# Designing Politically Acceptable and Effective Policies to Mitigate Climate Change

**by**

**Ekaterina Rhodes**

M.Sc., Aston University, 2009
B.A., St. Petersburg State University of Engineering and Economics, 2008

Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy

in the
School of Resource and Environmental Management
Faculty of Environment



**SIMON FRASER UNIVERSITY**

**Summer 2016**

## Approval

**Name:** **Ekaterina Rhodes**

**Degree:** **Doctor of Philosophy (Resource and Environmental Management)**

**Title:** ***Designing Politically Acceptable and Effective Policies to Mitigate Climate Change***

**Examining Committee:** **Chair:** Murray Rutherford
Associate Professor

**Mark Jaccard**
Senior Supervisor
Professor

**Jonn Axsen**
Supervisor
Assistant Professor

**Kathryn Harrison**
Supervisor
Professor
Department of Political Science
University of British Columbia

**Shane Gunster**
Internal Examiner
Associate Professor
School of Communication

**Robert Gifford**
External Examiner
Professor
Department of Psychology
University of Victoria

**Date Defended/Approved:** May 25, 2016

## Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

a. human research ethics approval from the Simon Fraser University Office of Research Ethics

or

b. advance approval of the animal care protocol from the University Animal Care Committee of Simon Fraser University

or has conducted the research

c. as a co-investigator, collaborator, or research assistant in a research project approved in advance.

A copy of the approval letter has been filed with the Theses Office of the University Library at the time of submission of this thesis or project.

The original application for approval and letter of approval are filed with the relevant offices. Inquiries may be directed to those authorities.

# Abstract

Several criteria are usually considered when evaluating climate policy options. If the policy is ineffective, it will not achieve the emission reduction goal. If the policy is effective and economically efficient, it could achieve the goal at a relatively low cost. But if the policy is likely to trigger strong opposition from an influential segment of the public, its inability to achieve political acceptability may prevent its implementation, even by politicians who are keen to reduce emissions. The goal of this thesis is to identify the key attributes of acceptable climate policies to help policy-makers improve their chances of implementing and sustaining policies that actually reduce greenhouse gas emissions.

The thesis consists of four distinct research papers. The first paper focuses primarily on the assessment of policy effectiveness and efficiency using British Columbia's carbon tax and clean electricity standard as a case study for comparing two policies that differ significantly. Specifically, I describe and analyze these policies using multi-attribute policy evaluation criteria that include annual emission reductions and economic costs of emission reductions due to each policy. The other three papers address the issue of political acceptability by exploring in different ways its one key component, citizen support. In particular, I assess citizen support for different types of climate policies and identify the key factors predicting policy support, using a representative sample of Canadian citizens (n=1,306). Several findings emerge from my research. First, while carbon taxes are considered the most economically efficient climate policy, they are the least popular type of policy among the general public. In contrast, regulatory policies, including clean electricity standards, low carbon fuel standards, and efficiency regulations, appear to receive relatively high citizen support while causing substantial emission reductions. Second, citizen knowledge of climate policy is not associated with higher policy support, suggesting that widespread knowledge and well-informed citizen support may not be required for implementation of effective climate policies. Third, only a few factors are consistent predictors of citizen support across policy types, including being concerned about climate change, having trust in scientists, and being female. Other significant factors are unique to different policy types.

**Keywords**: climate policy; emission reductions; economic efficiency; political acceptance; citizen support; policy knowledge

## Dedication

This dissertation is dedicated to my mom, Galina Petropavlova. Her constant love, encouragement, and support have sustained me throughout my life.

## Acknowledgements

I would like to thank my senior supervisor, Mark Jaccard, for his continuous assistance, guidance, and encouragement throughout my Ph.D. experience at REM. You have helped me advance multiple professional skills and influenced my career path in climate policy making. Thanks for your time and effort to help me succeed in the Ph.D. program.

My thanks also go to the rest of my supervisory committee, especially Jonn Axsen, whose research interests and skills have strongly influenced the direction of my research. Everything I learned about behavioural surveys and peer-reviewed publications is a result of your excellent mentoring abilities, continual encouragement, and constructive feedback.

Finally, thanks to my family for their support throughout the whole Ph.D. process. Special thanks to my loving husband, Graham, who has read and edited all of my papers, has listened to my practice talks, and has always shared his passion for environmental change with me.

# Table of Contents

# List of Tables

## List of Figures

# Chapter 1. Introduction

Substantial reductions in greenhouse gas emissions (GHG) are required to limit the impact of global climate change. However, governments at all levels and regions over the past decades have almost universally failed to achieve their emission reduction targets. Several factors may explain this failure. At the international level, GHG emission reduction represents a global public good whose benefits are unconstrained by national boundaries but whose costs are only borne by those jurisdictions that make a concerted abatement effort. Because this creates an incentive to free-ride on the efforts of others, international coordination is required to ensure a comprehensive effort to reduce emissions (Sandler, 1996). However, self-interest bias influences the views of different countries and regions on the fair allocation of this effort between, for example, developed and developing countries, making an effective agreement elusive. Thus, the international climate negotiations in Paris in 2015 failed to produce binding national GHG abatement targets that would collectively prevent temperatures from rising more than 2 C above pre-industrial levels. In this context, one still encounters the concern that costly national efforts to reduce emissions may be of little effect.

Climate policy failure might also be explained by the abundancy and high energy quality of fossil fuels. These fuels reward continuous efforts to innovate in technologies that produce and use them, and these innovations can significantly reduce the costs of such use. As this occurs, energy efficiency, renewable energy and nuclear energy appear less beneficial as alternatives to fossil fuels. Also, the fossil fuel industry has a vested interest in the status quo, and as a powerful interest group, can lobby aggressively to delay the implementation of effective climate policies. Given that the benefits of emission reduction will be realized in a future period well beyond the typical political timeframe, meaningful climate action does not provide a political gain in the eyes of most politicians.

Even in jurisdictions in which political leaders are willing to reduce emissions, climate policy making has been difficult due to strong opposition from some segments of the public. This resistance is particularly strong for pricing policies, such as carbon taxes, that have highly visible ('salient') costs (Lachapelle et al., 2014). In the last 25 years in North America, only the province of British Columbia has successfully implemented a serious carbon tax, but even there it was met with controversy (Harrison, 2012). Instead, most governments have implemented relatively ineffective non-compulsory policies that encourage voluntary behaviour to reduce emissions.

Emerging behavioural research explains that a perceived self-interest bias influences people's interpretations of the consensus evidence provided by climate scientists and climate policy experts (Caplan, 2007; Thaler and Sunstein, 2008). As a result, there is a substantial gap between what policy analysts suggest as effective policy and the policy design that achieves political acceptance. Unfortunately, the most effective policy may often be the least politically acceptable, limiting its chances for long-term implementation.

My thesis aims to contribute to this line of research by investigating attributes and perceptions of effective climate policies that may also perform well in terms of political acceptability. Specifically, my goals are to (1) assess the effectiveness and economic efficiency of British Columbia's carbon tax and clean electricity standard, (2) assess citizen support for different types of existing and hypothetical climate policies in Canada, and (3) identify the key factors influencing citizen support for different policy types, using survey data collected from a representative sample of Canadian citizens (n=1,306). By assessing the effectiveness, efficiency, and acceptance of climate policy designs, my research integrates concepts from various disciplines, including economics, environmental science, and social psychology.

In the following sections, I describe and compare the key types of climate policies that may be implemented to reduce GHG emissions. Section 1.1 presents the main policies for reducing GHG emissions. Section 1.2 reviews some of the literature on conceptual frameworks used to explain citizen support for climate policy. This section also describes the key literature gaps that I attempt to address in my thesis. Finally, in section 1.3, I provide a summary of the thesis.

## 1.1. Policies to reduce greenhouse gas emissions

One way to categorize climate policies is based on their degree of compulsoriness (Jaccard, 2006). Compulsory policies require emission reductions via regulation of technologies or fuels, or financially penalize emissions to such an extent that many firms and households are bound to take emission-reducing actions. Non-compulsory policies encourage voluntary behaviour to reduce emissions without entailing any negative consequences for non-compliance. These policy options are discussed below in terms of the typical evaluative criteria that include effectiveness in reducing GHG emission, economic efficiency, administrative feasibility, and political acceptance (Goulder and Parry, 2008). A policy is considered effective if it contributes substantially to meeting GHG reduction targets at national and sub-national levels. The criterion of economic efficiency assesses policy costs against the “equi-marginal principle.” According to this principle, a policy is considered economically efficient if it imposes the same price signal on every individual and/or business for its last (marginal) unit of emissions reduction, thereby minimizing total costs of emissions reduction. Administrative feasibility implies that a policy is not overly complex and can be implemented without a significant expansion of bureaucracy and government administrative costs. Finally, politically acceptance implies that a policy is perceived as justified and fair by most members of the general public and other influential groups. A policy is especially likely to face opposition if it imposes explicit visible costs on certain individuals or interest groups (Chetty, Looney, and Kroft, 2009).

Regulatory policies include emission standards, energy efficiency standards (e.g., vehicle efficiency regulations, building efficiency standards), building code provisions, and other requirements that set specific technology characteristics. By causing the substitution towards zero-emission and near-zero-emission technologies and energy forms, regulations can be highly effective in reducing GHG emissions. Moreover, some types of regulations may be relatively acceptable to consumers and firms, depending on the costs they impose and their visibility. Specifically, regulations increase internal operations costs for businesses and individuals but do not require direct transfers to government. However, regulations can be economically inefficient if they are not matched by policies that impose similar marginal costs on all other emissions. These inefficiencies can be minimized if regulations include market flexibility features that, for example, allow participants to choose among low carbon technologies or energy forms, or allow credit trading among regulated agents. Regulations can be administratively feasible depending on their design.

Climate policies that increase the cost of emitting typically include carbon taxes, charges, and levies on GHG emissions on a per unit basis. These policies do not prescribe specific actions but require businesses and individuals to either pay emission charges or invest in emission reduction technologies to lower their charges. This choice also gives participants an incentive to innovate (Goulder and Parry, 2008). Carbon taxes can be effective in reducing GHG emissions if set at a relatively high level, but do not guarantee exact emission reductions in advance. These policies are usually considered economically efficient because they put a universal price on emissions, thereby satisfying the equi-marginal principle to achieve GHG reductions at the lowest total cost. Further, if carbon tax revenues are used to reduce other taxes that impede economic output, the policy may stimulate some compensating economic growth (Goulder, 1995). Carbon taxes are generally considered administratively feasible because they can be integrated with existing methods of collecting taxes. However, by imposing explicit visible costs, these policies may face strong opposition from individuals and interest groups. In particular, because carbon taxes require direct payments to government, these can be portrayed as simply another 'tax grab' (Harrison, 2012).

Among compulsory climate policies, policy analysts also distinguish emissions cap and tradable permit schemes (known as 'cap-and-trade') that combine features of regulations with the emissions pricing of carbon taxes. In this case, a governing agency sets an emissions limit (cap) and then allocates tradable emission permits that equal the aggregate level of the cap. By setting a limit on emissions, the GHG reducing effectiveness of cap-and-trade can be known in advance, similar to most regulations. By allowing participants to trade emission permits, cap-and-trade can ensure that marginal costs of emission reductions are equalized across participants, thereby achieving GHG reduction goals at a relatively low cost. Cap-and-trade programs can be more politically acceptable than carbon taxes but can be administratively complex.

Non-compulsory policies typically include subsidies to purchase low-carbon technologies (grants, rebates, tax credits, low-interest loans), educational and informational programs, and direct government investments. Subsidies are one of the most popular policy types among politicians because they provide immediate financial benefits to the recipients and thus rarely face any opposition. However, subsidies are often ineffective in reducing emissions because of the so-called “free-ridership” problem (Joskow and Marron, 1992). Free-riders are those people who would have taken the desired action regardless of the provided subsidy. Because it is inherently impossible to know people’s true intentions and to exclude all free-riders, subsidies do not always result in additional emission reductions (Joskow and Marron, 1992). Moreover, subsidies may be economically inefficient if they support high-cost options, which require raising substantial revenues from other sources (Stavins, 2001). Also, subsidies can be expensive because of sizeable administration expenditures associated with the recruitment of participants, monitoring emission reduction actions, and assessing the effectiveness of the policy. Jaffe et al. (1989) find that energy efficiency subsidies do not reduce the use of energy consuming technologies to the same extent as do policies that increase energy prices.

Informational programs promote benefits of environmentally responsible choices, such as saving money due to energy efficiency (private benefit) and limiting energy use to reduce carbon emissions (social benefit). Informational programs about private benefits tend to have a little impact on reducing emissions because significant GHG reduction is rarely profitable (Jaffe et al., 1999). Information about social benefits represents a quasi-public good, the benefits of which accrue to all individuals and businesses regardless of the amount of time they spend on studying this information (Caplan, 2007). Therefore, there is an incentive to free-ride on other people who invest their time in understanding information about social benefits of pro-environmental behaviour.

Government efforts to reduce emissions in their own assets (e.g., buildings, equipment, infrastructure) can be somewhat effective because government controls a large portion of the economy. But because government does not control the whole economy, total costs of emission reductions are not minimized, making government procurement policies inefficient. In terms of political feasibility, both government investments and informational programs are highly acceptable because of their non-compulsory nature, and therefore, have been widely used to create an impression that emission reduction actions are happening.

I have thus far defined the criterion of policy acceptance through the lens of citizen and stakeholder perceptions of policy costs and fairness, as suggested in some policy literature. However, policy support is also likely to be affected by factors other than perceived costs and fairness. Specifically, support among individuals can vary because of multiple characteristics, including values, social norms, and other contextual factors (Gifford, Kormos, and McIntyre, 2011). In my thesis, I investigate how and why certain citizens may support different types of climate policy in order to help policy-makers design acceptable and effective policies that are likely to endure. The following section describes some of the key theoretical frameworks used in the past to explain citizen support for climate policy.

