuts. The combined effect of the CATC and tax cuts results in a steep, positive slope between the first and second deciles and a flatter but still positive slope up to the eighth decile. Together, the CATC and tax cuts result in net benefits for low-income households

in the first six deciles from 0.03% to 2.19% of household disposable income (Figure 11). Moving up the income ladder, the net carbon tax as a share of disposable income becomes increasingly positive (tax payments greater than rebates), reaching 0.11% for the eighth decile.

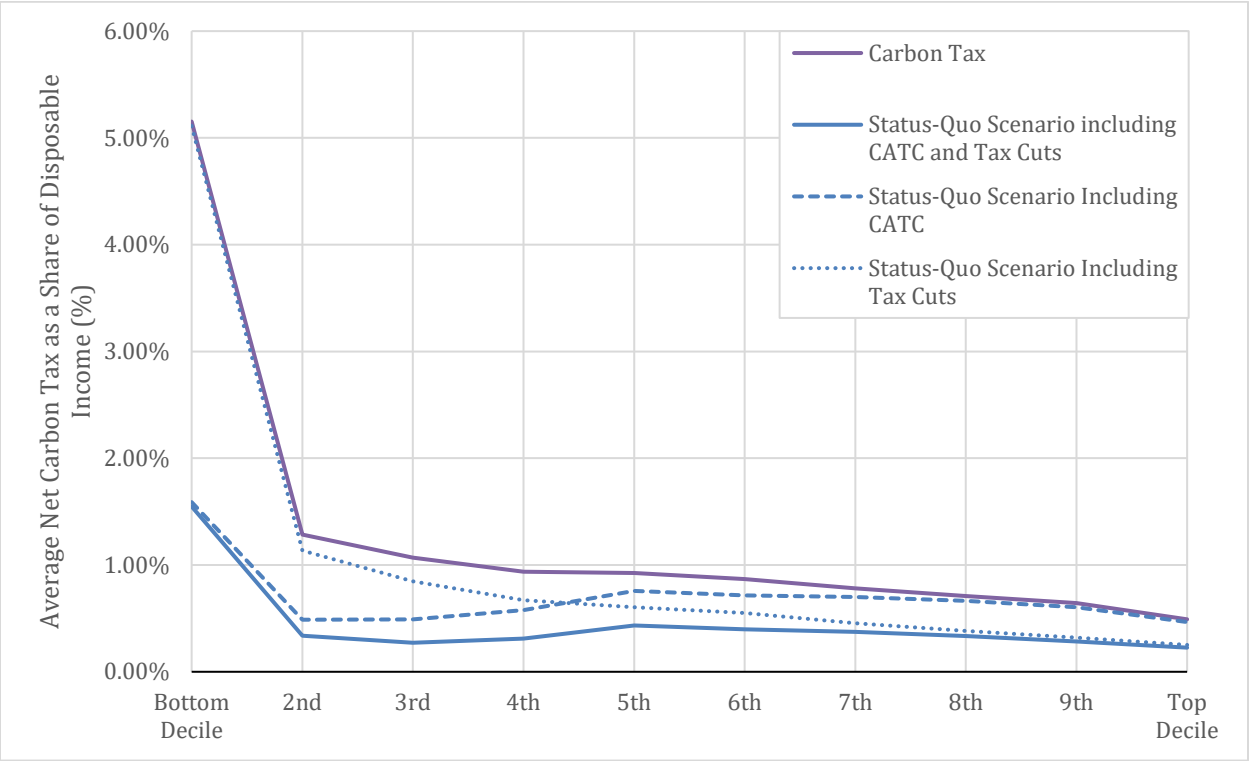

Figure 10: Net carbon tax— carbon tax costs less tax savings and CATC rebates — as a share of household disposable income across deciles, under the status-quo revenue recycling scenario.
Source: Author's calculations using SPSD/M v. 29.

