UNIVERSITY OF CALGARY | THE SCHOOL OF PUBLIC POLICY

MASTER OF PUBLIC POLICY
CAPSTONE PROJECT

How to protect lower-income Albertans from a carbon tax:
An analysis of lump-sum transfers and personal income tax cuts

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Capstone Executive Summary

The decision in fall 2015 to implement an economy-wide carbon tax is one of the most significant policy shifts ever made by Alberta. The provincial government's attempt to become a global leader in climate change policy will be a major task made even more difficult as Alberta has both high greenhouse gas emissions and high emissions per capita. One of the biggest challenges facing policymakers will be addressing the impact that a carbon tax has on low-income households. A vast body of research finds that pricing carbon unfairly targets low-income households, potentially worsening inequality and forcing those with the lowest ability to pay to bear the tax's greatest burden. This paper seeks to find the best solution to this problem.

The Government of Alberta has chosen to address this issue by introducing a lump-sum transfer to lower-income Albertans alongside the carbon tax. The stated goal of these transfers is to repay the full costs of the carbon tax to the lowest-earning 60 per cent of households. This 'carbon rebate' is one approach to providing benefits to lower-income households. Some economists argue that the alternative policy approach of reducing personal income taxes on the lowest earners is superior. The goal of this paper is to evaluate these two policies in order to determine which is best able to achieve Alberta's stated policy goal.

This paper looks first at the potential impact of Alberta's carbon tax on households. Distributional impacts are central to the analysis and the impacts of carbon pricing are examined by income quintile. An accurate estimate of the costs faced by households across the income distribution is performed using data on each quintile's expenses on residential fuel, transportation fuel and electricity. The estimate is strengthened by a separation of fixed and variable costs based on electricity and residential fuel billing data. This paper finds that the carbon tax has an uneven impact, hitting the second and third quintiles hardest but leaving the lowest quintile the least impacted of the five income groups. The centerpiece of this paper is the evaluation of two test policies, each designed to represent one approach to providing benefits to lower-income households. The lump-sum transfer is designed to be as close as possible to the government's carbon rebate. The PIT cuts are introduced using an alternative PIT system that offers tax cuts to the lowest tax bracket. Simulations using Statistics Canada's SPSD/M program determine the effects of both policies.

The evaluation finds that the lump-sum transfer is able to make the lowest and second quintiles better off and the third quintile almost no worse off under a carbon tax. The PIT cuts, on the other hand, fare poorly. PIT cuts provide the greatest benefits to Alberta's highest-earners, while the lowest-three quintiles receive benefits far below the costs they incur under a carbon tax. This paper concludes that a lump-sum transfer system is the mechanism best suited to meeting the government's policy goal. However, Alberta's lump-sum transfer system is likely to fall short of making 60 per cent of Albertans no worse off under a carbon tax.

Introduction

The Government of Alberta's decision in fall 2015 to expand its carbon pricing policy and introduce an economy-wide carbon tax led the *Calgary Herald's* political commentator Don Braid to call it "perhaps the most radical policy shift ever seen in this province."[1] Beginning in January 2017, Alberta will place a $20 per tonne tax on carbon dioxide (CO_2) emissions, increasing to $30 per tonne in January 2018. The changes are predicted to increase the cost of energy goods such as electricity, transportation fuel and natural gas. These cost increases are likely to hit lower-income households particularly hard, as they tend to spend a greater percentage of their income on energy.

The provincial government has chosen to mitigate the impact on lower-income Albertans through the use of a lump-sum transfer called a carbon rebate. The government estimates this transfer will make the lowest-earning 60 per cent of Albertan households no worse off under a carbon tax.[2] In other words, they will receive at least as much money from the carbon rebate as they will face in additional energy costs. But is a lump-sum transfer the most effective policy mechanism for protecting lower-income Albertans from increased energy costs? Some economists argue that cutting personal income tax (PIT) is a superior approach.[3] Evaluating these two policy approaches for mitigating the cost of the carbon tax and determining which is best able to protect low-income Albertans is the primary focus of this paper.

[1] Don Braid, "Notley's climate plan is Alberta's most powerful policy jolt ever," November 23, 2015, http://calgaryherald.com/opinion/columnists/braid-notleys-climate-plan-is-albertas-most-powerful-policy-jolt-ever/.
[2] Government of Alberta, Carbon levy and rebates, accessed on July 14, 2016, http://www.alberta.ca/climate-carbon-pricing.cfm/.
[3] Kenneth J. McKenzie, "Make the Alberta carbon tax revenue neutral," The School of Public Policy Briefing Paper 9, no. 15 (2016), https://www.policyschool.ca/wp-content/uploads/2016/05/carbon-levy-revenue-neutral-mckenzie.pdf/.

The first step in this paper's analysis is to determine whether Alberta's carbon tax will be regressive. This is done using consumption data on residential fuel, transportation fuel and electricity and by estimating the increases to these goods' price as a result of a carbon tax. As distributional implications are central to the analysis, the cost impacts of the carbon tax are divided by income quintile.[4]

After determining the costs of Alberta's carbon tax to each income quintile, the focus shifts to the aforementioned policies for mitigating the tax's impact on lower-income Albertans. A literature review will present the existing research on the strengths and weaknesses of both policies with a particular focus on their ability to provide benefits to lower-income households. The findings of this section will inform the calculations performed in the subsequent section evaluating the two test policies – a lump-sum transfer and a PIT cut.

The lump-sum transfer test policy is based on the carbon rebate that will be used by the Government of Alberta. The test policy assessing changes to Alberta's PIT system includes a cut to the tax rate on the lowest tax bracket. The PIT cuts are designed to reduce government revenue by an amount equal to the cost of the lump-sum transfer program. Both policies will be evaluated for their ability to meet the government's stated intention for their carbon rebate - to make the lowest-three quintiles no worse off under a carbon tax. These three quintiles will be referred to as "lower-income" households.

Before proceeding, it is necessary to define why a carbon tax might be seen as regressive or unfairly targeting lower-income households. A regressive tax is one that burdens lower-

[4] A quintile represents 20 per cent of the population. This means that the lowest-earning 20 per cent of Albertan households fall into the lowest-quintile. The second quintile will contain the next-lowest earning 20 per cent of Albertans and the highest quintile will contain the highest-earning 20 per cent of Albertans.

income individuals (those with lower ability to pay) more than it does wealthier people (who have a higher ability to pay). This means that the tax's burden relative to income decreases as income increases.[5] If lower-income households spend a larger portion of their income on energy than wealthier people, a tax on energy use (like a carbon tax) could be regressive.

Economists consider a regressive tax to be contrary to the ideals of vertical equity, which is one measure of a tax's fairness.[6] Vertical equity requires that households with higher incomes pay more taxes to reflect their greater ability to pay. Some economists take the notion of vertical equity a step further, deeming that it requires progressive taxation.[7] Such a system requires higher-income households to pay not only more taxes, but also a higher proportion of their income in taxes.[8] An example is a progressive income tax that levies higher tax rates on higher income brackets. A tax is in line with the principle of vertical equity when higher earners pay a higher effective tax rate.

A government desiring vertical equality can counteract the impacts of a vertically inequitable tax by implementing a policy that protects lower-income households. One way to do this is to give them a cash transfer. This is the simple principle behind the government's decision to provide lower-income Albertans with lump-sum transfers.[9] Whether this is the best approach, however, will be determined in the "Evaluation of test policies" section of this paper.

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[5] Harvey S. Rosen et al., *Public Finance in Canada*, 3rd ed. (Toronto: McGraw-Hill Ryerson, 2008), 216.
[6] Canada's Ecofiscal Commission, "Provincial Carbon Pricing and Household Fairness," (2016), http://ecofiscal.ca/reports/provincial-carbon-pricing-household-fairness/.
[7] Vertical Equity, Investopedia, accessed on July 14, 2016, http://www.investopedia.com/terms/v/vertical_equity.asp/.
[8] Canada's Ecofiscal Commission, "Provincial Carbon Pricing and Household Fairness".
[9] Andrew Leach, "The economic cost of carbon policy," *MacLean's*, June 19, 2016, http://www.macleans.ca/economy/economicanalysis/the-economic-cost-of-carbon-policy/.

Carbon pricing's impact on Albertans

The primary goal of this section is to determine whether Alberta's carbon tax will be regressive. Determining this requires an analysis of the carbon tax's impact on households across the income distribution. This section starts by looking at the energy expenditure of each income quintile in the absence of a carbon tax. If the data show that lower-income Albertans spend a higher percentage of their income on energy, it is a good first indicator of whether the carbon tax will be regressive. Next, the tax's direct costs to each income quintile will be approximated using data on household energy consumption and the price increases resulting from a carbon tax. Finally, the costs imposed on each income quintile will be compared. Once the additional costs to each quintile have been determined, it will be possible to see if Alberta's carbon tax is regressive, and if so, by how much. A projection of the tax's impact on each quintile will also provide parameters for how much money households from each income quintile will need to receive from a lump-sum transfer or PIT cut in order to be made no worse off from Alberta's carbon tax.

Energy expenditure

The first step in understanding how a carbon price will hit Albertans is to know how much they currently spend on energy. Table 1 presents data on household energy expenditures[10] by income quintile. The data show that the average highest-quintile household spends three per cent of their total income on energy, while the average lowest-quintile household spends 14 per cent. This disparity shows that lower-income households spend a higher share of their total income on energy than wealthier Albertans. As such, they are likely to be disproportionately impacted by increased energy costs.

[10] Energy expenditures include household spending on residential fuel, transportation fuel and electricity.

Table 1: Albertans' annual household energy expenditures by income quintile (2013)

Quintile	Total energy expenditure	Total household expenditure (less income taxes)	Total income	Energy expenditure as share of total expenditure	Energy expenditure as share of total income
Lowest	$2,832	$42,778	$20,400	6.62%	13.88%
Second	$4,517	$54,357	$50,900	8.31%	8.87%
Third	$5,298	$74,473	$82,800	7.11%	6.40%
Fourth	$5,305	$96,893	$124,350	5.48%	4.27%
Highest	$7,011	$135,853	$237,050	5.16%	2.96%
Average	$4,996	$79,901	$103,100	6.25%	4.85%

Source: Author's calculations using Statistics Canada's CANSIM Tables 203-0022 and 206-0031.
Notes: Total energy expenditure is the sum of transportation fuel, residential fuel and electricity spending. Air transportation is not included because Alberta's carbon tax will not be levied on interprovincial and international flights. Statistics Canada's category "other fuel for principle accommodation" is not included in the residential fuel calculation as data is classified as too unreliable to be published. Quintiles are determined by total income, which is defined as income from all sources before the deduction of federal and provincial income taxes.

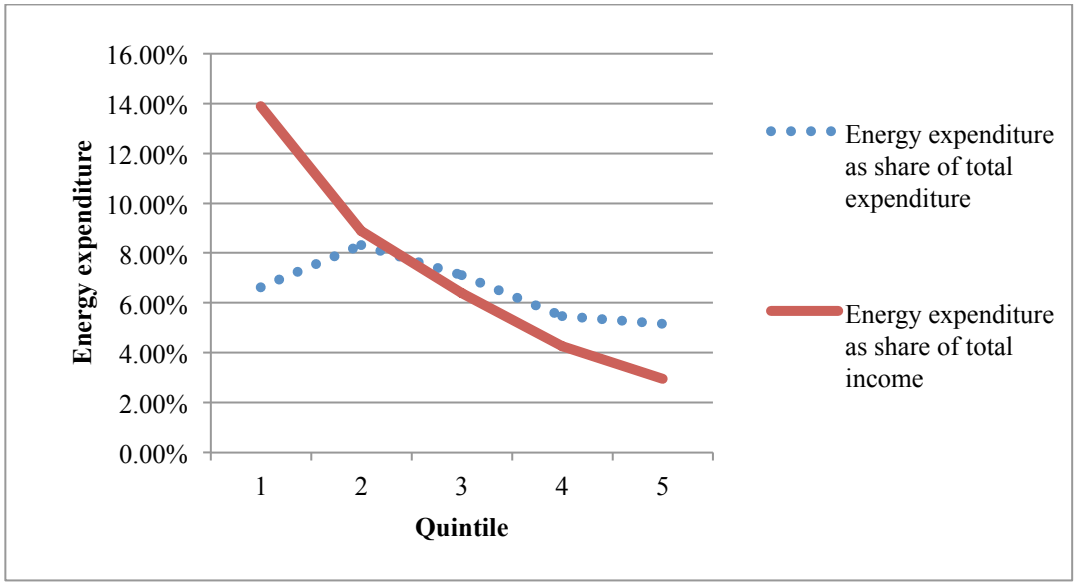
The energy expenditure of each quintile is used to estimate their energy expenditures in the first two years of Alberta's carbon tax. Using the data presented in Table 1 to estimate future energy costs is imperfect due to the fluctuating nature of consumption and energy prices. For example, the cost of electricity in Alberta in 2016 is about half of its 2013 cost.[11] Despite this significant variation, changing prices impact households from every quintile, meaning price changes will have a limited impact on the consumption differences between quintiles.