## 1.2. Conceptual frameworks of climate policy support

Most conceptual frameworks of climate policy support build on other models of pro-environmental behaviour. Researchers tend to assume that climate policy support represents a public-sphere type of pro-environmental behaviour that indirectly impacts GHG emissions by altering behaviours of many people and organizations (Stern, 2000). Most models of pro-environmental behaviour can be divided into three major categories: internalist, externalist, and integrative models (Jackson, 2005). Internalist frameworks treat pro-environmental behaviour primarily as a function of attitudinal motivations that are considered ‘internal’ to the individual, including values, beliefs, emotions, and habits (Ajzen, 1991; Schwartz, 1992; Stern et al., 1999). For example, the Norm Activation Theory suggests that pro-environmental behaviour is driven primarily by personal norms arising from an awareness of consequences of one’s actions and the willingness to take responsibility for those actions (Schwartz, 1992). However, internalist models tend to be weak predictors of difficult and costly behaviours that might be influenced by multiple contextual forces, including social processes (e.g., trust in governments, social expectations), financial constraints (e.g., income, cost of low-carbon technologies) and institutional factors (e.g., availability of public transit, building design) (Bamberg and Schmidt, 2003).

Externalist frameworks focus mostly on cultural, political, and economic factors of pro-environmental behaviour. For instance, the Cultural Theory suggests that pro-environmental behaviour is influenced by differences in social organization that can take multiple forms (Thompson et al., 1990). In contrast to the internalist insights, the externalist approach overlooks many attitudinal characteristics explaining pro-environmental behaviour. As a result, these two approaches offer different policy prescriptions. The internalist approach promotes educational programs, information provision, and marketing campaigns to influence people's attitudes. In contrast, proponents of externalist perspectives suggest the provision of incentives, institutional reforms and regulatory changes.

Integrative models combine insights from the internalist and externalist frameworks in an effort to provide a more comprehensive perspective on drivers of pro-environmental behaviour. In ascending order of conceptual complexity, the major integrative frameworks include Stern's (2000) Attitude-Behaviour-Context model, Triandis' (1977) theory of interpersonal behaviour, the motivation-opportunity-abilities model (Ölander and Thøgersen, 1995), and Bagozzi's model of consumer action (Bagozzi et al., 2002). While more sophisticated models account for more explanatory variables and complex relationships between them, they lack parsimony and sometimes are not empirically testable (e.g., Bagozzi et al., 2002). Stern's (2000) Attitude-Behaviour-Context (ABC) framework is among a few integrative models that account for multiple internal and external factors, while being parsimonious and practical enough to facilitate empirical testing. For these reasons, my research draws from Stern's (2000) ABC theory.

According to the theory, policy support is an interactive product of attitudinal variables, contextual variables, and personal capabilities. Attitudinal variables typically include values, beliefs, and personal norms. These variables have been successful in explaining attitudinal causes of climate policy support in the past. For example, Dietz et al. (2005) and Steg et al. (2005) found that citizen support for climate policy is associated with altruistic and biospheric values, general environmental concern (i.e., beliefs that the biophysical world is fragile), concern about climate change (i.e., beliefs in human causes and adverse consequences of climate change), beliefs in responsibility to reduce climate change, and personal norms (i.e., guilt and moral obligation to reduce climate change). Further, people who believe in human causes and adverse consequences of climate change are more likely to be willing to pay the cost of climate policy and adopt pro-environmental behaviours (Clark et al., 2003; Dietz et al., 2007; Zahran et al., 2006).

The second category of variables comprises contextual variables, which include social, political, and economic factors. Social and political variables are typically measured through trust, social networks, and political ideology. Trust in entities assessing and solving environmental issues tends to influence policy support when people do not possess sufficient knowledge or time to assess those issues (Cvetkovich et al., 2002). Trust in governments, industry, and scientists has been associated with citizen support for climate policy in the past (Dietz et al., 2007; Kallbekken and Sælen, 2011; Shwom et al., 2010). Participation in social networks that regularly discuss environmental issues and engage in environmental activities has also predicted climate policy support (Lubell et al., 2007). Further, support for climate policy tends to be higher among people with left-liberal political perspectives than conservative ideologies (Lyon and Yin, 2010).

Socio-economic contexts of policy support are usually assessed using household variables, including area of residence and reliance on single-occupancy vehicle use. Urban residents tend to show higher support for environmental policy if they are less directly dependent for income on the extraction of natural resources (Elliott et al., 1997; Shwom et al., 2010). In addition, urban residents tend to have more transportation options, reducing the tendency for single-occupancy vehicle use (Kallbekken and Sælen, 2011). In contrast, people heavily relying on personal vehicles are more likely to oppose climate policies that increase the cost of driving (Shwom et al., 2010). Further, people willing to spend more money on reducing GHG emissions tend to show higher support for climate policies that increase the cost of emitting (Borick et al., 2011).

The final category of variables, referred to as personal capabilities, is generally assessed through socio-demographics and behaviour-specific knowledge (Stern, 2000). Higher support for environmental policies is associated with being younger, wealthier, more educated, and a female (Elliott et al., 1997; Klineberg et al., 1998). Unsurprisingly, people living in regions that are heavily dependent on carbon intensive industries, such as fossil fuel production, tend to show lower support for climate policies (Matisoff and Edwards, 2014). Finally, behaviour-specific knowledge can be measured through citizen knowledge of climate policy and climate science.

Research into the effect of citizen knowledge of *climate policy* on policy support is limited. Indeed, to the best of our knowledge, no previous studies have tested citizen awareness of policy existence and/ or citizen knowledge of policy effectiveness prior to measuring citizen support for different climate policies. In other words, the existing research implicitly assumes that citizens are aware of different types and designs of climate policies and can provide informed policy assessments. The absence of strong empirical research on the role of knowledge of climate policy in shaping citizen support raises the question of whether well-informed citizen support is essential for effective climate policy implementation. I explore this question in detail by testing the link between citizen knowledge of climate policies and climate policy support in Chapter 3. Given the lack of research in this area, I draw from existing studies on the role of citizen knowledge of *climate science* in shaping policy support (Lorenzoni et al., 2007; Stedman, 2004; O'Connor et al., 2002; Dietz et al., 2007; Kellstedt et al., 2008). While definitions of citizen "beliefs" and citizen "knowledge" vary widely across the literature, I distinguish these terms in my research. Specifically, I define citizen "knowledge" as consistency between citizen beliefs (i.e., perceptions) in the effectiveness of specific climate policies and the beliefs of experts. I also define citizen "awareness" as acknowledgement that a particular climate policy exists in British Columbia.

Several studies have tested Stern's (2000) Attitude-Behaviour-Context theory and other behavioural frameworks to explain citizen support for climate policy. While most of these studies assess *levels* of citizen support by policy type, they tend to overlook differences in the *factors* of support for different policies (Dietz et al., 2007; O'Connor et al., 2002; Shwom et al., 2010; Steg et al., 2005; Zahran et al., 2006). In particular, they construct aggregate 'indices' of policy support by amalgamating or averaging responses to a variety of policy and behaviour questions. The results of such studies are not policy specific, and therefore, should be treated with caution in climate policy-making. I address this issue by studying individual characteristics of citizen support for different types of climate policy, including market-based, regulatory, and voluntary climate policies (see chapter 5).

## 1.3. Summary of the thesis

My thesis consists of four papers. In the first paper, I describe and analyze British Columbia's two significant climate policies: the first broadly based carbon tax and the first almost 100-percent 'clean' electricity standard in North America. These policies have been in place for more than seven years, making British Columbia an ideal region for conducting a climate policy analysis. I focus specifically on the assessment of GHG emission reductions and economic costs due to each policy. I find that the carbon tax is estimated to reduce four to six times less emissions per year by 2020 than the clean electricity standard, yet anecdotal observations of media focus suggest that the carbon tax is British Columbia's dominant climate policy for reducing GHG emissions. I also find that the carbon tax reduces emissions at a cost per tonne of carbon dioxide ($CO_2$) reduced that is substantially lower than that of the clean electricity policy. Yet, again, anecdotal observations of the carbon tax's treatment in the media suggested that some if not many British Columbians perceived it to be an extremely costly policy. These controversial perceptions of the carbon tax in media sources motivated me to explore citizen knowledge and support for different types of climate policies in the following three Ph.D. papers.

The papers used empirical data collected through a web-based survey with a representative sample of Canadian citizens (n=1,306) aged 19 or older in January 2013 (see Appendix for the survey questionnaire). In the second Ph.D. paper, I separated and oversampled British Columbia respondents (n=475) for the purpose of assessing (1) citizen awareness and knowledge of British Columbia's climate policies, (2) citizen support for different climate policies in British Columbia, (3) the relationship between citizen knowledge and policy support, and (4) the effect of information provision on policy support. I find that most survey respondents are not aware of any of British Columbia's climate policies, and have little understanding of the potential effect of these on reducing greenhouse gas emissions. Once they are made aware of different types of climate policies, respondents are more likely to express support for regulations, such as the zero-emissions electricity standard and energy efficiency regulations, and less likely to support a carbon tax. Statistical analysis indicates that citizen knowledge of policy is not associated with higher policy support. Furthermore, providing information on likely policy effectiveness does not translate into higher support.

In the third paper, I analyze citizen support for a low carbon fuel standard (LCFS) that represents a regulatory performance-based climate policy that aims to decarbonize transportation by reducing average GHG intensities in transportation fuels. Specifically, I elicit citizen support for an existing LCFS in British Columbia and a hypothetical (proposed) LCFS for the rest of Canada. The research objectives are to assess: (1) citizen awareness of British Columbia's LCFS, (2) stated citizen support for the LCFS, and (3) how individual characteristics relate to levels of citizen support. I find that British Columbia's LCFS is almost unknown among British Columbia respondents, but once explained, 90% of respondents support it. I refer to this combination of low knowledge and high support as "passive support." I find similarly broad support in all other Canadian provinces. Statistical analysis identifies some individual characteristics associated with LCFS support, including attitudes, demographics, and contextual factors. Results indicate where policy-makers might anticipate opposition if it arises due to increased policy stringency or media coverage.

In the fourth paper, I examine citizen support for several hypothetical market-based, regulatory, and voluntary climate policies in Canada. My research objectives are to (1) assess citizen support for different types of climate policies, (2) identify attitudinal factors (e.g., values and beliefs), contextual factors (e.g., area of residence and driving patterns) and demographic variables that predict citizen support for different policy types, and (3) explore heterogeneity across respondents based on policy support patterns. The results indicate that most regulatory and voluntary policies receive high levels of support, while carbon taxes receive the highest levels of opposition. Regression analysis identifies several factors associated with citizen support, including values, trust, and household characteristics. However, only a few factors are consistent predictors across policy types, including being concerned about climate change, having trust in scientists, and being female. Other significant factors are unique to different policy types. Cluster analysis identifies four distinct respondent clusters based on policy support: those who strongly support all climate policies, those who are moderately supportive of all policies including the carbon tax, those who support policies other than the carbon tax, and those who strongly oppose most climate policies.

The structure of my thesis is as follows. The first three papers described above are presented in chapters 2, 3, and 4 as they were published in *Canadian Public Policy, Global Environmental Change,* and *Energy Policy*, respectively. The fourth paper is presented in chapter 5 in the format required by *Ecological Economics,* where it is currently being considered for publication. Chapter 6 summarizes the key findings from the four papers and describes several policy recommendations that emerge from my research.

# Chapter 2. A tale of two climate policies: Political economy of British Columbia's carbon tax and clean electricity standard[1]

## 2.1. Abstract

In 2007–08, British Columbia implemented two significant climate policies: the first broadly based carbon tax and the first almost 100-percent "clean" electricity standard in North America. We describe the key design characteristics of these policies and analyse them against the criteria of greenhouse gas (GHG) emissions reductions, economic efficiency, administrative feasibility, and public acceptance. We find that the clean electricity standard is estimated to reduce four to six times more emissions per year by 2020 than the carbon tax, but at an average cost per tonne of $CO_2$ reduced that is significantly higher than the carbon tax at its current level. Interestingly, the clean electricity standard achieves higher and steadier levels of public acceptance, which might be attributed to its lack of visibility, relative to the carbon tax.

## 2.2. Introduction

Many governments have established stringent targets to reduce greenhouse gas (GHG) emissions. However, effective climate policy-making has been extremely difficult for a number of reasons.

First, climate policies provide a form of global public good whose benefits are unconstrained by national boundaries but whose costs are concentrated in the countries

[1] This paper was published as: Rhodes, E., and Jaccard, M. (2013). A tale of two climate policies: Political Economy of British Columbia's carbon tax and clean electricity standard. *Canadian Public Policy, 39,* S37-S51.

or regions cutting the carbon dioxide ($CO_2$) emissions. Unless every country participates, a country that reduces emissions more than others will likely face greater costs than benefits, thus deterring its willingness to act unilaterally (Sandler, 1996). To ensure collective and cooperative actions, effective global compliance and enforcement mechanisms are needed.

Second, climate policies cause costs in the present for benefits in the future, and while the costs of climate policies are visible, people find it difficult to visualize the future benefits of lower GHG concentrations and temperatures for certain countries and regions. Moreover, although the likelihood of significant negative outcomes beyond certain temperature thresholds is virtually certain, the complexity of the earth-atmosphere system causes multiple uncertainties about “specific” impacts of climate change mitigation on certain countries and regions (IPCC, 2007).

Third, emerging research from psychology and behavioural economics suggests that many people exhibit significant distortions in how they interpret independent evidence from natural and social sciences, including climate science and climate-policy information, and that these distortions are driven by perceived self-interests (Caplan, 2007; Thaler and Sunstein, 2008). This can quickly lead to a significant gap between what policy analysts propose as optimal policy and the policy design with the greatest chance of garnering sufficient political support. In some cases, however, the most politically acceptable policy may be ineffective in achieving its stated objective of reducing emissions. For these reasons, climate policies in most countries over the past three decades have been largely ineffective, especially due to their voluntary nature and/or inability to incorporate human biases and preferences with infrastructure- and technology-purchasing decisions (Jaccard, 2012a). However, there have been some modest successes. In the 1990s, a number of northern European countries implemented carbon taxes and supporting policies that caused some shift from fossil fuels to renewable energy. For example, between 1990 and 2006, Sweden’s carbon tax and other climate policies appear to have played a significant role in decreasing its emissions by 9 percent, while its GDP increased by 44 percent (Ministry of the Environment, Sweden, 2008).

