

**British Columbia's carbon tax:
Addressing gender, age, and locational impacts**

**by
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B. A. Hons., University of Alberta, 2011

Project Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Public Policy

in the
School of Public Policy
Faculty of Arts and Social Sciences

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Spring 2017

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Abstract

This paper explores ways to design equitable carbon taxes across genders, ages, and locations in BC. This research begins to fill in the gaps in empirical knowledge about the impacts of a carbon tax on community groups beyond income-only based assessments. I begin this paper by outlining BC's GHG emissions history, the structure of BC's carbon tax, and a feminist approach to analyzing environmental and fiscal policies. I then outline my research, which uses multiple methods, and the results of the quantitative data analysis and expert interviews. My data analysis concludes that the carbon tax at its current rate does not disproportionately impact women or youth across urban and rural locations in BC to a significant extent. My research analyzes three policy options to recycle revenue back to households to off-set inequities. I make recommendations to improve the equity effects of BC's carbon tax as the carbon tax rate increases.

Keywords: carbon tax; feminism; gender; environment; equity

This work is dedicated to all the feminist intellectuals and activists whose shoulders I stand on and to all those working to incorporate feminist principles of equity into policymaking.

Acknowledgements

First, I would like to acknowledge my supervisor Olena Hankivsky, who consistently supported the premise of this project and whose guidance helped to keep this project on track. I would also like to thank my internal examiner Josh Gordon for his thoughtful feedback on the data analysis section. Lastly, I would like to thank Nancy Olewiler for encouraging me to pursue this project from the beginning and whose support ensured that the scope of the policy analysis remained reasonable and whose feedback enhanced its quality. I extend this appreciation to the School of Public Policy and its faculty.

I would like to thank all of the research participants for lending me their time, expertise, and thoughts on BC's carbon tax that were invaluable in considering the broader implications of this research.

This project was made possible in part by the financial support of the Smart Prosperity Institute and the SFU School of Public Policy. Additionally, I would like to thank the Smart Prosperity Institute for the opportunity to present this research at their March 2017 conference, where audience members provided thought-provoking feedback.

I would be remiss not to acknowledge the support and escape my comrades in the MPP 2015/2016 cohort provided during the course of obtaining this degree. Thank you to all who shared their thoughts and analyses of policy with me, commiserated over beers, and provided much needed comedic relief throughout.

Thank you to my entire family, who have always encouraged my academic endeavours and who patiently supported me from afar in Edmonton. Lastly, I would like to thank my husband, David Peddie, who has shown me the true meaning of partnership by fueling me through this process with delicious soups, guitar serenades, and his laughter and love.

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List of Acronyms

CATC	The low-income climate action tax credit.
CCPA	Canadian Centre for Policy Alternatives; a left-of-centre national non-profit research organization.
ETS	emissions-trading scheme; also known as cap-and-trade
GDP	Gross-domestic product
GHG	Greenhouse gases; carbon based gases that contribute to global warming and climate change as defined by the Intergovernmental Panel on Climate Change (IPCC)
IPCC	Intergovernmental Panel on Climate Change
MBI	market-based instrument
OECD	Organisation for Economic Co-operation and Development
PITs	Personal income taxes
RTC	Refundable tax credits

Executive Summary

Policy Problem and Research Objectives

The impacts of climate change are forecast to disproportionately affect marginalized and vulnerable communities (IPCC, 2014). Any policy framework designed to mitigate greenhouse gas (GHG) emissions, whether regulations or market-based instruments (MBI) such as a carbon tax, must be both effective and fair to avoid exacerbating inequities. Few to no empirical studies of BC's carbon tax have examined the intersections between income and the organization of community groups and households according to other axes of equity such as gender and age. Carbon taxes are potentially regressive in impact, and may thereby disproportionately hurt women, youth, and rural dwellers in their operation. To date, there has been insufficient measurement of the various dimensions of equity that could be inhibiting carbon policy development.

The objective of my capstone is to fill the empirical research gap in assessing the differential impact of British Columbia's revenue neutral carbon tax on residents of the province by accounting for gender, age, and location. I explore options to develop and design a carbon pricing scheme for BC that is redistributive and fair, whilst helping to reduce GHG emissions.

Methodology

This study uses a multiple method research approach, in line with feminist research praxis. An initial literature review was complemented by quantitative secondary data analysis and qualitative primary data analysis.

I have undertaken a quantitative analysis of secondary data from Statistics Canada and BC Stats to determine the tax burden between different genders, ages, and urban and rural populations. Additionally, I conducted semi-structured interviews with experts in this field to generate and assess policy options to mitigate regressive or unfair effects of carbon pricing schemes uncovered in the quantitative analysis and literature review. I applied for and received ethics approval for this research. To complete the analysis in this study, a number of assumptions were made that could under-estimate the equity impacts of the tax in its current design. Better data would help ensure that

policy analysis and recommendations match the reality of impacts felt by residents in BC.

Research Findings

To a small degree, concerns of vertical inequities between men and women, older and younger cohorts, and horizontal inequities between urban and rural dwellers were confirmed in the quantitative data analysis. The three findings are: due to income inequality, the carbon tax is more regressive for BC women to a small degree than BC men; the Climate-Action Tax Credit helps to off-set disparities; and rural dwellers who are not homeowners, including youth, are disproportionately affected by the tax, but overall amounts are currently small.

Participants in the expert interviews largely agreed to keep the carbon tax, but disagreed over how to spend the revenue generated by the tax. Lastly, several participants recommended regulations to complement a moderately priced carbon tax to reach emissions reductions as opposed to relying on a carbon tax alone.

Policy Options and Recommendations

Three policy options to address inequities within the personal off-setting measures in the carbon tax's revenue recycling regime are evaluated: further decreases in personal income tax rates (PITs) for low-income brackets; a Status Quo + option, where the CATC is unfrozen to the original rate and indexed with future increases in the carbon tax rate; and enhanced targeting of refundable tax credits (RTCs) like the CATC.

As the carbon tax rate increases over time, regressivity and inequities will need to be accounted for. Based on the quantitative and qualitative data analysis, and policy analysis of options, I give three policy recommendations to alleviate inequities in BC's carbon tax structure:

1. Eliminate revenue negativity to the degree possible;
2. Increase the overall share of personal off-setting measures in revenue recycling similar to 2008 levels;
3. In designing the personal off-sets, implement Option 3: Enhancing targeted refundable tax credits, which includes:

- Raising and properly indexing the low-income Climate Action Tax Credit;
- Increasing the CATC threshold amounts and/or reducing the claw back rate so that the rebate is not clawed back for those living under or near low-income cut-off lines;
- Expanding the Northern & Rural Homeowner benefit to include renters.

Policymakers often must choose between equity and economic efficiency, but enhancing targeted refundable tax credits under the revenue recycling regime already in place is the most equitable personal off-setting option while losing relatively little in efficiency and cost. Equitable revenue recycling ensures BC's carbon tax is not only the first comprehensive carbon pricing scheme in North America, but also sustainable in the long-term.

Chapter 1.

Introduction

1.1. Policy Problem

Due to the imperative placed on policymakers to address climate change, carbon pricing policies are gaining wider traction in public and policy discourse every year, both globally and in Canada (IPCC, 2014a). When British Columbia initiated a provincial-wide carbon tax in 2008, it became the first comprehensive carbon pricing scheme in North America (Harrison, 2013). Reducing the production of emissions and the consumption of carbon is increasingly considered necessary for a sustainably growing economy, but it is crucial that BC and Canada move forward with carbon pricing schemes that do not create or intensify societal inequities. The impacts of climate change are forecast to disproportionately affect marginalized and vulnerable communities (IPCC, 2014b). Any policy framework designed to mitigate greenhouse gas (GHG) emissions, whether command and control regulations or market-based instruments (MBI) such as a carbon tax, must be both effective and fair to avoid exacerbating inequities (Bubna-Litic & Chalifour, 2012; Chalifour, 2010; Cohen, 2014; IPCC, 2014b). Effective and equitable policy requires attention to the nuanced, complex, and dynamic ways climate change will impact different communities and groups in our society.

Studies have begun to assess both the effectiveness and fairness of BC's carbon tax in practice (Beck, et al., 2015; Lee, 2011; Murray & Rivers, 2015). To date, most empirical studies of BC's carbon tax concerned with fairness model their work around income as a proxy for both social and economic equality (Lee & Sanger, 2008; Murray & Rivers, 2015). Few to no empirical studies of BC's carbon tax have examined the intersections between income and the organization of community groups and households according to other axes of equity such as gender and age.

Income is an important cross-cutting factor when looking at equity impacts, but literature shows that other demographic factors—such as people's gender, age, and where they live—also play a role in the income they make, the type of work they have access to, how they spend, among many other considerations. Therefore, as feminist

scholars have shown, it is necessary to develop more nuanced understandings of social inequities (Cohen & Pulkingham, 2011; Hankivsky, 2011).

This study seeks to answer the following question: if market-based instruments are a primary policy instrument designed to reduce GHG emissions and mitigating climate change, both in BC and Canada, how can a carbon tax's design allow it to meet sustainability goals whilst not creating or exacerbating social inequities? I focus on carbon taxes rather than cap and trade policies (e.g., the Western Climate Initiative) as that is the policy BC introduced and generalizations are easier than with the more complex market-creation systems. Carbon taxes are potentially regressive in impact, and may thereby disproportionately hurt women, youth, and rural dwellers in their operation. I define my policy problem as the following: to date, there has been insufficient measurement of the various dimensions of equity that could be inhibiting carbon policy development. Political feasibility, as well as the design of the tax, have been impacted by discourse concerned with the carbon tax's regressivity throughout its history. Debates continue over the degree of regressivity of a flat-tax such as a carbon tax, especially in relation to low-income residents in BC, who are more likely to be women and youth (Lambert & McInturff, 2016; Gill, Knowles & Stewart-Patterson, 2014). Therefore, the degree to which BC's carbon tax exacerbates inequities associated with people's gender, age, and location is examined in the data analysis section of this study, and ultimately, policy options to alleviate inequities are recommended.

1.2. Objective of my study

The objective of my capstone is to fill the empirical research gap in assessing the differential impact of British Columbia's revenue neutral carbon tax on residents of the province by accounting for gender, age and location. I explore options to develop and design a carbon pricing scheme for BC that is redistributive and fair, whilst helping to reduce GHG emissions.

1.3. Overview of my paper

Chapter 2 provides a background to the issue of climate change and emissions history in Canada and BC, market-based instruments to address climate change, and feminist perspectives on environmental and economic policies. Chapter 3 outlines the

methodology used to complete the data analysis results described in Chapter 4. Chapters 5 through 7 details the policy analysis of the carbon tax's personal revenue recycling regime, and Chapter 8 provides my policy recommendations and conclusion.

Chapter 2. Background

2.1. Addressing climate change in BC

Canada and BC's GHG emissions history

According to data from the Organisation for Economic Co-operation and Development (OECD), Canada has a history of being one of the world's top polluters of GHG emissions amongst both OECD economies and non-OECD economies (OECD, 2015; Harrison, 2013). OECD data show that Canada is among the top ten of GHG emitters in terms of overall mega tonnes from 1990 until the most recent available data in 2014. In per capita terms, Canada is in the top five of OECD countries during this 25-year time frame.

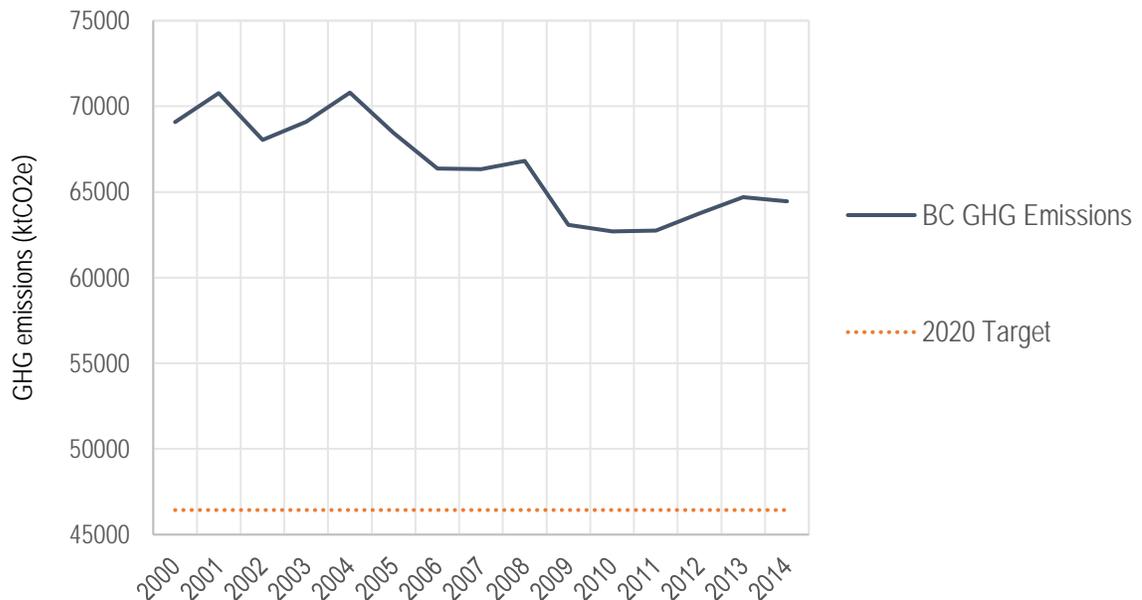


Figure 2.1 BC GHG emissions (ktCO2e), 2000 - 2014 from DataBC (2017)

Despite its relatively small population, Canada is a major contributor to carbon emissions in the global atmosphere due to our economic reliance on carbon-intensive manufacturing, fossil fuel extraction industries, and a large transportation sector (Harrison, 2013; Davis et al., 2011). According to Statistics Canada data, the biggest

emitters within the country are the fossil fuel and manufacturing-heavy economies of Alberta, Ontario, Quebec, and Saskatchewan. Although BC has a relatively large economy and population, it has been a historically smaller producer of GHG emissions: by 2005 BC ranked 5th in terms of overall emissions (65.2 mega tonnes), but 10th when measuring the emissions per capita. Academics and the BC government attribute BC's relatively small carbon footprint to industrial and residential reliance on hydro-electricity compared with other provinces' use of fossil fuel power plants, notably coal and gas (Harrison, 2013; Murray & Rivers, 2015). Despite BC's relatively small carbon footprint, the first comprehensive carbon tax in North America was proposed and implemented in the province in the early 2000's and provides the empirical data necessary to conduct a fairness analysis of climate change mitigation market-based instruments for this study.

Implementing a carbon tax in BC

BC passed North America's first comprehensive and stand-alone carbon tax in 2008. Political scientist Kathryn Harrison (2013) credits the passing of the tax to five characteristics of BC's political landscape at the time: the prevalence of hydropower; climate change becoming a "top-of-mind" voter issue in 2006; the BC Liberals were seen as "friendly" to business interests; Premier Gordon Campbell's personal commitment and leadership to a carbon tax; and the combination of a parliamentary government and single-member plurality political system that concentrates executive power in the case of a majority government, facilitating their ability to pass the tax.

2.2. Market-based instruments for climate change mitigation

Putting a price on carbon

Economic theory operates under the assumption that competitive markets will lead to the greatest level of efficiency provided there are no market failures. Efficiency has a precise meaning in economics, which is the understanding that individuals and firms will seek to maximize their net benefits (profits) when making decisions in a competitive market, specifically when they are accounting for the marginal benefits (profits) and costs of production (Keohane & Olmstead, 2007). Since the beginning of the 20th century, economic theory has been attempting to address unwanted by-products

of economic activities associated with market failures. Pollution is an example of a market failure – a negative externality that occurs because waste products from consumption and production typically are not priced in any unregulated market. Greenhouse gas emissions are a pollutant emitted from fossil fuel combustion and other anthropogenic sources. A negative externality imposes a social cost on a third party who did not choose to incur that cost (Ragan & Lipsey, 2011; Field & Olewiler, 2015). In the case of GHG emissions, producers impose the social cost of global warming and climate change onto the rest of society by emitting carbon into the atmosphere, whilst gaining the entire net benefit of their activity (Keohane & Olmstead, 2007).