Figure 1 plots each income quintile's energy expenditure relative to two measures of household income: total income (solid line) and total expenditure (dotted line). The solid line's downward slope indicates that there is a negative correlation between having a lower income and

[11] Utilities Consumer Advocate, Historic Rates, accessed on July 14, 2016, https://ucahelps.alberta.ca/historic-rates.aspx/.

spending a higher percentage of your total income on energy. The dotted line, which shows the ratio of energy expenditure to total expenditure, tells a slightly different story. There is significantly less variation between the quintiles, although the lowest two quintiles still spend a greater percentage on energy than the highest two. The difference between the two measures stems primarily from lower-income households having higher household spending than total income, whereas the opposite is true for high-income households.[12] Although the two measures offer a different interpretation of the carbon tax's impact, they both reveal the same trend. There is a negative correlation between income and expenditure on energy.

Figure 1: Albertans' energy expenditure shares by income quintile (2013)



Source: Author's calculations using Statistics Canada's CANSIM Tables 203-0022 and 206-0031.
Note: Quintiles are determined by total income, which is defined as income from all sources before the deduction of federal and provincial income taxes.

Costs of the carbon tax

Having determined the energy expenditures of Albertan households by income quintile, the next step is to determine how much Alberta's carbon tax will increase these expenditures.

[12] Canada's Ecofiscal Commission, "Provincial Carbon Pricing and Household Fairness".

The impacts will be divided by income quintile to determine the distributional impacts of the carbon tax. The carbon tax will not increase energy costs evenly. Some energy goods will be more impacted by a carbon price than others. This makes it necessary to look at the different purchases that comprise a household's energy expenditure. Data on the amount spent by households in each quintile on their three most carbon-intensive purchases (transportation fuel, electricity and residential fuel) are available from Statistics Canada's National Household Survey, the same source as was used to create Table 1.[13] The price increase of each of these purchases can be estimated by looking at its carbon content, the price that the government has put on CO_2 emissions and the energy consumption habits of each quintile.

Calculating the cost increase requires a tailored approach for each of the three energy goods. Transportation fuel costs were determined by first assuming that average household emissions are reflective of the third quintile's energy consumption habits. Next, it was assumed that the emissions of other quintiles would vary at a one-to-one ratio with their expenditures on transportation fuel. This means that a quintile consuming half as much transportation fuel would have half the carbon emissions. Once a household's carbon emissions from transportation fuel are known, these need only be multiplied by the price on emissions to estimate the additional costs that the tax will impose. This approach makes it possible to estimate the carbon tax's impact on transportation fuel costs to each income quintile.

Estimating the carbon tax's impact on electricity involved a different approach. Making a one-to-one assumption is not accurate for expenditures on electricity, as electricity bills have a significant fixed-cost component that is largely independent of the quantity of electricity

[13] Trevor Tombe, "Here's what we know-and don't know-about Alberta's carbon tax," *Maclean's*, November 23, 2015, http://www.macleans.ca/economy/economicanalysis/heres-what-we-know-and-dont-know-about-albertas-carbon-tax/#pq=c8IOdq.

consumed. A carbon tax will directly impact variable (or energy) costs. As such, the carbon tax's impact on the cost of electricity is only considered for the effect it will have on variable costs. This paper's analysis holds fixed costs constant under a carbon tax. This made it critical to accurately estimate the fixed costs of electricity bills for each quintile. An estimate was made using data from Alberta's Market Surveillance Administrator. This organization has extensive electricity bill data for major towns and cities, and divides the billing data between the fixed and variable costs. Data for 2013 was used from four municipalities (Calgary, Edmonton, Hinton and Grande Prairie), one from each service area, chosen to equitably represent Alberta. This information made it possible to determine the fixed costs paid by the average Albertan household in a year. This amount, $401, was then assigned as the fixed cost for all quintiles. The difference between each quintile's annual expenditure on electricity and their fixed costs is their variable costs. The result of this approach is that the lowest quintile, which spends relatively little on electricity, has fixed-costs (as a percentage of their bill) significantly higher than the highest quintile. Table 2 shows the fixed and variable costs of electricity by income quintile in both dollars and as a percentage of their bill.

Table 2: Fixed and variable costs of electricity by income quintile (2013)

	1st	2nd	3rd	4th	5th
Annual expenditures	$809	$1,122	$1,441	$1,543	$1,767
Fixed costs ($)	$401	$401	$401	$401	$401
Fixed costs (%)	49.5%	35.7%	27.8%	26.0%	22.7%
Variable costs ($)	$408	$721	$1,040	$1,142	$1,366
Variable costs (%)	50.5%	64.3%	72.2%	74.0%	77.3%

Source: Author's calculations using Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

The fixed and variable costs of residential fuel were determined using a similar approach. The Market Surveillance Administrator has extensive data on natural gas bills across Alberta. The fixed costs paid by Albertans were again estimated by selecting one municipality from each service zone (Calgary, Grande Prairie and Beaumont) in order to equitably represent Alberta. The fixed costs paid by the average household were assigned as the fixed costs for each household. The variable costs were determined by using the differences between each quintile's annual expenditure on residential fuel minus the fixed cost of residential fuel. Table 3 displays each quintile's fixed and variable costs in dollars and as a percentage of their annual expenditure on residential fuel.

Table 3: Fixed and variable costs of residential fuel bills by income quintile (2013)

	1st	2nd	3rd	4th	5th
Annual expenditures	$553	$817	$1,079	$1,095	$1,384
Fixed costs ($)	$475	$475	$475	$475	$475
Fixed costs (%)	85.9%	58.1%	44.0%	43.4%	34.3%
Variable costs ($)	$78	$342	$604	$620	$909
Variable costs (%)	14.1%	41.9%	56.0%	56.6%	65.7%

Source: Author's calculations using Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Calculating the increase to the cost of residential fuel using the same fixed costs ($475) for each quintile means that the lowest quintiles have the highest fixed costs as a percentage of their bill. This is to be expected, as the lowest quintiles have the lowest annual expenditures on residential fuel. But Table 3 shows that the average lowest-quintile household's residential bill is 86 per cent fixed costs, a very high amount. Potential reasons for this is that households in this quintile underreported their spending on natural gas or that some households have very small or no natural gas bills. Regardless, separating fixed and variable costs on energy bills allows for a

more accurate estimate of the impact of a carbon tax than if it were assumed that an increase to the cost of residential fuel would lead to an equal increase to residential fuel bills.

Having determined the variable costs for electricity and residential fuel, the next step is to calculate the increase to each quintile's expenditures resulting from the carbon tax. The cost increases to each of the three energy categories were then summed to find the total direct costs of the carbon tax. Tables 4.1 through 4.5 show the total direct costs to each income quintile and break down the costs by type of energy purchase.

Table 4.1: Annual cost of carbon tax to lowest-quintile households by energy type

Lowest quintile		Residential fuel	Road transportation	Electricity	Total energy expenditure	Total household expenditure (less income taxes)
Annual Household Expenditures		$553	$1,470	$809	$2,832	$42,778
$20 per tonne	Cost increase	$15	$58	$48.51	$122	
	Per cent increase	2.8%	4.0%	6.0%	4.3%	0.3%
$30 per tonne	Cost increase	$23	$88	$72.76	$183	
	Per cent increase	4.1%	6.0%	9.0%	6.5%	0.4%

Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Table 4.2: Annual cost of carbon tax to second-quintile households by energy type

Second quintile		Residential fuel	Road transportation	Electricity	Total energy expenditure	Total household expenditure (less income taxes)
Annual household expenditures		$817	$2,578	$1,122	$4,517	$60,488
$20 per tonne	Cost increase	$67	$102	$85.79	$255	
	Per cent increase	8.2%	4.0%	7.6%	5.6%	0.4%
$30 per tonne	Cost increase	$100	$153	$128.69	$382	
	Per cent increase	12.3%	5.9%	11.5%	8.5%	0.6%

Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Table 4.3: Annual cost of carbon tax to third-quintile households by energy type

Third quintile		Residential fuel	Road transportation	Electricity	Total energy expenditure	Total household expenditure (less income taxes)
Annual household expenditures		$1,079	$2,778	$1,441	$5,298	$73,761
$20 per tonne	Cost increase	$118.01	$110	$123.71	$352	
	Per cent increase	10.9%	4.0%	8.6%	6.6%	0.5%
$30 per tonne	Cost increase	$177.02	$165	$185.57	$528	
	Per cent increase	16.4%	6.0%	12.9%	10.0%	0.7%

Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Table 4.4: Annual cost of carbon tax to fourth-quintile households by energy type

Fourth quintile		Residential fuel	Road transportation	Electricity	Total energy expenditure	Total household expenditure (less income taxes)
Annual household expenditures		$1,095	$2,667	$1,543	$5,305	$93,591
$20 per tonne	Cost increase	$99	$106	$135.88	$341	
	Per cent increase	9.0%	4.0%	8.8%	6.4%	0.4%
$30 per tonne	Cost increase	$149	$159	$203.82	$511	
	Per cent increase	13.6%	6.0%	13.2%	9.6%	0.5%

Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Table 4.5: Annual cost of carbon tax to highest-quintile households by energy type

Highest quintile		Residential fuel	Road transportation	Electricity	Total energy expenditure	Total household expenditure (less income taxes)
Annual household expenditures		$1,384	$3,860	$1,767	$7,011	$127,866
$20 per tonne	Cost increase	$133	$153	$162.42	$449	
	Per cent increase	9.6%	4.0%	9.2%	6.4%	0.4%
$30 per tonne	Cost increase	$200	$230	$243.64	$673	
	Per cent increase	14.5%	6.0%	13.8%	9.6%	0.5%

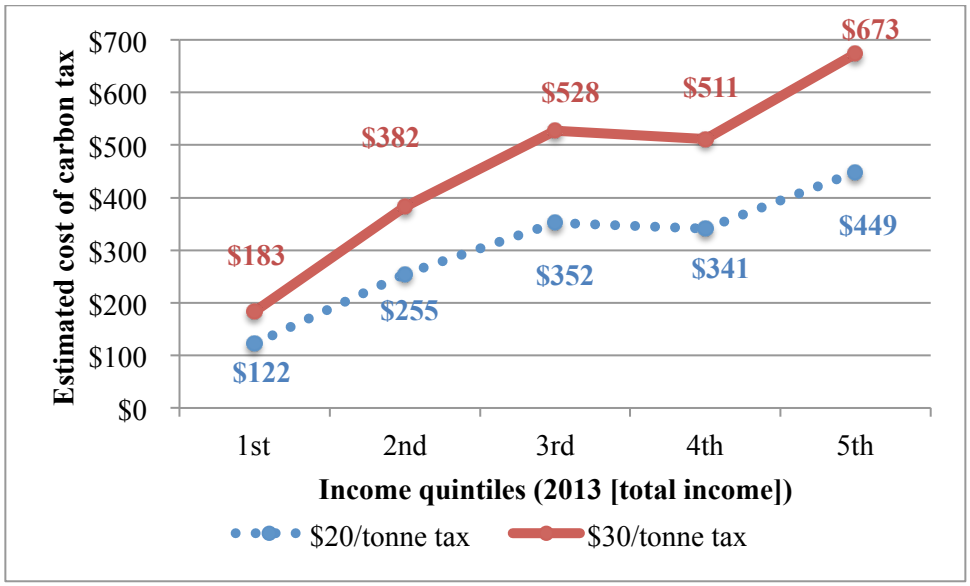
Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

These calculations assume that households' consumption remain unchanged, which is neither accurate nor the intended outcome of the carbon levy. Such an approach is necessary, however, as this study does not have the capacity to accurately predict Albertans's behavioural

change. This approach means that the calculations presented herein will represent an upper boundary to the cost of the carbon levy in a very short-run scenario where households have not adjusted their consumption in response to the tax. This approach to calculating the carbon tax's costs also assumes that fuel suppliers pass on the full cost of the tax to consumers. Making such an assumption is in keeping with the research of Canada's Ecofiscal Commission (2016b) and Rivers (2012) on the incidence of carbon taxes.