In Canada, the province of British Columbia undertook an aggressive climate-policy effort in 2007–08, with a target of reducing GHG emissions 33 percent by 2020, and 80 percent by 2050 (Government of British Columbia, 2008). To this end, government introduced a carbon tax, a clean electricity regulation, a low-carbon fuel standard, and several other policies. Although it may be difficult to predict the ultimate impact of some of these, the carbon tax and the electricity standard are “firsts” in North America in terms of their coverage and ambition, the latter being the first almost 100-percent “clean” electricity standard in North America.

These two types of policies are widely recognized in climate policy literature as having features that can be highly effective, depending on the design details and degree of stringency selected by government. An economy-wide carbon tax, if rising to a sufficient level, is favoured by most economists because it should reduce emissions at the lowest possible total cost. Moreover, if carbon tax revenues are used to reduce other taxes that impede economic output, the policy may stimulate economic growth that offsets some or all of its negative impacts. But, because of its high visibility and a bias among many members of the public against any policy that “appears” to increase taxes, it is seen as a difficult policy to implement (Harrison, 2012).

A clean electricity standard (CES) requires that a certain percentage (or all) of new electricity is generated from zero-emission sources, such as hydro, solar, or wind. It is less favoured by economists if it is not matched by policies in other sectors that impose similar marginal costs on emissions. However, as a regulation, the policy can be highly effective for GHG reduction. And, by not favouring any specific technologies or energy forms (other than zero-emission), the policy allows electricity producers to achieve the zero-emission requirement as cheaply as possible. In comparison to the carbon tax, the clean electricity standard may have better political prospects to the extent that it is less likely to be perceived in a negative light by significant members of the public. Several Canadian provinces and 30 US states now have some form of CES (usually called a “renewable portfolio standard” and focused on renewables instead of zero-emission technologies and fuels), which suggests a higher level of political acceptance. In contrast, in the last four years since British Columbia’s carbon tax implementation, not a single provincial or state government in Canada or the United States has implemented, or is planning to implement a “serious” carbon tax.

Both of these policies were implemented in the 2007–08 period of intensive climate policy development in British Columbia, and both continue to stand out as the most aggressive climate policies in North America. In the intervening years, interest in climate policy has diminished; yet the climate threat only grows with time, creating a high likelihood that climate policy activity will intensify again at some point.

Since both policies have been in place for several years and provide interesting contrasts, they create an opportunity to compare their performances thus far across a spectrum of policy evaluation criteria, and to see what lessons might be drawn for future climate policy initiatives. Our goals in this paper are to:

1. Describe the key design characteristics of British Columbia’s carbon tax and clean electricity standard; and

2. Analyze these two policies using multi-attribute policy evaluation criteria.

## 2.3. Description of the carbon tax and clean electricity standard

### 2.3.1. Carbon tax

The BC carbon tax applies to 75 percent of British Columbia’s total GHG emissions, notably from fossil fuel use. The only exemptions are fuels used by planes and ships travelling to or from the province; fuels exported from British Columbia; and all non-fossil fuel GHG emissions, including emissions from industrial processes, landfills, and forestry and agricultural activities. Overall, 14 percent of British Columbia’s emissions are industrial-process emissions not covered by the carbon tax (Horne, Petropavlova, and Partington, 2012).

The BC carbon tax was introduced at ten dollars per tonne of $CO_2$ and has been rising annually at a scheduled rate of five dollars per tonne to reach 30 dollars in 2012. It will not increase further unless specified by new legislation or regulation. At ten dollars, the carbon tax raises the price of gasoline by 2.34 cents per litre (c/L) and at 30 dollars, by 6.67 c/L. The tax collection mechanism uses the existing provisions of the Motor Fuel Tax Act applied to fuels in the province. Specifically, final-fuel consumers pay the tax to retailers, retailers pay the tax to wholesalers, and wholesalers pay the tax to the BC government.

The government designed the tax to be revenue-neutral, which implies that all carbon tax revenues are recycled through personal and corporate income tax reductions and low-income tax credits. However, several revenue-investment streams, such as the northern and rural homeowner benefit, property tax cuts for schools, and payments to municipal governments for their efforts to reduce emissions, were introduced after implementation of the carbon tax to address complaints from these constituencies.

In the period July 2008–12, the carbon tax generated $2,548 million, and the government estimates that its income tax cuts and tax credits generated returns of $3,048 million to British Columbian individuals and corporations (BC Ministry of Finance, 2010, 2011, 2012, 2013). In hindsight, to make the carbon tax precisely revenue-neutral, the income tax reductions and tax credits should have been smaller. The annual balance of carbon tax revenue and lost revenue from tax cuts and tax credits in future is uncertain, since it depends on the evolution of fuel consumption, among other things.

In the 2013 election, the main opposition party, the New Democratic Party (NDP), promised to extend the carbon tax to some industry emissions that are still untaxed, while the incumbent governing party, the Liberals, promised to freeze the carbon tax at its current level of $30 to the year 2018. The Liberals won the election.

### 2.3.2. Clean electricity standard

British Columbia derives over 90 percent of its electricity from "clean" resources, specifically hydropower. The 2010 Clean Energy Act defines "clean or renewable resources" as "biomass, biogas, geothermal heat, hydro, solar, ocean, wind or any other prescribed resources" (Government of British Columbia, 2010). This definition replaces the previous definition from the BC clean electricity guidelines that included cogeneration of heat and power, energy from landfill gas, and energy efficiency improvements as "clean" electricity sources (BC Ministry of Energy and Mines 2004, 2012).

Under the policy, independent power producers (IPPs) are exclusively responsible for new electricity supply in British Columbia, except for large hydropower, which can only be developed by the publicly owned electric utility, BC Hydro. To ensure that the established clean energy objectives and British Columbia's electricity needs are met, the Clean Energy Act requires BC Hydro to submit 20-year integrated resource plans to the BC government. In the draft of the 2012 Integrated Resource Plan, BC Hydro proposed to meet the clean electricity objective "on average" (BC Hydro 2012, 6-7). BC Hydro manages a competitive bidding process, resulting in long-term supply agreements with IPPs. In 2003, the government required IPPs to generate at least 50 percent of new electricity supply from clean sources. This clean electricity initiative was increased to 90 percent in the 2007 B.C. Energy Plan (BC Ministry of Energy, Mines and Petroleum Resources, 2007), and to 93 percent in the 2010 Clean Energy Act. As noted, the BC clean electricity policy is similar to the renewable portfolio standards existing in many US states and several other countries—except for its broader prescription of zero-emission instead of renewable supply.

## 2.4. Analysis of the policies

To assess and compare these two climate policies, we applied criteria that include estimated GHG emission reductions, economic efficiency, administrative feasibility, and public acceptance. We first estimate the annual emission reductions of each policy compared to a business-as-usual scenario by 2020. We use 2008 as a reference year (when British Columbia's Climate Action Plan was implemented) and ignore government policies or decisions made between 2008 and 2012. (We chose 2020 because it is the target year by which the province had aimed to reduce its GHG emissions 33 percent below 2007 levels.) For economic efficiency, we estimate the average cost per tonne of $CO_2$ reduced due to each policy in 2020.[2] For administrative feasibility, we assess the administrative complexity and costs associated with implementation and operation of each policy. We use our personal judgment to rate the policies on a qualitative scale, which ranges from "high" (administrative feasibility or low level of complexity) to "medium" and "low." Finally, the criterion of "public acceptance" relates to the extent to which a policy does not provoke public resistance and appears to enhance the chances of policy endurance. Based on the available surveys, we measure this criterion on a qualitative scale from a "high" level of acceptance to "medium" and "low" levels.

### 2.4.1. Carbon tax

Using a hybrid energy-economy model, independent researchers for the BC government estimated that without any additional policies, the carbon tax could reduce British Columbia's annual emissions in 2020 by three megatonnes (Mt) of $CO_2$ (Government of British Columbia, 2008). In one hindsight estimate, Elgie (2012) noted that British Columbia's overall per capita fuel use (subject to the carbon tax) fell 16.4 percent more than the rate at which fuel use fell on average in the rest of Canada, between 2008 and 2011. Rivers and Schaufele (2012) estimated that over the first four years, the carbon tax reduced British Columbia's emissions by 3.04 Mt. They argued that this suggests a high sensitivity of fuel demand to the level of the tax, and they attributed this to its high "salience." Tax salience implies that consumers are more responsive to tax-induced than to market-driven price changes because of the high visibility of taxes (Chetty, Looney, and Kroft, 2009; Finkelstein, 2009). According to Rivers and Schaufele (2012), British Columbia's carbon tax has been four and one-half times more salient than an equivalent change in gasoline prices.

While high policy salience may ensure a significant impact on emissions, it may also imply significant negative political consequences. Evidence shows that those

[2] Comparing the economic efficiency of the two policies depends on assumptions about the response to prices and regulation and the costs of incremental increases in emissions abatement—both economy-wide and within the electricity sector (in the case of the electricity-focused regulation).

constituencies that are particularly sensitive to a highly visible policy that increases the cost of fuels (e.g., northern and rural communities, greenhouse growers) may influence political decisions and can achieve tax exemptions or credits that ultimately undermine the primary policy goals. Hence, high salience may entail considerable trade-offs between significant emissions reductions and political acceptance.

In terms of economic efficiency, British Columbia’s carbon tax could be considered highly efficient for a number of reasons. First, the low initial tax rate and the five-year phase-in provided individuals and businesses with certainty about economic costs, and time to alter their fuel consumption and to plan investments. Second, the carbon tax imposes the same price for every unit of GHG emissions on almost all individuals and businesses, minimizing the total cost of emissions abatement to society. According to economists’ “equi-marginal principle,” each individual or business has an incentive to reduce emissions up to the point where any additional reductions are more expensive than paying the tax. Finally, to the extent that the revenue-recycling mechanism decreases growth-hindering taxes elsewhere in the economy, it provides a macro-economic benefit additional to its emissions-reducing effect.

For estimating the cost of reducing GHG emissions with a carbon tax, the tax revenues must be ignored. These are simply a transfer payment to government which, in this case, is immediately returned via tax cuts. Economists estimate abatement cost curves by simulating the abatement that occurs over several years due to a fixed carbon tax level. This exercise is complicated by the fact that British Columbia’s carbon tax was not fixed for its first five years. The cost of GHG emissions abatement at low carbon prices is controversial. Recent reports by the McKinsey consulting company for the United States estimated a negative average cost for carbon abatement for carbon rates up to 50 dollars per tonne of $CO_2$ (McKinsey & Company, 2009). In other words, carbon tax rates between zero and 50 dollars would stimulate profitable investments (mostly in energy efficiency) that would offset abatement investments and actions that have a positive cost. However, many economists argue that such results are only possible if researchers ignore hidden costs and risks of energy efficiency and other abatement investments. Murphy and Jaccard (2011) show how the integration of these factors into the McKinsey analysis leads to positive costs of GHG abatement. But, at low carbon tax levels, such as zero to 30 dollars per tonne, these average costs are small.

An additional complication occurs if one considers the macro-economic effect of using the carbon tax revenues to reduce corporate and personal income taxes, as in British Columbia. Goulder and Parry (1995) explained this double-dividend effect from recycled tax revenue and, more recently, Peters and Melton (2013) estimated its effect for the BC carbon tax. They concluded that, from a macro-economic perspective, the BC carbon tax at its current levels has had a net positive effect on the economy. In other words, to the year 2020, the macro-economic benefits of carbon tax recycling have exceeded the micro-economic abatement costs triggered by the tax.

To represent the diversity of cost (and benefit) estimates for the carbon tax, we provide a range for the average per tonne abated cost of the BC carbon tax. At the low end, we put the average cost at zero. At the high end, we follow cost curves produced by Murphy and Jaccard (2011) and other researchers using similar models (like the NEMS model of the US government) to estimate an average cost of five dollars per tonne, assuming that the carbon tax would stay constant at 30 dollars from 2012 to 2020, as initially modelled by the BC government and independent researchers at Simon Fraser University (Government of British Columbia, 2008; Peters 2013). The carbon tax scores high on administrative feasibility because it only requires changing the tax rates of an existing tax. Thus, administrative costs to the government, companies, and final consumers are minimal.

Governments have recognized the need for climate policies for over two decades, and economists have convinced most climate policy advisors that a carbon tax in a market economy is the most economically efficient and effective policy. Yet there are still few jurisdictions in the world that seriously apply carbon taxes. Kallbekken and Sælen (2011) note that this is not surprising, given the salience of the tax in attracting opposition from key interest groups. This explanation is consistent with earlier arguments of Olson (1971), who noted how public policies are influenced especially by groups who face concentrated costs or who stand to gain concentrated benefits. Because the tax represents different combinations of losses (carbon tax) and gains (income tax cuts) to different people, it is perhaps important to also consider the tendency of people to value losses higher than otherwise equivalent gains, as noted by Kahneman, Knetsch, and Thaler (1991). This suggests that the carbon tax would be seen more negatively than it should be, considering that it is revenue-neutral.

When the carbon tax was first announced in February 2008, political support for the governing BC Liberal party was at 50 percent, and for the opposition NDP, at 30. The growing opposition to the carbon tax from multiple interest groups, as well as rapidly rising oil and gasoline prices, motivated the provincial NDP to launch an “axe the tax” campaign. The NDP claimed that the carbon tax put an additional burden on ordinary British Columbians; however, they kept quiet about the tax’s revenue-recycling mechanisms. By November 2008, political support for the Liberals had decreased to 43 percent while NDP support had risen to the same level as the Liberals. In other words, the attack on the carbon tax appears to have played a significant role in the elimination, in eight months, of a 20-point lead in the polls (Harrison 2010, 2012; Jaccard 2012b).

Luckily for the government party, the global economic crisis shifted public concerns from environmental issues to the economy, an area where it polled higher than the NDP (Harrison 2012), while international oil prices (and thus gasoline prices) started to fall. Consequently, the Liberals regained a small lead, in time to just barely win the May 2009 election and preserve the carbon tax for the time being. Several public opinion polls by Environics have tracked public support for British Columbia’s carbon tax over time. In November 2011, 57 percent of British Columbians supported the carbon tax, whereas in February 2008, the level of support had been at 54 percent and by July 2008, when the economy was the dominant public concern and the NDP was campaigning against the tax, the level of support had fallen to 40 percent.