Economist Arthur Pigou (1920) is credited with developing the definition of economic externalities, both positive and negative, as a type of market failure in competitive markets.¹ Pigou's theorization continues to influence the development of environmental policies, specifically because pollution is a negative externality. GHG emissions are so pervasive that it is impossible to imagine that individuals could bargain to an efficient outcome without some form of government policy intervention. Government intervention generally takes two forms: regulations or market-based instruments (MBIs). Regulations are prescriptive rules enforced by government that coerce the actions of firms or individuals to produce the desired societal outcome, such as to produce less pollution. Market-based instruments are government interventions where pricing of pollution induces individuals and firms to internalize the externalities in the market (Keohane & Olmstead, 2007; Field & Olewiler, 2015). According to Kallbekkan, et al. (2011), governments are increasingly turning to incentive-based environmental policies away from command-and-control environmental regulations to avoid stunting economic growth.

Carbon taxes are an example of a Pigouvian tax because they are meant to internalize the negative externality of environmental pollution from emissions intensive human activities into manufacturing costs and market prices (Kallbekkan, 2011). Without a tax, current market prices of goods—such as gasoline, food, and commercial products—do not account for the pollution they create. In theory, a carbon tax will internalize pollution costs to the environment with higher market prices, which

¹ For a further discussion on the differences between positive and negative externalities, please see Keohane & Olmstead's "Chapter 5: Market Failures in the Environmental Realm" in *Markets and the Environment* (2007).

encourages consumers and producers to buy/make products that are less emissions intensive because they will cost less (Ragan & Lipsey, 2011).

For the purposes of this study, changing BC's carbon tax into a cap-and-trade system will not be addressed. This study assumes that BC will keep its carbon tax, especially under the recently announced national framework for carbon pricing. Debates continue to exist over the efficacy of BC's carbon tax in its current form and in relation to other policy tools, such as regulations (Tieleman, 2016; Bennet, 2016; Ball, 2016). However, like most provinces BC already has a complementary regulatory regime in place to help reduce emissions. Regulating producers of emissions is viewed by some as a more direct and effective way to achieve emissions reduction, though it is generally conceded that they are not as economically efficient as carbon pricing policies since they distort markets (Field & Olewiler, 2015; Jaccard, Hein & Vass, 2016). Flexible regulations, as used in California, differ from conventional command-and-control regulations by reducing prescriptiveness in favour of setting emissions targets and allowing producers to find ways to meet targets on their own (Jaccard, Hein & Vass, 2016). Proponents of flexible regulations consider them a more efficient option than command-and-control regulations since they encourage innovation and competition amongst producers (Jaccard, Hein & Vass, 2016). It is also argued that regulations may be more politically feasible than carbon pricing policies, since consumers do not perceive direct impacts in their spending (Bennet, 2016; Jaccard, Hein & Vass, 2016). Lastly, regulations and ETS are considered by some to be more equitable than a flat carbon tax, since the onus is placed primarily on producers to change their behaviour as opposed to consumers (Aldy & Stavins, 2012).

In October 2016, the federal Liberal government announced the 2018 implementation of a national carbon price floor of \$10 per tonne, rising by \$10 each year to \$50 per tonne in 2022. If provinces and territories do not implement a price on carbon, they will be subjected to the federal implementation of a price floor of \$10 per tonne in 2018. Under this national framework, there is strong evidence that BC will keep its carbon tax even as a complement to other environmental policies such as regulations, or harmonization with other provinces and territories' cap-and-trade systems. Therefore, this study concentrates on specific design questions for an effective and fair carbon tax while acknowledging broader climate policy structures, such as complementary policy tools.

Structure of BC's carbon tax

There are four major design components of BC's carbon tax: the carbon tax rate, emissions coverage, revenue use, and tax credits, also known as off-setting measures, to combat regressive distributional impacts. I discuss each of these components below.

BC's carbon tax was implemented in 2008 at a modest price of \$10/tonne, rising \$5 per tonne/year until it reached \$30 per tonne in 2012. The rate has been frozen at \$30 per tonne since 2012, despite legislated obligations in the *Greenhouse Gas Reduction Targets Act* (2008) to lower BC's GHG emissions 33% below 2007 levels by 2020. The act stipulates the 2020 target, plus an additional reduction of 80% below 2007 levels by 2050, but allows the government to use multiple policy instruments to achieve these goals.² It has already been established by experts and the government itself that BC will not meet these goals (Climate Leadership Team, 2015; Meissner, 2015).

Economists estimate that the carbon tax was designed to 'cover' roughly 70-75% of BC's GHG emissions that are emitted in the province (Field & Olewiler, 2015; Horne & Sauve, 2014). According to a Canadian Centre for Policy Alternatives (2011) report, the other 25-30% of emissions that are not covered by the tax are from 'non-combustion sources' and include "industrial processes in the production of cement, lime, and aluminum; 'fugitive' emissions from coal and oil and gas extraction; agriculture emissions (manure and fertilizers; and landfills" (p. 12). To reduce emissions from these sectors, the carbon tax will need to be expanded for full coverage of our domestic emissions output or other policy mechanisms, such as sector-specific regulations, will need to be put in place. Additionally, the tax covers all fossil fuels combusted in the province, but not any fossil fuels that are combusted outside of the province or Canada, which is important to note because both BC and Canada heavily pursue the exportation of fossil fuel products to other jurisdictions and global markets. The current structure does not follow the lifecycle of the emissions that originate in BC, meaning the social cost of these emissions that originate in BC but are released into the environment in other jurisdictions are not internalized by the carbon tax. Ultimately, the carbon tax does not incentivize

² The act gave the government authority for the creation of regulations, such as the Emissions Offsets Regulation (2008) and the Carbon Neutral Government Regulation (2008).

domestic producers of fossil fuels or consumers of our fossil fuels in other jurisdictions to reduce emissions beyond our borders.³

A defining feature of BC’s carbon tax is its revenue-neutrality, which has proven to be a sticking point amongst proponents, critics, and researchers regarding its impact on the carbon tax’s effectiveness, fairness, and political feasibility. Revenue neutrality means that any revenue generated by the tax is offset by tax decreases and credits to consumers (personal tax measures) and industry (business tax measures), thus the BC government does not generate any revenue from the tax that can go towards government spending (see Table 2.1 for a list of these measures).

Table 2.1 Revenue neutrality measures for BC’s carbon tax

Personal Tax Measures	Business Tax Measures
Low income climate action tax credit of \$115.50 per adult plus \$34.50 per child effective July 1, 2011	General corporate income tax rate reductions: 12% to 11% effective July 1, 2008, to 10.5% effective January 1, 2010, to 10% effective January 1, 2011 and increased to 11% effective April 1, 2013
Reduction of 5% in the first two personal income tax rates	Small business corporate income tax reduction from 4.5% to 3.5% effective July 1, 2008 and to 2.5% effective December 1, 2008
Northern and Rural Homeowner Benefit of up to \$200	Industrial Property Tax Credit of 60% of school property taxes payable by major industry
BC Senior’s Home Renovation Tax Credit	School property taxes reduced by 50% for land classified as “farm”
Children’s Fitness Credit and Children’s Arts Credit	Corporate income tax small business threshold increase
Small business venture capital tax credit budget increased	Interactive digital media tax credit
Training Tax Credit extended – Individuals	Training Tax Credit extended – Businesses
	Scientific Research and Experimental Development Tax Credit extended in 2014
	Film Incentive BC tax credit extended in 2009 and enhanced in 2010
	Production Services Tax Credit extended in 2009 and enhanced in 2010

Note: Grey text denotes measures put in place, or used in the calculation of off-setting measures, from 2010 onward. Source: Tables 1 & 2 Revenue Neutral Carbon Tax Plans 2010/11 and 2011/12 and 2014/15 to 2016/17 from Data BC.

³ It is beyond the scope of this paper to address ‘leakage’ of domestic emissions into other jurisdictions.

Calculations of the tax's actual revenue neutrality have varied. According to the BC government's own calculations, the tax has always been, and is projected to be, revenue negative insofar as the government offsets more in tax credits than is revenue received. However, the degree to which the tax is revenue negative or neutral is contested amongst critics from both sides of the political spectrum. According to some calculations, the tax shifted from being revenue neutral to revenue negative around 2010 when the tax credits and rebates outspent the revenue generated by the carbon tax (Lee, 2011). On the other hand, The Fraser Institute charges the government with creative accounting and disputes the idea that the government is offsetting more than it is taking in (Lamman & Taylor, 2017). Figure 2.2 shows the trajectory of the carbon tax's revenue neutrality over its lifetime using the government's calculations of its off-setting measures. For comparison, the figure also shows a calculation of the tax's revenue neutrality if only the original 2008 tax credits are used, which include the personal and business tax measures in black text in Table 2.1.

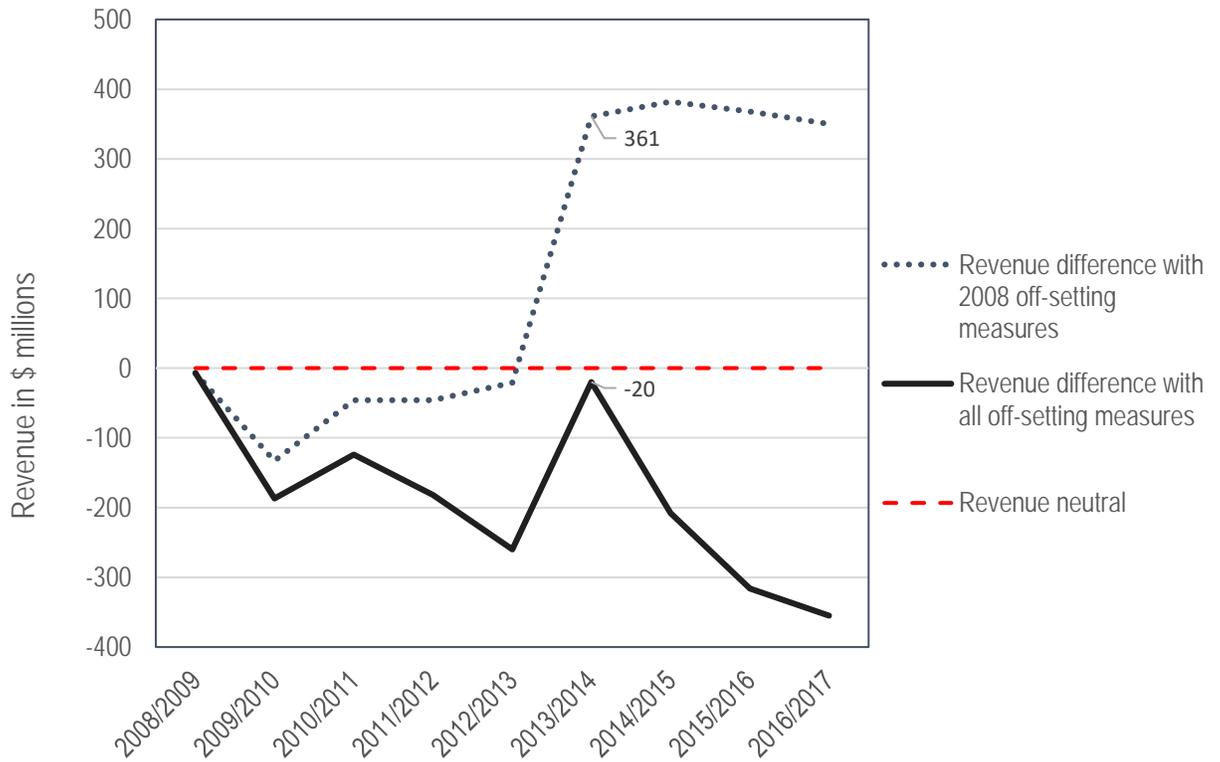


Figure 2.2 BC's Carbon Tax revenue neutrality calculations: 2008 original off-setting measures versus additional off-setting measures used by the Ministry of Finance post 2010

Source: Tables 1 & 2 Revenue Neutral Carbon Tax Plans 2010/11 and 2011/12 and 2014/15 to 2016/17 from Data BC.

For the purposes of this study, I will use the government's own accounting that includes the off-setting measures as calculated by the Ministry of Finance, as outlined in Appendix A.4 Based on the government's accounting methods, the tax has been revenue negative up to the 2012/2013 fiscal year, and is projected to become increasingly revenue negative in the coming years.

Off-setting measures have become increasingly directed towards businesses rather than individuals and households over the lifetime of the tax. As Table 2.2 shows, the revenue recycling began giving more back in personal tax credits (68%) than

⁴ It is beyond the scope of this study to conclude which independent off-setting measures should be used in calculating the revenue neutrality of BC's carbon tax. As outlined in Appendix A, 2012/2013 is the last fiscal year that carbon tax revenue historical actuals are available; each fiscal year after that point are based on forecasted numbers for revenue and offsetting measures.

business credits (32%); by 2016/2017, that dynamic is expected to be flipped with businesses receiving substantially more in terms of overall off-setting revenue than individuals.

Table 2.2 Type of off-setting measure as a proportion of total off-sets over the lifetime of BC's carbon tax

Type of off-set	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Personal off-sets	68.1%	49.2%	45.2%	41.2%	39.6%	42.4%	38.3%	35.8%	34.7%
Business off-sets	31.9%	50.8%	54.8%	58.8%	60.4%	57.6%	61.7%	64.2%	65.3%

Grey boxes denote forecasted rates. Source: Tables 1 & 2 Revenue Neutral Carbon Tax Plans 2010/11 and 2011/12 and 2014/15 to 2016/17 from Data BC. Grey denotes forecasted rates.

Lastly, the Low-Income Climate Action tax credit (CATC) was frozen in 2011 despite increases in the carbon tax rate until 2012/2013 (\$20 to \$30/tonne) (see Table 2.3). Freezing the CATC while continuing to increase the carbon tax rate has negative distributional impacts for low-income families who were receiving more as a proportion of the carbon tax paid in the initial 2008 design, including for those whose incomes put them in the category of 'working poor' (Lee, 2011). The working poor are typically defined as those who have employment but continue to make less in after-tax income than Statistics Canada's Low Income Cut-Off and are not receiving government transfers in the form of social assistance (Ivanova, 2016).⁵

⁵ According to the Metcalf Foundation's report on the working poor, such individuals are also defined by the following characteristics: are working age (18 to 64); not students; live independently and not considered dependents on their parents, but may have their own dependents, spouses or children; earn at least \$3000 per year to qualify for the federal Working Income Tax Benefit (Ivanova, 2016).

Table 2.3 BC Low-Income Climate Action Tax Credit rate schedule, 2008-2016

BC CATC	2008	2009	2010	2011	2012	2013	2014	2015	2016
Adult	100	105	105	115.5	115.5	115.5	115.5	115.5	115.5
Child	30	31.5	31.5	34.5	34.5	34.5	34.5	34.5	34.5
Single threshold	\$30,000	\$30,600	\$30,722	\$30,968	\$31,711	\$32,187	\$32,219	\$32,445	\$32,737
Married threshold	\$35,000	\$35,700	\$35,843	\$36,130	\$36,997	\$37,552	\$37,589	\$37,852	\$38,193
Claw back rate	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Source: *Canadian Tax and Credit Simulator (CTaCS)*

2.3. The need for feminist analysis of economic and environmental policies

Feminists and feminist economists have critiqued the underlying assumptions of economics—and neoclassical economics, in particular—on the basis that “women have been largely absent as both economic researchers but also the subjects of economic study” (Ferber & Nelson, 2009, pp.4; Longino, 2009; Waring, 1988). Significantly, feminists critique the historical construction of economics as singularly incorporating the “paid economy”, whilst ignoring the unpaid, care work economy, where women have been historically overrepresented (Ferber & Nelson, 2009; Longino, 2009; Cohen & Pulkingham, 2009). Ignoring women in economics has had significant impacts on our public policies, including fiscal and environmental policies, where economic analysis is one of the most used tools in making policy decisions (Cohen & Pulkingham, 2009; Waring, 1988).