Summing the carbon tax's impact as a total cost and a per cent increase, as is done in the two most right-hand columns in Tables 4.1 through 4.5, allows for insight into the relative and absolute impacts of a carbon tax on each income quintile. Figure 2 presents the costs in absolute terms, while Figure 3 displays the costs as a percentage of total household expenditure.

Figure 2: The cost of Alberta's carbon tax to each income quintile



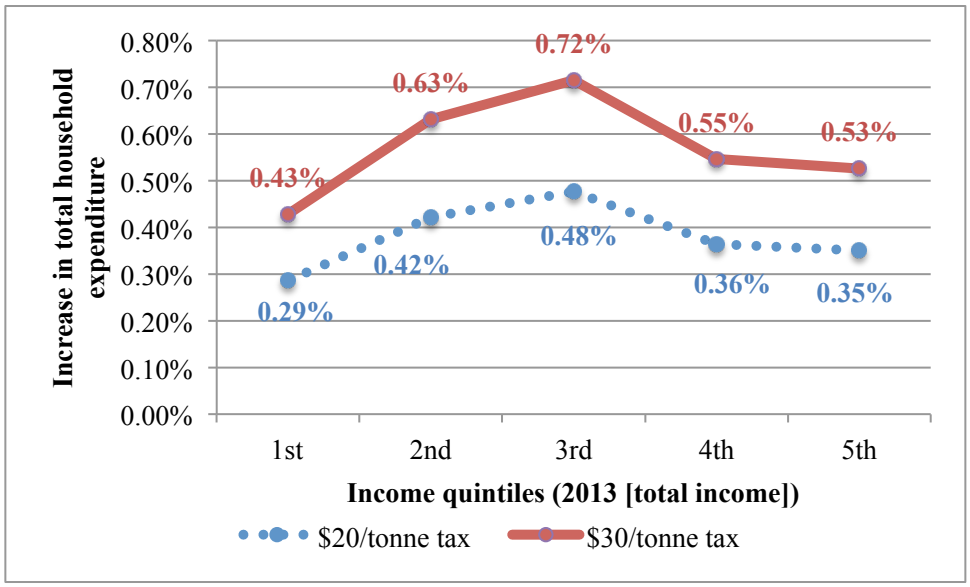
Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Figure 2 shows that there is a positive correlation between the level of income and the estimated costs of the carbon tax. The upward sloping line indicates that higher-income households will face higher costs. Under a $30 per tonne tax, the average highest-quintile household would have to pay an additional $673 per year assuming they maintained their consumption of transportation fuel, home heating fuel and electricity. This cost is significantly higher than the additional $183 per year that the average lowest-quintile household would face. These values indicate that higher-income households will pay more in carbon taxes than lower-income households. As such, the carbon tax would meet the first requirement for vertical equity, where higher earners pay more than lower earners.

In order to meet the second stipulation of vertical equity, higher earners must also pay a higher proportion of their income in carbon tax. This can be determined by comparing each quintile's carbon tax costs to their household income. There are a few ways to measure household income. An obvious measure is current household income, which has been used by many studies assessing the fairness of carbon pricing.[14] A drawback of this approach, however, is that many households have an income that varies year to year. This leads to households with significantly different lifetime earnings being grouped in the same income quintile. Using a household's current expenditure can minimize this issue. Some economists argue that current expenditure better reflects a household's expected lifetime income.[15] Figure 3 below uses this approach, illustrating carbon tax costs relative to total household expenditure.

[14] Canada's Ecofiscal Commission, "Provincial Carbon Pricing and Household Fairness."
[15] Ibid.

Figure 3: Increased energy costs as a per cent of total household expenditure



Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Note: Household expenditure is total expenditure less income taxes.

Figure 3 shows the increased energy costs associated with Alberta's carbon tax relative to household expenditure. The impacts cannot be neatly classified as either regressive or progressive. The figure indicates some regressivity in that the second and third quintiles will face the largest increases to their energy costs. A $30 per tonne carbon tax would increase the total household spending of these quintiles by 0.63 per cent and 0.72 per cent respectively. The fact that the fourth and highest quintiles are less negatively impacted also suggests that the carbon tax is regressive. But the lowest quintile goes against this trend. These households have the smallest increase to their total household expenditure, with a 0.43 per cent increase under a $30 per tonne price. The non-uniform impact of the carbon tax means it cannot be classified by looking at its impact on each quintile. One conclusion that can be drawn is that the carbon tax would not meet

the second stipulation of vertical equity. This is because the second and third quintiles will face a larger tax burden than the fourth and highest quintiles, which have a greater ability to pay.

Insight into the impact on Albertans can also be drawn from the calculations performed by the Government of Alberta. The government's approach is quite different from the calculations presented above, looking only at the carbon tax's impacts on costs of transportation and heating fuels and excluding the impact on the cost of electricity. The provincial government's approach also differs in that it presents carbon tax costs by household size rather than income quintile. The government analysis concludes that the carbon tax would cost the average couple $259 in 2017 and $388 in 2018, and a household consisting of a couple with two children would face increased costs totalling $338 in 2017 and $508 in 2018.[16] It is difficult to directly compare the government's estimates to those presented here due to the different definitions of households. But the government's failure to include increases to electricity costs in their analysis suggests that their estimates will be lower than the real impact on Albertans. This is important because the provincial government's calculated impacts are being used to guide their lump-sum transfer system. If the carbon tax has a larger than anticipated impact on lower-income Albertans, it is likely that the government's carbon rebate will be insufficient to fully offset the negative impact on these households. As such, it is important that this paper compare the test policies' ability to offset the costs determined by both the provincial government and the data presented in the tables and figures above.

This section's estimates of the carbon tax's impact on Albertans provide insight that informs the evaluation of the two test policies. The significant impact to the second and third quintiles means that the ideal policy mechanism will need to provide these quintiles with

[16] Government of Alberta, Carbon levy and rebates.

significant benefits to be able to meet the government's policy goal. The lowest quintile, however, will face smaller energy cost increases, meaning these households will need fewer benefits to be made no worse off under a carbon tax.

Literature review

This section investigates the academic research and grey literature on the use of lump-sum payments and personal income tax cuts as mechanisms for shielding lower-income households from the negative price effects of a carbon tax. To fit with the scope and purpose of this paper, the literature review is limited to research on these two policy mechanisms and how they may operate within the context of Alberta. As such, this section intentionally excludes general research on carbon taxes.

This review is split into three parts. Firstly, the pros and cons of lump-sum payments and PIT cuts are examined. Exploring the advantages of each policy mechanism is important as it will lay the foundation for the subsequent evaluation of the test policies. Secondly, this section will review British Columbia's experience protecting lower-income households through carbon revenue-recycling policies. This examines whether BC's cost-mitigation policies met their policy goals and provides insight on what can be expected from similar policies in Alberta. Finally, the political implications and policymaking considerations of carbon taxes and revenue recycling mechanisms are considered. The research presented within these three sections will provide guidance for this paper and offer a lens through which to view its findings.

Pros and cons of the two policy mechanisms

The literature overwhelmingly finds that PIT cuts are an ineffective tool for reducing the regressive impact of carbon taxes. Canada's Ecofiscal Commission (2016a) examined the

implications of different policies for protecting lower-income households by modelling their impacts on provincial income (in terms of GDP), GHG emissions, business competitiveness and household budgets. The study focused on the equity impacts of a $30 per tonne Albertan carbon tax to each income quintile. The authors found that PIT cuts, even when they target lower-income households, are ill-suited to overcoming a carbon tax's regressive impacts. Simulating the impact of recycling all of Alberta's carbon tax revenue into PIT cuts to the lowest income bracket was found to partially compensate lower-income households, yet the lowest and second quintiles would still be made worse off under a carbon tax.[17] These PIT cuts are thus unable to fully protect lower-income Albertans from a carbon tax.

Williams et al. (2015) also reach this conclusion from evaluating cost-mitigation policies combined with an economy-wide $30 per tonne carbon tax on all fossil-fuel-related CO_2 emissions, using a general equilibrium model of the United States' economy. The PIT cuts and carbon tax resulted in a net decrease to the income (after taxes and transfers) of every quintile. Because the bottom-three quintiles are still worse off after the benefits of the PIT cuts, it can be concluded that Williams et al.'s PIT cut mechanism is unable to fully protect lower-income households from the carbon tax's costs.[18]

Many studies go further than saying that PIT cuts do not provide lower-income households the desired benefits, claiming they have the counterproductive effect of benefitting high-income earners more than low-income earners. Research finds that PIT cuts exacerbate the regressiveness of a carbon tax, rather than reducing the impact on lower-income households. PIT cuts were found to be regressive by Beck et al. (2015) in their analysis of British Columbia. The

[17] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues," (2016), http://ecofiscal.ca/reports/choose-wisely-options-trade-offs-recycling-carbon-pricing-revenues/.
[18] Robert C. Williams III et al., "The Initial Incidence of a Carbon Tax Across Income Groups," *National Tax Journal* 68, no. 1 (2015): 207.

research of Canada's Ecofiscal Commission (2016a) also finds that lowest-income households benefit the least from PIT cuts. Why is it that PIT cuts tend to benefit higher-earners most even when they are designed to benefit low-income households?

The academic and grey literature find two reasons that PIT cuts, even when targeting low-income households, have the effect of benefitting high-income earners more than low-income earners (Lee, 2013; Canada's Ecofiscal Commission, 2016a; Williams et al. 2015; Beck et al., 2015). Lower-income households are less likely to contain individuals with an income high enough to warrant paying PITs. Paying fewer PITs means that lower-income households are less directly impacted by any change to the PIT rate. As a result, cuts to these taxes will thus have a relatively smaller effect on lower-income households. This outcome is an important consideration for policymakers if they are seeking a mechanism that will reduce regressiveness.

Despite the evidence suggesting that PIT cuts are an ineffective means for providing benefits to lower-income households, the policy mechanism does have an upside. William et al. found that mitigating the costs of a carbon tax with PIT cuts resulted in a reduction to total welfare (defined as the sum of consumer and producer surplus) of only 0.32 per cent. This was less than half the negative impact on total welfare compared to when a carbon tax was used in conjunction with a lump-sum payment mechanism. Other research from both grey and academic literature has also found that PIT cuts have a more positive economic impact than lump-sum payments (Canada's Ecofiscal Commission, 2016a; Beck and Wigle, 2014; Beck et al., 2015). The underlying reason for these benefits is that PIT cuts reduce the distortionary effect of income taxes on the labour market. This conclusion conforms to the economic theory that cutting

existing income taxes can improve the efficiency by which an economy uses labour and capital, leading to improved productivity and economic growth.[19]

Although William et al.'s findings provide insight on the impact of PIT cuts and lump-sum transfers, there are some factors that render their results less relevant to Alberta. Firstly, their analysis is specific to the United States, which differs from Alberta in many ways. There are critical differences between the income distributions, PIT regimes and economic sector compositions of each. Secondly, the mechanisms evaluated by Williams et al. do not specifically target lower-income households, but were applied to all income levels. In particular, the lump-sum transfer provided equal payments to every citizen regardless of age or income level, and the PIT cut was structured so that all households received a constant decrease in their effective marginal tax rate regardless of income.[20] Because the mechanisms examined do not specifically target lower-income households, they will be less progressive. Finally, the mechanisms considered by Williams et al. are funded by 100 per cent of carbon revenues. This is significantly different from the mechanisms examined in this paper, which are funded by approximately 25 per cent of carbon tax revenue, a proportion based on the government's stated allocation of carbon tax revenue.[21]

Despite these drawbacks, Williams et al.'s study provides insight relevant to this paper by quantifying the impacts of lump-sum rebates by income quintile. The authors found the lump-sum rebate was strongly progressive, with the transfer more than offsetting the increased cost of energy goods for the bottom three quintiles.[22] Lump-sum payments were also found to have

[19] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues."
[20] Williams III et al., "The Initial Incidence of a Carbon Tax Across Income Groups," 198.
[21] Government of Alberta, Carbon levy and rebates.
[22] Williams III et al., "The Initial Incidence of a Carbon Tax Across Income Groups," 207.

progressive incidence by Boyce and Riddle (2007) and Beck et al. (2015). The progressive incidence of lump-sum payments makes them an effective policy mechanism for shielding lower-income households from the impact of a carbon tax.