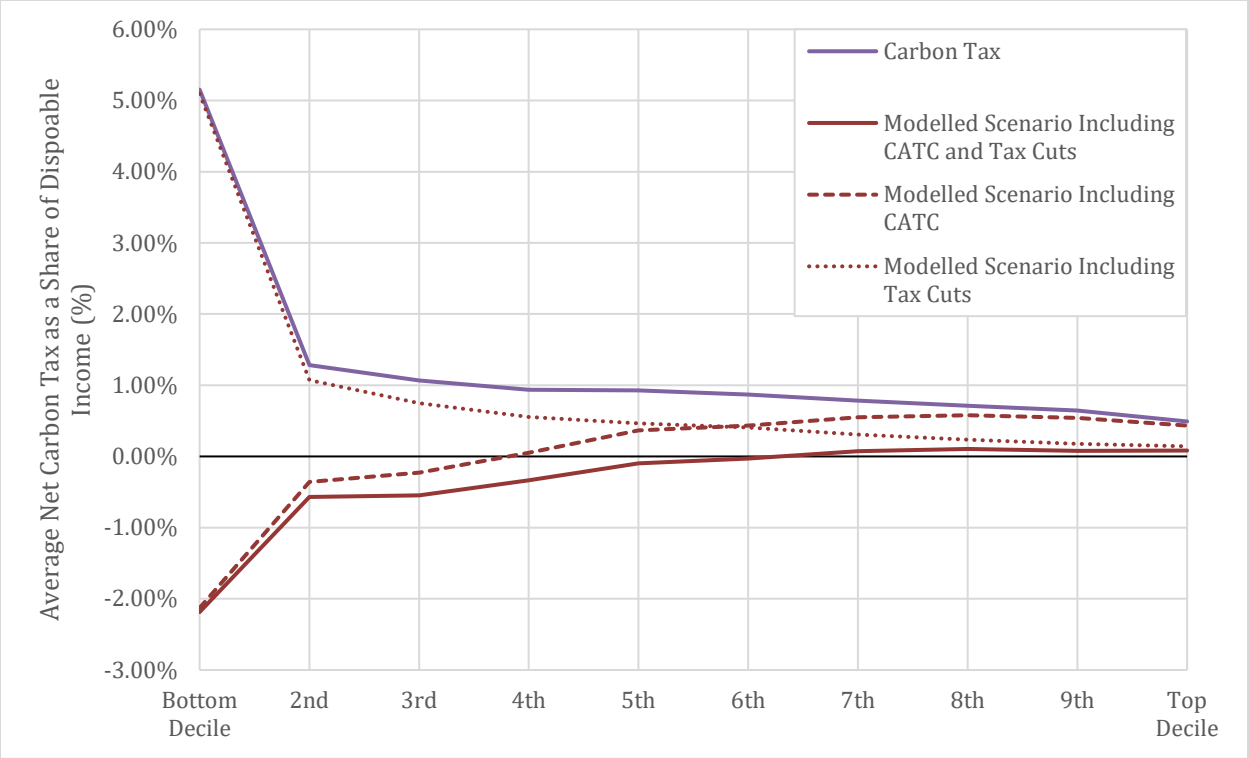

Figure 11: Net carbon tax — carbon tax costs less tax savings and the CATC rebates — as a share of household disposable income across deciles, under the modelled revenue recycling scenario.
Source: Author's calculations using SPSD/M v. 29.

4.4 Carbon Tax Policy Implications

Figure 12 displays the average net carbon tax across deciles, the carbon tax less CATC rebates and tax savings. Without exhausting all carbon tax revenue, a "textbook" policy, such as the one modelled in this paper, can make low-income households in the bottom six income deciles better off, improving the distributional equity of the carbon tax. More specifically, using 34.9% of carbon tax revenue towards the CATC is enough to offset the regressivity of the carbon tax.[6] This is an increase of 19.2 percentage points from the estimated 15.7% of carbon tax revenue used towards the CATC in the status-quo scenario. Increasing the generosity of the CATC can allow policymakers to meet the policy objective of mitigating the distributional effects of the

[6] A caveat of my analysis is that is does not identify the CATC value that exactly offsets the regressivity of the carbon tax.

carbon tax. This progressive outcome is possible without changing the income thresholds for the CATC, an alternative way to address distributional equity concerns.