Feminist critiques of economics and traditional methods of policymaking tackle the underlying assumption that policies affect individuals in the same way, or in a gender-neutral way; they eschew the concept of formal equality, or ‘equal opportunity’, and advocate instead for substantive equality that recognizes that certain groups in society will face distinct barriers and social constraints to full participation in social, economic, and political systems (Cohen & Pulkingham, 2009, pp. 15). As Cohen & Pulkingham (2009: 15) succinctly put it: “Equality requires substantive outcomes.”

To address the impacts of women’s inequality in economics and policymaking, feminists, researchers, and policymakers developed methodological and policy tools, including gender mainstreaming, gender-based analysis (GBA in Canada), and equity

lenses, among others (Cohen & Pulkingham, 2009; Hankivsky, 2009). Gender equity tools in policymaking, as Hankivsky (2009: 115) states, was intended for the following:

It makes it possible for policy to be undertaken with an appreciation of gender differences, of the nature of relationships between women and men and of their different social realities, life expectations; and economic circumstances; it is a tool for understanding social processes and for responding with informed and equitable options.

Canada is now in an era of GBA+: a commitment the Canadian government made in 1995 at the United Nations' *Fourth World Conference on Women* in Beijing. The department responsible for GBA+ tools and training is the Status of Women in the federal government, where the 'plus' indicates that GBA "goes beyond gender, and includes the examination of a range of other intersection identity factors (such as age, education, language, geography, culture, and income)" (Status of Women, 2016). The method of analyzing policies based on multiple social locations, such as GBA+, in part provides the conceptual framework for the approach and methodology of this study. While the demographic factors chosen for analysis in this study are not entirely comprehensive, I have chosen three in gender, age, and location that literature on climate change and work done by international bodies shows are important dynamics in climate change policy (IPCC, 2014b).

Feminist perspectives on taxes

Since the induction of BC's carbon tax, it has been generally acknowledged that while reducing both the production and consumption of emissions is necessary, it is undesirable for BC society to have the burden of carbon pricing disproportionately shared amongst lower income levels or community groups, especially when considering relative carbon footprints (behavioural and spending habits) between low and high income groups. Research on the equity impacts of BC's carbon tax has thus yielded mixed results—studies have found the revenue-neutral carbon tax to be both progressive and regressive (Lee, 2011; Beck, et al., 2015; Murray & Rivers, 2015).

Policies can be proportional, regressive, or progressive in their outcomes (Field & Olewiler, 2015). Proportional policies include those that take the same level of income from each income level; regressive policies "provide higher net-benefits to high-income people than to low-income people as a proportion of their income"; and progressive

policies provide higher net-benefits to lower-income individuals than high-income individuals (Field & Olewiler, 2015, pp. 101). Discussions about the regressivity of the carbon tax must also consider the overall net-benefits of the regime, which includes the revenue recycling mechanisms and how the revenue is spent overall. To determine overall net-benefits, the following questions must be asked: If a carbon tax rate is going to increase over time, which type of revenue recycling will ensure that inequities are not created or exacerbated to undesirable degrees? If the policy is regressive, how exactly is the regressivity off-set and to what degree? The degree to which the policy is regressive and how to off-set regressivity is examined in the policy analysis section of this study. However, additional questions about regressivity include the following: Along with increased revenues, how will we spend that revenue? Will we continue to recycle all of the revenue, or, as with the current revenue negative regime, more than the policy brings in? The current 'revenue neutral' design of the tax does not allow for progressive spending of the carbon tax revenue, and therefore, those experiencing regressivity through a flat carbon tax do not receive progressive net-benefits in the form of other welfare state policies (Kato, 2003).

Fairness and regressivity of flat taxes have been examined and criticized by feminist scholars and activists. Indigenous feminist scholar Andrea Smith criticizes past market-based environmental policies, similar to a carbon tax, insofar that they primarily target consumers, which hits marginalized groups the hardest (Smith, 2005). As with other sales taxes, a carbon tax places the onus of behavioural change on all community members at an equal rate, resulting in regressivity (Beneria, Berik & Floro, 2015). Ruttenberg and McCarthy-Richard (1991) note that regressive instruments like fees and levies inordinately impact the poor, who are disproportionately women, especially when they are not offset by progressive net benefits elsewhere. Progressive net-benefits of the carbon tax could include investment in green policies and infrastructure to ensure reduced emissions, or investments and the expansion of social services to reduce overall inequality in BC society.

Literature shows that Canadian women make less income than men, both for the same work and in lifetime earnings (Lambert & McInturff, 2016; Vosko, 2005). Other scholarship shows that social mobility in Canada is decreasing, particularly for youth who for the first time in Canadian history are more likely to be less well-off than their parents (Corak, 2013; Gill, Knowles & Stewart-Patterson, 2014; OECD, 2011).

Additionally, rural communities will bear the brunt of climate change more than urban populations, due to their remoteness; the types of industry located in rural areas and, therefore, the types work rural dwellers have access to; lifestyle and geographical differences and the types of social services they have access to; among others (Bubnalitic & Chalifour, 2012; Reed, forthcoming).

This study shares the same concern as previous empirical studies of BC's carbon tax: if not designed properly, the carbon tax will not cause communities who profit from climate change or have larger carbon footprints in their own consumption to change their behaviour, undermining its main objective. However, my work is additionally concerned that demographics or communities that are of lower income, and who face challenges associated with socio-political location and status, will be disproportionately and unfairly burdened by the tax. This study thus foregrounds equity considerations to determine a fair policy design for BC's carbon tax.

Chapter 3. Methodology

This study uses a multiple method research approach. An initial literature review was complemented by quantitative secondary data analysis and qualitative primary data analysis. A multiple method approach is in line with feminist research praxis; despite its utility in understanding the implications of fiscal policies, feminist researchers have critiqued the limitations of quantitative research on the grounds of its limited descriptive capacity, pre-defined categories of analysis, and inability to gain understanding into the multiple causes of gendered, and other effects (Hesse-Biber & Levy, 2007). Qualitative research, on the other hand, allows for research to delve into questions of ‘why’ or ‘how’ that can be particularly helpful in policy analysis (Hesse-Biber & Levy, 2007).

Following other feminist researchers, my work used both quantitative and qualitative methods, wherein the qualitative data provides elaboration and clarification on how to address the results of the quantitative findings (Hesse-Biber & Levy, 2007). I have undertaken a quantitative analysis of secondary data from Statistics Canada and BC Stats to determine the tax burden different genders, ages, and urban and rural populations. Additionally, I conducted semi-structured interviews with experts in this field to generate and assess policy options to mitigate regressive or unfair effects of carbon pricing schemes uncovered in the quantitative analysis and literature review. I applied for and received ethics approval for this research.

3.1. Macro demographic profiles

To develop a comprehensive picture of the structural differences that might affect various community groups’ impacts from the carbon tax, I developed macro demographic profiles based on gender, age, and location for the province of BC. I used Statistics Canada information and descriptive statistics to examine the magnitude of difference between men, women, and youth’s incomes, employment trends, and transportation use trends in different areas of the province. Since a sales tax, such as the carbon tax, is applied equally to individuals upon the purchase of carbon taxed goods, comparing relative incomes is an important factor in determining the effects of the carbon tax on different individuals’ everyday purchasing power.

3.2. Micro demographic studies

For this study, I use a household analysis to model the impacts of the carbon tax on different community groups based on gender, age, and location in BC for the year 2014; this model does not account for behavioural changes over the lifetime of the carbon tax. I developed eleven quantiles of distributional comparison between women and men in the province and ten snapshot cases of comparison to determine gendered, age, and locational impacts of BC's carbon tax; see Tables 9.1-9.3 in Appendix C for a full summary.

The Survey of Household Spending (SHS) was used to calculate direct costs on fossil fuels by family type for BC; indirect costs were not included in this analysis.⁶ Information from the SHS was used to develop adjusted spending estimates for each item: natural gas for principal accommodation, other fuel for principal accommodation, and gas & other fuel for private transportation. I used the Canadian Tax and Credit Simulator (CTaCS), developed by UBC social policy expert Kevin Milligan, to calculate the rate of tax credits received by the ten demographic profiles. CTaCS simulates the personal tax and transfer system in Canada at a micro-demographic level and is an open software that incorporates national and provincial tax program information and characteristics from 1962 to 2016. Using this software, I ran the thirty-three cases to determine how much each profile would receive back in the carbon tax's personal off-setting measures. Finally, I cross-referenced each case's direct spending on carbon taxed fuel with the amount each case would receive back in tax credits to determine the overall impact of the carbon tax on each case's income.

To determine gendered distributional impacts, I calculated the distribution of incomes between men and women in BC divided into eleven quantiles. Across the eleven quantiles, I compared how much women and men spend on the direct costs of the carbon tax as a proportion of their income. Lastly, I compared how much women and

⁶ Fuel is considered a good with direct carbon tax costs to the consumer. Other studies calculate the indirect cost increases that a carbon tax may produce for other goods, notably, food costs. It is beyond the scope of this study to assess the indirect costs of the carbon tax on gender, age, and location, though including them in an assessment produces a more robust picture of differential impacts. Please see Lee, 2011; Beck, et al., 2015; Murray & Rivers, 2015; Jaccard, Hein & Vass, 2016 for further discussion on indirect costs. The Survey of Household Spending (2014) provided information on overall spending amounts for transportation fuel, household heating fuel, and natural gas.

men spend on the carbon tax with what they receive in rebates as a proportion of their income. Comparing how much women and men spend on the tax before and after the rebate allowed me to determine the overall progressivity or regressivity of the tax structure.

Next, I used a snapshot analysis to evaluate the equity impacts of BC's carbon tax on different family structures. I developed eight demographic profiles using Statistics Canada data from the year 2014. The profiles are divided into two main categories of urban and rural, for which I chose median employment incomes from Vancouver and Prince Rupert as case examples of a large urban centre and a smaller northern and rural community that would qualify for the Northern & Rural Homeowner Benefit. This model does not account for spending across income levels in family structures; it is a snapshot look at each family type based on overall median incomes in the province.

Several assumptions are built into the ten demographic profiles. Due to issues of scope and availability of data, the potentially disproportionate impacts on same-sex families are not considered in this study. I do not attempt to tease out gendered impacts on dual-earner couple families, since the Survey of Household Spending does not disaggregate data by gender within the same household. It is beyond the scope of this paper to attempt to discern how dual-income earning heterosexual families divide their spending habits on carbon taxed goods and money received back in tax-credits. Instead, I use the median employment incomes between male-single-earner and female-single earner couple families to explore the impact that gendered pay and wage gaps has on fiscal policy instruments like the carbon tax. In the simulation, I also assume that each family, in both couple and lone-parent families, has two children based on average family sizes in BC.

The last case of comparison is between urban and rural youth against their baseline populations, using median incomes between the two groups. I do not break down the median employment incomes of youth by gender and I do not apply the Northern and Rural Homeowner Benefit to rural youth, since it is less likely that they will have a mortgage than their older working age counterparts.

3.3. Expert Interviews

Interviews were conducted with experts in the fields of environmental, gender, and youth policy. I sought out experts on these topics in academia, not-for-profit organizations, and community leaders, including elected officials. I sought to interview a wide-variety of people based on demographics, including women, men, and youth, but who had familiarity with the structure and impacts of BC's carbon tax. The goal of the interviews was to collect thoughts on experts' perceived efficacy and fairness of BC's current carbon pricing scheme compared to other policy instruments, potential socio-economic or cultural impacts of the scheme, how to best address perceived inequities created or exacerbated by BC's carbon tax, as well as stakeholder and public acceptance of the carbon tax as it is currently structured and if it were changed.

Potential participants were selected based on publicly available information about their respective institutions and work in their fields or through a snowball sampling method by which introductions were made over email through mutual acquaintances. Participants were contacted via email and interviews were conducted in person or over the phone. Consent was obtained according to research ethics procedures either prior to the interview via a consent form or at the beginning of each interview. Every participant consented to being identified and quoted in the study.

Semi-structured interviews were used to guide discussion with participants but allow for flexibility in responses (see Appendix B). Interview length was targeted at thirty minutes. Questions were tweaked depending on a participant's field of expertise or the community they were representing, particularly in the case of elected officials. Fields of expertise for participants broke down as follows: two participants from academia, two participants from BC based non-governmental organizations, and two participants who are elected officials. In total, six interviews were completed; four interviews were completed in person and two interviews were completed over the phone.

3.4. Limitations of my research

Complexity and uncertainty

As previously stated, I assume that the government's own revenue neutrality calculations as correct and that the tax is in fact revenue negative. If the tax is not revenue negative, the analysis and recommendations on revenue use remain important. It is beyond the scope of this paper to assess the government's full budget to see where tax, and carbon tax, revenue should go towards green or social justice initiatives although it would be a worthy and necessary endeavour in assessing the fairness of fiscal policies in BC.

This study assumes that the carbon tax can be effective in reducing emissions. However, the causal links between the carbon tax and reduced emissions compared to other factors (other policy mechanisms, recessions, etc.) are complex but important to assess and consider.

Finally, data on carbon taxed goods only includes direct expenditures on fuel (gasoline, natural gas, and heating) and not on indirect expenditures on other items that could be affected by the carbon tax, such as food. However, indirect expenditures are not expected to be large because many of these products are imported from other jurisdictions not covered by the carbon tax.

Disaggregated data

For the purposes of this study, I differentiate only between the genders of men and women due to the limitations of non-disaggregated data presented by Statistics Canada's data collection categories. Statistics Canada currently uses two pre-defined categories of 'sex', whereas feminist theory recognizes that both gender and 'sex' are fluid categories on a spectrum (Butler, 1990). For example, it was not possible to determine the impacts of the carbon tax on trans or non-binary individuals and families, although disaggregated data based on this type of information would make such an analysis more viable. Additionally, spending data (SHS) is collected by family type and age, but not gender or gender of each family's earner. Collecting sample sizes large enough to analyze spending information by the gender of the earner (i.e. men and

women lone-parent or single-earner households) would allow for a more robust analysis of spending habits between genders.

Chapter 4. Data Analysis

4.1. Macro demographic profiles

Women in BC

Income

Due to the gender-neutral way in which a sales tax is applied to individuals, women's earnings compared to men is an important factor in determining effects of the carbon tax on women in the province. Historically, women have earned less money than men both in overall pay and in terms of pay for the same work, also known as the gender wage gap (Statistics Canada, 2017). Earnings statistics in BC for the years 2000-2014 indicate that BC is no exception, with women's overall median earnings shown to be between 31-45% less than men's in that timeframe (CANSIM Tables 206-0053 & 202-0407). A limitation of comparing overall median earnings between genders is that it does not account for family structure or household income, meaning that women may have access to household income earned by their partners, and so median employment incomes alone do not account for the full-range of income that women in the province may have access to. However, we know that couple families have higher median earnings than lone-parent families by 46% on average in BC between 2000 and 2014, and that men lone-parent earners have 35% higher median earnings than women lone-parent earners for the same time frame (CANSIM Tables 111-0012 and 111-0011). As of 2014, women are making 35-37% less than the men counterparts in BC for the same family structures (see Table 9.1 in Appendix C).