Although lump-sum payments are progressive, they have a drawback. Lump-sum payments are less economically efficient than PIT cuts. Academic research by Williams et al. (2015) and grey research by Beck and Wigle (2014) both found that the use of lump-sum payments meant significantly higher total welfare reductions than when PIT cuts were used. This is because choosing to use lump-sum payments means forgoing the economic efficiency advantage that comes from PIT cuts.[23]

Many of the aforementioned studies simplify their analysis by assuming that policymakers will employ only a single mechanism (Canada's Ecofiscal Commission, 2016a; Williams et al., 2015; Beck and Wigle, 2014). This paper also takes such an approach. Of course, real-world policymakers have the option of using a combination of policies. Taking this approach would mean partial benefits from each policy and may be favourable, as the marginal benefits of each will decline as the amount of resources allocated to it increases (Beck and Wigle, 2014; Williams et al., 2015). Some research asserts that a diversified portfolio of policies may be the best approach for mitigating the cost increases associated with a carbon tax (Beck and Wigle, 2014; Williams et al., 2015). This should be kept in mind when evaluating the conclusions of this paper.

[23] Marisa Beck and Randall Wigle, "Carbon Pricing and Mind the Hissing," *Sustainable Prosperity*, (2014). http://www.sustainableprosperity.ca/carbon-pricing-and-mind-hissing/.

British Columbia's experience

One region that uses multiple policies to offset the impact of its carbon tax is British Columbia. The province uses its carbon revenue to fund lump-sum payments and PIT cuts to lower-income households, a lump-sum payment to rural and northern residents, various business tax cuts and a children's fitness credit.[24] Keeping with the focus of this paper, only BC's lump-sum payments and PIT cuts to low-income households will be considered here.

BC's lump-sum payments are distributed via the Low Income Climate Action Tax Credit. This program gives $115.50 to each adult and $34.50 per child or $115.50 for the first child in a single parent family.[25] The credit is means-tested, beginning to be clawed back when a family's net income exceeds an annually rising threshold of around $33,000 for singles and $38,000 for couples or single parents.[26] British Columbia has also cut its PIT rates for the lowest and second lowest brackets from 5.7 and 8.65 per cent to 5.06 and 7.7 per cent respectively, an 11 per cent cut to both.[27] These cuts apply to individuals earning up to $76,421 per year in 2016, [28] a figure very close to the 2014 median household income in BC of $76,770.[29]

Before analyzing BC's lump-sum transfer and PIT cuts, it is first necessary to determine the impact of the province's carbon tax. The cost of the carbon tax to households across the income distribution will provide a marker by which the policy mechanisms for protecting lower-income households can be measured.

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[24] Government of British Columbia. Ministry of Finance, *Budget and Fiscal Plan: 2015/16- 2017/18* (Victoria: Minister of Finance, 2015), 60.
[25] Government of British Columbia. Low Income Climate Action Tax Credit, accessed on June 28, 2016, http://www2.gov.bc.ca/gov/content/taxes/income-taxes/personal/credits/climate-action/.
[26] Ibid.
[27] Government of British Columbia, Tax Rates, accessed on August 4, 2016, http://www2.gov.bc.ca/gov/content/taxes/income-taxes/personal/tax-rates/.
[28] Ibid.
[29] Statistics Canada, CANSIM Table 111-0009, accessed on June 28, 2016, http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/famil108a-eng.htm/.

The literature draws contradictory conclusions on whether BC's carbon tax is regressive or progressive. These differing conclusions result from researchers taking two different approaches when quantifying the carbon tax's cost to households. One approach is to only consider the spending-side effect of the carbon tax and policies for mitigating energy cost increases. The spending-side effect is the change to a household's ability to consume resulting from a change to their income. In the case of a carbon tax, the spending-side effect would be the net impact of higher energy costs. Using such an approach in conjunction with Statistics Canada's SPSD/M program, Lee (2013) concludes that BC's carbon tax is regressive.[30]

Beck et al. (2015) argue that Lee's analysis is missing an important factor – the income-side effects. In the context of a carbon tax and policies for mitigating cost increases, the income-side effect is the impact of the cost-mitigation policies on a household's ability to consume. Beck et al. (2015) look at both the income-side and spending-side effects separately and then combine them to find the net impact of BC's carbon tax and cost-mitigation policies.

The authors find that the spending-side effect is slightly regressive because low-income households have higher energy expenditures as a share of their income. The spending-side effects are only slightly regressive because BC's electricity system has low carbon intensity. As BC's electricity is primarily generated from hydropower, a carbon tax will increase the cost of electricity less than it would in a jurisdiction with a carbon-intensive electricity system like Alberta. Albertan policymakers should thus expect greater regressive spending-side effects from a carbon tax than were experienced by BC.

[30] Marc Lee, "Fair and effective carbon pricing," *Canadian Centre for Policy Alternatives and the Sierra Club,* (2013), https://www.policyalternatives.ca/publications/reports/fair-and-effective-carbon-pricing/.

Beck et al. next look at the income-side effects of BC's cost-mitigation policies, which they find to be progressive. This is primarily because of the design of the lump-sum transfer system. BC's carbon rebate provides targeted benefits to low-income households, resulting in the policy having a progressive incidence. In the BC context, this means the income-side effects of the carbon tax are progressive.[31]

The authors find that the progressive income-side effects dominate the regressive spending-side effects, resulting in the overall impact of BC's carbon tax and cost-mitigation having a progressive incidence. This finding is aligned with other studies that consider spending-side and income-side effects and concludes that the net effects of carbon taxes and cost-mitigation polices are progressive (Rausch, Metcalf, Reilly, and Paltsev, 2010; Metcalf, Mathur, and Hassett, 2010; Dissou and Siddiqui, 2014; Canada's Ecofiscal Commission, 2016b).

Understanding Beck et al.'s assertion that BC's cost-mitigation policies have a progressive impact requires looking at the province's PIT cuts and carbon rebate system individually. Regardless of whether BC's carbon tax is actually regressive, the province uses cost-mitigation policies to address the perceived equality concerns.[32] Research on how these mechanisms have worked in BC provides insight on how they might function in Alberta.

BC's PIT cuts have been found to provide very little benefit to low-income households.[33] Research performed by Lee finds that rather than protect lower-income households, the PIT cuts actually make the carbon tax more regressive. This can be seen by comparing the PIT cuts'

[31] Marisa Beck et al., ""Carbon Tax and Revenue Recycling: Impacts on Households in British Columbia," *Resource and Energy Economics*, Vol. 41 (2015), http://ssrn.com/abstract=2492766/.
[32] Government of British Columbia, Low Income Climate Action Tax Credit.
[33] Marc Lee, "Fair and effective carbon pricing," 17.

benefit to the lowest quintile ($5) with their benefit to the highest quintile ($243).[34] Lee's calculations of BC's PIT cuts match the large amount of research that finds that PIT cuts benefit high-income earners more than low-income earners (Canada's Ecofiscal Commission, 2016; Williams et al. 2015; Beck et al., 2015).

BC's lump-sum transfer system has been found to have a quite different impact. Lee's (2013) research concluded two things about the policy mechanism. Firstly, the lump-sum payment provides lower-income British Columbians with significantly larger benefits than the PIT cuts. Secondly, the lump-sum transfer benefits lower-income households more than higher-income households. This allows us to conclude that BC's lump-sum transfer has a progressive incidence. This progressive income-side effect offers lower-income households some protection from the cost of the carbon tax.

When the benefits are compared to the costs of the carbon tax, however, Lee finds that the net impact of the carbon tax and cost-mitigation policies is regressive.[35] He argues that the regressive incidence of the spending-side effect dominates the progressive incidence of the cost-mitigation policies.[36]

Beck et al. (2015) echoes Lee's conclusions on the effects of BC's lump-sum transfer and PIT cuts. The authors find that the lump-sum transfer has a progressive incidence, providing significant benefits to the lowest-two income quintiles. They find the PIT cuts are regressive, providing more benefits to wealthier households and thus mitigating the progressiveness of the policies. Overall, the progressiveness of the lump-sum transfer is found to dominate the regressiveness of the PIT cuts, resulting in the combined effect of the policies being progressive.

[34] Ibid.
[35] Ibid., 18.
[36] Ibid., 16.

Political considerations

A government implementing a carbon tax and cost-mitigation policies will be interested in the impact it will have on their re-election. This section will highlight the political ramifications of introducing a carbon tax and revenue recycling (including cost-mitigation) policies by looking at the existing academic and grey literature on the subject. Important considerations include the carbon tax's impact on lower-income voters and the political feasibility of cost-mitigation policies. This section will first discuss whether carbon tax revenue differs from other government revenue. Secondly, it will look at the options policymakers have for spending carbon tax revenue. Next, the most important factors contributing to public acceptance will be explored. Finally, the political considerations of implementing PIT cuts and lump-sum transfers will be analyzed. The findings of this section will provide policymakers with insight on how PIT cuts and lump-sum transfer systems may influence the durability and public support for a carbon tax.

Revenue generated by carbon pricing is not inherently different than any other government revenue. A government can spend the money in any manner they want. What governments often choose to do, however, is to create a ring-fence around revenue from carbon pricing. This is done by declaring rules in the form of promises or laws for how the revenue will be used. This gives carbon revenue the superficial appearance of being distinct from other government revenues. But deciding how to spend carbon tax revenue is entirely up to the government's discretion. This brings us to the topic of our next section, which looks at the many options for spending carbon revenue.

The first step in deciding how to spend carbon revenue is to understand the government's priorities and the context in which the policies are being implemented. Canada's Ecofiscal

Commission (2016a) and Beck and Wigle (2014) both make this point, emphasizing the need for policymakers to consider their jurisdictional context and choose the mechanism(s) that will best allow the government to meet its policy and political priorities. Beck and Wigle (2014) assert that the factors to be considered include public attitude (What do they consider fair? What would increase their acceptance?), fiscal budget (Should money be allocated towards other priorities?), existing economic inefficiencies and tax distortions (Are corporate or personal taxes too high?) and whether there are concrete opportunities for technological innovation (Would research spending yield significant improvements?). The authors also argue that policymakers should consider any productivity challenges or potential opportunities that could be addressed by funding general productivity-enhancing measures (i.e. infrastructure or education). The differences between the political contexts may lead one government to prioritise public acceptance, while another government may choose an approach that will yield the greatest total emissions reduction.

Once policymakers have determined their most important priorities, they must identify the policy mechanisms that are best suited to achieving their desired results. Beck and Wigle (2014) and Canada's Ecofiscal Commission (2016a) assert that there are generally four general revenue recycling mechanisms: (1) reducing existing taxes, (2) investing in low-carbon technology/infrastructure, (3) redistributive measures, and (4) general productivity measures like education and debt reduction. Choosing the right mechanism(s) is a difficult task as each has its own pros and cons. Beck and Wigle assert that the benefits and drawbacks of each policy can be evaluated based on three factors: (1) economic efficiency, (2) emissions reduction and (3) public acceptability. Trade-offs exist amongst the four revenue-recycling mechanisms and three policy objectives. Baylin-Stern (2015) uses a table to show the interplay between the mechanisms and

objectives, which has been reproduced as Table 5 below. An upward arrow denotes a positive impact on a given policy objective, a downward arrow denotes a negative impact, and a question mark means that the influence is uncertain due to too many interacting effects or regional variability.