While the BC carbon tax still retains public support in British Columbia, Borick, Lachapelle, and Rabe (2011) and Environics (2011) find that the majority of Canadians (74 percent), including British Columbians, prefer regulatory approaches over carbon taxes for climate policy. This preference could be attributed to a variety of factors suggested by the behavioural economics literature, including the high salience of taxes and an anti-tax bias (Caplan 2007).

The political challenges associated with British Columbia's carbon tax survival in 2008–09 might be one of the reasons why no other North American jurisdiction has implemented a true carbon tax (Harrison, 2012). When first applied in Scandinavia, carbon taxes (for the most part) did not involve increases in energy prices for final consumers—carbon taxes either replaced existing energy security-motivated fuel taxes, or included multiple exemptions and differences in rates across sectors (Bruvoll and Larsen, 2004; Sumner, Bird, and Smith, 2009). And while gradual increases in carbon taxes have occurred in Sweden, Norway, Denmark, and a few other European countries, the global tendency has been to avoid the policy. Based on this evidence and experiences, both in British Columbia and elsewhere, we rank the carbon tax as "medium-low" in terms of public and political acceptance.[3]

### 2.4.2. Clean electricity standard

To estimate GHG emissions reductions due to the clean electricity standard (CES), we assessed the amount of emissions that would have been released from the cheapest alternatives to renewables if the policy had not been implemented.[4] According to the 2007 BC Energy Plan, resources for electricity generation should be developed on a lowest-cost basis for final consumers. To meet this requirement and to ensure dispatchable electricity generation, GHG-emitting natural gas and coal plants are British Columbia's lowest cost options. For reasons of political acceptability, BC Hydro has not been able to develop more of the province's potential largescale hydropower—for 25 years the government has refused to permit the Site C Dam on the Peace River, in spite of several major attempts to move ahead. For these reasons, during the last decade, BC Hydro had planned to build large natural gas plants on Vancouver Island and had

[3] Australia recently implemented a modest carbon tax that applies to fuels used to produce electricity, but not to carbon fuels consumed directly by consumers (such as vehicle fuels and home heating fuels). It is still too early to tell if the Australian carbon tax will survive or if it will be applied more effectively, as in British Columbia.

[4] Although British Columbia's CES was actually implemented and refined in three steps (50 percent clean electricity requirement in 2003, 90 percent in 2007, and 93 percent in 2010), we treat the policy as one step because we are interested in the emergence of CES as an important policy option, rather than its evolution over time by the same government. Thus, we calculate GHG reductions due to the CES as the amount of emissions that would have been released from coal and natural gas if the CES had not been implemented at all.

contracted with private developers planning coal plants. Additional similar projects would have been likely in the absence of the clean electricity policy.

In its Integrated Electricity Plan (2000), BC Hydro's proposed combined cycle gas turbine (CCGT) plants of up to 660 megawatts (MW) on Vancouver Island would be supplied by a proposed new natural gas pipeline, the Georgia Strait Crossing. The CCGT plant at Duke Point, called the "Vancouver Island Generation Project," would have had a capacity of 265 MW and would have generated 0.75 Mt $CO_2$ per year based on an estimated electricity production of 2,100 gigawatt hours (GWh) per year and a GHG intensity of 356 tonnes per GWh (Vancouver Island Energy Corporation, 2003). If the Georgia Strait Crossing pipeline had been built and used to its full capacity, it could have powered two additional plants of a similar size that would have produced 1.87 Mt of $CO_2$ per year.

To meet the least-cost supply requirement from the 2002 BC Energy Plan, in July 2006, BC Hydro awarded contracts to two coal-fired power plant proposals. AES Wapiti Energy Corporation proposed to build a 184 MW coal plant near Tumbler Ridge that would have produced 1,612 GWh of electricity per year; and Compliance Power Corporation proposed to develop a 56 MW wood residue and coal power generation plant near Princeton that would have produced 421 GWh of electricity per year. Together, the coal plants would have emitted up to 1.8 Mt $CO_2$ per year depending on the fuel mix (BC Sustainable Energy Association et al., 2006; BCTC, 2007; Compliance Energy Corporation, 2006).

Clearly, the impact of the clean electricity policy was dramatic. BC Hydro was forced to abandon its plans to contract for electricity from natural gas and coal, and instead issued requests for proposals from zero-emission IPPs developing small-scale hydropower and some other renewables projects, like wood waste and wind. Table 2.1 summarizes annual $CO_2$ emissions prevented in British Columbia by halting the natural gas project on Vancouver Island and the two coal plants at Tumbler Ridge and Princeton. British Columbia's clean electricity policy helped to prevent up to 3.67 Mt $CO_2$ per year. This estimate is based on the assumption that the proposed natural gas plant(s) on Vancouver Island would have been built to match the full capacity of the Georgia Strait Crossing pipeline (660 MW).

**Table 2.1. CO2 emissions prevented in British Columbia by halting a natural gas project and two coal plants**

| # | Plant Name | Annual Output of Electricity (GWh/year) | Mt $CO_2$ Prevented Per Year |
|---|---|---|---|
| 1 | 265 MW Vancouver Island Generation Project (VIGP) in Duke Point | 2,100 | 0.75 |
| | If the Georgia Strait Crossing pipeline was used to its full capacity of 660 MW | 5,230 | 1.87 |
| 2 | 184 MW AES Wapiti Energy Corporation's coal plant in Tumbler Ridge | 1,612 | 1.8 |
| 3 | 56 MW Compliance Power Corporation's coal/biomass plant in Princeton | 421 | |
| TOTAL | | 7,263 | 3.67 |

Notes: Annual electricity and emissions output is based on the capacity factor assumptions from BC Hydro's report, *F2006 Open Call for Power* (2006), and Vancouver Island Energy Corporation's application (2003) for the Vancouver Island Generation Project (VIGP). MW=megawatt(s). GWh=gigawatt hour(s). Mt=megatonne(s). Sources: Authors' calculations based on BC Sustainable Energy Association et al. (2006); BCTC (2007); Compliance Energy Corporation (2006); Vancouver Island Energy Corporation (2003).

According to BC Hydro's 2008 Long-Term Acquisition Plan, domestic demand for electricity is projected to reach about 70,000 GWh per year by 2020. Knowing electricity output and GHG emissions from the proposed natural gas and coal plants, we calculated the annual amount of GHG emissions in 2020 if we were to meet the additional electricity demand of 22,000 GWh per year solely by natural gas and coal generation (BC Hydro 2008). Our calculations are based on the reference case "high" and "low" natural gas price forecasts[5] outlined in the BC Climate Action Plan (2008).[6] Under the high gas price scenario, the price for natural gas in BC reaches $12.10 per gigajoule

[5] Under the "high" and "low" natural gas price scenarios, the price of coal also varies slightly. The coal price is 2.40/GJ under the "high" gas price and $1.70/GJ under the "low."

[6] Although forecasts of future prices have changed considerably, we used the values that decision-makers were considering at the time of implementing the policies in order to make our results comparable and consistent with projections and goals outlined in British Columbia's Climate Action Plan (2008).

(GJ) in 2020, and so more electricity generation comes from coal. Under the low gas price scenario, the natural gas price is $4.70/GJ lower than in the high price case. Thus, in this scenario, more than 75 percent of electricity generation comes from natural gas and only 25 percent from coal, while this ratio is reversed under the high gas price scenario. Based on these assumptions, 10.8 Mt $CO_2$ per year would have been emitted by 2020 under the low gas price scenario, and 16.6 Mt under the high.

To estimate the cost of the clean electricity standard, we focus on the additional cost that the policy caused by prohibiting lower-cost coal and natural gas electricity generation. We thus compare the cost of providing all incremental electricity in British Columbia with coal and gas under the business-as-usual scenario versus the cost of providing the same amount of electricity with just renewables under the CES (Table 2.2). Since our perspective is looking forward from 2008, we replicate the price forecasts used at the time and use the same scenarios that BC Hydro and the BC government were using in terms of fuel prices and electricity demand. However, we incorporate additional information on: 1) the cost range for energy storage for non-dispatchable renewable supplies like micro-hydro and wind, and 2) uncertainty about the mix of natural gas and coal in power generation. The reductions in emissions due to the electricity policy are divided by the extra generation costs of renewables to calculate the average cost per tonne of $CO_2$ abated.

The cost of new electricity acquired under the CES includes BC Hydro's long-run marginal cost of acquiring firm energy from renewable resources, 11.8 cents per kilowatt hour (c/kWh), and the fixed cost of energy storage ranging from two c/kWh ("low cost storage" scenario) to five c/kWh ("high cost storage" scenario). We added the cost of storage to the long-run marginal cost because the small-scale renewables being developed thus far in the province are intermittent sources that require either dispatchable back-up capacity or storage. Two to five c/kWh is the most common range for the full cost of building brand new pumped hydro storage or back-up electricity storage identified in multiple sources (Poonpun and Jewell, 2008). Thus, the estimated cost of new electricity acquired from renewables is 13.8 c/kWh under the low cost storage scenario and 16.8 c/kWh under the high. The annual average cost of meeting additional electricity demand of 22,000 GWh by 2020 is therefore between $3,036 and $3,696 million.[7]

To estimate the cost of new electricity generation under the business-as-usual scenario, we calculated the cost of electricity acquired from state-of-the-art combined cycle natural gas and coal plants. The estimated cost of new electricity is 6.5 c/kWh under the low gas price, and 7 c/kWh under the high. The annual average cost of meeting additional demand of 22,000 GWh by 2020 is $1,436 million under the low gas price scenario, and $1,542 million under the high.

We determined the cost of the clean electricity policy (Cost of CES in Table 2.2) as the difference between the cost of new electricity acquired under the CES and the cost of new electricity acquired under the business-as-usual scenario. Under the low cost storage/low gas price scenario, it is estimated to be 7.3 c/kWh (13.8 – 6.5 = 7.3 c/kWh in the first row under the Cost of CES) or $1,600 million per year (mil/year) in 2020 ($3,036 – $1,436 = $1,600 mil/year in the second row under the Cost of CES). Under the low cost storage/high gas price scenario, the cost of CES is 6.8 c/kWh (13.8 – 7 = 6.8 c/kWh) or $1,494 million ($3,036 – $1,542 = $1,494 mil/year). Under the high cost storage/low gas price scenario, the cost is 10.3 c/kWh (16.8 – 6.5 = 10.3 c/kWh) or $2,260 million per year in 2020 ($3,696 – $1,436 = $2,260 mil/year). Finally, under the high cost storage/high gas price scenario, the cost of CES is estimated to be 9.8 c/kWh (16.8 – 7 = 9.8 c/kWh) or $2,154 million ($3,696 – $1,542 = $2,154 mil/year).

Therefore, the clean electricity standard reduces CO2 emissions at an average cost of $148 per tonne under the low cost storage/low gas price scenario ($1,600 / 10.8 Mt CO2 = $148/tonne CO2 in the last row of Table 2.2). Under the low cost storage/ high gas price scenario, the cost is $90 per tonne ($1,494 / 16.6 Mt CO2 = $90/tonne CO2). Under the high cost storage/low gas price scenario, the cost is $210 ($2,260 / 10.8 Mt CO2 = $210/tonne CO2). Finally, under the high cost storage/high gas price scenario, the cost is $130 per tonne ($2,154 / 16.6 Mt CO2 = $130/tonne CO2).

[7] We calculated the cost of meeting additional electricity demand in 2020 using the current cost estimates for renewable electricity. The best sites are being exploited, which may lead to rising costs, while technological innovation may counter this enough to keep costs approximately stable, at least until 2020.

**Table 2.2. Cost of British Columbia's clean electricity standard (CES)**

| | |
|---|---|
| *Cost of Incremental Electricity with Renewables (CES)* | |
| Cost per kWh | |
| • Low cost storage | 13.8 c/kWh |
| • High cost storage | 16.8 c/kWh |
| Annual average cost for additional demand of 22,000 GWh/year in 2020 | |
| • Low cost storage | \$3,036 mil/year |
| • High cost storage | \$3,696 mil/year |
| *Cost of Incremental Electricity with Natural Gas and Coal (Business-as-Usual)* | |
| Cost per kWh | |
| • Low gas price | 6.5 c/kWh |
| • High gas price | 7 c/kWh |
| Annual average cost for additional demand of 22,000 GWh/year in 2020 | |
| • Low gas price | \$1,436 mil/year |
| • High gas price | \$1,542 mil/year |
| *Cost of CES* | |
| Cost per kWh (cost per kWh under CES minus cost per kWh under business-as-usual) | |
| • Low cost storage/Low gas price | 7.3 c/kWh |
| • Low cost storage/High gas price | 6.8 c/kWh |
| • High cost storage/Low gas price | 10.3 c/kWh |
| • High cost storage/High gas price | 9.8 c/kWh |
| Annual average cost for additional demand of 22,000 GWh/year in 2020 | |
| • Low cost storage/Low gas price | \$1,600 mil/year |
| • Low cost storage/High gas price | \$1,494 mil/year |
| • High cost storage/Low gas price | \$2,260 mil/year |
| • High cost storage/High gas price | \$2,154 mil/year |
| Additional GHG emissions in 2020 if the proposed coal and natural gas plants were built to meet additional demand of 22,000 GWh/year in 2020 | |
| • Low gas price | 10.8 Mt $CO_2$/year |
| • High gas price | 16.6 Mt $CO_2$/year |
| Cost of CES per tonne of $CO_2$ | |
| • Low cost storage/Low gas price | \$148/tonne $CO_2$ |
| • Low cost storage/High gas price | \$90/tonne $CO_2$ |
| • High cost storage/Low gas price | \$210/tonne $CO_2$ |
| • High cost storage/High gas price | \$130/tonne $CO_2$ |

Note: KWh=kilowatt hour(s), GWh/year=gigawatt hour(s), c/kWh=cents per kilowatt hour(s), Mt=megatonne(s). Source: Authors' calculations.

In terms of administrative burden, the carbon tax is ideal. Since it simply changes the rate of the fuel taxes and income taxes that the government already collects, and the rate of tax credits that the government already distributes (rebates to low-income people of goods and services taxes), it causes no additional administration burden. The CES, on the other hand, appears to have a higher administrative burden because BC Hydro operates a competitive bidding process to develop long-term supply contracts with independent power producers. This burden in general is the result of the IPP supply policy, not the requirement that IPPs be engaged in producing zero-emission electricity. But to the extent that the CES policy favours a larger number of smaller producers (many micro-hydro and wind IPPs, instead of one or two IPPs developing large coal and natural gas plants), the CES policy does increase BC Hydro's administrative burden. Overall, we score the clean electricity standard at "medium" for administrative feasibility.