Family structures: couple families, lone-parent families, children

As BC's population continues to grow, it is important to consider the composition of BC families and how different family structures and compositions will be affected by a carbon tax. In terms of family composition, BC families compare to national averages of lone-parent families as a share of total families between 2000 and 2014: Canada, 18%; BC, 17%. Of lone-parent families in both Canada and BC, 80% of those families are women lone-parent families (Canada: 83%; BC: 84%), which has meant that single mothers have made up 10-13% of all BC families in that fourteen-year time frame (see Appendix C). Women in BC are more likely to be in a lone-parent situation than men,

thereby responsible for both unpaid caretaking activities and paid breadwinning for their families.

Table 4.1 Median employment incomes by family type in BC, 2014

Family type	Median income	% difference
Couple families	\$83,120	
Lone-parent families	\$39,790	52% less
Couple families		
Dual-earner couple families	\$87,860	
Single-earner-male couple families	\$31,550	
Single-earner-female couple families	\$19,790	37% less
Lone-parent families*		
Male lone-parent families	\$57,370	
Female lone-parent families	\$37,140	35% less

**Income for lone-parent families are median total incomes, as opposed to median employment incomes due to availability of data. Source: CANSIM Tables 111-0012, 111-0009, 111-0011*

Youth in BC

For the purposes of this study, I consider the category of ‘youth’ to be anyone under 30, or in some cases 34, depending on the age categories used by Statistics Canada for different surveys and sources. The cohorts aged 30 to 34 and under best represent similar lifecycle situations and contexts, including time spent in secondary and post-secondary education, initial entrance into the workforce and entry-level pay, starting a family, as well as the lack of time to build equity, among others. Those currently 35 and under are considered part of the millennial generation and will face different challenges and barriers than the previous post-WWII generations, including climate change.

Income

Unsurprisingly, youth in BC make the least amount of employment income other than seniors. Many lifecycle factors may account for this discrepancy, including time spent in secondary and post-secondary education, initial entrance into the workforce and entry-level pay, initial expenses in starting a family, as well as the lack of time to build

equity, among others. However, the discrepancy between age cohorts in BC is getting worse according to Statistics Canada data, as shown in Figure 4.1. A ten percent increase in median income disparity between young working age adults (25 to 34 years) and older working age adults (35 to 54 years) between the years 2000 and 2014 lends support to other studies contending that intergenerational income inequality is growing (Corak, 2013; Gill, Knowles & Stewart Patterson, 2014). Disparity also exists between young men and women (aged 25 to 34 years), with young women’s median incomes amounting to consistently less than young men, as shown in Figure 4.1.

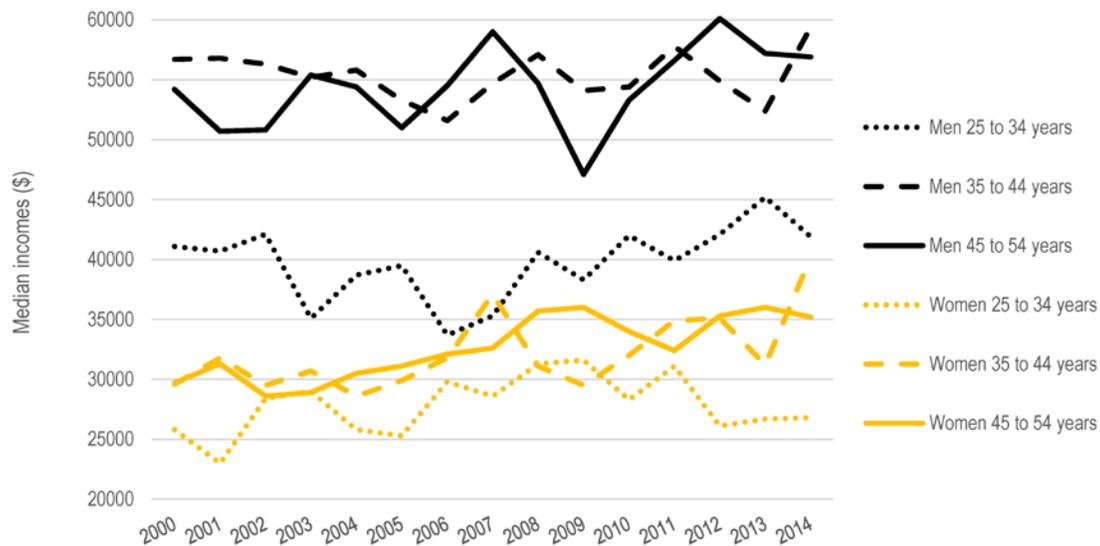


Figure 4.1 Median incomes between gender and age for BC, 2000-2014

Urban vs. Rural BC

Income

Median employment incomes across geographical locations in BC vary greatly, as shown in Table 4.4. According to a *Human Resources and Social Development Canada* report (Fortin, 2008), the share of earners living in low-income situations is similar across urban and rural location in Canada but the type of employment differs. Low-income earners in rural location are more likely to be self-employed compared to urban low-income earners that receive low-waged work (Fortin, 2008). Variations in median employment incomes between urban and rural locations is better explained by differences in family composition, education levels, and industry of employment rather than being tied to the regional type itself (Fortin, 2008; Statistics Canada, 2015).

Median employment incomes do not account for the full picture of socio-economic differences across urban and rural locations. Statistics BC calculates a socio-economic hardship index by region and census metropolitan areas that accounts for disparities in socio-economic factors between urban and rural families and individuals. For example, Vancouver and Prince Rupert have shown similar median employment incomes since 2008, but rank very differently according to Statistics BC's socio-economic hardship index: Prince Rupert was ranked 2nd worst in the province, while Vancouver was ranked 29th out of 77 for 2012 (BC Stats, 2012). For the purposes of the micro demographic profiles and simulations in the following section, I use the median employment incomes of different demographics case studies from Vancouver and Prince Rupert to reflect effects of BC's carbon tax based on location.

4.2. Micro demographic studies

As outlined in the methodology section of this paper, I developed eleven quantiles for an income distributional analysis between women and men, as well as ten demographic cases for a household analysis between family types, ages, and locations (Appendix C). Determining the fiscal impact on each case of comparison required the following calculations:

1. Converting spending on transportation fuel, household heating fuel, and natural gas to consumption levels;
2. Calculating the overall carbon tax paid by each profile for the year 2014 based on their consumption of these goods;
3. Using the Canadian Tax and Credit Simulator to determine the amount each profile received in personal off-sets;
4. For each profile, calculating the proportion of income paid towards the carbon tax;
5. Calculating the proportion of income paid towards the carbon, or payment received in off-sets;
6. Comparing profiles against one another to determine the degree of regressivity or progressivity.

Findings

The results of the simulation support the hypothesis of this research to varying degrees, that the carbon tax creates differential impacts based on gender, age, and between urban and rural locations, but by small amounts overall. Findings for each group are discussed below. For a table summarizing the exact findings, see Appendix E.

Distributional impacts by gender

Based on this analysis, lower income individuals are paying more as a share of their income towards the carbon tax than middle and high income earners, even after the Northern & Rural Homeowner Benefit and the Low-Income Climate Action Tax Credit (CATC). The CATC provides relief to low-income individuals in BC, but not at a rate that

is high enough to make the tax progressive overall; high income individuals still pay the smallest share of income (see Figure 4.2). Quantile 5 (\$40,000 to \$49,999) is, roughly, where the CATC is completely phased out. As Figure 4.2 shows, those in the third income quantile (\$20,000 to \$29,999) get the biggest break from the rebate and are paying the least towards the carbon tax in terms of low-income individuals.

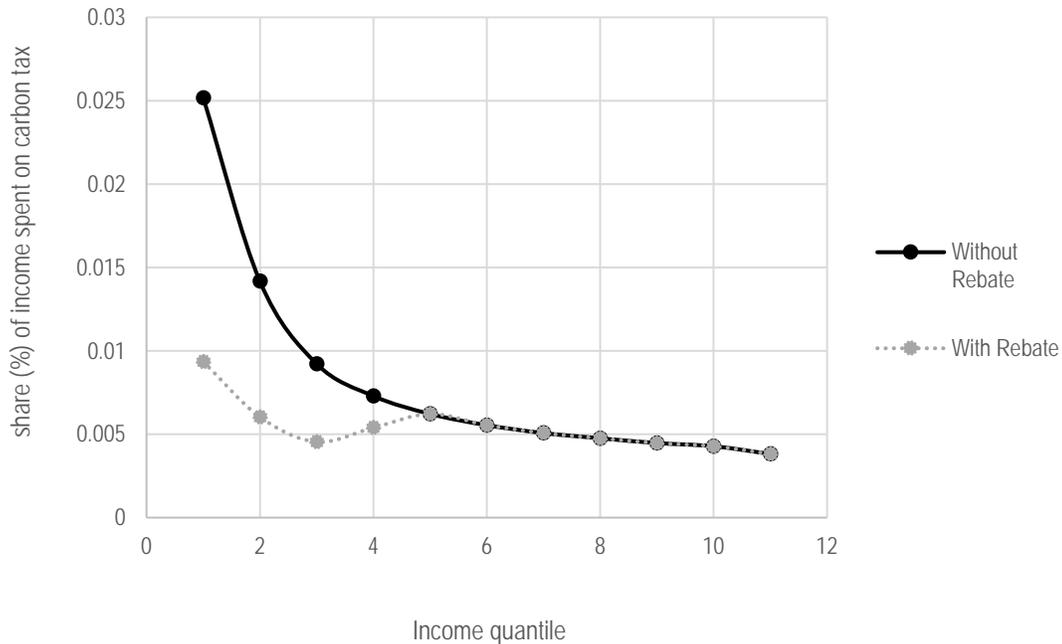


Figure 4.2 Share of income (%) spent on carbon tax before and after CATC rebate by income quantile in BC, 2014

However, Figure 4.2 shows that those in the fourth income quantile (\$30,000 to \$39,999) are hit with paying a larger share of their income towards carbon taxed goods, which includes some families living below low-income cut-off (LICO) lines or very close to them. As Table 4.2 displays, CATC threshold amounts became increasingly close to the LICO for urban families; in fact, the LICOs surpassed the threshold amounts for urban couple families in 2011, 2012, and 2014, indicating that some families living beneath the LICO line would have been phased-out of receiving the CATC. However, as the modelled numbers in Table 4.3 outlines, overall amounts are small when the carbon tax is at its current level of \$30/tonne rate.

Table 4.2 CATC threshold amounts and LICO rates for rural and urban BC, 2008-2014

BC CATC	2008	2009	2010	2011	2012	2013	2014
Single threshold	\$30,000	\$30,600	\$30,722	\$30,968	\$31,711	\$32,187	\$32,219
LICO rural	\$20,845	\$20,900	\$21,283	\$21,905	\$22,233	\$22,434	\$22,873
LICO urban	\$27,844	\$27,918	\$28,430	\$29,260	\$29,699	\$29,968	\$30,553
Married threshold	\$35,000	\$35,700	\$35,843	\$36,130	\$36,997	\$37,552	\$37,589
LICO rural	\$26,007	\$26,075	\$26,554	\$27,329	\$27,739	\$27,990	\$28,537
LICO urban	\$34,738	\$34,829	\$35,469	\$36,504	\$37,052	\$37,387	\$38,117
Claw back rate	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Source: Canadian Tax and Credit Simulator

LICO rates in the table are parallel to family size (e.g. rates under the single threshold are for 3 persons to parallel average family size of lone-parent families; rates under the married threshold are for 4 persons to parallel average family size of couple-families).

Table 4.3 Distributional impacts of carbon taxed goods based on income quantile in dollars, 2014

Lower quantile income limit (\$)	Amount (\$) spent without the rebate	Amount (\$) spent with the rebate	Difference (\$)
\$5,000	\$125.88	\$46.77	\$79.10
\$10,000	\$141.70	\$60.36	\$81.33
\$20,000	\$184.39	\$90.87	\$93.52
\$30,000	\$218.71	\$161.75	\$56.95
\$40,000	\$248.63	\$248.63	\$0
\$50,000	\$277.12	\$277.12	\$0
\$60,000	\$304.13	\$304.13	\$0
\$70,000	\$332.95	\$332.95	\$0
\$80,000	\$357.62	\$357.62	\$0
\$90,000	\$385.05	\$385.05	\$0
\$100,000	\$381.67	\$381.67	\$0

The regressivity of the tax has relatively small gendered implications—low-income women pay a slightly larger share of their incomes towards the tax both before and after the CATC rebate (Figures 4.3 & 4.4). Figure 4.3 displays the distribution of men and women’s incomes in BC for 2014 and shows that women are more likely to be in low-income quantiles and less likely to be in high income quantiles than men.

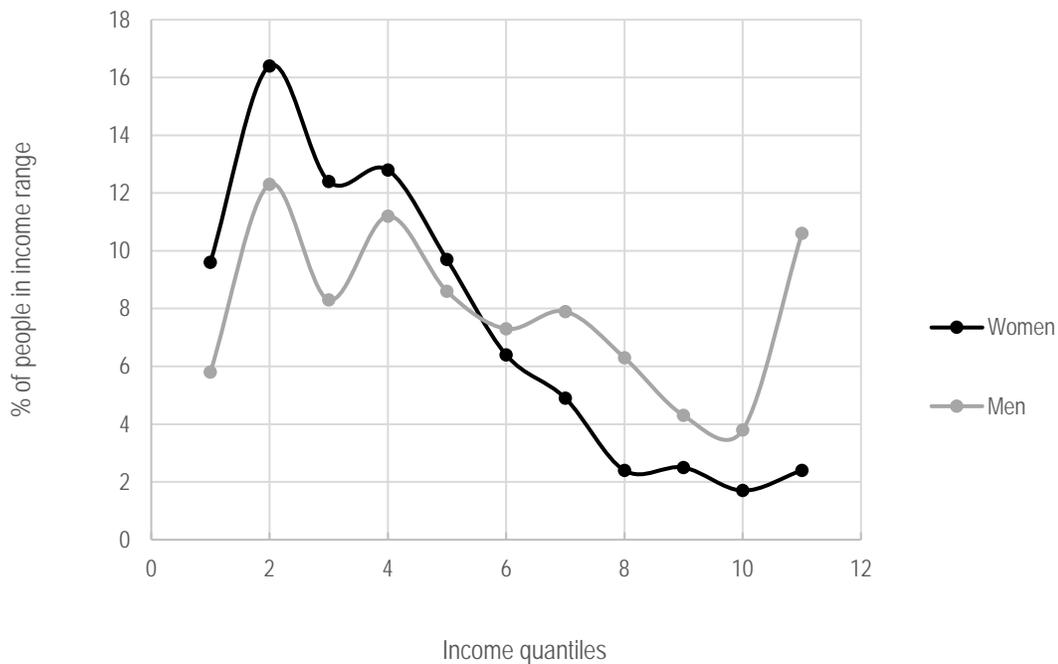


Figure 4.3 Distribution of income of men and women in BC, 2014

Unsurprisingly, women are hit slightly harder by the tax because they make less than men across income quantiles (Figure 3.1), especially before the rebate. To compare overall regressivity between genders, I calculated weighted aggregates across income quantiles (see Table 4.4). This model show that the CATC provides relief in the gendered impacts of the tax; without receiving the rebate, women overall pay 0.2% more towards the tax, which decreases to only 0.04% after receiving the CATC.