Table 5: Interplay between policy objectives and carbon revenue options

Objectives / Options	Economic Efficiency	Emission Reductions	Public Acceptability
Reduce existing taxes	↑	?	↑
Invest in low-carbon technology/infrastructure	↑	↑	?
Spend on redistributive measures	?	↓	↑
Target spending to general productivity measures	↑	?	?

Source: Adam Baylin-Stern, "How to maximize value: Options for allocating carbon pricing revenue," Sustainable Prosperity (blog), September 8, 2015, http://www.sustainableprosperity.ca/node/1849/.

This table shows the strengths and weaknesses of the four approaches to spending carbon revenue. It illustrates that there is no policy option that is right for all jurisdictions as no approach has positive impacts on every policy objective.

Policymakers will be interested in choosing a mechanism that will improve public acceptance of their carbon tax. Beck and Wigle assert that public acceptance is strongly influenced by the public's perception of the policy's fairness. But what does the public believe is fair? Beck and Wigle find that the idea of fairness is primarily based on whom the public believes will be most heavily impacted by the carbon tax. The fairness of a carbon tax will thus differ between jurisdictions. BC's carbon tax experience provides an example of tax fairness.

Beck and Wigle claim that the greatest fairness problems with BC's carbon tax were its regressive impact on lower-income income households and the lack of low-carbon transportation alternatives for rural residents. The BC government likely reached a similar conclusion, as they committed to spending carbon revenue on policies to mitigate these concerns.

Although equity considerations are important, placing too much emphasis on protecting residents from perceived inequalities can detract from the tax's economic efficiency and environmental effectiveness. The research of Peet and Harrison (2012) and the grey research of Clean Energy Canada (2015) both found that BC's revenue allocation policies were greatly influenced by the public's perception of the tax's winners and losers – rather than by actual evidence. The influence of the public's perception of fairness is particularly evident in the government's decision to provide transfers to northern and rural households. Clean Energy Canada found that strong criticism of the carbon tax from rural residents was influential in the government's decision to provide these households with a rebate, despite a government official saying that government analysis showed they were not made any worse off than other residents. This case illustrates that policymakers must be careful to not overemphasize public acceptance at the expense of economic efficiency and environmental effectiveness.

Transparency is another factor that influences public acceptance of a carbon tax. This requires policymakers to clearly communicate how revenue will be spent. Ring-fencing carbon tax revenue is one way to explain this to voters. The emphasis that the BC government placed on transparency contributed to the strong public support for their carbon tax. In their efforts to convince the public that the carbon tax would be revenue neutral, BC's *Carbon Tax Act* (2008) included a stipulation that the Minister of Finance must forfeit 15 per cent of their annual salary if the government fails to ensure the carbon tax is revenue neutral. The Australian carbon tax is a

contrasting example. This government's poor communication of their revenue recycling plans was one factor contributing to the carbon tax's poor reception and subsequent repeal.[37]

There are conflicting claims made in the literature regarding the influence of revenue neutrality on public acceptance. Amdur et al. (2014) conclude that revenue-neutral approaches elicit the most support from the public. Beck and Wigle (2014) conclude that European countries' experience with carbon pricing schemes shows that revenue neutrality is essential to achieving public support. But Beck and Wigle also acknowledge the finding of Dresner et al. (2006) that public understanding of revenue neutrality is poor and thus revenue neutrality may not be the best tactic for building public support. Clean Energy Canada (2015) also finds that revenue neutrality has a mixed impact on public support. Looking at BC's experience, the authors found that revenue neutrality reduced opposition to the carbon tax, particularly from the private sector. The authors also found, however, that many voters had difficulty understanding revenue neutrality, often considering the carbon tax to be a new source of government revenue. Further insight on the opinion of Canadian voters of can be gained from the work of polling firm Abacus Data (2015), which found revenue neutrality the second-most popular revenue-recycling option after investments in infrastructure and clean technology.[38] Revenue neutrality scored better than lump-sum transfers or debt reduction. These findings show that revenue neutrality can strengthen public support but should not be presumed to be voters' favoured approach.

[37] Margaret Wente, "Why Australia's carbon tax bombed," *Globe and Mail,* July 22, 2014, http://www.theglobeandmail.com/opinion/why-australias-carbon-tax-bombed/article19704906/.
[38] Abacus Data, Study of Canadian public opinion on carbon pricing, accessed on August 16, 2016, http://abacusdata.ca/new-poll-most-canadians-support-with-qualifications-carbon-pricing/.

Lump-sum payments have the political benefit of being highly visible and providing clear and tangible benefits.[39] This makes it easier for governments to communicate the policy and helps the public understand its benefits. Although the visibility of lump-sum payments can be a strength, it can also lead to this mechanism being seen negatively by the public. According to Harrison (2013) the one-time "Climate Action Dividend" used by the BC Government was seen by many voters as a cynical attempt to buy support for the carbon tax. Thus a government should be wary of how their lump-sum transfers are perceived by the public. The public can also misconstrue lump-sum transfers as defeating the purpose of the carbon tax. A question often asked of BC policymakers was that if someone gets their increased energy costs returned via lump-sum transfers leaving them no worse off, what is their motivation to reduce their consumption?[40] This is a question that a government should anticipate having to answer.

PIT cuts provide a benefit to policymakers not through public support but by contributing to the durability of a carbon tax. Harrison (2013) credits BC's PIT cuts with helping to lock in the province's carbon tax. This is because repealing the carbon tax would likely force the government into reversing the PIT cuts, effectively raising PIT rates on lower-income households. Such a move would likely be politically unpopular.

A drawback of PIT cuts in terms of public acceptability is that they are not highly visible. This makes it more difficult for voters to quantify and appreciate their benefit. Insight can be gained from Former BC Environment Minister Mary Polak who, speaking about the ability of

[39] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues."
[40] Clean Energy Canada, "How to Adopt a Winning Carbon Price," (2015), http://cleanenergycanada.org/wp-content/uploads/2015/02/Clean-Energy-Canada-How-to-Adopt-a-Winning-Carbon-Price-2015.pdf/.

PIT cuts to increase public acceptance, said that PIT cuts were not memorable enough to voters.[41]

Evaluation of test policies

Having examined how Alberta's carbon tax will impact households and evaluated the literature on cost-mitigation policies, the next step is to evaluate the ability of these cost-mitigation policies to provide benefits to lower-income Albertans. This section will evaluate two mechanisms: a lump-sum transfer system and personal income tax cuts. These two policies were chosen for a few reasons. Firstly, both policies can be tailored to provide benefits that target lower-income households. This is important because the Government of Alberta's policy goal is to protect these Albertans. Secondly, these test policies can be assessed in a straightforward and transparent manner. The benefits of each policy can be measured in the dollars they provide to a household. This allows for an uncomplicated prediction of who will benefit and by how much. Alternative policy approaches, such as spending on clean technology, infrastructure improvements or debt reduction, offer benefits that are much more difficult to predict, especially across different income-groups. As this paper intends to provide insight on the distributive impacts of carbon revenue recycling across the income distribution, it will only consider the two mechanisms with impacts that can be accurately assigned to each income quintile.

The first policy to be assessed is the approach that will be used in Alberta: a lump-sum transfer. The Government of Alberta has passed Bill 20, the *Climate Leadership Implementation Act*, introducing a transfer system called a carbon rebate. Lower-income households will receive a payment based on the number and ages of people within the household and their level of

[41] Ibid.

income. The government's rebate schedule is such that higher-income households will not receive a rebate. It will cost the government $2.3B of the estimated $9.6B raised by the carbon tax in the first five years of its existence.[42]

The second policy assessed is a reduction to the personal income tax rate on the lowest tax bracket. This cut will allow working Albertans to pay fewer taxes while also reducing the distortionary effect of income taxes on the labour market. The benefits to Albertans of this policy will be calculated using Statistics Canada's SPSD/M software to model changes to the province's PIT system and the subsequent redistributive effects on households of all income levels.

The primary goal of this section is to determine which policy is better suited to protecting lower-income Albertans from the costs of the province's carbon tax. It is thus necessary to directly compare the policy mechanisms with the costs of Alberta's carbon tax, which were calculated in the previous section. The mechanism that is best able to reimburse the bottom-three incomes quintiles their carbon tax costs will be deemed the superior policy approach. The findings of this evaluation are dependent on these goals. If an alternative goal such as making all Albertans no worse off was the basis of this evaluation, the policies' rankings may not be the same.

Lump-sum transfers

Evaluating Alberta's carbon rebate policy is a three-step process. The first part of this subsection will present the rebate parameters set by the government. Secondly, data on the income and composition of households in the bottom three quintiles will be used to estimate who will be eligible for a rebate. The bottom three quintiles will be focused on as the government's

[42] Government of Alberta, Carbon levy and rebates.

rebate schedule is such that higher-income Albertans will not receive a rebate and this is an analysis of the announced policy. Lastly, the data on household composition and income will be combined with the rebate parameters in order to generate estimates of who will receive rebates and for how much. Completing these three steps will make it possible to achieve the primary goal of this subsection, which is to determine the capacity of Alberta's lump-sum rebate system to protect lower-income households from a carbon tax. This approach also brings the secondary benefit of being able to assess the feasibility of the government's promise that 60 per cent of households will receive a full lump-sum transfer, with a further six per cent receiving a partial rebate.

There are two factors that determine whether a household is eligible for a rebate. The first factor is the number and ages of the persons composing the household. Households will receive funds for each person in the household, with no limit on the number of adults and up to a maximum of four children. Single-parent families will be able to claim the spousal amount for one child. The second factor that determines a household's rebate is the family's net income. The government defines this as a family's income before taxes but minus deductions for CPP, RRSPs, union dues and expenses from child care and moving.[43] The system is designed so that rebates primarily go to lower-income households; no household earning more than $103,000 in 2017 is eligible to receive a rebate. Generally speaking, the higher a household's income, the less likely they are to benefit from the lump-sum transfer. Table 6 below presents the rebate parameters in greater detail.

[43] Government of Alberta, Alberta Family Employment Tax Credit, accessed on August 16, 2016, http://www.alberta.ca/alberta-family-employment-tax-credit.cfm/.

Table 6: Government of Alberta carbon tax rebate schedule

	2017	2018
Benefit Amounts		
First adult	$200	$300
Spouse/Equivalent to spouse	$100	$150
Child (max. 4)	$30	$45
Phase-out Thresholds (Family Net Income)		
Single	$47,500	$47,500
Couple	$95,000	$95,000
Families	$95,000	$95,000
Income at which rebate is fully phased out (Family net income)		
Single	$51,250	$55,000
Couple	$100,000	$103,750
Couple with 2 children	$101,500	$106,000
Couple with 4 children	$103,000	$108,250

Source: Government of Alberta, Carbon levy and rebates, accessed on July 16, 2016, http://www.alberta.ca/climate-carbon-pricing.cfm.

It is possible to get an idea of who will benefit from the rebate by comparing the parameters above with total income data by quintile. This information can be estimated using the Social Policy Simulation Database Model (SPSD/M). Developed by Statistics Canada, SPSD/M is a statistically representative database capable of computing an individual or family's taxes paid and transfers received from the provincial and federal governments. Table 7 shows the income cut-off points for each quintile using SPSD/M data.