Borick, Lachapelle, and Rabe (2011) found that public support for regulatory policies in Canada, such as renewable electricity portfolios (69 percent) and vehicle fuel efficiency standards (60 percent), is greater than for market-based initiatives, including fossil fuel taxes (43 percent), gas taxes (36 percent), and cap-and-trade systems (51 percent).[8] Interestingly, when asked about willingness to pay for greenhouse gas reduction, 28 percent of Canadians would pay one to 49 dollars per year, followed by zero dollars per year (21 percent). Knowing that the cost of British Columbia's clean electricity standard is clearly higher than that of the carbon tax, it appears that the level of public support for renewable electricity portfolios does not align with people's willingness to pay for climate change mitigation. The lack of cost visibility, or awareness of the actual cost of regulations, may explain the relatively high levels of support for clean electricity and renewable portfolio standards. Thus, we score the clean electricity standard "high" for public acceptance.

However, it is important to remember that polling questions about policy support and willingness to pay could be framed around specific contexts that induce certain answers. To some extent, Horne, Petropavlova, and Partington (2012) tested this issue

[8] These levels of public support are found for climate policy implementation at both the federal and provincial levels.

by asking BC stakeholder groups about their support for the clean electricity policy, if its approximate price was 100 dollars per tonne of CO2. The number of stakeholders who would or would not support the policy was split equally. The majority of stakeholders opposing the policy felt they could support it, but not at the cost of 100 dollars per tonne, considering the absence of carbon pricing in other jurisdictions.

## 2.5. Overall assessment and conclusion

Table 2.3 summarizes our assessment. To 2020, the clean electricity policy is projected to reduce emissions by 10.8 to 16.6 Mt CO2 per year, which is 3.6 to 5.5 times more than the carbon tax policy. However, the clean electricity policy achieves these substantial reductions at an average cost of $90 to $210 per tonne of CO2, a sharp contrast with the carbon tax's average cost of zero to five dollars per tonne. In hindsight, however, the effect of the carbon tax might be substantially larger than three Mt CO2 per year in 2020, if it continues to have the salience effects identified by Rivers and Schaufele (2012). But hindsight also shows that natural gas prices have fallen substantially since 2007 and are now forecast to remain very low to 2020. If this happens, the actual cost of the clean electricity policy will be even higher than we have estimated using the information at the time it was implemented.

**Table 2.3. Summary of the Evaluation of British Columbia's Carbon Tax and Clean Electricity Standard**

| | Carbon Tax | Clean Electricity Standard |
|---|---|---|
| Annual GHG emission reductions in 2020 | 3 Mt $CO_2$ | 10.8–16.6 Mt $CO_2$ |
| Economic efficiency | \$0–5/tonne $CO_2$ | \$90–210/tonne $CO_2$ |
| Administrative feasibility | High | Medium |
| Public acceptance | Medium-low | High |

Notes: GHG= greenhouse gas. For other abbreviations, please see Tables 2.1 and 2.2. Source: Authors' calculations.

Although the economic efficiency of the clean electricity regulation is much lower than that of the carbon tax, high levels of acceptance and administrative feasibility suggest that the policy may endure (BC Hydro 2012; Borick, Lachapelle, and Rabe, 2011; Environics, 2011). Steady and high levels of acceptance of the clean electricity standard could be attributed to its invisible costs.[9] In contrast, public acceptance of the carbon tax may be sensitive to any changes to the rate, revenue streams, and low-income tax credits post 2012 (Horne, 2011; Horne, Petropavlova, and Partington, 2012). In future research, we intend to further explore the issue of policy-cost visibility and policy support. While high-tax salience seems to matter for policy "emissions impact," it is likely also to matter for "political acceptability," with these two working in opposite directions.

This comparative study illustrates the dilemma for climate policy-makers and advisors. While it might be easy for advocates of a particular policy to focus on a single criterion, such as economic efficiency or emissions reductions, this is not a luxury available to politicians. They must navigate the difficult trade-offs between economic, environmental, and political criteria when choosing among policy options. A carbon tax has significant benefits. Yet it is easy to understand why politicians who claim to seek emissions reductions in North America have avoided this policy in the two decades since it was first seriously considered (around 1990) and then quickly implemented in a few Scandinavian countries. It is also easy to understand why these countries introduced carbon taxes as partial replacements for existing energy taxes or established multiple exemptions and differences in rates across sectors. In this regard, British Columbia's carbon tax stands as an anomaly that none have thus far been willing to emulate. In contrast, its electricity policy has strong similarities to policies in 30 US states and several European countries, although it is far more stringent than most. In the years ahead, there may well be pressures to undermine both policies (reducing the carbon tax, decreasing the percentage zero-emission requirement), and it will be interesting to see which policy performs better in such a case. In a world that seems less and less concerned with the threat of global warming, policy "endurance" may well become an additional policy evaluation criterion.

[9] There is now pressure to "relax" the CES because of all the expensive zero-emission electricity that would be required by processing plants planned for British Columbia's north coast as part of major projects to liquefy and export natural gas. Recently, the government has actually redefined CO2 emissions from burning natural gas at these plants as somehow not "emissions."

# Chapter 3. Does effective climate policy require well-informed citizen support?[10]

## 3.1. Abstract

Citizen support for climate policies is typically seen as an important criterion in climate policy making. Some studies of climate policy support assume that a significant number of citizens need to be aware of the policies in question and able to provide informed opinions. In this study, we probe this assumption using a web-based survey of residents of the Canadian province of British Columbia (n = 475) by assessing: (1) citizen awareness and knowledge of climate policies, (2) citizen support for different climate policies, (3) the relationship between citizen knowledge and policy support, and (4) the effect of information provision on policy support. Our main finding is that most survey respondents are not aware of any of British Columbia's climate policies, and have little understanding of the potential effect of these on reducing greenhouse gas emissions. Once they are made aware of different types of climate policies, respondents are more likely to express support for regulations, such as the zero-emissions electricity standard and energy efficiency regulations, and less likely to support a carbon tax. Statistical analysis indicates that citizen knowledge of policy is not associated with higher policy support. Furthermore, providing information on likely policy effectiveness to our survey respondents did not translate into higher support, suggesting that widespread knowledge and well-informed citizen support are not necessarily required for implementation of effective climate policies.

[10] This paper was published as: Rhodes, E., Axsen, J., and Jaccard, M. (2014). Does effective climate policy require a well-informed citizen support? *Global Environmental Change,* 29, 92-104.

## 3.2. Introduction

Climate policy that is effective might not be implemented if it is not politically acceptable. Often, this concept of political acceptance is simplified as meaning ‘‘citizen support,’’ with the assumption being that the extent of such support is somehow related to the level of citizen awareness and knowledge of climate science and climate policies. But the relationship between climate policy support or acceptance, on the one hand, and climate-related knowledge, on the other, is difficult to discern. Moreover, some climate policies are quite effective at reducing GHG emissions while others are not. While experts can generally agree on this distinction, it is likely beyond the grasp of all but the most keenly interested citizens. This raises several interesting questions about what level of citizen knowledge about science and policy might be required before effective climate policies would actually be enacted.

In the research described in this paper, we explore some of these questions. In particular, we investigate the idea that well-informed citizen support is needed for effective climate policy implementation by using British Columbia (BC), Canada as a case study – one of the leading climate policy jurisdictions in North America. With survey data collected from a representative sample of citizens in this region, our research objectives are to assess:

1. citizen awareness and knowledge of climate policies,
2. citizen support for different climate policies,
3. the relationship (if any) between citizen knowledge and policy support, and
4. the impact of information provision on climate policy support, especially support for effective climate policies.

In this paper, we distinguish two terms – citizen awareness and citizen knowledge of climate policy. We define citizen awareness as acknowledgement that a particular climate policy exists in BC. By citizen knowledge, we imply consistency between the beliefs (i.e., perceptions) of citizens in the effectiveness of specific greenhouse gas (GHG) reduction policies and the beliefs of experts.

### 3.2.1. The knowledge deficit model: description and critiques

It is sometimes assumed that conflicts over public policies and science are caused by citizen ignorance – a gap between citizen and expert knowledge, also known as a ‘‘knowledge deficit’’ (Stoutenborough and Vedlitz, 2014). According to the knowledge deficit model, providing more detailed information to citizens about science and policy should increase citizen knowledge, which in turn should change citizen perceptions to be more aligned with the perceptions of natural scientists, economists, and policy experts. Guided by this premise, many policy-makers, scientists, and science communicators believe that citizens need to be better educated about climate change and climate policies for these to gain support (Lorenzoni et al., 2007). Indeed, many of the current attempts to increase citizen concern for climate change and support for climate policies are based on the knowledge deficit model. This is manifested through calls for more scientific articles in newspapers and journals, and more appearances of scientists on television, radio shows, online blogs, public lectures, educational books and films (Nisbet and Scheufele, 2009).

The knowledge deficit model has been criticized, however, for being somewhat simplistic where it is taken to imply that more information can directly translate into higher citizen knowledge and, as a consequence, support for science-based policies. Reynolds et al. (2010) showed that despite two decades of widespread coverage of climate change in the mainstream media and political discourse, citizen understanding of climate science has changed little since 1992, remaining at a superficial level. Furthermore, while some researchers find a moderate association between knowledge of climate science and policy support, others show that more accurate knowledge does not necessarily affect citizen support for climate policies, and may even undermine any existing support, if that scientific evidence is perceived as overwhelming, frightening, uncertain, or disempowering (O’Connor et al., 2002; Dietz et al., 2007; Kellstedt et al., 2008).

The absence of strong empirical research supporting the knowledge-deficit model raises the question of whether well-informed citizen support is essential for effective climate policy implementation. To our knowledge, the present study is the first to empirically test the knowledge deficit model in regards to the link between citizen knowledge of climate policies and climate policy support.

### 3.2.2. Beyond the knowledge deficit: alternative models of public policy implementation

Alternative theories of human behaviour challenge the knowledge deficit model. Drawing from theories of collective action and democratic participation, economists explain that self-investment in scientific and/or policy knowledge represents a public good, the benefits of which accrue to all citizens regardless of the amount of time (if any) a given individual spends on studying information about scientific issues and/or public policies (Olson, 1971; Caplan, 2007). Therefore, there is an incentive to invest less time in researching or understanding science and policy and to instead free-ride on other people who invest their time in gaining this knowledge. Moreover, because climate science and climate policies are particularly complex issues, requiring a high level of background knowledge and attention, the incentive to free-ride on the knowledge of others is particularly strong (Cvetkovich et al., 2002).

Long before climate change was a policy concern, Olson (1971) argued that support for public policies is primarily influenced by minority groups who face concentrated costs or who hope to gain concentrated benefits. This explanation is supported by the more recent arguments of Caplan (2007), who noted how a self-serving bias (i.e., people believe whatever appears to benefit them) induces the discrepancy between citizen and expert assessments of policy effectiveness and ultimate policy support. As a result, highly salient policies with visible costs (such as carbon taxes) attract strong opposition from interests who believe the policies to be especially detrimental to them, whereas less salient policies (such as regulations) tend to avoid such opposition (Harrison, 2012).

Besides the economic arguments, some social psychologists suggest that pre-held values and beliefs, social networks and peer pressures can have a stronger impact on citizen support for climate policies than knowledge about climate science (Shwom et al., 2010; Semenza et al., 2008). Consistent with these claims, research into human cognition of scientific information has shown that prior to accepting facts, citizens filter new information in a selective manner that tends to reinforce their values and world-views – a theory known as cultural cognition (Kahan and Braman, 2006). This theory suggests that unless new information conforms to cultural values and beliefs of an individual or a group he/she is identified with, that information will tend to be considered less reliable and will thus have a higher chance of being ignored or rejected.

Cultural cognition is induced by a series of interconnected psychological and social processes forming citizen perceptions of scientific information. Some of the psychological mechanisms include cognitive dissonance avoidance, affect, and biased assimilation. Cognitive-dissonance avoidance leads some people to deny information that endangers their beliefs and actions (Festinger, 1962). Affect determines some people's perceptions through positive or negative emotional reactions defined by cultural values (Nussbaum, 2001). Biased assimilation inclines individuals to accept new information based on its congeniality to their prior beliefs, especially when these prior beliefs are strongly related to cultural identities (Lord et al., 1979).

Social mechanisms, such as group dynamics, also induce cultural cognition and have a prominent effect when individuals lack time or capacity to assess new information (Kahan and Braman, 2006). To determine if new information is credible, individuals rely on knowledge and beliefs of people they trust (Cvetkovich et al., 2002). Given the scientific complexity of climate change, conflicting and controversial media coverage of climate policies, and the human tendency to free-ride on policy knowledge of a few people, trust in information sources plays a particularly important role (Marx et al., 2007). Although scientists are generally considered credible sources of information, they are not necessarily the most trusted with all types of information and are generally not trusted among some social groups (Cvetkovich and Lo¨ fstedt, 2000). In fact, media information presented by elites and advocacy groups appears to have a stronger impact on citizen perceptions of climate science than information from independent scientific sources (Brulle et al., 2012). Cohen et al. (2003) explain that trusted sources are represented by commentators and in some cases experts who share citizen values and worldviews and therefore are inclined to have similar opinions regarding the public policies in question. As a result, the efforts of independent scientists to educate citizens about public policies may be undermined and at times ineffective.

Our study seeks to contribute to this field of research by exploring the relationship between citizen knowledge of individual climate policies and their level of support for these. Even though climate policy experts recognize British Columbia as a North American climate policy leader, in terms of both its emission reduction goals and the likely effectiveness of its policies to achieve them, we hypothesize: (1) that most of the province's climate policies are not well-known among the general population, (2) that citizen awareness and knowledge about a particular policy are not strongly associated with stated support for it, and (3) that providing information about a climate policy does not significantly increase stated support for it. We thus anticipate that increasing citizen awareness and knowledge of a given climate policy is not certain to lead to increased citizen support, and may not increase the political acceptability of a policy.