Table 4.4 Proportion of income paid towards carbon tax before and after CATC for men and women in BC, 2014 (weighted aggregates)

Demographic	Proportion of income paid towards carbon tax (weighted aggregated across income quantiles)	
	Without CATC	With CATC
Men	0.83%	0.54%
Women	1.04%	0.58%
Difference (%)	0.21%	0.04%

As shown in Figure 4.4, low-income women pay the highest share of their income towards the tax before and after the CATC rebate. Again, the CATC provides relief, but

individuals must file taxes to receive the credit, which is something low-income individuals are less likely to do (Bubna-Litic & Chalifour, 2012).

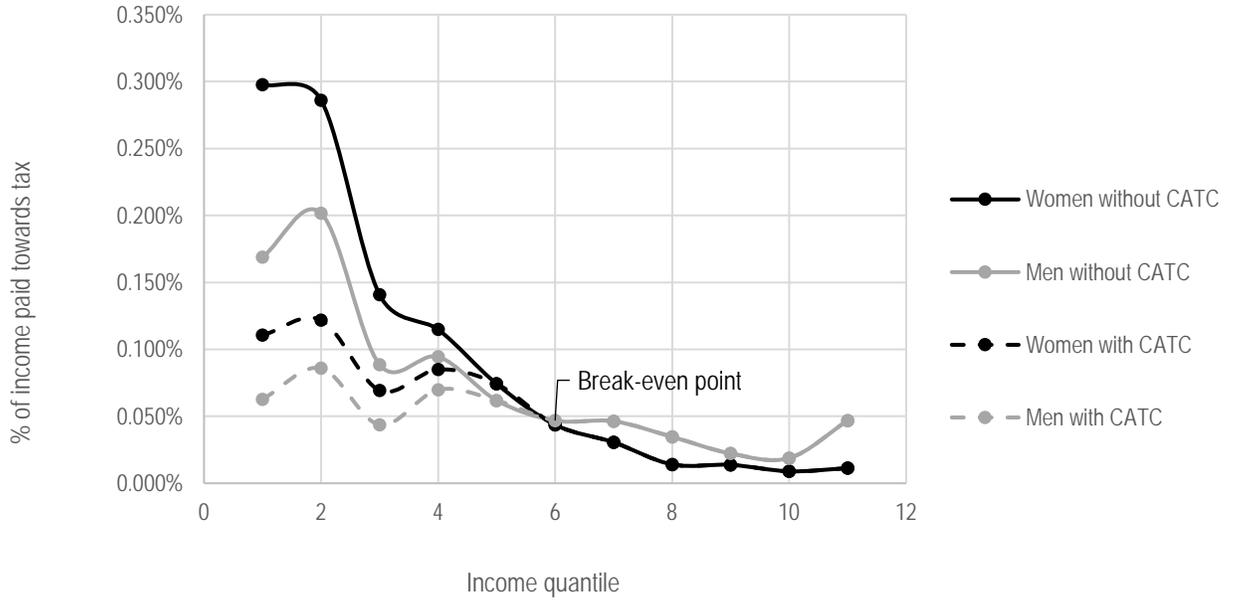


Figure 4.4 Share of income (%) spent on carbon tax before and after CATC rebate by income quantile in BC, 2014

To understand these findings in terms of dollars, see Table 4.5 below. Again, as the modelled numbers in Table 4.3 displays, overall amounts are very small when the carbon tax is at the current \$30/tonne rate.

Table 4.5 Amount spent on carbon taxed goods men and women in BC without and with CATC rebate, 2014

Lower quantile income limit	Amount (\$) spent without the rebate			Amount (\$) spent with the rebate		
	Men	Women	Difference (\$)	Men	Women	Difference (\$)
5000	8.45	14.88	6.43	3.14	5.53	2.39
10000	20.17	28.62	8.45	8.59	12.19	3.60
20000	17.71	28.16	10.44	8.73	13.88	5.15
30000	28.35	34.48	6.13	20.97	25.50	4.53
40000	24.75	29.70	4.95	24.75	29.70	4.95
50000	23.41	21.84	-1.57	23.41	21.84	-1.57
60000	27.81	18.35	-9.46	27.81	18.35	-9.46
70000	24.28	9.84	-14.44	24.28	9.84	-14.44
80000	17.80	11.01	-6.79	17.80	11.01	-6.79
90000	16.94	8.06	-8.87	16.94	8.06	-8.87
100000	46.83	11.28	-35.54	46.83	11.28	-35.54

Gendered impacts by family type

The household analysis shows that couple single-earner families are getting more back in the rebates as a proportion of income than lone-parent families in urban locations. In rural locations, couple single-earner and lone-parent families are paying the same proportion of income as long as all the families are homeowners and receive the Northern and Rural homeowner benefit (\$200) on top of the CATC. Therefore, the carbon tax revenue recycling regime is fair to rural homeowners, but not to rural dwellers who are not homeowners and do not qualify for the extra benefit.

In this household analysis, women have lower median earnings for each family type, thus paying a higher proportion of income before the CATC than men. However, the CATC does help to off-set the regressive effect of the carbon tax between men and women in similar family types and low-middle incomes, because women tend to make more back in the rebate. This analysis shows the importance of the low-income tax credit in off-setting regressive effects of a sales tax.

Age

When looking at median incomes across ages in BC, the snapshot analysis comparing youth (under 30) to all cohorts in BC shows that urban youth are paying relatively the same amount of their income towards the carbon tax. However, rural youth, who are less likely to own homes and qualify for the extra Northern and Rural homeowner benefit, pay more towards the tax compared to the baseline of all cohorts.

Rural youth are also paying more than anyone else before the rebate, pointing to the importance of considering rural dwellers who are not homeowners in designing off-sets.⁷

Table 4.6 Snapshot analysis of proportion of income paid towards carbon tax between urban and rural youth compared to all cohorts in BC, 2014

Demographic	Location	Proportion of income paid towards carbon tax	
		Without CATC	With CATC*
All cohorts	Vancouver	0.75%	0.48%
Less than 30 years	Vancouver	0.74%	0.51%
All cohorts	Prince Rupert	0.75%	-0.12%
Less than 30 years	Prince Rupert	0.85%	0.43%

**Negative numbers denote receiving a rebate amount more than the tax paid; positive numbers denote paying more towards the tax than received in the CATC rebate.*

Location

The comparison between Vancouver and Prince Rupert makes clear that the Northern & Rural off-set does return more to low to middle-income families than they pay in the carbon tax compared to large urban centres. Therefore, the Northern & Rural homeowner benefit does provide relief for northern and rural residents if they are homeowners.

4.3. Qualitative Interviews

Qualitative interviews were undertaken to complement the quantitative data analysis and to 1) explore the nuances of carbon pricing’s fairness impacts compared to other policy tools, and 2) solicit opinions on the current design of the tax and potential policy options. As previously stated in the methodology section of this paper, I used a semi-structured interview guide that sought to explore the following topics with the participants: revenue use; perceived equity impacts; political feasibility in terms of stakeholder and public acceptance; and complementary climate policy tools. Analysis of

⁷ Youth who live at home are likely not paying towards household consumption of carbon taxed goods, except for gas, and are not the targeted population of this study. A Statistics Canada report (2016) provides information about the distribution of youth (ages 20-29) who live with their parents vs. live on their own in BC. By 2011, BC youth were less likely to live with their parents than live on their own (12.7% with parents; 13.3% independent), except for youth in Vancouver where the opposite was true (8.4% with parents; 7.0% independent).

the participants' responses to these questions has been completed on a thematic basis that correlates with the interview topics.

Revenue use

Consistent with the literature, participants disagreed with the potential use of revenue generated by a carbon tax. Some participants agreed with the status quo revenue-neutral approach to the carbon tax, such as Paul Ives, the Mayor of Comox and a participant on the Climate Leadership Team. He supported the general design of the carbon tax as it currently exists, stating: "I think the province has been the vanguard of this for some time and to remain the vanguard of it we have to think about the national framework and, of course, the global economy and not to put us at a competitive disadvantage." Competitive disadvantage is often cited as an economic efficiency concern with implementing a tax increase and an impetus for the revenue neutrality component of the design.

Peter McCartney, speaking on behalf of The Wilderness Committee, views the current revenue neutral design of the tax as unfair, insofar as it does not invest in low-carbon options for communities that may need it most. Specifically, Peter mentioned retrofitting suburbs and reducing the need for long commutes that funnel people towards cities, thereby contributing to vehicle use emissions.⁸ Peter also discussed that revenue neutrality, particularly in terms of exemptions for emissions-intensive trade-exposed industries, could undermine the efficacy of the tax at reducing emissions:

I do think that by sheltering the very industries that we need to transition away from we're not doing ourselves any favors and that there's no long-term economic future in industries that are heavily polluting. And so continuing to stake our economy on it, isn't a responsible stewardship of where we need to go with our economy. We need to reduce emissions both here at home and around the world and the economic reality is beginning to reflect that.

Another participant discussed the potential to use carbon tax revenue not only for emissions reductions and climate change mitigation or adaptation policies, but also in terms of funding social justice initiatives important to a younger generation. Justin

⁸ See Condon, et al. (2011) for a joint report on complete communities in BC by the Wilderness Committee and the Canadian Centre for Policy Alternatives.

Rawlins of Check Your Head: Youth Global Education Network spoke to the intergenerational differences he perceived in environmental and social policy concerns for a generation that will inherit the costs of climate change, stating his belief that youth are generally more engaged and concerned than older cohorts. In terms of revenue use, he addressed concerns that the revenue could be used for both environmental and social justice initiatives instead of the current off-setting measures:

If you look at the carbon tax, it's revenue neutral and doesn't really address climate change in any meaningful way. That's money that could be used for all kinds of projects, like social housing, that would have positive effects on climate change and also the housing crisis in the Lower Mainland.

The design element of revenue neutrality continues to be a sticking point between carbon tax supporters and opponents, as well as within different factions of supporters, as illustrated by the participants in this study.

Political feasibility

Both in the literature and throughout the interviews conducted for this study, political feasibility is closely linked with the revenue neutrality component of the carbon tax. Participants cited the acceptance of the tax by industry as being particularly tied to revenue neutrality. When asked if Mayor Ives supports the revenue-neutrality design element he stated:

Absolutely. I think that's the key in acceptance, over time, of this plan. I know that there's those who would like to see it not applied to specific industries, but I think that if you make it revenue neutral and you set a price on carbon that's going to happen anyway. To avoid concern expressed by the public that this is another tax grab, I think you have to respect that, and say there will be a tax here but there will be off-sets elsewhere, that overall we're giving things back.

In terms of public acceptance, Councilor Reimer identified corporate tax cuts associated with the carbon tax, meant to increase business stakeholder acceptance, as something that could weaken public support for the tax:

Remember this is 2008, this was post-Enron and not the right time to be having a corporate give-away of any tax, let alone what should have been a very positive news story. The result of that is that the NDP came out against [the carbon tax], and we hadn't anticipated how against it they would be, and that actually fueled public...a lot of people who should have

been, “thank God this is here,” became resistant because of the corporate tax cuts associated with it, which literally have nothing to do with a carbon tax, other than the Liberals’ decision to conflate the two.

Peter McCartney of The Wilderness Committee acknowledged that business stakeholders may support the revenue-neutrality of the design, but sees revenue neutrality as a design flaw that could undermine the potential of a carbon tax to reduce emissions:

I understand that the Liberal government who may have introduced it, that revenue neutrality is seen as making it politically palatable, but for a carbon tax to really work it needs to take the money that its generated and use it to create jobs and foster industries that are low carbon. Revenue neutrality really only gets you halfway there. What we’d like to see from a carbon tax is the majority of the money used to lessen the impact on low income and rural people who don’t have a choice about moving, or who can’t afford to pay for extra taxes, and then also to spend that money on things like transit, energy retrofits, and innovations.

In opposition, Mayor Ives views the off-setting measures to gain public acceptance of the tax, as shown in his previous quote. Mayor Ives expected community members to oppose such an immediate effect on their daily lives if the tax was raised too quickly, particularly if gas prices suddenly surged upwards. However, he suggested that opposition to the carbon tax may be short-lived: “I guess when you compare concerns for things like the carbon tax to healthcare, education, and other standing items in people’s daily lives it falls down the list and you don’t hear too much about it.” Peter McCartney also spoke to objections of the carbon tax by northern and rural communities, who felt unfairly targeted by the tax without being provided with other low carbon options that may exist for those who live in urban areas and with better access to low-carbon public services, such as public transportation.

Equity impacts

When asked if participants perceived any inequities associated with the carbon tax, many expressed uncertainty about specific fiscal impacts on different demographic groups. However, several participants expressed concern about broader issues with the economy and inequality as a whole, and government reticence to make broad moves towards a sustainable economy. Marjorie Griffin Cohen, professor emeritus of Simon Fraser University, discussed the difference between proactive and reactive policies. In

her view, proactive policies would address the structure of the economy beyond strategies for economic growth, having less ‘wear and tear’ on the climate. Particularly, an economy, “that was not focused primarily on resource extraction, then you could develop a lot more that was focused on meeting the needs of people in areas we aren’t now, such as personal care sectors (healthcare, education, and things like this).”

Nathalie Chalifour, a professor of law at the University of Ottawa who has written a feminist analysis of BC’s carbon tax (2010), advocates for a social justice screening process for fairness and equity for fiscal policies like the carbon tax. For example, she stated, “just having that screening process to put those choices in that are not just about economic efficiencies. Because there’s the [economic] argument, ‘well, that’s going to benefit everybody in the long run,’ but that for me it’s not sufficient.” Professor Chalifour, similar to some other participants, also expressed that revenues could be earmarked for other initiatives other than simply climate change mitigation or adaptation from a social justice perspective. She additionally stated that funds could also be used for climate change mitigation or adaptation, particularly in regards to Northern communities:

If Northern communities are going to be disproportionately impacted by climate change then maybe some of those revenues should be earmarked for helping those communities to adapt. And maybe there is a valid argument for investing in renewable energy if it’s going to speed up the mitigation process, which will have long-term impacts for communities.

The off-setting measures, personal and business tax credits, were repeatedly highlighted as problematic from a fairness perspective amongst several participants. Peter McCartney outlined The Wilderness Committee’s position as the following:

At least two-thirds of the tax goes to corporate tax reductions, which from our point of view is taking money from everyday working people and giving it to corporate tax breaks. We find that particularly concerning [...] The rebates that goes to households, rural, northern and low income, hasn’t increased since the tax came in. It started off that, it was probably a progressive tax in terms of giving money back to low income people more than they paid for, but from what I understand now it’s probably a regressive tax, and taking the money and giving it to corporate tax breaks.

Income inequality, as described by Peter above, was a concern for Justin Rawlins as well, particularly in terms of growing intergenerational income inequality. Justin relayed how fewer younger people living in urban areas are partaking in

emissions intensive activities, such as driving, due to unaffordability. He voiced that he views issues of climate change and inequality as intertwined with the following:

I can imagine a future where we address climate change but we just don't address everything else. We don't address inequality, we don't address racism, patriarchy--we don't address all these things and it's a concern. It's really important that we don't just address climate change or don't just address inequality, but we find ways where we can address both.

Conversely, Mayor Ives stated that he hasn't perceived inequities in terms of the carbon tax's impact on the community of Comox:

Costs associated with travel, I suppose are always a concern but not particularly focused on the carbon tax. When we talk about the impact of a \$10 increase in the carbon tax and describe what's going to happen, people are sensitive to gas price changes but I suppose they're paying more attention to things like what the price at Costco's gas pump as opposed to Chevron's, they don't really focus in on the carbon tax aspect of it.

Disparate views on the equity impacts of the carbon tax are taken into consideration in analyzing the appropriate mechanism for the carbon tax's revenue recycling to households.

Complementary climate policy tools

In terms of other or complementary policy tools, none of my participants voiced support for moving from a carbon tax to a cap-and-trade, emissions trading regime. In fact, some participants expressed concerns that emissions trading could be less effective than carbon pricing due to gaming the trading system. Additionally, none of my participants explicitly stated a desire to eliminate the carbon tax and our conversations remained focused on questions of carbon tax design.