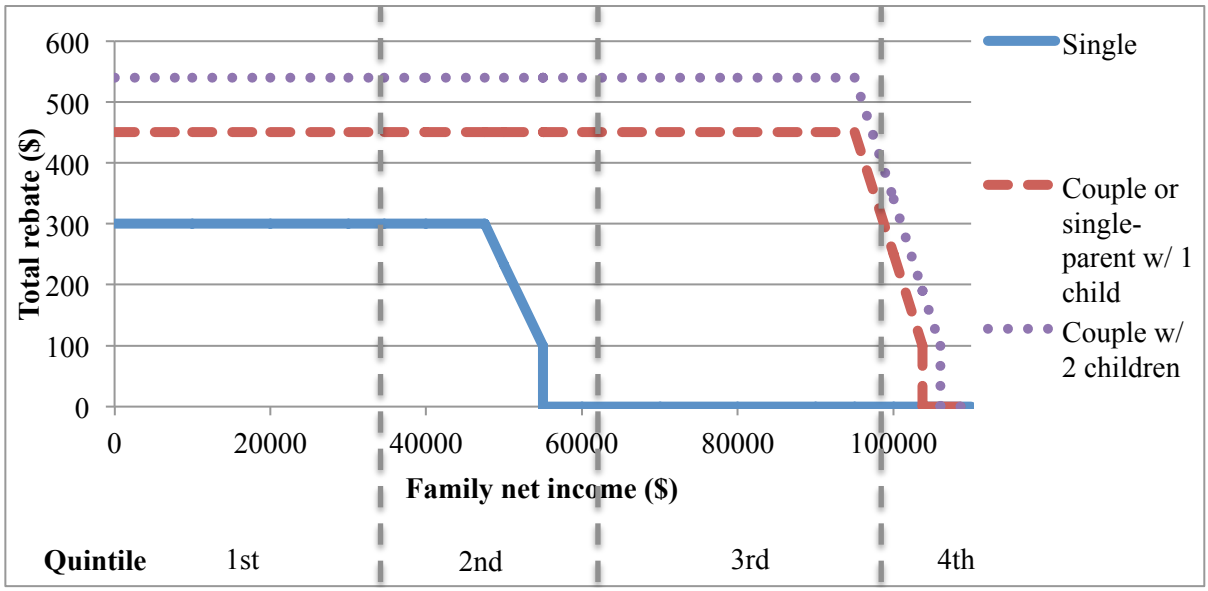
Table 7: Total Income data by quintile (2017)

Quintile	Minimum Income	Maximum income	Avg. total income
1st	$0	$34,655	$21,706
2nd	$34,656	$62,553	$47,245
3rd	$62,554	$97,998	$79,624
4th	$97,999	$154,752	$123,642
5th	$154,753	Max.	$282,127

Source: Author's calculations using SPSD/M.

Figure 4 below combines the information in Tables 6 and 7 in a way that illustrates the rebate for which various family types from each quintile would be eligible. The downward sloping section of each line reflects the rebates' phase-out and the point at which the slope becomes a vertical line shows the $100 minimum payment to eligible households that the government has included in the rebate parameters. The income range of each quintile is shown using dashed vertical lines.

Figure 4: Alberta's carbon rebate benefits by income and family type (2018)



Source: Government of Alberta, *Fiscal Plan 2016-19* (Edmonton: Minister of Finance, 2016), 97; author's calculations using SPSD/M.

Figure 4 includes income quintile cut-off points to show which quintiles benefit most from the rebates. The graphic shows that every non-single household in the lowest-three quintiles will receive at least a partial rebate. Rebates to these households begin to be phased out very close to the cut-off point between the third and fourth quintiles, leaving only a small portion of the fourth quintile eligible for only a partial rebate. Because the fourth and fifth quintiles are nearly entirely excluded from the rebates, these quintiles will be largely omitted from the following analysis of the rebates' distributional impact.

Figure 4 provides only a rough estimate of who is eligible for the rebates. A superior approach is to look at the composition and income of households in each quintile. Data on both of these factors are available from SPSD/M. The following analysis uses the first year of Alberta's carbon tax, 2017, as the base year.

Table 8 shows the percentage of every family type within Alberta's lowest income quintile. The data show that 75 per cent of households in the lowest quintile are single-person households. The second-largest group are couples without children, comprising 10.6 per cent of the quintile. It is also possible to determine that this quintile is 2.1 per cent single-parent families with one child, 2.4 per cent single-parent families with two children and so on.

Table 8: Composition of households in the lowest income quintile (2017)

		Number of children					
		0	1	2	3	4	5
Number of adults	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	1	75.0%	2.1%	2.4%	0.5%	0.0%	0.0%
	2	10.6%	3.2%	1.6%	1.1%	0.4%	0.3%
	3	1.2%	0.4%	0.0%	0.0%	0.0%	0.0%
	4	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Author's calculations using SPSD/M.

Note: Numbers may not sum to 100 per cent due to rounding.

This data on household composition combined with the government's rebate parameters makes it possible to estimate the quintile's average potential carbon rebate. We know, for example, that a couple with one child will be eligible for a potential rebate of $330 in 2017. The potential rebate size for each family type multiplied by the percentage of households with that composition yields a weighted rebate. The products of these calculations for the entire quintile can be summed to find a weighted average rebate for the entire quintile. Table 9 shows the results of these calculations. The result is that the average lowest quintile household will potentially receive a carbon rebate of $236 in 2017. Similar calculations using the rebate parameters for 2018 show that the quintile's average 2018 rebate is $355.

Table 9: Weighted average rebate for the lowest quintile (2017)

		Number of children					
		0	1	2	3	4	5
Number of adults	0						
	1	$150.07	$6.24	$8.07	$1.80		
	2	$31.81	$10.68	$5.78	$4.41	$1.66	$1.44
	3	$6.18	$2.37				
	4	$5.84					
			Quintile's average rebate 2017: $236.34				

Source: Author's calculations using SPSD/M.

The estimated rebate of $236 per household is only considered a potential rebate as the calculations have thus far ignored whether households' income is above or below the threshold at which the rebate is clawed back. This consideration can be added to the calculation by referring to the income data for each quintile in Table 7. The table shows that the lowest quintile's upper income limit is $34,655. This is below the point at which the rebate begins being clawed back. It can thus be concluded that every household in the lowest quintile will receive a full rebate.

Second-quintile households' potential rebate can be estimated by repeating the calculations presented in Tables 8 and 9 above with the appropriate second-quintile data. These calculations are presented below as Tables 10 and 11.

Table 10: Composition of households in the second quintile (2017)

		Number of children						
		0	1	2	3	4	5	6
Number of adults	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	1	47.1%	3.3%	1.0%	0.5%	0.1%	0.0%	0.2%
	2	34.2%	4.0%	3.1%	0.7%	1.8%	0.9%	0.0%
	3	1.8%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	4	0.0%	0.0%	0.03%	0.0%	0.0%	0.0%	0.0%

Source: Author's calculations using SPSD/M.

Note: Numbers may not sum to 100 per cent due to rounding.

Table 11: Weighted average rebate for the second quintile (2017)

		Number of children						
		0	1	2	3	4	5	6
Number of adults	0							
	1	$94.25	$9.92	$3.46	$1.89	$0.51		$0.88
	2	$102.57	$13.25	$11.15	$2.56	$7.49	$3.64	
	3	$8.92	$6.26					
	4			$0.17				
				Quintile's average rebate 2017: $266.93				

Source: Author's calculations using SPSD/M.

The household composition data in Table 10 show that single-person households are again the most common type of household, making up 47 per cent of households in the quintile. The second-largest family type is couples without children, which make up 34 per cent of households. Alberta's carbon rebate system pays considerably more to couples than to singles, which is the primary reason that the average second quintile household has a larger potential rebate than the first quintile. The calculations in Table 11 show the average second quintile household can expect a rebate of $267 in 2017 and $401 in 2018.

Table 7 shows that the second quintile's upper income limit is $62,553. This is above the threshold at which the rebate is fully phased out for singles, which has been set at $51,250 in 2017 and $55,000 in 2018. As a result, some second-quintile singles will receive only a partial rebate or none at all, depending on their incomes. Assuming that incomes are equally distributed within the income limits, it can be estimated that 27 per cent of singles will receive a partial rebate and a further 27 per cent of singles will be ineligible. When the second quintile is viewed as a whole, 75 per cent of households will receive a full rebate with the remaining quarter split evenly between households receiving either partial rebates or none at all. Only singles in this quintile are affected, as the thresholds at which the rebate is phased out for other family types are above the second quintile's upper income limit.

Table 12 shows that the composition of the third quintile has even fewer single-person households, with only 38 per cent of the quintile this family type. There are more children in this quintile than the lowest two. Twenty-four per cent of third-quintile households have one or more children, while only 12 and 17 per cent of households have children in the lowest and second quintiles respectively. This contributes to the third quintile potentially receiving rebates higher than the other two quintiles.

Table 12: Composition of households in the third quintile (2017)

		Number of children					
		0	1	2	3	4	5
Number of adults	0	0%	0%	0%	0%	0%	0%
	1	38.1%	1.7%	0.6%	0%	0%	0%
	2	31.3%	5.1%	8.6%	2.2%	1.5%	0.2%
	3	5.9%	1.2%	0.7%	0.3%	0%	0%
	4	0.9%	0.9%	0.7%	0.2%	0%	0%
	5	0%	0%	0%	0%	0%	0%

Source: Author's calculations using SPSD/M.

Note: Numbers may not sum to 100 per cent due to rounding.

The household compositions shown in Table 12 are used to create the weighted average rebate, presented in Table 13. The data show that the average third-quintile household will be eligible for a $299 rebate in 2017 and a $449 rebate in 2018.

Table 13: Weighted average rebate for the third quintile (2017)

		Number of children					
		0	1	2	3	4	5
Number of adults	0						
	1	$76.15	$5.14	$1.91			
	2	$93.75	$16.70	$31.11	$8.63	$6.42	$0.66
	3	$29.64	$6.42	$3.69	$1.71		
	4	$5.53	$5.81	$4.52	$1.27		
				Quintile's average rebate 2017: $299.09			

Source: Author's calculations using SPSD/M.

As was previously mentioned, the threshold at which the rebate is fully phased out for singles is $51,250 in 2017. This value is below the lower income limit for the third quintile. It can thus be concluded that all singles in the third quintile will be ineligible for a rebate. As this

quintile is 38 per cent composed of singles, this means a significant number of third-quintile households will not receive a rebate.

Some non-singles in the third quintile will also face claw-backs. Table 7 shows that the upper income limit for the third quintile is $97,998. With the threshold at which the rebates begin being clawed back for couples and families set at $95,000, it can be concluded that third-quintile households with an income between these two figures will receive only a partial rebate. But because the point at which the rebate is fully phased out for these households is above the quintile's upper income limit, all non-single third-quintile households will receive at least a partial rebate. None will be ineligible.

Assuming equal distribution of incomes between the quintile's lower and upper income limits, seven per cent of non-single families in the third-quintile families will receive a partial rebate. The remaining 93 per cent will receive a full rebate. Combining these estimates for non-single households with the previous calculation that no singles in the quintile will receive a rebate, it can be concluded that about 58 per cent of the third quintile will receive a full rebate. Four per cent will receive a partial rebate and 38 per cent will receive no rebate.

No fourth-quintile households will be eligible for a full rebate, although a small number will receive a partial rebate. Based on SPSD/M data on the number of non-single households in this quintile, about seven per cent of fourth-quintile households will receive a partial rebate. Highest-quintile households have incomes well above the point at which rebates are phased out for all households, meaning that no households in this quintile will be eligible for any rebate.

The weighted-average rebates for the lowest-three quintiles are summarized in Table 14 below.

Table 14: Weighted average rebates for lowest-three quintiles (2017 and 2018)

Quintile	2017	2018
1st	$236.34	$354.66
2nd	$266.93	$400.78
3rd	$299.09	$448.71

Source: Author's calculations using SPSD/M.