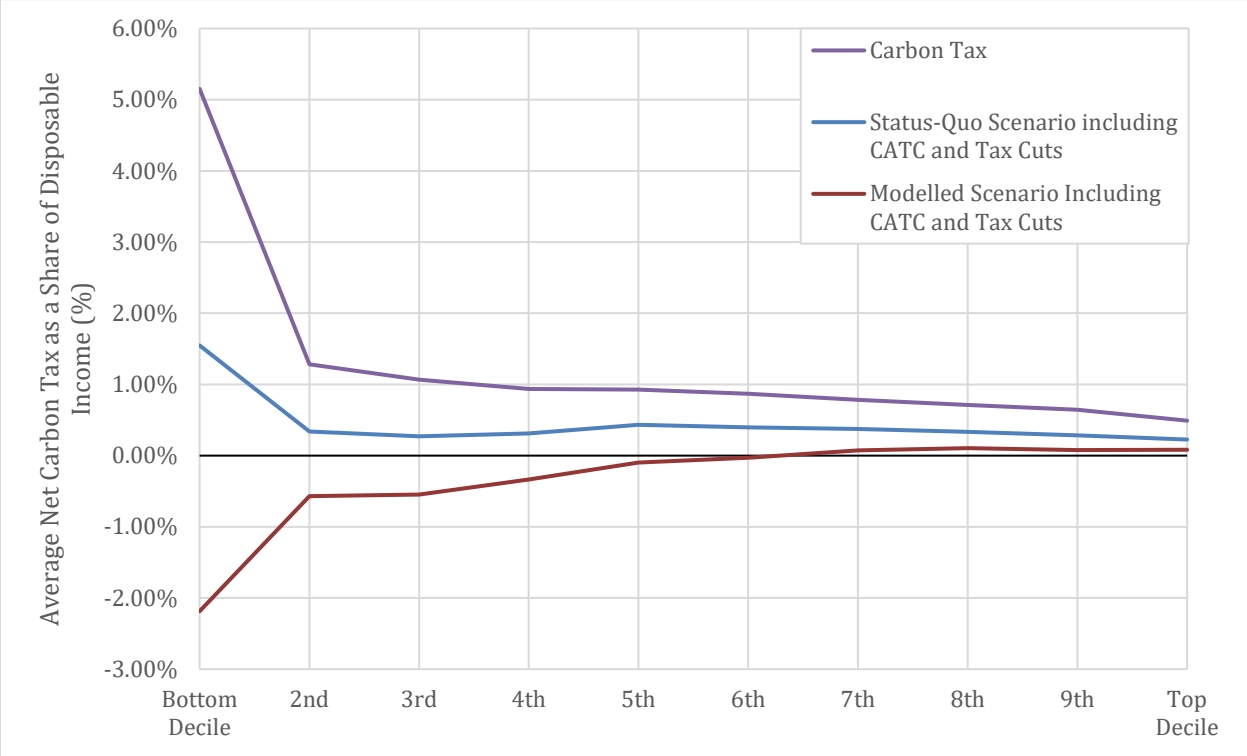

Figure 12: Net carbon tax — carbon tax costs less CATC rebates and tax savings — as a share of household disposable income across deciles, under current policy and modelled revenue recycling scenarios.
Source: Author's calculations using SPSD/M v. 29.

An important consideration is the impact of corporate income tax cuts, which I do not include in this analysis. Under BC's "textbook" 2008 policy, the province returned the remaining 30% of carbon tax revenue to taxpayers through corporate income tax cuts. Several studies argue that corporate income taxes are progressive, meaning the tax on returns to capital falls disproportionately on high-income earners (Canada's Ecofiscal Commission 2016b; Lee 2011). This means corporate income tax reductions will likely benefit high-income earners the most (Canada's Ecofiscal Commission 2016b). Specifically, Lee (2011) finds that corporate income tax cuts concentrate benefits at the top of the income distribution, making the richest 10% of households net beneficiaries of the carbon tax. Nonetheless, a hybrid approach to revenue recycling — consisting of low-income tax credits and income tax cuts — may be preferable to

balance distributional equity and efficiency concerns. Several studies argue that using carbon tax revenue toward lowering existing distortionary taxes can mitigate efficiency costs associated with the carbon tax (Canada's Ecofiscal Commission 2016a; 2016b; Goulder 2013). British Columbia's 2008 "textbook" carbon tax policy of personal income tax cuts and the CATC is a hybrid approach to revenue recycling that can achieve a progressive outcome in 2022.

5 Conclusions

Since the implementation of British Columbia's carbon tax in 2008, the province has changed how it uses its carbon tax revenue. The proportion of carbon tax revenue used to provide BC's low-income climate action tax credit and personal income tax cuts has decreased between 2008 and 2022, from 70% to an estimated 40%, resulting in a disproportionately high average carbon tax burden on low-income households.

The BC carbon tax is regressive without revenue recycling, meaning that the carbon tax constitutes a larger share of income for lower-income households. Simulations show that BC's low-income Climate Action Tax Credit (CATC) reduces carbon tax costs for low-income households and improves the progressivity of the carbon pricing policy. By simulating BC's 2008 "textbook" revenue recycling scheme, I find that directing a larger share of carbon tax revenue toward increasing the CATC can improve distributional equity. Increasing the CATC alone, offsets the regressive effect of BC's carbon tax, creating a progressive carbon tax regime. Revenue-recycling provides benefits — net of the carbon tax — to households in the three lowest income deciles. Contrastingly, simulations show that personal income tax cuts are regressive, providing little benefit to low-income households but significant tax savings to high-income households. In other words, reducing marginal tax rates in the bottom two tax personal

income brackets, generates benefits that fail to reach many households that pay little income tax. This means that personal income tax cuts make BC's carbon tax policy relatively more regressive. Combining the CATC and personal income tax cuts, the modelled "textbook" revenue recycling scenario is progressive, providing net benefits to low-income households in the bottom six deciles.

Current revenue recycling fails to make low-income households no worse off from the carbon tax. This paper's results suggest that a "textbook" revenue recycling scenario — in other words, directing at least 70% of BC's carbon tax revenue toward BC's low-income CATC and personal income tax cuts — significantly improves distributional equity. Simulation results show that households in the bottom decile currently paying 1.55% of their disposable income in net carbon taxes will receive net benefits of 2.19% of household income under a "textbook" carbon pricing policy.

By providing insight into the relative progressivity of BC's low-income CATC and personal income tax cuts in 2022, this research can inform policymakers on the design of BC's carbon pricing policy. The findings in this paper indicate how revenue uses can mitigate the distributional effects of the tax. Increasing the CATC adult and child amounts by 104% can make low-income households — with up to $44,760 in disposable income — better off. The differing distributional impacts of personal income tax cuts and low-income tax credits — individually and combined — are important considerations for policymakers aiming to improve fairness of a carbon tax regime.

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