Some participants expressed support for complementary regulations, and California was mentioned by Peter McCartney as a successful jurisdiction in terms of flexible regulations that could effectively and efficiently reduce emissions in tandem with carbon pricing schemes. However, he also expressed that governments need to put investments into the infrastructure that enables those regulations and used electric cars as an example: "You can't mandate people to have electric cars if you're not building the supercharging network." Peter ended the interview by stating that policymakers are focusing on the carbon pricing question, when climate policy can and should incorporate

many other policy tools, like regulations, “to enable a lower carbon lifestyle [...] if not with a higher priority.”

Marjorie Griffin Cohen expressed support for using regulations for emissions reduction. She discussed the complementary role regulations can play in tandem in carbon taxes, but she also stated that regulations are not being used to their full potential in reducing emissions. Additionally, Marjorie recalled an experience she had while on the board of directors for a heavy oil upgrader at a time when the company and the industry were anticipating and fully planning for imminent increased regulations under the federal Liberal government. But the plans were abandoned when the Conservatives won the election:

I’ve seen firsthand how readily these heavy hitters can accommodate regulations—they can, they’re good for it. [...] They were creating a whole market for capturing emissions and trading them [...] how they were going to recover the money, not immediately but over time [...] I came back after the election and it wasn’t on the agenda so I said, ‘what happened to this?’ and they said, ‘we’re not going to do it, nobody’s going to do it, we won’t need to.’ So, you can see that they can cope with regulations, when everybody is regulated, they could cope.

Marjorie also discussed the efficacy of regulations versus the carbon tax in terms of fairness; if producers can continue to emit but ship it to be consumed in another jurisdiction without a carbon tax, then the purpose of the carbon tax is partially defeated. Similarly, Nathalie Chalifour discussed the need for a social justice lens in terms of complementary policy tools like regulations, proposing that they also have distributional impacts although they are less likely to be accounted for by economists. She uses coal as an example:

If you regulate—phase out coal let’s say, which of course I’m largely in favor of—that’s still going to impact people differently. Jobs are going to be impacted differently, costs of energy are going to change very much in the same way that they do in the carbon tax, and that’s going to have implications for people in lower incomes and people in different communities. They have very similar impacts, we just don’t tend to think about them or measure them in the same way.

Based on the literature and concerns heard through the interview process on regulations, I briefly discuss the need to complement carbon taxes with other policy tools in the further considerations section of this paper.

Chapter 5. Policy Options

In this chapter, three policy options to address inequities within the personal off-setting measures in the carbon tax's revenue recycling regime are discussed: further decreases in personal income tax rates (PITs) for low-income brackets; a Status Quo + option, where the CATC is unfrozen to the original rate and indexed with future increases in the carbon tax rate; and enhanced targeting of refundable tax credits (RTCs) like the CATC.⁹ Options were developed based on the current design elements of the carbon tax, the literature review, and the quantitative and qualitative data analysis outlined in Chapters 3 and 4. Finally, options were developed whilst foregrounding a fairness lens as opposed to a sustainability lens to address the specific equity policy problem of this study.

Each option assumes that the provincial government will comply with the federally mandated price floor and increases to the carbon tax rate beginning in 2018. BC already meets the \$10/tonne price floor requirement (2018) but will have to raise the carbon tax to \$50/tonne by 2022; at least \$5/tonne per year. It also assumes that BC will continue the carbon tax's revenue recycling regime in personal off-sets, but considers which personal off-sets (personal income tax decreases or refundable tax credits) should be used and how to structure them for the greatest effect in off-setting inequities.

Lastly, with increases in the carbon tax rate on the horizon, revenue from the carbon tax can be expected to increase as well. As previously stated, the revenue recycling regime has become increasingly revenue negative throughout the carbon tax's existence (see Figure 2.2). From both sustainability and equity perspectives, the carbon tax should not continue a revenue negative trend since the revenue can be used in numerous ways to reduce emissions as well as social inequities, as described in the literature and qualitative interviews. As Table 2.2 displayed, the majority of new tax credits are targeted at business off-sets as opposed to personal off-sets, which has not been proven to reduce emissions nor inequities (Figures 2.1 & 4.2). Regardless of the recommended policy option for personal off-setting measures, the continuation of increased refundable tax credits for businesses at a rate that keeps the revenue

⁹ For a definition of refundable tax credits, see Batchelder, Goldberg & Orszag (2006) pp. 33.

recycling revenue negative at the expense of freezing personal offsets is not recommended.

Chapter 6 outlines the criteria measures used to evaluate the options below, Chapter 7 provides an evaluation of these options, Chapter 8 outlines the recommendations of this study, and finally, Chapter 9 describes further considerations that were not explicitly included in the policy analysis of this paper.

5.1. Further decreases in personal income tax rates for low-income brackets

When the carbon tax was first implemented in 2008, two personal off-setting measures were put in place: a low-income refundable tax credit (CATC) and a reduction of 5% in the first two personal income tax rates. In economic literature, reducing personal income tax rates are posited to be less distortionary on the allocation of resources in the economy (market efficiency), and are expected to stimulate economic activity, both in consumption and by providing incentives to work (Bergevin & Le Goff, 2006; Mirrlees, et al. 2011; Tuomala, 1990).

To address the distributional impacts on low-income individuals in BC, who are disproportionately women and youth, the government could opt to further decrease the personal income tax (PIT) rates of the two lowest income brackets. Changes made to the personal income tax rates in 2008 expressed in terms of marginal tax rates are shown in Table 5.1 below; the 2014 PIT schedule is used as an example. Although the taxable income levels have changed since 2008, the marginal tax rates are the same as 2008.

Table 5.1 Personal income tax rate (PIT) schedule before the carbon tax (2007) and after (e.g. 2014)

2007	2014	2008 change in marginal tax rate
5.70% on the first \$34,397 of taxable income +	5.06% on the first \$37,568 of taxable income +	-0.64%
8.65% on the next \$34,397 +	7.70% on the next \$37,568 +	-0.95%
11.10% on the next \$10,190 +	10.50% on the next \$11,140 +	-0.60%
13.00% on the next \$16,925 +	12.29% on the next \$18,503 +	-0.71%
14.70% on \$95,909 and over	14.70% on \$104,754 and over	0
Total decrease in marginal tax rates:		-2.9%

**This number reflects that this policy option would be adding to the decreases to marginal tax rates made in 2008. Source: Canada Revenue Agency, 2017*

BC’s current PIT schedule is one of the lowest overall in the country; only Nunavut’s is consistently lower across income brackets (CRA, 2017). This study considers the possibility that the BC government could opt to further lower the marginal tax rates of low-income brackets. The BC government may opt to decrease PITs at different rates, therefore exact numbers are not prescribed nor evaluated. The effectiveness of this option for off-setting the distributional impacts of the carbon tax is assessed in the policy analysis section of this paper.

5.2. Status Quo +

The status quo revenue recycling regime for personal off-sets will be assessed with some small adjustments, hence the ‘plus’ portion of this option. To distinguish the Status Quo + from the previous option, further PIT decreases are not included. Instead, this option focuses on the refundable tax credit (RTC): the low-income Climate Action Tax Credit (CATC).

As previously discussed, the CATC rate was frozen in 2010/2011 despite an increase in the carbon tax rate of \$10/tonne in the subsequent two years. Advocates in favour of the CATC opposed freezing the rate while the carbon tax rate continued to rise, as it made the whole regime more regressive (Tieleman, 2016). By 2011, individuals were not receiving the same amount back in low-income tax credits as a proportion of tax paid as they were in the initial design in 2008 (see Table 2.3).

To abide by federal government mandates on carbon pricing in the coming years, BC will need to raise the carbon tax rate by \$5/tonne per year to reach \$50/tonne by 2022. Therefore, the design of the Status Quo + policy option is to unfreeze the CATC

rate and bring it back up to 2008 proportions, with continued indexation with every rise of the carbon tax rate. Exact amounts for indexing the CATC are not prescribed nor evaluated, as calculations will depend on numerous factors and are likely to change annually. However, the concept of indexation is the hallmark feature of the CATC's original design and the factor assessed in this option.

Unfreezing the CATC rate and indexing it to the same degree as the 2008 schedule is expected to help alleviate the vertical equity concerns of the current design. Supporters of the carbon tax, even those who disagree with the revenue recycling (i.e. revenue neutrality) design of the tax, advocate for a properly indexed low-income credit. (Callan, et al., 2009; Lee, 2016). Additionally, some participants in the expert interviews undertaken for this study also advocated for continued indexation. The quantitative data analysis portion of this study—a snapshot analysis of the regressivity of the tax in 2014—will be used as a proxy for the current design in the policy analysis since figures for more recent years are unavailable.

5.3. Enhanced targeting of refundable tax credits (RTCs)

The data analysis portion of this paper outlined both regressive distributive overall impacts of the carbon tax as well as impacts felt disproportionately by women and youth—particularly, rural youth who do not live with their parents or own a home. Enhancing the targeting of refundable tax credits (RTCs) is another option the BC government can take to relieve both vertical and horizontal design inequities evaluated in the data analysis section of this study. I assume that this option also includes the measures outlined in option two, Status Quo +, since it is unlikely the government would address additional vertical inequities and some horizontal design inequities without also indexing the CATC.

In economic literature, RTCs are gaining traction as an economically efficient method of redistribution in the tax system (Batchelder, Goldberg & Orszag, 2006; Simpson & Stevens, 2015).¹⁰ The efficiency argument in favour of redistribution subsidies (tax credits) to low-income individuals and households is that those groups are

¹⁰ Refundable tax credits can be traced to the economic theory of Milton and Rose Friedman, and are part of a continuum of “negative income taxes”, or basic guaranteed annual income (Batchelder, Goldberg & Orszag, 2006).

less able to change their behaviour when a carbon tax is attempting to correct for the negative externality, and market distortion, of pollution (Batchelder, Goldberg & Orszag, 2006).¹¹ Providing less elastic consumers (e.g. low-income earners) with RTCs is efficient because those consumers are generating less of the negative externality (Batchelder, Goldberg & Orszag, 2006).

Due to the regressive impact on the working poor in BC demonstrated in the quantitative findings (Figure 4.2, after rebate line), this option entails either raising the threshold amounts of the CATC beyond LICOs, reducing the claw back rate, or both. Additionally, enhancing targeted RTCs corrects the horizontal inequity design between homeowners and renters in rural locations that disproportionately affects youth who do not live at home. Increases in targeted RTC measures are expected to cost more, but this additional cost may be partially offset by the anticipated increases in revenue as the carbon tax rate is increased towards 2022.

¹¹ Economists consider the ability to change behavior elastic or, in the case of being unable to change behavior, inelastic (Batchelder, Goldberg & Orszag, 2006; Mirrlees, et al., 2011). Low income earners' behavior is generally considered inelastic (less options to change their behavior because more of their income goes towards everyday necessities), while high income earners are able to absorb small price shocks more easily as well as have many options for changing their behavior, such as lessening their carbon footprint (Mirrlees, et al., 2011)

Chapter 6. Criteria and Measures

This study evaluates three policy options against four criteria: equity, efficiency, cost, and stakeholder acceptance. I use existing literature, as well as the quantitative and qualitative data analysis undertaken in previous sections, to develop criteria and measure policy options against each other. To avoid repetition of other analyses of BC's carbon tax, this analysis prioritizes equity impacts as opposed to sustainability or efficiency objectives, particularly on the three community groups chosen for evaluation: gender, age, and location. Table 6.1 outlines each criteria, measure, scoring, and source. The equity (effectiveness) criterion is weighted doubly, but efficiency and government management objectives are weighted equally to provide counterbalance. I first explain each objective, and then explain how each criterion will be measured.

6.1. Societal Objectives

Equity

As previously stated, this study foregrounds an equity lens in order to assess the fairness of BC's carbon tax, and is therefore the primary societal objective used for policy evaluation in this section. I evaluate each policy option based on the distributive impacts of the measure overall and on the groups selected for this study.

To measure the criterion, I use a combination of existing literature as well as the quantitative data analysis undertaken in Chapter 4 to make educated predictions. Additionally, this criterion is weighted twice as heavily compared to all other criteria to ensure that the chosen option is effective at alleviating the policy problem, and that economic efficiency and cost do not outweigh solving the problem. Other than equity, the other three criteria are weighted equally to avoid the equity criterion from distorting the results to an undesirable degree (e.g. an option would not be considered by government because it is too costly to implement).

Efficiency

Evaluating policies for economic efficiency is generally understood to encompass two facets: 1) if markets operated under perfect competition, which policy would distort

markets the least, and 2) if markets do not operate under perfect competition, which policies help to correct market failures, including externalities. Since the carbon tax is the policy used to address the negative externality of pollution, policies will be evaluated on the first facet. The criterion considers each policy option's anticipated distortionary effects on labour markets and work incentives. For example, economic theory posits that taxes reduce labour supply (known as the substitution effect) and the effect increases as taxes increase (Mirrlees, et al., 2011). However, other literature suggests that refundable tax credits can have the effect of 'smoothing,' "household income shocks and other macroeconomic fluctuations" (Batchelder, Goldberg & Orszag, 2006). Policy options are evaluated using literature to assess their economic efficiency by the degree of its predicted distortionary effects on labour markets and work incentives.

6.2. Government Objectives

Cost

Governments have an obligation to spend public funds responsibly, and the pressure to do so is particularly acute when tax increases are suggested. The cost criterion will address how much each option is expected to cost in government expenditure in recycled revenue, as well as anticipated administrative costs. The administrative complexity of each option is considered in evaluating its cost, since tax measures cost the government to administer in staff and resources.

The cost of each option to the government is qualitatively estimated, since exact numbers are not available, will depend on many factors, and likely to change annually.

Stakeholder Acceptance

For the purpose of this study, stakeholders are defined as the public. Since each option was developed to alleviate disparities felt by individuals and households, special consideration will be given to members of the disadvantaged groups that are the focus of this study when possible. However, some members of the public oppose the perception of preferential treatment in the tax system, especially when broad-based tax increases are proposed. Policies are more likely to be effective and sustained if they have broad support from the public. Industry stakeholders are not included in this criterion, since the

business off-setting measures indirectly effect individuals and households, which is beyond the scope of this study.

Stakeholder acceptance is measured qualitatively through media reports and, when available, opinion polling.

6.3. Measuring the Criteria

Measures use either quantitative or qualitative information to predict effects and impacts of policy options on criterion. I use a high-medium-low method to assess options against each other in each of the four categories. The measures, scoring system, and sources for each criterion are summarized below in Table 6.1.

Table 6.1 Measures and sources for evaluation criterion

Objective	Criterion	Measure	Scoring	Source
Societal Objectives				
Equity (x2)	Does the option reduce regressive impacts of the carbon tax with special consideration to gender, age, and locational impacts?	The degree to which regressive effects of the carbon tax are off-set with special consideration to gender, age, and locational inequities.	1. Regressive effects are off-set to a small degree.	Quantitative data analysis; qualitative interviews, literature
			2. Regressive effects are moderately off-set.	
			3. Regressive effects are off-set to a large degree or completely off-set.	
Efficiency	To what degree does the policy option promote economic efficiency?	The degree to which the policy will produce distortionary effects.	1. Policy likely to create moderate distortionary effects.	Literature
			2. Policy likely to create little to moderate distortionary effects.	
			3. Policy likely to create small distortionary effects.	
Government Objectives				
Cost	How much does the policy cost the government in recycled revenue and administrative costs?	Comparing the relative cost to government between options.	1. Substantial cost required for the option.	Literature; calculated estimations
			2. Moderate cost required for the option.	
			3. Little cost required for the option.	
Stakeholder acceptance	Does it have support from the public and impacted groups?	Proportion of stakeholders in favor of the policy.	1. Little stakeholder acceptance for the option.	Qualitative interviews; literature and media reports
			2. Moderate or unclear stakeholder acceptance.	
			3. Moderate to high stakeholder acceptance for the option.	