Having estimated the number of households in each quintile that will receive a carbon rebate, the next step is to determine the total number of Albertans that will receive one. The previous calculations found that 100 per cent of lowest-income households will receive a rebate. 87.5 per cent of second-quintile Albertans and 62 per cent of third-quintile Albertans should expect to receive some rebate. Only seven per cent of fourth-quintile Albertans will receive some rebate. All highest-quintile families earn too much to be eligible for a rebate. Using these estimates, it can be predicted that 51 per cent of Albertans will receive a carbon rebate. This is less than the government's prediction that 60 per cent of households will receive a rebate equal to or greater than the average cost of the carbon tax. The government's prediction is even more inaccurate when it is considered that the 51 per cent estimate includes families receiving a partial rebate, which would be as low as $100 to some households. This would be insufficient to cover the average cost of Alberta's carbon tax, leaving these households worse off under a carbon tax. The Government of Alberta is thus overstating the benefits offered by the carbon rebate. Alberta's carbon rebate is unlikely to meet its intended goal of making 60 per cent of Albertans no worse off under a carbon tax.

Personal income tax cuts

Analyzing personal income tax cuts requires a different approach than was used to assess the carbon rebate system. This is because, unlike the lump-sum transfer mechanism, there has been no PIT-cut mechanism proposed by the government on which to base the policy. The alternative PIT system assessed here has been designed for the purposes of this evaluation. It is loosely based on the design of Ontario's PIT system,[44] which features lower tax rates for lower earners. The alternative PIT system that will be evaluated here is constrained by the current amount budgeted for carbon rebates. Making both policy mechanisms equal in cost improves the accuracy of a direct comparison. SPSD/M is used to simulate the distributional impacts of the alternative PIT system on households of all income levels.

The simulation uses the tax brackets for 2017, as this is the year the carbon tax becomes effective. Table 15 below shows Alberta's PIT system as it currently is and the tax rates under the alternative system. It should be noted that Alberta uses a PIT system where the income limits for each tax bracket change annually based on changes to the Consumer Price Index (CPI).[45] This means that the upper limits for each tax bracket are estimates produced by SPSD/M, and the income limits will change in each subsequent year depending on changes to the CPI.

[44] Ontario's current PIT system has a lowest tax bracket with a tax rate of 5.05 per cent on the first $41,536 of taxable income. The rate nearly doubles to 9.15 per cent on subsequent income up to $85,381.
[45] Government of Alberta, Personal Income Tax, accessed on August 16, 2016, http://www.finance.alberta.ca/business/tax_rebates/personal-income-tax/income-tax-credit-indexing.html/.

Table 15: Personal income tax rates in Alberta under the existing and alternative systems (2017)

2017 taxable income	Existing tax rates	Tax rates with PIT cuts
$0-$19,004 (Basic exemption)	0%	0%
Over $19,004 up to $22,000	10%	9%
Over $22,000 up to $127,560		10%
Over $127,5600 up to $153,072	12%	12%
Over $153,072 up to $204,097	13%	13%
Over $204,097 up to $306,145	14%	14%
Over $306,145	15%	15%

Source: Author's calculations using SPSD/M and Government of Alberta, Changes to Personal Income Tax – Questions and Answers, last modified April 2, 2016, http://www.finance.alberta.ca/business/tax_rebates/personal-income-tax/personal-income-tax-questions-and-answers.html/.

Table 15 shows that under the status quo, the lowest tax bracket covers income up to $127,560. This is a wide range that contains a majority of Albertan households. Based on the income data in Table 7, over 70 per cent of Albertan households likely fall within this tax bracket. Having Alberta's lowest earning households in the same income bracket as some fourth-quintile households means that a tax cut on the lowest tax bracket won't necessarily be targeting lower-income households. The alternative PIT system splits the lowest tax bracket, making it possible to cut PITs on a tax bracket that only contains lower-income households. The alternative system introduces a new tax bracket covering only the first $22,000 of taxable income.

The creation of a smaller lowest tax bracket makes it possible to introduce a tax cut that targets lower earners. Income within the new tax bracket will be taxed at nine per cent, a decrease of one percentage point. These cuts attempt to target lower-income earners by only providing benefits to the first $22,000 of income. As the 2017 average market incomes of the

lowest-two quintiles are $11,698 and $36,036, respectively, the cuts should provide these households large benefits.[46] Targeting lower-income households, however, does not guarantee lower-income households will benefit most. In fact, the literature review showed that reducing tax rates on the lowest income brackets provides greater benefits to higher earners. Determining whether this will be true of the alternative PIT system requires an assessment of income tax incidence in Alberta. This will be conducted below.

The impact of the alternative PIT system to both households and government revenue was modeled using SPSD/M. Under the status quo, the model predicts that the Government of Alberta will generate $12.44 billion from personal income taxes in 2017. If the alternative PIT system were implemented, revenue from PITs would fall to $11.98 billion. This equates to a revenue decrease of $460 million per year, which is the same as the cost of the lump-sum transfer system. As such, the proposed alternative system features the greatest possible tax cuts while remaining within the aforementioned cost parameters.

The benefits of the alternative PIT system were estimated by running two simulations. The first simulation determined the PITs paid by each income quintile under the status quo. The second estimated the PITs paid by each quintile under the alternative PIT system. Table 16 below compares the results of the two simulations.

[46] Author's calculations using Statistics Canada's SPSD/M program

Table 16: Estimated costs per household of Albertan personal income taxes under the status quo and the alternative PIT system (2017)

	Average provincial PIT paid		Benefits of tax cuts	
Income quintile	Status quo	With PIT cuts	Savings per household	Increase to net income
1st quintile	$72	$43	$29	0.18%
2nd quintile	$1,095	$947	$147	0.34%
3rd quintile	$3,420	$3,159	$261	0.36%
4th quintile	$6,410	$6,055	$355	0.31%
5th quintile	$21,730	$21,315	$415	0.16%

Source: Author's calculations using SPSD/M.

The simulation results show that the average lowest-quintile household stands to save $29 per year from these tax cuts. This means the quintile will receive the smallest dollar benefit from the PIT cuts. Moving upwards from the lowest quintile, each successive quintile benefits more than the previous. The highest quintile is expected to save the most money, saving $415 per household, or about 14 times the lowest quintile's savings.

Why do tax cuts targeting lower-income households actually provide the most savings to high earners? Lower-income quintiles are less likely to contain individuals with an income up to $22,000. This means that these lower-income households pay fewer PITs and are less directly impacted by any change to the PIT rate. As a result, lower-income households pay less PITs relative to other households under the status quo. Cuts to these taxes will thus have a relatively smaller effect on lower-income households. Higher-earning households benefit the most because they are more likely to contain people with an income up to the $22,000 threshold. This means that these households are more likely to be paying these PITs and will stand to benefit more from a tax cut on these earnings.

Of course, a higher-earning household may value $100 in savings differently than a lower-earning household. It is thus necessary to estimate the relative value of the tax savings to each quintile, which can be done by comparing each quintile's tax savings with their net income. These data, presented in the rightmost column in Table 16, confirm that the alternative PIT system does little to benefit the lowest quintile. The lowest quintile will see their net income increase the second-least of any quintile. This is not a good result for a policy mechanism that is supposed to protect lower-income households.

The alternative PIT system proposed here does not go nearly as far as Ontario's in offering low tax rates to the lowest-earning households. The alternative PIT system is unable to do so because of the constraint of keeping the cost of the policy equal to the cost of the lump-sum transfers. Ontario's current PIT system has a lowest tax bracket with a tax rate of 5.05 per cent on the first $41,536 of taxable income. It is possible to use SPSD/M to simulate what would happen to government revenue if Alberta were to introduce an identical lowest tax bracket. Table 17 below shows the tax schedule used in this simulation.

Table 17: Tax schedule used for simulation with 5.05% tax rate on lowest bracket

2017 taxable income	Tax rate
0-$19,004	0%
Over $19,004 up to $42,688	5.05%
Over $42,688 up to $127,560	10%
Over $127,5600 up to $153,072	12%
Over $153,072 up to $204,097	13%
Over $204,097 up to $306,145	14%
Over $306,145	15%

Source: Author's calculations using SPSD/M.

The simulation found that an Ontario-style lowest tax bracket would decrease government revenue from PITs in 2017 from $12.44 billion to $8.8 billion, a 30 per cent decrease. This change would also have a dramatic effect on households. Table 18 shows the changes to the provincial PITs paid by the average household in each income quintile. Every lowest-quintile household would no longer pay any provincial PITs. The second quintile would see an 86 per cent reduction to their PITs, saving on average $930 per year. The third quintile would see a 59 per cent decrease, resulting in average tax savings of over $2000 per year.

Table 18: Average per household provincial PITs in Alberta with 5.05% tax rate on lowest bracket (2017)

	Average provincial PITs paid		Benefits from change
Income quintile	Status quo	With 5.05% tax rate on lowest bracket	Savings per household
1st quintile	$72	$0	$72
2nd quintile	$1,095	$165	$930
3rd quintile	$3,420	$1,409	$2,011
4th quintile	$6,410	$3,451	$2,958
5th quintile	$21,730	$18,034	$3,696

Source: Author's calculations using SPSD/M.

The introduction of an Ontario-style lowest tax bracket in Alberta would provide greater benefits to Albertans than the alternative tax system. Among the quintiles that the government intends to provide benefits, the increased savings from a 5.05 per cent tax rate on the lowest bracket would make the second and third quintiles no worse off under a carbon tax. The lowest-quintile, however, would still be receiving significantly less than the additional costs imposed on them by the carbon tax. Despite now paying $0 per household in provincial PIT taxes, the relative insignificance of PITs on lowest-quintile households' net income means that even a 100

per cent reduction to their PITs is still not enough to fully protect them from a carbon tax. It can thus be concluded that no PIT-cut mechanism in Alberta would be able to provide benefits to lowest-income households large enough to make them no worse off under a carbon tax.

Comparison of the economic benefits of the carbon rebates and PIT cuts

The calculations performed in the previous two subsections have resulted in an estimation of who will benefit and how much they will receive from a lump-sum rebate and PIT cuts. Table 19 summarises the results and compares the benefits of each test policy by income quintile.

Table 19: Annual benefits of each test policy by income quintile

	Policy mechanism		
	PIT cuts	Carbon rebate	
	2017 onwards	2017	2018 onwards
1st	$29	$230	$355
2nd	$147	$261	$401
3rd	$261	$275	$449
4th	$355	Ineligible	
5th	$415	Ineligible	

Source: Author's calculations using SPSD/M.

Note: Seven per cent of fourth-quintile households will be eligible for a partial carbon rebate, but none will receive a full rebate.

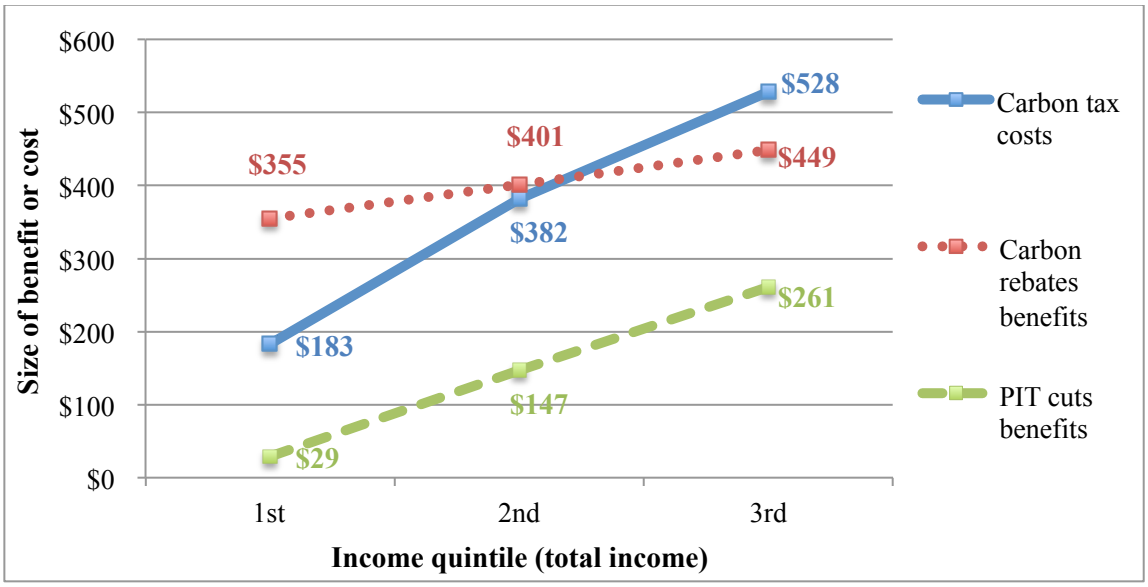
Table 19 reveals that the lump-sum rebate offers lower-income Albertans far greater benefits than the PIT cuts. The data show that the difference is particularly large for the lowest-quintile, which would receive over ten times more from the carbon rebate than the PIT cuts.[47] The average second and third quintile household will receive $245 and $151 more per year under the lump-sum transfer system respectively.