The paper is organized as follows. Section 3.3 reviews British Columbia's key climate policies. Section 3.4 describes the survey sample and methodology. Section 3.5 presents the study results. Finally, Section 3.6 discusses how the results confirm or challenge the knowledge deficit model, and how they align in general with some of the alternative theories of policy implementation reviewed in this section.

## 3.3. Case study: climate policy in British Columbia

Different levels of governments in Canada have made apparent efforts to reduce GHG emissions for at least two decades without much success (Simpson et al., 2007). However, in the period from 2006 to 2009, British Columbia enacted North America's most substantial carbon tax and several other forceful policies guaranteed to reduce emissions. During this time, the BC government made a substantial effort to inform citizens about the development and implementation of all climate policies by publically presenting policy documents, enacting legislation, issuing press releases, and conducting media interviews. With the passage of more than half a decade (at the time of the study implementation in 2013), it is interesting to assess citizen knowledge of and support for these policies.

Table 3.1 summarizes the key design characteristics of BC's five climate policies studied in this paper. BC's carbon tax is an emissions pricing policy that applies to 75%

of BC's total GHG emissions, primarily from fossil fuel combustion. The tax was introduced at $10 per tonne of carbon dioxide emissions (CO2) in 2008 and rose annually at a scheduled rate of $5 per tonne until it reached $30 in 2012. It has been frozen at $30 since then. All revenues from the carbon tax are recycled (known as revenue neutrality) through corporate and personal income tax reductions and low-income tax credits for individuals who pay little or no income taxes. The carbon tax was, in 2008, projected to reduce about 3 megatonnes (Mt) CO2/year by 2020 (BC Government, 2008). However, Rivers and Schaufele (2012) estimate that the high cost visibility (salience) of the carbon tax had already induced higher than expected reductions after just a few years, and would likely surpass the reductions that had been anticipated to occur by 2020.

**Table 3.1. Summary of design characteristics of BC's climate policies**

| Policy name | Policy description | Policy type | Expected GHG reductions, $MtCO_2$/year by 2020 |
|---|---|---|---|
| Carbon tax | Introduced at $10/tonne of $CO_2$ in 2008, rose annually by $5, and reached $30 in 2012; revenues recycled through income tax cuts | Emissions pricing | 3 or higher |
| Energy efficiency regulations for buildings | Requires increasing efficiency of water heaters, furnaces, boilers, lighting, and motors in buildings starting in 2007-2009 (depending on the type of equipment and buildings) | Regulation | 2.3 |
| Low Carbon Fuel Standard | Requires reducing the average carbon intensity of transportation fuels by 10% by 2020 starting in 2008 | Regulation | up to 0.7 |
| Clean Electricity Standard | Requires 93% of new electricity supply to come from zero-emission sources starting in 2010 | Regulation | up to 16 |
| Carbon neutral government | Requires government agencies to purchase carbon offsets for possible emission reductions in private sector starting in 2010 | Subsidy-like | up to 1 |

Sources: BC Government (2008), Rivers and Schaufele (2012), BC Government (2007), Bailie et al. (2007), Rhodes and Jaccard (2013), Lau and Dowlatabadi (2011).

British Columbia also has several regulations, including:

1. Updated, increasingly stringent energy efficiency regulations for residential and commercial buildings and their contents, which include efficiency standards for water heaters, furnaces, boilers, lighting, and motors as part of the new Energy Efficiency Act and BC's Building Code. The expected GHG reduction from these updated standards is 2.3 Mt CO2/year by 2020 (BC Government, 2007).

2. The Low Carbon Fuel Standard (LCFS) – more formally labelled the Renewable and Low Carbon Fuel Requirements Regulation – that requires reducing the average carbon intensity of transportation fuels by at least 10% by 2020. The LCFS is estimated to reduce up to 0.7 Mt CO2/year by 2020 (Bailie et al., 2007).

3. The Clean Electricity Standard (CES), which requires at least 93% of new electricity supply from zero-emission sources, such as ''biomass, biogas, geothermal heat, hydro, solar, ocean, wind'' (BC Government, 2010). The CES is similar to the renewable portfolio standards existing in many U.S. states and some other countries – except for its broader prescription of zero-emission instead of renewable supply (meaning that the use of fossil fuels with carbon capture and storage is possible as an electricity generation option). A recent study projected the impact of BC's CES at 16 Mt of annual reductions of CO2 by 2020 compared to a business-as-usual scenario (Rhodes and Jaccard, 2013).

These three policies are regulatory in nature, although CES and LCFS have flexibility features – CES allows the utility to choose among any zero-emission technologies or energy forms and LCFS allows credit trading among regulated agents.

Finally, among the set of implemented policies, British Columbia also has a carbon neutral government policy that requires all ministries, agencies and corporations of the provincial government to purchase carbon offsets for all emissions. Offsets require payments to private sector entities that are supposed to reduce emissions, which makes the carbon neutral government policy a subsidy-like policy. Lau and Dowlatabadi (2011) predict up to 1 Mt CO2/year in reductions from this policy by 2020.

The five chosen policies provide interesting contrasts in terms of their typology, expected GHG reductions, social costs, and citizen support. The carbon tax is typically favoured by economists because its flexibility is presumed to enable total emissions reductions at the lowest possible cost. However, some research indicates that carbon taxes tend to be the least popular type of climate policy (Borick et al., 2011; Bostrom et al., 2012). According to the theory of collective action (discussed in the previous section), this low support may be a result of high tax salience (i.e., cost visibility) that attracts opposition from interests who face concentrated costs, and thus consider the policy especially harmful to them (Harrison, 2012; Olson, 1971). Even the revenue neutral version of the tax combines highly visible losses (i.e., carbon tax) with poorly visible gains (i.e., income tax cuts and GHG reductions). Considering the tendency to value losses greater than otherwise-equivalent gains, some citizens might see the policy as mostly a loss and therefore still be unsupportive, even though analysis would show them to be net winners under the revenue neutral tax (Kahneman et al., 1991). Low support might also be induced by negative media coverage, especially if misinformation campaigns are significant – as has been prevalent in BC since the enactment of the carbon tax in 2007 (Harrison, 2012). For these reasons, we expect that the carbon tax will be both well-known among BC citizens and achieve stronger opposition than the other key policies.

In contrast to the carbon tax, the energy efficiency regulations, the LCFS, and the CES are less favoured by economists because they impose costs on some sectors of the economy that are not matched by policies imposing similar costs on other sectors (thus leading to higher than necessary abatement costs). However, regulations can be highly effective in terms of GHG reductions and have been more frequently implemented than carbon taxes in the past, implying that they may be perceived as more acceptable in some way. Borick et al. (2011) and Environics (2011) find that most Canadians, including British Columbians, prefer regulatory approaches (74%) over carbon taxes (57%) for climate policy. This preference could be attributed to a variety of factors suggested by the behavioural economics literature, including low cost visibility of regulations and an anti-tax bias among citizens (Caplan, 2007). Thus, climate regulations tend to receive much less media attention than carbon taxes. For example, BC's LCFS has been mentioned 21 times in the province's two leading newspapers (the Vancouver Sun and the Province) since 2007, while the carbon tax was mentioned 1714 times (Factiva, 2014). We thus hypothesize that BC's energy efficiency regulations, the LCFS, and the CES will be less well known than the carbon tax but will also garner less opposition.

## 3.4. Methods: data collection and analysis

We collected primary data to assess citizen awareness of, knowledge of, and support for British Columbia's climate policies. We conducted a web-based survey of BC citizens (age 19+) in January 2013 as part of a larger national survey on climate policy support in Canada. We separated and oversampled British Columbians (n = 475) to minimize the sampling error to +/-4.5%. Eighty-five percent of respondents are self-reported voters. We have not found any substantial demographic differences in results between voters and the entire BC sample, thus, we used the entire sample in our analysis. When compared to the Census data, the BC sample is slightly biased in that it is more educated, older, and underrepresented by Asian and Aboriginal citizens (Table 3.2). However, we minimized these demographic differences by applying corrective weights to ensure that the sample is representative of British Columbia's actual income, education, age by sex, and ethnic composition according to the Census data.

**Table 3.2. Socio-demographics of the BC sample group compared to the Census data.**

| Socio-demographic variables | Sample, % | Census, % |
|---|---|---|
| Income | | |
| Less than $15,000 | 8 | 7.9 |
| $15,000 to $34,999 | 18.5 | 17.3 |
| $35,000 to $49,999 | 14.5 | 13.4 |
| $50,000 or over | 47.7 | 50.1 |
| Education | | |
| Secondary or less | 68.4 | 82.6 |
| Post-secondary | 31.6 | 17.4 |
| Age by sex | | |
| Male 19-39 | 8.8 | 18.8 |
| Male 40-64 | 30.1 | 21.8 |
| Male 65+ | 9.7 | 7.8 |
| Female 19-39 | 13.7 | 19.5 |
| Female 40-64 | 29.2 | 22.7 |
| Female 65+ | 8.5 | 9.4 |
| Race | | |
| First Nation or Aboriginal | 2.1 | 3.4 |
| South/Southeast Asian | 6.5 | 14.3 |
| Black and other | 9.3 | 6.3 |
| White | 82.1 | 76.0 |

Our survey consisted of three key sets of questions (Appendix) that measured:

1. respondent awareness of climate policy existence in an open-ended and a closed-ended format,

2. respondent beliefs (i.e., perceptions) and knowledge (i.e., beliefs that are consistent with the beliefs of experts) of policy GHG reduction effectiveness, and

3. respondent support for climate policies before and after the provision of additional policy effectiveness information.

All questions were pre-tested with a wide range of people of different ages, occupations, education, and genders. Survey respondents were not allowed to return to previously answered questions and change their answers due to the knowledge-testing nature of the study. All statistical analyses were performed in the IBM SPSS Statistics and Microsoft Excel.

### 3.4.1. Awareness of climate policy existence

We tested respondent awareness of climate policy existence in two ways. In the first open-ended question, we explained what is meant by the term ‘‘climate policy’’ and asked respondents to name up to five climate policies currently implemented in BC, or choose the option ‘‘I cannot think of any climate policies currently being implemented.’’ Due to the open-ended nature of the question and the wide range of elicited policy descriptions, we conducted a manual content analysis to identify which of the five key policies (if any) were reported by respondents. The second question was closed-ended, where we provided the names and brief definitions of fourteen climate policies listed in a random order, and asked respondents to choose policies currently implemented in the province. BC’s existing climate policies were taken from the BC Climate Action Plan and included the five key policies summarized in Section 3.3. To test for respondent awareness, the list also included the following non-existing policies taken from the climate policy literature:

- a cap on provincial emissions,
- energy efficiency regulations for public transportation fleet,

- carbon offsets for converting methane gas into electricity,
- subsidies to help power producers capture carbon emissions from coal-fired or natural gas-fired power plants and store them underground,
- carbon offsets for electricity generation from clean sources,
- education programmes on energy efficiency for residential landlords,
- a cap on emissions from the electricity sector,
- government investments in the BC clean energy fund, and
- a cap on emissions from fuels exported from BC.

For each policy on the list, respondents were asked to choose one of the following answers:

- I know that this policy is in place in BC, or
- I know that this policy is NOT in place in BC, or
- I do not know about this policy.

We grouped respondents according to their answers to the first (open-ended) and second (closed-ended) questions into categories based on the number of correct policies identified. We used descriptive statistics (i.e., frequencies) to assess and compare the level of respondent awareness of policy existence in BC in the open-ended and closed-ended formats.

### 3.4.2. Beliefs and knowledge of climate policy effectiveness

To assess respondent beliefs in policy effectiveness, we then provided respondents with a list of the five key climate policies BC actually had in place at the time of the survey, as summarized in Section 3.3. We asked them to rate these policies in order of their effectiveness in terms of expected GHG emission reductions in the period from 2008 to 2020. We used a five-point scale ranging from ‘‘not effective at all’’ to ‘‘very effective’’ with an option ‘‘I do not know.’’ We did not provide projected reductions in Mt CO2 or percentages as response categories due to our expectation that respondents might not be familiar with such quantitative units and might experience difficulties in interpreting them. We defined ‘‘very effective’’ policies as those ‘‘that reduce the most greenhouse gas emissions in BC over the time period from 2008 to 2020.’’ Because our goal was to assess citizen beliefs about BC’s policies in their current (not future hypothetical) design, we did not explain how each policy could be designed to be less or more stringent (e.g., we did not explain the difference between a $5 and $200 carbon tax or a 5% and 100% Clean Electricity Standard). We used descriptive statistics (i.e., frequencies) to assess respondent beliefs in policy GHG effectiveness.

To assess respondent knowledge of policy GHG effectiveness, we compared respondent beliefs in policy effectiveness with the forecasts made by climate policy experts as summarized in Section 3.3 and depicted in Table 3.1. We used BC government documents and the academic literature to obtain expert assessments of each policy’s expected contribution to the achievement of BC’s 2020 emission reduction target (second column in Table 3.3). These assessments were prepared by independent academics, academic advisors to the BC government, BC government officials, and experts working for environmental non-government organizations (ENGOs) (as cited in Table 3.3). To compare respondent beliefs with expert estimates, we translated each policy’s expected GHG effect into the two qualitative survey response options that we felt most closely described each GHG reduction estimate relative to a business-as-usual evolution of provincial emissions (third column in Table 3.3). We chose two (instead of one) qualitative descriptions per each quantitative GHG estimate to maximize reliability of our analysis.

We organized the obtained responses based on the number of policies rated consistently with expert assessments, as indicated in Table 3.3. We used descriptive statistics to assess respondent knowledge about expert-predicted emission reductions from BC’s climate policies.

**Table 3.3. GHG effectiveness of BC's climate policies: quantitative and qualitative assessments**

| | Expert assessments: each policy's expected contribution to the achievement of BC's emission reduction target of 33% by 2020 | Survey response options (beliefs in policy GHG effectiveness) consistent with expert assessments |
|---|---|---|
| Energy efficiency regulations for buildings | 7% | (2) Not effective or (3) Somewhat effective |
| Carbon tax | 10% | (3) Somewhat effective or (4) Effective |
| Low Carbon Fuel Standard | 2% | (1) Not effective at all or (2) Not effective |
| Clean Electricity Standard | 40% | (4) Effective or (5) Very effective |
| Carbon neutral government | 1% | (1) Not effective at all or (2) Not effective |

Sources: BC Energy Plan (2007), BC Climate Action Plan (2008), Bailie et al. (2007), Rhodes and Jaccard (2013), Lau and Dowlatabadi (2011).