Chapter 7. Policy Analysis

In this section I apply the criteria and measures outlined in Chapter 6 to each of the three policy options chosen for analysis and provide a written rationale. See Table 7.4 for a matrix table summarizing the analysis of all policy options. I assess the relative merits of each policy below and draw conclusions in Chapter 8.

7.1. Further decreases in personal income tax rates for low-income brackets

Further decreasing the PITs for the two lowest income tax brackets receives the lowest score based on the criteria chosen for this analysis with 10 out of 15 points, due to its low effectiveness on the prioritized societal objective and relatively high cost.

Table 7.1 Summary evaluation for PIT decreases

Objective	Option 1: Decrease PITs
Equity (x2)	2
Efficiency	3
Cost	1
Stakeholder acceptance	3
Total / 15	10

Equity

The major drawback of using further decreases in PITs to recycle revenue back to low-income earners is that it does little to address overall regressivity of the carbon tax, nor specifically relieves inequities related to gender, age, or location. Technically, the policy will recycle more revenue to families than without the decrease—and therefore, less regressive—because all families will be able to retain more income (Bergevin & Le Goff, 2006). However, the policy does relatively little to address discrepancies in the share of income spent on carbon taxed goods between low and high income earners because high income earners will also benefit with the change in

their effective tax rate¹² (PBO, 2016; Mirrlees, et al., 2011). A report by the Parliamentary Budget Officer (2016) demonstrates the distributional effects of lowering PITs for lower brackets: “since income taxes are incremental, making changes to the lowest tax bracket will affect the most individuals,” including middle to high income earners (pp. 12). Additionally, it does not address horizontal inequities in the design of the existing Northern & Rural Homeowner Benefit.

Efficiency

Economic literature posits that personal income taxes produces distortions in the allocation of resources in the economy because they apply to savings, thus distorting an individual’s choice whether to consume now or save now and consume later (Bergevin & Le Goff, 2006). Theoretically, a reduction in income taxes increases an individual’s income, thereby increasing their standard of living (Mirrlees, et al., 2011).¹³ Additionally, economic theory also advances the idea that allowing individuals to keep more of their earnings will encourage them to work more; tax increases are theoretically expected to reduce the supply of labour (Mirrlees, et al., 2011).

Another reduction in PITs would theoretically be the most efficient policy option, because it would create the least distortionary effects compared with keeping PITs at their current levels and offering tax credits.

Cost

Modelling completed by the Parliamentary Budget Officer has shown that reducing rates for the lowest income tax bracket at the federal level is more costly than lowering the second lowest bracket, and neither cost can be made up for a small increase in the top bracket due to the broader base of individuals that lower brackets impact (PBO, 2016). As Appendix A demonstrates, reducing PITs has been more costly over time compared with the CATC. For these reasons, reducing marginal tax rates in the lowest income brackets is evaluated as a moderately costly option. Lastly, the overall

¹² According to Mirrlees, et al. (2011) the effective tax rate is, “the total amount of earnings taken in tax and withdrawn benefits” (pp. 55).

¹³ This is known as the *income effect*.

cost of this option is not expected to be impacted by administrative costs since reducing PITs can easily be incorporated into the existing tax system.

Stakeholder acceptance

Tax cuts are often assumed to be viewed favorably by the public, and the revenue recycling regime of BC’s carbon tax is often credited with its survival (Harrison, 2012; Willcocks, 2010). Stakeholder acceptance is expected to be high for this option, especially since both low and high income earners will benefit.

7.2. Status Quo +

Enhancing the CATC by unfreezing the tax credit rate and indexing with future carbon tax rate increases receives the medium score of all the options. It received 11 out of 15 points due to its relatively low cost and moderate effectiveness.

Table 7.2 Summary analysis for Status Quo +

Objective	Option 2: Status Quo +
Equity (x2)	4
Efficiency	2
Cost	3
Stakeholder acceptance	2
Total / 15	11

Equity

Status Quo + is a redux of the original 2008 personal revenue recycling design, and therefore upholds the original arguments made in favour of a low-income tax credit as a means to off-set regressive distributional impacts. Properly indexing the CATC can help increase the progressivity of the carbon tax system overall, because some may receive back more in credit than paid in carbon tax as shown in the quantitative analysis in Chapter 4.

Some studies are less concerned with those in the lowest income earning quantiles, because they are the most likely to receive government transfers (Beck, et al., 2015). However, other literature demonstrates the pervasiveness of the working poor in BC: Vancouver has the 2nd highest rate of working poor individuals in the country when comparing census metropolitan areas (Ivanova, 2016; Stapleton & Kay, 2015). According to Ivanova (2016), only 4% of British Columbians receive social assistance (government transfer) of the 14% of the population that lives in poverty, demonstrating the number of individuals and households who are likely to feel the regressive distributional impacts of the carbon tax (pp. 4).

The CATC was shown to provide relatively larger benefits to lower-income households, particularly those in income quantile three (\$20,000 - \$29,999), who continue to live below the LICO rate and likely part of the working poor. However, the same degree of advantage is not expected for those in income quantiles four and five (\$30,000 - \$39,999; \$40,000 - \$49,999) who are families still potentially living below or close to LICO rates. Indexing the CATC can help reduce the regressive impacts of the carbon tax felt by lower income groups.

Other benefits this option provide in reducing inequities is that it provides cash payments to households even if they owe no tax, is a tax incentive that can reach families and their children directly, and could help to encourage tax-filing which helps individuals and families qualify for other unrelated government subsidies and programs.

Efficiency

In this analysis, tax credits are considered less efficient than decreasing PITs to a small degree; there are also efficiency arguments in favor of tax credits, especially relatively small tax credits such as the CATC. Correcting for vertical inequities felt by the working poor is desirable from an economic perspective because they are likely to bear more of the burden of income shocks or may be more likely to base their spending decisions on current after-tax income (Simpson & Stevens, 2015; Batchelder, Goldberg & Orszag, 2006). Additionally, indexing the CATC to levels that reduce regressivity for the working poor, whom lone-parent women are particularly overrepresented, is not predicted to decrease work incentives (create distortions in the market) to a conspicuous degree (Mirrlees, et al., 2011).

Cost

Indexing the CATC is predicted to be the least costly option in this analysis. As shown in Appendix A, the CATC has recycled less revenue back than lowering PITs over the existence of the carbon tax. Revenues are expected to be gained in the upcoming years due to an increase in the carbon tax rate, and the cost of indexing the CATC by itself could easily be funded by this revenue source.

Stakeholder acceptance

Increasing the CATC received the lowest score on stakeholder acceptance of the three options, due to a small amount of anticipated backlash that subsidies to low income earners receive in public discourse about taxes. Conversely, this option does not address inequities perceived by rural dwellers, nor those felt by rural renters. While it is unlikely rural dwellers would oppose this option overall, support is not expected to be as high as options that are perceived to directly impact them as discussed in the qualitative interviews in Chapter 4.

7.3. Enhanced targeting of refundable tax credits (RTCs)

Enhancing targeting measures through the existing refundable tax credits is the recommended policy option of this analysis, scoring 13 out of 15 points. As this option includes the measures taken in Status Quo +, its benefits and trade-offs will not be repeated here for the sake of brevity.

Table 7.3 Summary analysis of enhanced targeting of RTCs

Objective	Option 3: Enhanced targeting
Equity (x2)	6
Efficiency	2
Cost	2
Stakeholder acceptance	3
Total / 15	13

Equity

As the data analysis of this study shows, the carbon tax is regressive to low income earners and, to a small degree, more regressive to women and youth in terms of vertical and horizontal design inequities. Although indexing the subsidy amounts for the CATC will relieve some of the regressive impacts, the working poor still get clawed back. Raising threshold amounts above, or further above, LICO lines, or reducing the claw back rates are expected to reduce regressivity in this regard. Enhancing targeting measures is expected to relieve overall regressivity, which would have disproportionate impacts by marginalized groups overrepresented in lower income quantiles. For this reason, enhanced targeting measures scores the highest in terms of the primary societal objective of equity.

Additionally, expanding the Northern & Rural Homeowner Benefit to renters would correct for the horizontal inequity in its design; there is no substantive reason why renters are excluded from the off-setting measure provided to rural homeowners. Regarding age disparities, older working age adults are more likely to be homeowners than youth and therefore more likely to receive the extra benefit.

Efficiency

As with Status Quo +, enhanced RTC targeting measures are not expected to have large distortionary effects on work incentives or consumption and savings patterns, and thus receives a medium score. As previously argued, RTCs can improve economic efficiency by eliminating the carbon tax penalty for the working poor by smoothing

household income shocks and macroeconomic fluctuations (Batchelder, Goldberg & Orszag, 2006).

Cost

Expanding the CATC and Northern and Rural Homeowner Benefit is expected to cost more than the Status Quo + option, potentially at levels on par with decreasing PITs. This option will also incur the most administrative cost out of three due to its moderate complexity. Although the CATC and Northern & Rural benefit are already part of the tax system, recycling revenue to tax filers who did not previously receive the off-sets will likely require additional time. As stated in the previous option, revenue from the carbon tax is expected to increase in the coming years. For equity purposes, it is recommended that increased revenue is not further recycled back to businesses but instead used for personal off-setting measures.

Stakeholder acceptance

Stakeholder acceptance is expected to be high for this option, especially regarding rural dwellers who have historically opposed the carbon tax and would receive an extra benefit (Harrison, 2012; Peet & Harrison, 2012). Expanding the CATC would also likely be a relatively popular choice given the revenue recycling regime already in place, though personal income tax cuts are expected to receive the least amount of backlash overall.

7.4. Summary of policy analysis

Table 7.4 Summary of policy analysis

Objective	Option 1: Decrease PITs	Option 2: Status Quo +	Option 3: Enhanced targeting measures
Societal Objective			
Equity (x2)	2	4	6
Efficiency	3	2	2
Government Objective			
Cost	2	3	2
Stakeholder acceptance	3	2	3
Total / 15	10	11	13

Chapter 8. Conclusion and recommendations

BC's carbon tax presents an opportunity to achieve sustainability goals whilst lessening social inequities in society. This study has begun to fill the empirical research by examining the impacts of the tax according to axes of equity other than income, such as gender, age, and location, and examined comprehensive policy options to address inequities observed in quantitative data and discussed in literature and qualitative data.

To summarize, this analysis recommends the following:

4. Eliminate revenue negativity to the degree possible;
5. Increase the overall share of personal off-setting measures in revenue recycling similar to 2008 levels;
6. In designing the personal off-sets, implement Option 3: Enhancing targeted refundable tax credits, which includes:
 - Raising and properly indexing the low-income Climate Action Tax Credit;
 - Increasing the CATC threshold amounts and/or reducing the claw back rate so that the rebate is not clawed back for those living under or near low-income cut-off lines;
 - Expanding the Northern & Rural Homeowner benefit to include renters.

Over the lifetime of the carbon tax, the lion's share of new tax credits have been targeted at business off-sets as opposed to personal off-sets, which has not been proven to reduce emissions nor inequities (Figures 2.1 & 4.2). From both sustainability and equity perspectives, the carbon tax should not continue a revenue negative trend since the revenue can be used in numerous ways to reduce emissions as well as social inequities.

With increases in the carbon tax rate on the horizon, revenues are expected to increase in lock-step, which could cover the cost of implementation of the recommended policies above. This study demonstrates that the CATC reduces regressivity of the carbon tax when the tax rate is at \$30/tonne. However, as the carbon tax rates increases steadily, it will be necessary to consider the change in amounts individuals pay towards carbon taxed goods both without and with a rebate structure with the following in mind: rebates are currently delivered once per year

and only to those who file taxes. This study finds that the regressive impacts across demographic groups are currently small, but should continue to be evaluated as the carbon tax rate climbs.

Ultimately, I recommend Option 3: Enhancing targeting RTCs to address concerns of regressivity and social inequity exacerbated by the carbon tax. Addressing regressive impacts will help reduce gender, age, and locational impacts felt by community groups who are disproportionately represented in low income situations. Policymakers often must choose between equity and economic efficiency, but enhancing targeted measures under the revenue recycling regime already in place (CATC and Northern & Rural benefit) is the most equitable personal off-setting option while losing relatively little in efficiency and cost. Equitable revenue recycling ensures BC's carbon tax is not only the first comprehensive carbon pricing scheme in North America, but also sustainable in the long-term.

Chapter 9. Further Considerations

9.1. Raise the carbon tax but continue to complement with other policy tools to achieve emissions reduction targets

It would be ill-advised from an equity perspective to raise the carbon tax rate to the level necessary to achieve desired emissions reductions by itself (~\$200+), and as literature and the expert interviews describe, I recommend that BC continue to complement the carbon tax with other policy tools that could include regulations. BC is not on track to meet necessary reductions and other policy instruments, such as more robust regulations, are likely needed to achieve emissions targets.

9.2. Addressing systemic social inequities

As long as women continue to make less than men, overall and for the same work, sales tax regimes will continue to disproportionately impact them and their everyday purchasing power. Women continue to make less and yet are more likely to be lone-parents and carry the care-giving burden in the home at higher rates than men. Women in rural and low-income situations will also bear the brunt of climate change differently than men. It is imperative our society moves towards paying women equally, lessening the unaffordability of care-taking (i.e. childcare) for women entering the labour force, and mitigating and adapting to climate change in gender-balanced ways. Additionally, measures to off-set disproportionate impacts of the carbon tax on youth will not address underlying factors related to decreasing social mobility.

9.3. Communities not addressed

Rural remote and Indigenous communities

Rural remote communities were not factored into this analysis due to issues of scope, but they would likely face much larger income inequality than the rural census metropolitan areas used in this study. Rural remote communities include Indigenous and federal designated reserves under the *Indian Act* (1876) that may face different and

additional hardships and barriers than other rural locations in BC related to both to remoteness and colonialism.

Seniors

Data for senior's median incomes in BC based on CANSIM Table 206-0052 was either unavailable or deemed too unreliable by Statistics Canada's data quality indicators to be used. It is beyond the scope of this study to evaluate senior's employment income or access to other forms of capital, such as capital gains, retirement savings, pensions, etc. Seniors would likely face different barriers to equity than the groups discussed in this study, and with an aging population, this may become an important area for future studies to consider.

9.4. Future areas of study

Calculations of relative carbon footprints between community groups was not factored into this study, but is worthy of analysis because it could alter what is determined to be 'fair'. For example, if men produce more emissions through their behaviour than women, perhaps it is fair that they pay more in the carbon tax. Or, perhaps they are not paying enough relative to the larger size of their footprint. A study by Cohen (2013) begins to address this issue, however there is little to no availability of recent data that could have provided a comprehensive basis for analysis in this study. Additionally, I recommend collecting the data necessary to measure and hence, assess, the multiple dimensions of equity as the price of carbon (either directly through a tax or cap and trade, or indirectly through regulation) rises. To complete the analysis in this study, a number of assumptions were made that could under-estimate the equity impacts of the tax in its current design. Better data would help ensure that policy analysis and recommendations match the reality of impacts felt by residents in BC.