[47] The carbon rebate size in 2018 is used as the primary measurement of this mechanism's benefits as the rebates will remain this size from 2018 onwards.

The only quintiles that benefit more under the PIT cuts are the fourth and highest quintiles. They would receive benefits greater than any of the lowest three quintiles. While the potential impact on the two highest quintiles should receive some consideration, the intention of these test policies is not to provide compensation to all households. Per the government's stated policy objectives, the goal is rather to provide targeted compensation to the lowest three quintiles, which the PIT cuts fail to do.

The PIT cut mechanism appears even more ineffective when the benefits to lower-income Albertans are compared to the potential costs of a carbon tax. Figure 5 plots the costs imposed by Alberta's carbon tax on the lowest-three quintiles as well as the potential benefits offered by the two test policies. This figure presents only the bottom three quintiles, as these are the households for which the provincial government wants to provide compensation.

Figure 5: Costs of carbon tax compared to benefits of carbon rebate and alternative PIT system to the bottom three quintiles (2018)



Sources: Author's calculations using SPSD/M, Statistics Canada's CANSIM Tables 203-0022 and 206-0031, Government of Alberta climate leadership website, Environment and Climate Change Canada: National Inventory Report 1990-2014 and the Alberta Market Surveillance Administration's Retail Electricity and Natural Gas Billing Tool.

Figure 5 illustrates that the benefits from PIT cuts are less than the costs of the carbon tax for the lowest-three quintiles. It can thus be concluded that the PIT cut mechanism is unable to make lower-income Albertans no worse off under a carbon tax. The benefits offered by the lump-sum rebates, however, are very close to completely offsetting the costs imposed by the carbon tax. When Alberta has a $30 per tonne carbon price and its 2018 carbon rebate implemented, the lowest quintile stands to receive a net benefit from the combined impacts of the tax and rebate. It is estimated that the average household in this quintile will see a $172 increase to their income under such policy changes. The second quintile will also receive a carbon rebate greater than the additional costs imposed by the carbon tax. The difference is small, however, making it fair to conclude that the rebate will serve to sufficiently make this quintile no worse off. The third quintile will see the vast majority of its carbon costs cancelled out by the carbon

rebate, but the average household will still incur a net carbon cost of $79 in 2018. Despite this shortcoming, the lump-sum rebate is clearly the superior policy for achieving the goal of protecting the lowest-three quintiles from the costs of Alberta's carbon tax.

There are some caveats, however, to this conclusion. Firstly, the verdict that lump-sum transfers are superior is dependent on the policy goal of making the lowest-three quintiles no worse off. The evaluation of test policies showed that a lump-sum transfer is best suited to achieving this goal. But if the test policies were evaluated based on an alternative goal, such as achieving the lowest total welfare reduction, lump-sum payments may not be the winner.

Secondly, choosing the right policy mechanism is not only a matter of economic analysis. There are significant political and contextual factors that policymakers will weigh in their decision-making process. These considerations are addressed in the subsection entitled 'Political Considerations,' including the importance of public acceptance and making the carbon tax difficult to repeal.

Thirdly, the calculations within this paper's analysis were done using Alberta-specific data on incomes, energy consumption and carbon emissions. Furthermore, the test policies were designed either by the Government of Alberta or to fit within the province's existing PIT system. All of these factors mean that the results of this paper's evaluation are specific to the Albertan context. The conclusions should not be assumed to hold true in other jurisdictions.

Finally, the evaluation within this paper simplifies its analysis by only considering the adoption of one test policy or the other. In reality, policymakers have the option of using multiple policies. As was addressed in the literature review, some research even finds that a diversified portfolio of cost-mitigation policies may be the best option. It may thus be that a

combination of policies would generate a preferable outcome in Alberta to only using lump-sum transfers. This is a question that warrants further investigation.

Contextual considerations

Choosing a policy mechanism for protecting lower-income households is a difficult decision for policymakers, requiring the consideration of many factors. Although the lump-sum rebate proved to be the superior policy option in the economic evaluation, there are additional considerations that were not considered in the preceding analysis. These include the political and economic contexts within which Alberta is introducing its carbon tax. The contextual factors that likely influenced Albertan policymakers are addressed in this subsection.

An important feature of the Albertan context relevant to policies for protecting lower-income households is that Alberta has high per capita and absolute emissions.[48] This is largely due to the province's energy sector and heavy reliance on coal-fired electricity. The average carbon intensity of Alberta's electricity generation is 790g CO_2e/kWh.[49] Compared to the Canadian average of 150g CO_2e/kWh, Alberta's electricity grid is over five times more carbon intensive.[50] The oil and gas industry, of which the large majority is in Alberta, had sectoral emissions of 192 megatonnes in 2014.[51] This equated to over 25 per cent of all Canadian emissions, giving it the highest total greenhouse gas emissions of any sector. Because of these realities, Albertans will face higher emissions costs per capita than households in regions with lower emissions (all else equal), even if both had the same price on carbon. This makes it even more important that the government employ a policy mechanism that can protect lower-income

[48] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues."
[49] Environment and Climate Change Canada, "National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada," (2014), http://www.ec.gc.ca/ges-ghg/.
[50] Ibid.
[51] Ibid.

households from the higher energy costs caused by the carbon tax. As this paper has shown, a lump-sum transfer is an effective way to provide substantial targeted benefits to the lowest-three income quintiles. The provincial government's decision to use a rebate is thus the logical choice for achieving this goal.

Another feature of the Albertan context that influences the choice of policy mechanism is that income taxes are already low relative to other provinces.[52] While further tax reductions could still bring economic benefits, they will not bring the competitiveness benefits that would result if Alberta were starting from a position of relatively high income tax rates. As a result, reducing corporate and personal income tax rates is likely a low priority, making the policy mechanism of PIT cuts less attractive to policymakers.[53]

Political considerations are also a factor when choosing a policy for protecting lower-income households. The Government of Alberta will not want to see its carbon tax repealed should they lose the next election. With both major opposition parties strongly against the tax, government policymakers were likely motivated to design the tax in a way that would minimize this possibility. Insight on how to achieve this can be drawn from BC's carbon tax experience. A study by Kathryn Harrison found that BC's carbon tax was 'locked in' in part by the government's decision to use carbon tax revenue to fund PIT cuts. This reduces the chances of repeal because the repealer would likely be forced to reverse the tax cuts. This would amount to a tax increase on the lowest tax bracket, which may be politically unpopular. The Government of Alberta's decision to forgo PIT cuts may have been a missed opportunity to increase the durability of its carbon tax. But the government did commit to using carbon tax revenue to fund

[52] Canada's Ecofiscal Commission, "Choose Wisely: Options and Trade-offs in Recycling Carbon Pricing Revenues."
[53] Ibid.

small-business tax cuts. This move will likely have a similar effect, making the repeal of Alberta's carbon tax more difficult.

These contextual considerations present policymakers additional factors to consider. The Government of Alberta's choice of policy mechanism will lead to trade-offs between protecting lower-income households from the costs of a carbon tax, maintaining competitiveness and protecting the carbon tax from repeal. Choosing between a lump-sum transfer system or PIT cuts requires an evaluation of not only their economic implications, but also Alberta's political and economic context.

Conclusion

This paper's study of carbon pricing in Alberta found that the carbon tax will have an impact that cannot be easily classified as either regressive or progressive. The lowest quintile faces the smallest increase to their energy costs as a per cent of their total household expenditure, which would suggest that the tax is progressive. But the two quintiles hardest hit by the carbon tax (in terms of energy costs relative to their household expenditure) are the second and third quintiles, which would suggest that the tax is regressive. The impact of Alberta's carbon tax is thus best determined by looking at each quintile individually.

It is perhaps surprising that the lowest-quintile is not harder hit by the carbon tax as this quintile spends more of its income (as a per cent of total income) on energy than any other quintile. The reason the lowest-quintile does not bear a greater burden is because of the way that fixed and variable costs are separated in this paper's calculations. A fixed-cost component was calculated for residential fuel and electricity costs. Applying the same fixed costs (in dollars) to each quintile for these energy goods means that quintiles with low consumption (which tend to be lower-income quintiles) have lower variable costs as a percentage of their bill. Because the calculations in this paper assume that a carbon price will only increase the price of variable (or energy) costs, the lowest quintile having lower variable costs means it is relatively less impacted by a carbon tax. Higher-income households, on the other hand, will face the largest increases (in both dollars and per cent increase) to their expenditures on these energy goods.

Having determined the carbon tax's impact, this paper next evaluated the impact of two cost-mitigation test policies. Each policy was evaluated based on the criteria that the Government of Alberta set for its own cost-mitigation policy, which was to make the lowest-three quintiles no worse off under a carbon tax. The lump-sum transfer mechanism was found to provide the

lowest-three quintiles with significant benefits. The lowest and second quintiles received transfers exceeding the costs of the carbon tax, leaving them better off under the combined policies. The third quintile received a transfer that offset nearly all of its carbon costs.

The PIT cuts, however, were found to be ineffective at providing benefits to the lowest-three income quintiles. An alternative PIT system ended up providing the most benefits to Alberta's highest earners. The bottom-three quintiles were left with tax savings that made up only a fraction of their carbon tax costs. The conclusion of the evaluation of test policies was that a lump-sum transfer is the superior mechanism for providing targeted and significant benefits to the lowest-three quintiles.

The findings of this paper have policy implications that warrant the government's attention. Firstly, the evaluation of test policies showed that a lump-sum transfer is better than PIT cuts for providing significant benefits to lower-income households. This means that the Government of Alberta chose the better policy mechanism of the two. That is not to say, however, that the government chose the best course of action. As was mentioned in this paper's literature review, it may be better to use a combination of both PIT cuts and lump-sum transfers. Analyzing the simultaneous use of both policies lies beyond the scope of this paper, but is a question that warrants further attention.

Secondly, this paper finds that only 51 per cent of Albertans will receive a full or partial rebate. This means that Alberta's carbon rebate is unlikely to achieve its stated goal of making 60 per cent of Albertans no worse off under a carbon tax. This is likely to present the provincial government with a few challenges. Public support for the carbon tax may fall if voters deem that the government overstated the benefits offered by its lump-sum transfer. A carbon rebate unable

to achieve its policy goal could also worsen inequality as a result of some lower-income Albertans not being protected from the cost increases associated with a carbon tax. These are important considerations for the government to monitor following the implementation of the carbon tax and rebate system.

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Appendix

Appendix 1: SPSD/M Disclaimer

This analysis is based on Statistics Canada's Social Policy Simulation Database and Model. The assumptions and calculations underlying the simulation results were prepared by Zachary Biggs and the responsibility for the use and interpretation of these data is entirely that of the author.

Appendix 2: Assumptions used in modelling of PIT cuts

This paper used StatCan's SPSD/M to model the impact of tax cuts on Albertans. The model analyzed its impact on economic families, which it defines as a group of individuals living together who are all related by blood or marriage and share the same dwelling. This matches the definition of economic family used by StatCan in its CANSIM tables, which are cited throughout this paper.

Total income is calculated in SPSD/M as the sum of earnings from employment, OAS benefits, CPP benefits received, pension income, EI benefits received, interest and other investment income, capital gains and losses, RRSP withdrawals and various child and spousal benefits. The income quintiles used in SPSD/M were determined based on a household's total income in 2017, the first year of Alberta's carbon tax. As such, the quintiles in the SPSD/M modelling will differ from the quintiles presented in the 'Impact on Albertans' section, which are based on total income in 2013.

The PIT rates for Alberta in 2017 are the result of an SPSD/M prediction that is based on estimated changes to Alberta's Consumer Price Index.