### 3.4.3. Relationship between policy knowledge and support

To determine the effect of knowledge on policy support, we first measured respondent support for each of BC's five climate policies on a four-point scale ranging from ''strongly oppose'' to ''strongly support'' with no ''neutral'' response category. We grouped the policy support data into two response categories: ''oppose'' (an aggregate of ''strongly oppose'' and ''somewhat oppose'') and ''support'' (an aggregate of ''somewhat support'' and ''strongly support''). We then tested how policy support is affected by (1) awareness of policy existence, (2) knowledge of policy GHG effectiveness (consistent with expert assessments), and (3) beliefs in policy GHG effectiveness. As part of the national survey, we collected data on multiple explanatory variables that were used as control variables in this study (Table 3.4).

**Table 3.4. Explanatory variables used as control variables in the regression analysis**

| Variable name | Variable type used in: Analysis | Variable type used in: Survey | Measurement |
|---|---|---|---|
| **Attitudinal variables** | | | |
| Values (biospheric, altruistic, egoistic, and openness-to-change) | Continuous | Ordinal | Five-point scale from "not important at all" to "extremely important" (Schwartz et al., 1992) |
| General environmental concern (ecological worldviews) | Continuous | Ordinal | Five-point scale from "strongly disagree" to "strongly agree" (Dunlap et al., 2000) |
| Beliefs about consequences of climate change | Continuous | Ordinal | Five-point scale from "strongly disagree" to "strongly agree" (Dietz et al., 2007) |
| Ascription of responsibility for climate change | Continuous | Ordinal | Five-point scale from "strongly disagree" to "strongly agree" (Steg et al., 2005; Dietz et al., 2007) |
| Trust in the provincial government, fossil fuel and renewable industries, ENGOs, scientists, and media in assessing and solving climate change | Continuous | Ordinal | Five-point scale from "very low" to "very high" (Dietz et al., 2007) |
| Personal norms (beliefs in moral obligation to reduce climate change) | Continuous | Ordinal | Five-point scale from "strongly disagree" to "strongly agree" (Steg et al., 2005) |
| **Contextual variables** | | | |
| Social contexts (discussion of climate change, participation in environmental activities, following climate news) | Continuous | Ordinal | Five-point scale from "never" to "very often" (Zahran et al., 2006) |
| Economic contexts:<br>• willingness to pay for climate change mitigation<br>• role of markets versus governments in the economy | <br>Continuous<br>Continuous | <br>Nominal<br>Ordinal | <br>• Six categories ranging from "$0 each year" to "more than $500 each year" (Borick et al., 2011)<br>• Five-point scale from "strongly disagree" to "strongly agree" (Stern, 2000) |
| Political contexts:<br>• political ideology<br>• voting participation in elections | <br>Nominal<br>Continuous | <br>Nominal<br>Ordinal | <br>• Seven categories with names of federal parties<br>• Four-point scale from "never" to "always" |
| **Personal capability variables** | | | |
| Socio-demographics:<br>• age<br>• gender<br>• education<br>• income<br>• employment sector | <br>Continuous<br>Nominal<br>Continuous<br>Continuous<br>Nominal | <br>Nominal<br>Nominal<br>Nominal<br>Nominal<br>Nominal | <br>• Six categories from "19-24" to "65 and older"<br>• Two categories "male" and "female"<br>• Ten categories from "no degree" to "PhD"<br>• Twelve categories<br>• Twenty categories |
| Household variables:<br>• living area<br>• home type<br>• home size<br>• household size | <br>Nominal<br>Nominal<br>Continuous<br>Continuous | <br>Nominal<br>Nominal<br>Nominal<br>Nominal | <br>• Three categories "urban", "suburban," "rural"<br>• Five categories<br>• Three categories from "0 to 1" to "4 and more bedrooms"<br>• Four categories from "1" to "5 and more people" |
| Transportation variables:<br>• daily commute time to work/school<br>• mode of commute to work/school<br>• number of vehicles in a household | <br>Continuous<br>Nominal<br>Continuous | <br>Nominal<br>Nominal<br>Nominal | <br>• Five categories from "less than 30 minutes" to "more than two hours" with an option "N/A"<br>• Eight categories with an option "N/A"<br>• "Five categories from "none" to "4 or more" |

Because of the large number of explanatory variables to control for, we performed a forward stepwise binary logistic regression analysis (called ‘‘regression analysis’’ in the remainder of the paper) that finds the most parsimonious set of explanatory variables explaining the response variable (Kinnear and Gray, 2004; Menard, 2009). The forward stepwise regression starts with no predictors in the model and adds variables one at a time based on the criterion of reducing the -2 Log Likelihood (LL) error for the available predictors (Menard, 2009). At each step, all included variables are checked for significance to determine whether they improve the model or should be removed. The forward stepwise process stops when all variables have been included in the model or when it is not possible to make a statistically significant reduction in -2LL at the level of $p = 0.05$ using any of the remaining variables.

### 3.4.4. Effect of information provision on policy support

To explore the effect of providing information about GHG emission reduction effectiveness of climate policies (treatment) on citizen support, our survey instrument included a quasi-experiment (pre-test, post-test) with no control group. A ‘‘true’’ experimental design would have randomly assigned respondents to multiple treatment groups, and in principle provide more valid results. However, we did not want to increase sampling error by dividing up our total sample into treatment groups, and in the present case we also did not anticipate any particularly strong reliability issues from the quasi-experimental design. The flow of this quasi-experiment is depicted in Figure 3.1.

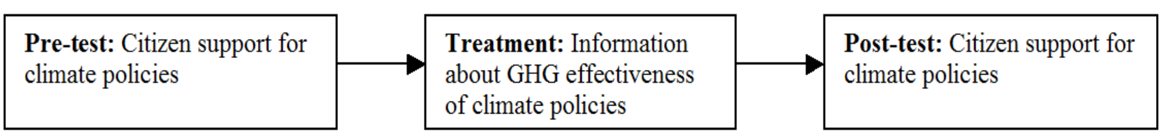


**Figure 3.1. The flow of quasi-experiment to test the effect of information provision on policy support**

First, we asked respondents to indicate their level of support for each of BC’s five climate policies as if there were a referendum on maintaining them in BC. We used two aggregated response categories – ‘‘oppose’’ and ‘‘support,’’ to understand if providing expert estimates of each policy’s expected GHG impacts changes respondent answers from ‘‘oppose’’ to ‘‘support’’. Second, we provided respondents with each policy’s expert-projected emission reductions from Table 3.3 and then again asked them to indicate their level of policy support. We used descriptive statistics (i.e., frequencies) to assess the level of support before and after providing policy GHG reduction information and to understand what types of climate policies achieve greater support. We also used inferential statistics to determine if providing policy effectiveness information is associated with a statistically significant change in citizen support for climate policies. Specifically, we utilized the Wilcoxon signed-rank test and the chi-square test for equality of proportions because the data on policy support were negatively skewed (not normally distributed), making the use of the dependent *t*-test inappropriate. The Wilcoxon signed-rank test is a non-parametric equivalent to the dependent *t*-test that determines signs and magnitudes of median differences between repeated measurements (such as pre- and post-test) without assuming normality in the data. The chi-square test for equality of proportions (also known as the chi-square goodness of fit test) allows testing whether the observed proportions (i.e., support post-test) differ from the expected proportions (i.e., support pre-test) without assuming normality in the data.

## 3.5. Results

### 3.5.1. Awareness of climate policy existence

Figure 3.2 shows the number of BC's current policies that respondents identified in the open-ended format (without seeing a reference list of climate polices) and in the closed-ended format (with a list provided of actual and false climate policies). In an open-ended question with no prompts, the vast majority of respondents (73%) could not name any climate policies. However, in the closed-ended format most respondents (78%) could identify at least one current policy after reviewing the list of policies with definitions. One explanation is that respondents might not know technical policy names but recognize certain policies once they are defined. Another explanation is that while a significant percentage of citizens might want effective climate policies to be implemented, they have little interest in acquiring detailed policy knowledge – unless they suspect that a given policy might be unfair to them personally or professionally.

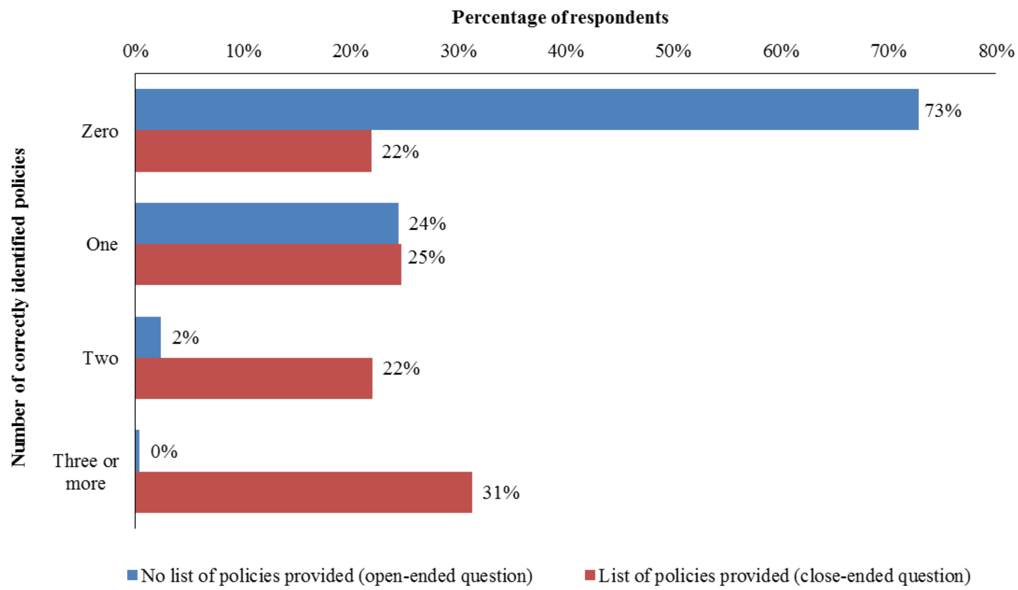


**Figure 3.2. Number of correctly identified climate policies**

Figure 3.3 shows that BC's carbon tax is the most frequently named climate policy in the open-ended (26%) and closed-ended (69%) questions. Other climate policies, including all tested regulations, are only named by 0–2% of respondents before any prompt. After receiving the list of policies with definitions, the majority of respondents (from 57 to 78%) still could not correctly identify any of BC's current key climate policies, other than the carbon tax.

Interestingly, among those respondents who named at least one correct BC policy in the closed-ended question, 78% incorrectly selected other non-existing policies (48% incorrectly selected three or more policies, 16% two, 14% one). Thus, some, or perhaps many, of the correct responses in the closed-ended question might have been due to successful guessing.

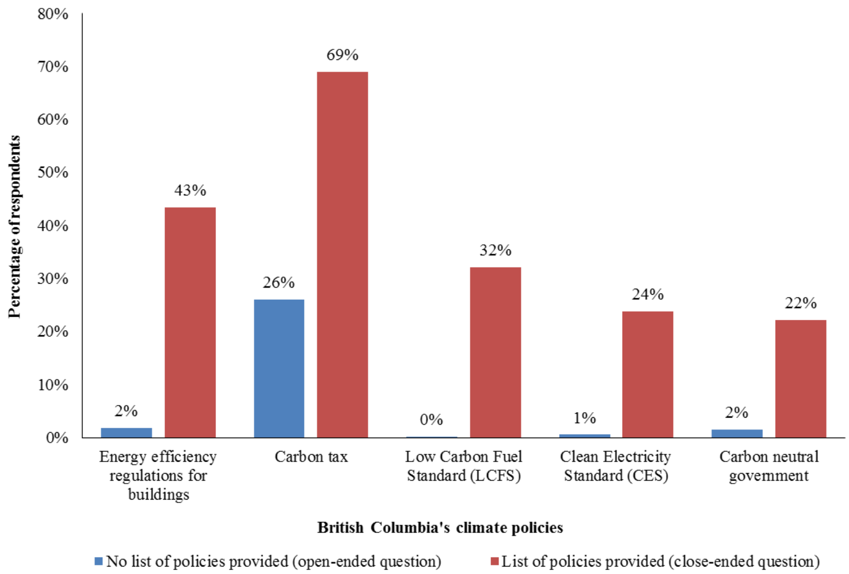


**Figure 3.3. Types of correctly identified climate policies**

### 3.5.2. Beliefs and knowledge of climate policy effectiveness

Figure 3.4 shows how respondents perceive BC's climate policies in terms of their expected emission reductions from 2008 to 2020. Energy efficiency regulations receive the highest frequency of GHG effectiveness ratings (68% rated them from ''somewhat effective'' to ''very effective''), followed by the Low Carbon Fuel Standard (66%) and the Clean Electricity Standard (60%). For all three of these regulatory policies, less than 10% believe them to be ''not effective.'' In contrast, BC's carbon tax had the highest share believing it to be ineffective (32%), followed by carbon neutral government (23%). The ''I do not know'' response is the most frequent for the carbon neutral government (36%), followed by the Clean Electricity Standard (31%), the Low Carbon Fuel Standard (25%), and energy efficiency regulations (23%). These findings are not surprising considering that most respondents are unaware of the existence of these policies as shown in Figure 3.3.