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Appendix A. Revenue Neutrality Calculations according to the BC Ministry of Finance's public numbers

REVENUE NEUTRAL CARBON TAX: CARBON TAX REVENUE AND OFF-SETTING MEASURES									
Carbon Tax Rate: tonne/CO2-e	\$10-15	\$15-20	\$20-25	\$25-30	\$30	\$30	\$30	\$30	\$30
						Revised Forecast	Forecasts		
Fiscal Year	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Carbon Tax Revenue (\$ millions)	306	542	741	959	1120	1212	1228	1248	1271
PERSONAL TAX MEASURES									
Low income climate action tax credit	106	153	165	184	195	194	194	194	194
Reduction of 5% in the first two personal income tax rates	107	206	207	220	235	237	250	258	262
Northern and Rural Homeowner benefit of \$200			19	66	67	69	71	73	74
BC Seniors' Home Renovation Tax Credit					27		4	4	4
Children's Fitness Credit and Children's Arts Credit					9	8	8	8	8
Small business venture capital tax credit budget increased					3	3	3	3	3
Training Tax Credit extended - Individuals					10	11	20	20	20
<i>Total personal tax measures original measures only</i>	213	359	372	404	430	431	444	452	456
<i>Total personal tax measures</i>	213	359	391	470	546	522	550	560	565
BUSINESS TAX MEASURES									
General corporate income tax rate cut from 12% to 11% effective July 1, 2008, to 10.5% effective January 1, 2010 and to 10% effective January 1, 2011	65	152	271	381	450	200	202	206	224
Small business corporate income tax rate reduced from 4.5% to 3.5% effective July 1, 2008 and to 2.5% effective December 1, 2008	35	164	144	220	261	220	200	222	241
Industrial Property Tax Credit of 50% of school property taxes payable by light and major industrial properties starting in 2009 taxation year rising to 60% in 2011		54	58						
Industrial Property Tax Credit of 60% of school property taxes payable by major industry				19	22	23	23	24	24
Industrial Property Tax Credit for school property taxes payable by light industry				49	46	20			
School property taxes reduced by 50% for land classified as "farm" starting in 2011			1	2	2	2	2	2	2
Corporate income tax small business threshold increased from \$400 000 to \$500 000					20	20	21	21	21
Interactive digital media tax credit					26	63	50	50	50
Training tax credit businesses					7				
Training tax credit extended - Businesses						8	11	11	11
Film incentive BC tax credit extended in 2009 and enhanced in 2010						88	80	80	80
Production Services tax credit extended in 2009 and enhanced in 2010						66	198	208	218
Scientific Research and Experimental Development Tax Credit extended in 2014							99	180	190
<i>Total business tax measures original measures only</i>	100	316	415	601	711	420	402	428	465
<i>Total business tax measures</i>	100	370	474	671	834	710	886	1004	1061
Total designated measures: original measures only	313	675	787	1005	1141	851	846	880	921
TOTAL DESIGNATED REVENUE MEASURES	313	729	865	1141	1380	1232	1436	1564	1626
Revenue difference: original measures only	-7	-133	-46	-46	-21	361	382	368	350
TOTAL REVENUE DIFFERENCE	-7	-187	-124	-182	-260	-20	-208	-316	-355

Appendix B. Semi- structured interview guide

For the semi-structured expert interviews, the four general interview questions used are as follows:

1. Since the 2008 implementation of BC's Carbon Tax, do you perceive any inequities in how it has impacted communities?
2. In your opinion, are people in concerned about the carbon tax? If so, what are some of their concerns?
3. In your opinion, were communities in BC initially consulted, meaningfully engaged, or considered in the development of the carbon tax?
4. Would you like to see the carbon tax change? If so, which changes would you like to see? If not, are there any changes you would oppose?

Follow-up questions asked are not listed above. Occasionally, additional questions were added to the interview guide tailored to each participant's area of expertise.

Appendix C. Micro demographic cases for simulation

Table C1 Distributional cases by income quantiles for men and women in BC, 2014

Income quantiles		Median incomes for population of BC	Distribution of incomes (%)	
			Men	Women
1	\$5,000 to \$9,999	7300	5.8	9.6
2	\$10,000 to \$19,999	14200	12.3	16.4
3	\$20,000 to \$29,999	24700	8.3	12.4
4	\$30,000 to \$39,999	34700	11.2	12.8
5	\$40,000 to \$49,999	44800	8.6	9.7
6	\$50,000 to \$59,999	54800	7.3	6.4
7	\$60,000 to \$69,999	65000	7.9	4.9
8	\$70,000 to \$79,999	74100	6.3	2.4
9	\$80,000 to \$89,999	85000	4.3	2.5
10	\$90,000 to \$99,999	94300	3.8	1.7
11	\$100,000 and over	128000	10.6	2.4

Table C2 Demographic cases for household analysis by family type

Case comparison	Individual Case	Demographics	Location	Median income 2014
1	1	Men (Median income)	BC	\$39300
	2	Women (Median income)	BC	\$24000
2	3	Men (Median income)	Vancouver	\$39300
	4	Women (Median income)	Vancouver	\$25100
3	5	Men (Single, Median income)	BC	\$39300
	6	Women (Single, Median income)	BC	\$24000
4	7	Men (Married, Median income)	BC	\$39300
	8	Women (Married, Median income)	BC	\$24000
5	9	Male-single-earner couple families	Vancouver	\$34430
	10	Female-single-earner couple families	Vancouver	\$21490
6	11	Lone-parent families male	Vancouver	\$42870
	12	Lone-parent families female	Vancouver	\$27865
7	13	Male-single-earner couple families	Prince Rupert	\$38750
	14	Female-single-earner couple families	Prince Rupert	\$22910
8	15	Lone-parent families male	Prince Rupert	\$33650
	16	Lone-parent families female	Prince Rupert	\$21872

Table C3 Demographic cases for household analysis by age and location

Case comparison	Individual Case	Demographics	Location	Median income 2014
9	17	All cohorts	Vancouver	\$33520
	18	Less than 30 years	Vancouver	\$34100
10	19	All cohorts	Prince Rupert	\$33520
	20	Less than 30 years	Prince Rupert	\$27770

Appendix D. Micro-simulation results

Case comparison	Case	Demographics	Location	Median income	Spending			Tax Paid				Rebates			Proportion of income paid towards carbon tax	
					Natural gas	Other fuel	Gas and other fuels	Natural gas	Other fuel	Gas and other fuels	TOTAL	CATC*	Northern & Rural homeowner benefit (\$200)	TOTAL	Before rebates	After rebates
1	1	Men (Median income)	BC	39300	456.90	40.36	1459.91	182.98	3.70	77.90	264.58	91.31		91.31	0.67%	0.44%
	2	Women (Median income)	BC	24000	391.11	37.30	1235.00	156.63	3.42	65.90	225.95	169.09		169.09	0.94%	0.24%
2	3	Men (Median income)	Vancouver	39300	456.90	40.36	1459.91	182.98	3.70	77.90	264.58	91.31		91.31	0.67%	0.44%
	4	Women (Median income)	Vancouver	25100	395.84	37.52	1251.17	158.53	3.44	66.76	228.73	169.09		169.09	0.91%	0.24%
3	5	Men (Single, Median income)	BC	39300	456.90	40.36	1459.91	182.98	3.70	77.90	264.58	0.00		0.00	0.67%	0.67%
	6	Women (Single, Median income)	BC	24000	391.11	37.30	1235.00	156.63	3.42	65.90	225.95	115.50		115.50	0.94%	0.46%
4	7	Men (Married, Median income)	BC	39300	456.90	40.36	1459.91	182.98	3.70	77.90	264.58	196.78		196.78	0.67%	0.17%
	8	Women (Married, Median income)	BC	24000	391.11	37.30	1235.00	156.63	3.42	65.90	225.95	231.00		231.00	0.94%	-0.02%
5	9	Male-single-earner couple families	Vancouver	34430	435.96	39.39	1388.32	174.59	3.61	74.08	252.29	300.00		300.00	0.73%	-0.14%
	10	Female-single-earner couple families	Vancouver	21490	380.32	36.80	1198.10	152.31	3.38	63.93	219.62	300.00		300.00	1.02%	-0.37%
6	11	Lone-parent families male	Vancouver	42870	472.25	41.07	1512.39	189.13	3.77	80.70	273.60	52.48		52.48	0.64%	0.52%
	12	Lone-parent families female	Vancouver	27865	407.73	38.07	1291.82	163.29	3.49	68.93	235.71	265.50		265.50	0.85%	-0.11%
7	13	Male-single-earner couple families	Prince Rupert	38750	454.54	40.25	1451.83	182.03	3.69	77.47	263.20	300.00	200	500.00	0.68%	-0.61%
	14	Female-single-earner couple families	Prince Rupert	22910	386.42	37.08	1218.98	154.76	3.40	65.04	223.20	300.00	200	500.00	0.97%	-1.21%
8	15	Lone-parent families male	Prince Rupert	33650	432.61	39.23	1376.86	173.25	3.60	73.47	250.32	265.50	200	465.50	0.74%	-0.64%
	16	Lone-parent families female	Prince Rupert	21872	381.96	36.87	1203.72	152.97	3.38	64.23	220.58	265.60	200	465.60	1.01%	-1.12%
9	17	All cohorts	Vancouver	33520	432.05	39.20	1374.94	173.03	3.60	73.37	249.99	89.48		89.48	0.75%	0.48%
	18	Less than 30 years	Vancouver	34100	434.54	39.32	1383.47	174.03	3.61	73.82	251.46	77.88		77.88	0.74%	0.51%
10	19	All cohorts	Prince Rupert	33520	432.05	39.20	1374.94	173.03	3.60	73.37	249.99	89.48	200	289.48	0.75%	-0.12%
	20	Less than 30 years	Prince Rupert	27770	407.32	38.05	1290.42	163.13	3.49	68.86	235.47	115.50		115.50	0.85%	0.43%
1	21	\$5,000 to \$9,999 (percent)	BC	7300	319.30	33.96	989.51	127.87	3.12	52.80	183.79	115.50		115.50	2.52%	0.94%
2	22	\$10,000 to \$19,999 (percent)	BC	14200	348.97	35.34	1090.94	139.76	3.24	58.21	201.21	115.50		115.50	1.42%	0.60%
3	23	\$20,000 to \$29,999 (percent)	BC	24700	394.12	37.44	1245.29	157.84	3.43	66.45	227.72	115.50		115.50	0.92%	0.45%
4	24	\$30,000 to \$39,999 (percent)	BC	34700	437.12	39.44	1392.29	175.06	3.62	74.29	252.97	65.88		65.88	0.73%	0.54%
5	25	\$40,000 to \$49,999 (percent)	BC	44800	480.55	41.46	1540.76	192.45	3.80	82.21	278.47	0.00		0.00	0.62%	0.62%
6	26	\$50,000 to \$59,999 (percent)	BC	54800	523.55	43.46	1687.76	209.67	3.99	90.06	303.72	0.00		0.00	0.55%	0.55%
7	27	\$60,000 to \$69,999 (percent)	BC	65000	567.41	45.50	1837.70	227.24	4.17	98.06	329.47	0.00		0.00	0.51%	0.51%
8	28	\$70,000 to \$79,999 (percent)	BC	74100	606.54	47.32	1971.47	242.91	4.34	105.20	352.45	0.00		0.00	0.48%	0.48%
9	29	\$80,000 to \$89,999 (percent)	BC	85000	653.41	49.50	2131.70	261.68	4.54	113.75	379.97	0.00		0.00	0.45%	0.45%
10	30	\$90,000 to \$99,999 (percent)	BC	94300	693.40	51.36	2268.41	277.70	4.71	121.04	403.45	0.00		0.00	0.43%	0.43%
11	31	\$100,000 and over (percent)	BC	128000	838.31	58.10	2763.80	335.73	5.33	147.48	488.54	0.00		0.00	0.38%	0.38%
	32	Men (Weighted aggregate)	BC												0.83%	0.54%
	33	Women (Weighted aggregate)	BC												1.04%	0.58%

Appendix E. Micro-simulation technical appendix

Spending assumption

Since the Survey of Household Spending (SHS) does not disaggregate the survey by individual, and therefore the earner's gender, I calculated adjusted spending amounts assuming a linear relationship to income. It is unlikely that residents across BC spend in the same ways based on their incomes: lifestyle factors related to gender, age, and location, among others, undoubtedly shape spending behaviours. However, the SHS provides the best available data and helps to provide a rough picture of spending habits based on income across the province.

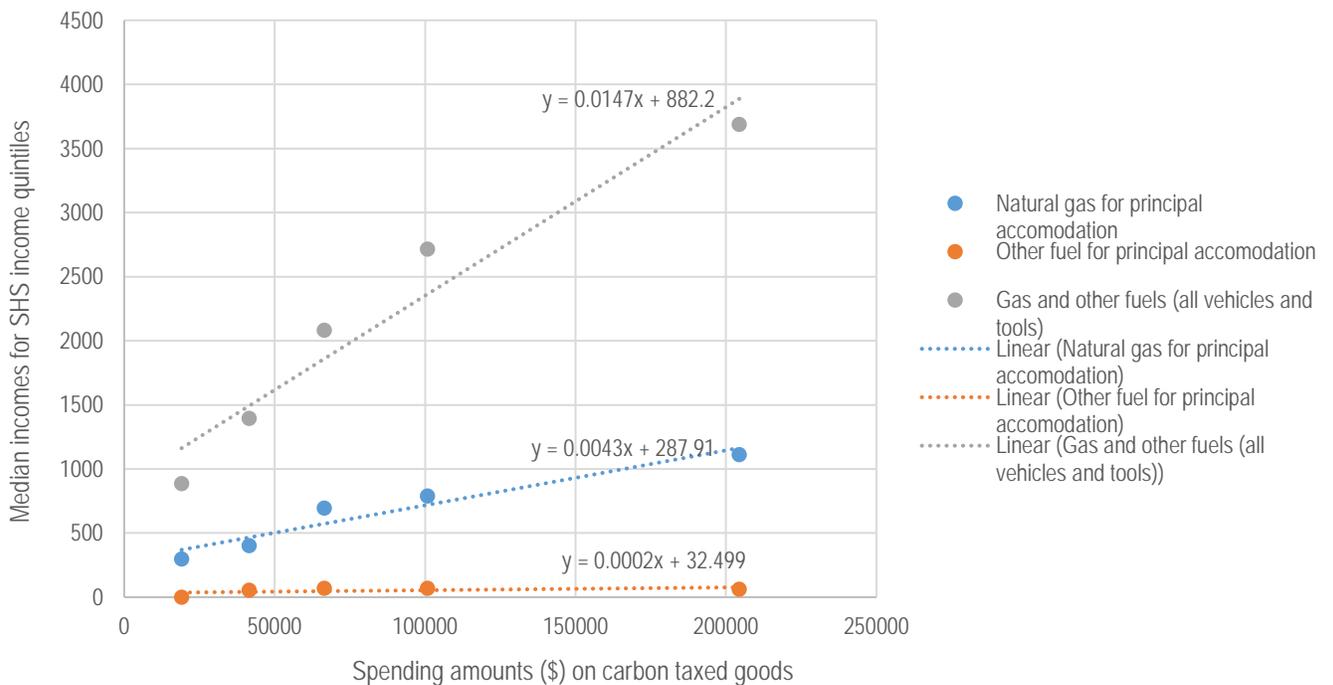


Figure E1 Income and spending relationship on carbon taxed goods

Marriage rates

For Cases 1-4 in Appendix D

, I used the BC marriage rate of 4.64 to address the discrepancy that individuals receive in CATC rebate amounts. Therefore, the calculated rebate amounts for Cases 1-4 are weighted based on amounts single and married individuals receive.

Pass through rate

Similar to other studies, I assume that producers fully pass on the added cost of producing carbon taxed goods to consumers in the final market price.

Family size assumption for CTaCS rebates

Lone-parent families in BC have a lower average size of 2.5 (1.5 children) than couple families at 3.8 (1.8 children). For calculations in the micro demographic profiles and modelling, I round-up estimates of children for couple and lone-parent families to two to cover the cost of the 0.5 and 0.8 children in the averages.