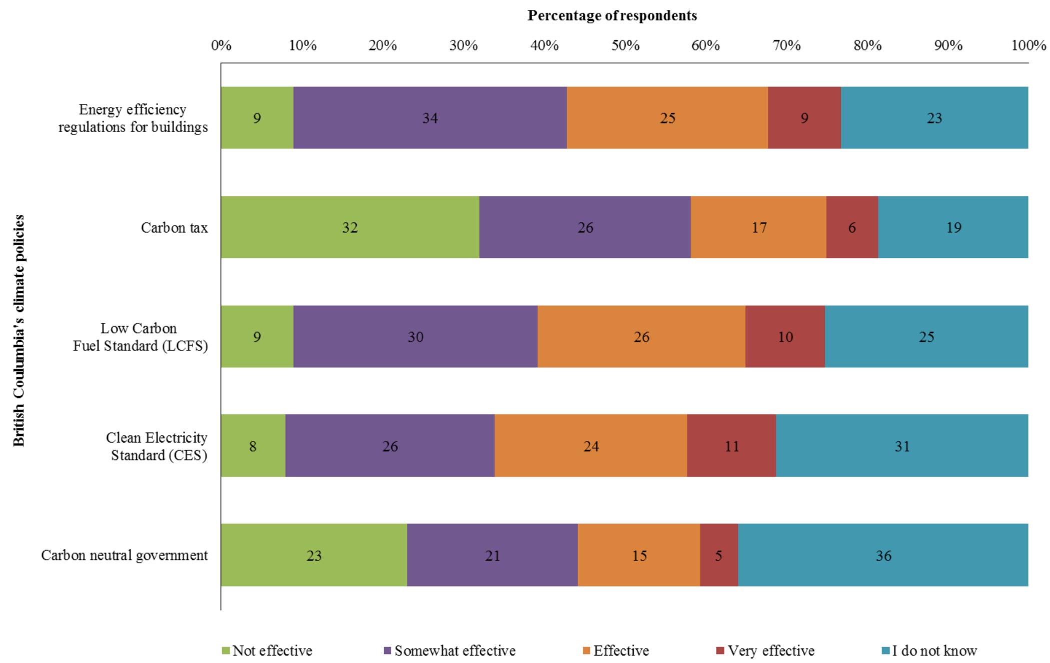


**Figure 3.4. Beliefs in policy effectiveness**

Figure 3.5 shows the results from comparing respondent beliefs in policy effectiveness with the forecasts of climate policy experts from Table 3.3. Knowledge of policy GHG effectiveness (consistent with expert assessments) is the highest for BC's carbon tax (43%) and the lowest for the Low Carbon Fuel Standard (9%). However, the majority of respondents (from 57 to 91%) provided policy effectiveness ratings that were not consistent with those of experts, which is not surprising given the limited awareness of policy existence as shown in Figures 3.2 and 3.3.

### 3.5.3. Citizen support for climate policies

Figure 3.6 shows that respondent support is the highest for the regulations, including the Low Carbon Fuel Standard (90%), energy efficiency regulations for buildings and their contents (89%), and the Clean Electricity Standard (89%). BC's carbon tax achieves the lowest level of support (56%) and the highest level of opposition (44%) among all climate policies, with the latter dramatically exceeding the levels of opposition to the regulatory policies. The carbon neutral government policy is supported by 78% respondents and opposed by 22%.

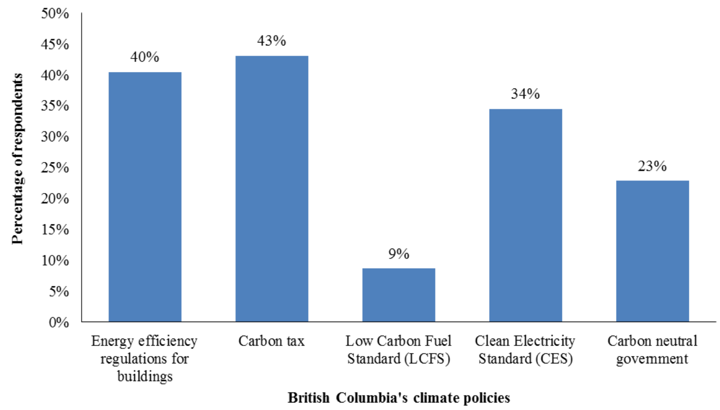


**Figure 3.5. Types of policies rated consistently with expert assessments of policy GHG effectiveness**

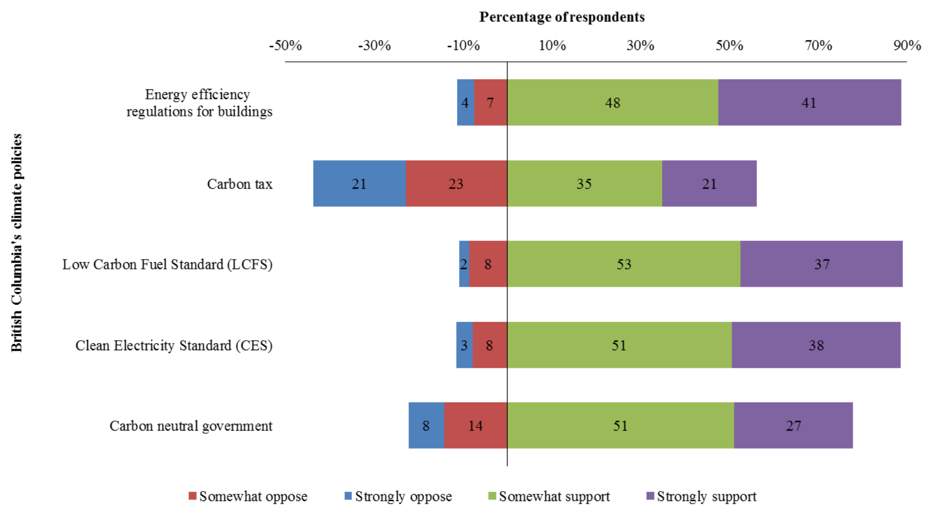


**Figure 3.6. Support/opposition to BC's climate policies**

## 3.5.4. Relationship between policy knowledge and support

Table 3.5 shows the results of the regression analysis performed to assess the effect of citizen knowledge about BC's climate policies on policy support. Specifically, we evaluated the effect of (1) awareness of policy existence, (2) knowledge of policy GHG effectiveness (consistent with expert assessments), and (3) beliefs in policy GHG effectiveness. The results are shown only for those variables that have been selected by the forward stepwise procedure as the most effective in predicting citizen support for each policy.

**Table 3.5. Forward stepwise binary logistic regression results: parameter estimates and odds ratios**

| Explanatory variables | B | S.E. | Sig. (p-value) | Exp(B) / Odds ratios |
|---|---|---|---|---|
| Energy efficiency regulations for buildings | | | | |
| **Beliefs in policy GHG effectiveness** | 1.293 | .277 | .000 | 3.642 |
| **Knowledge of GHG effectiveness** | .873 | .431 | .043 | 2.394 |
| Altruistic values | .607 | .273 | .026 | 1.835 |
| Beliefs about consequences of climate change | .093 | .017 | .000 | 1.098 |
| Participation in environmental activities of ENGOs | -.823 | .168 | .000 | .439 |
| Following climate change news | .514 | .216 | .017 | 1.672 |
| Gender: Male (reference “Female”) | -.989 | .432 | .022 | .372 |
| Income | .413 | .121 | .001 | 1.511 |
| Living area: Urban (reference “Rural”) | -.162 | .513 | .753 | .851 |
| Living area: Suburban (reference “Rural”) | 1.099 | .586 | .061 | 3.000 |
| -2LL 191.071; H&L $\chi^2$=5.960, *df*=8, *p*=.652; Nagelkerke $R^2$ 51.4%; Classification accuracy 91.9% | | | | |
| Carbon tax | | | | |
| **Beliefs in policy GHG effectiveness** | 1.291 | .151 | .000 | 3.635 |
| Beliefs about consequences of climate change | .031 | .013 | .020 | 1.032 |
| Trust in ENGOs | .360 | .128 | .005 | 1.433 |
| Willingness to pay for climate change mitigation | .408 | .098 | .000 | 1.504 |
| Gender: Male (reference “Female”) | -.648 | .244 | .008 | .523 |
| Number of vehicles in a household | -.285 | .131 | .030 | .752 |
| -2LL 427.636; H&L $\chi^2$=20.043, *df*=8, *p*=.110; Nagelkerke $R^2$ 50.3%; Classification accuracy 81.2% | | | | |
| Low Carbon Fuel Standard | | | | |
| **Beliefs in policy GHG effectiveness** | .740 | .233 | .002 | 2.095 |
| Beliefs about consequences of climate change | .079 | .017 | .000 | 1.082 |
| Trust in fossil fuel industry | -.634 | .200 | .002 | .530 |
| Personal norms | .101 | .035 | .004 | 1.106 |
| Participation in environmental activities | -.363 | .174 | .037 | .696 |
| Gender: Male (reference “Female”) | -.932 | .410 | .023 | .394 |
| Living area: Urban (reference “Rural”) | .421 | .464 | .364 | 1.523 |
| Living area: Suburban (reference “Rural”) | 1.645 | .537 | .002 | 5.180 |
| -2LL 204.045; H&L $\chi^2$=8.004, *df*=8, *p*=.433; Nagelkerke $R^2$ 43.3%; Classification accuracy 90.7% | | | | |
| Clean Electricity Standard | | | | |
| **Beliefs in policy GHG effectiveness** | .629 | .235 | .007 | 1.876 |
| Altruistic values | .715 | .231 | .002 | 2.045 |
| Beliefs about consequences of climate change | .091 | .017 | .000 | 1.096 |
| Trust in fossil fuel industry | -.831 | .214 | .000 | .435 |
| Trust in renewables industry | .674 | .263 | .010 | 1.962 |
| Education | .312 | .104 | .003 | 1.366 |
| Living area: Urban (reference “Rural”) | -.070 | .466 | .881 | .933 |
| Living area: Suburban (reference “Rural”) | .901 | .495 | .069 | 2.461 |
| -2LL 221.441; H&L $\chi^2$=4.390, *df*=8, *p*=.820; Nagelkerke $R^2$ 42.6%; Classification accuracy 89.4% | | | | |
| Carbon neutral government | | | | |
| **Beliefs in policy GHG effectiveness** | 1.447 | .194 | .000 | 4.249 |

| Explanatory variables | B | S.E. | Sig. (p-value) | Exp(B) / Odds ratios |
|---|---|---|---|---|
| Egoistic values | -.765 | .204 | .000 | .465 |
| Beliefs about consequences of climate change | .092 | .016 | .000 | 1.097 |
| Trust in ENGOs | .507 | .162 | .002 | 1.660 |
| Trust in university scientists | -.478 | .202 | .018 | .620 |
| Education | .193 | .077 | .012 | 1.213 |
| Living area: Urban (reference “Rural”) | -.177 | .399 | .658 | .838 |
| Living area: Suburban (reference “Rural”) | .725 | .402 | .071 | 2.064 |
| -2LL 312.857; H&L $\chi^2$=11.204, *df*=8, *p*=.190; Nagelkerke $R^2$ 50.4%; Classification accuracy 86.5% | | | | |

Positive parameters indicate a positive relationship between the response and explanatory variables. For example, respondent support for a carbon tax is more likely to increase with an increase in belief in the effectiveness of the policy, belief in the negative consequences of climate change, one’s trust in ENGOs, and one’s willingness to pay for climate change mitigation. In contrast, support for a carbon tax is more likely to decrease if respondents are males (as opposed to females) and in households possessing a greater number of vehicles.

Respondent awareness of policy existence is not a statistically significant predictor for any of the tested policies (and thus not depicted in Table 3.5). Knowledge of climate policy effectiveness (consistent with expert assessments) is not associated with support for most policies, except for energy efficiency regulations for buildings (respondents who know the potential GHG reduction effect of these regulations are 2.3 times more likely to support them). Unlike the awareness of policy existence and knowledge of effectiveness, respondent belief in climate policy effectiveness appears to be one of the strongest predictors of support for all tested climate policies, when controlling for attitudinal, contextual, and personal capability variables. Thus, respondents who believe that BC’s climate policies are effective are 1.9–4.2 times more likely to support them than those who think they are ineffective. The greatest effect of respondent GHG beliefs on policy support is observed for the carbon neutral government (4.2 times more likely to support), followed by the energy efficiency regulations and the carbon tax (3.6 times more likely to support). Other strong predictors of policy support include pre-held altruistic values and beliefs, including trust in ENGOs and the renewable industry, and beliefs about the negative consequences of climate change.

We also estimated regression models with all significant and non-significant explanatory variables included, and still found that policy awareness and knowledge of GHG effectiveness are not significant predictors of support. Because our goal was to determine the roles of awareness and knowledge in policy support, we were not concerned about presenting a full model with all nonsignificant variables, and therefore consider the choice of the forward stepwise binary logistic regression appropriate. We did not detect any multicollinearity issues among the tested explanatory variables. Variance Inflation Factor (VIF) is lower than 3.5 and tolerance is higher than 0.28 for all variables, whereas the rule of thumb is to avoid VIF higher than 5 and tolerance lower than 0.20 (O'Brien, 2007).

### 3.5.5. Effect of information provision of policy support

Figure 3.7 shows the levels of respondent support for BC's climate policies before and after receiving information about each policy's effectiveness in reducing GHG emissions as estimated by climate policy experts (Table 3.3).

After receiving the GHG reduction information (Table 3.3), respondent support remains at relatively the same levels for all policies except the carbon neutral government and LCFS, which experience a 10% and 7% decrease in support. With or without information provision, a higher proportion of respondents would support energy efficiency regulations for buildings, the Low Carbon Fuel Standard, and the Clean Electricity Standard (83–90%) than would support carbon taxation (56–59%) to meet BC's GHG reduction objectives. The carbon tax once again achieves the lowest levels of support (59%) and the highest levels of opposition (41%).

To compare the results before and after providing information, we used the Wilcoxon signed-rank test and the chi-square test for equality of proportions. Both tests showed that providing climate policy effectiveness information does not elicit any statistically significant change in respondent support for energy efficiency regulations (Wilcoxon $z$ = -1.671, $p$ = 0.095; $x^2$ = 1.778, $p$ = 0.182), the carbon tax (Wilcoxon $z$ = -0.753, $p$ = 0.080; $x^2$ = 0.907, $p$ = 0.341), and the Clean Electricity Standard (Wilcoxon $z$ = -0.457, $p$ = 0.647; $x^2$ = 0.158, $p$ = 0.691). However, the GHG information prompts a statistically significant decrease in support (from "support" to "oppose") for the Low Carbon Fuel Standard (Wilcoxon $z$ = -3.677, $p < 0.001$; $x^2 = 14.894$, $p < 0.001$) and the carbon neutral government policy (Wilcoxon $z$ = -4.950, $p < 0.001$; $x^2 = 20.838$, $p < 0.001$). The decrease in support could be attributed to the fact that the expert-projected GHG reductions from these policies were relatively small (Table 3.3).

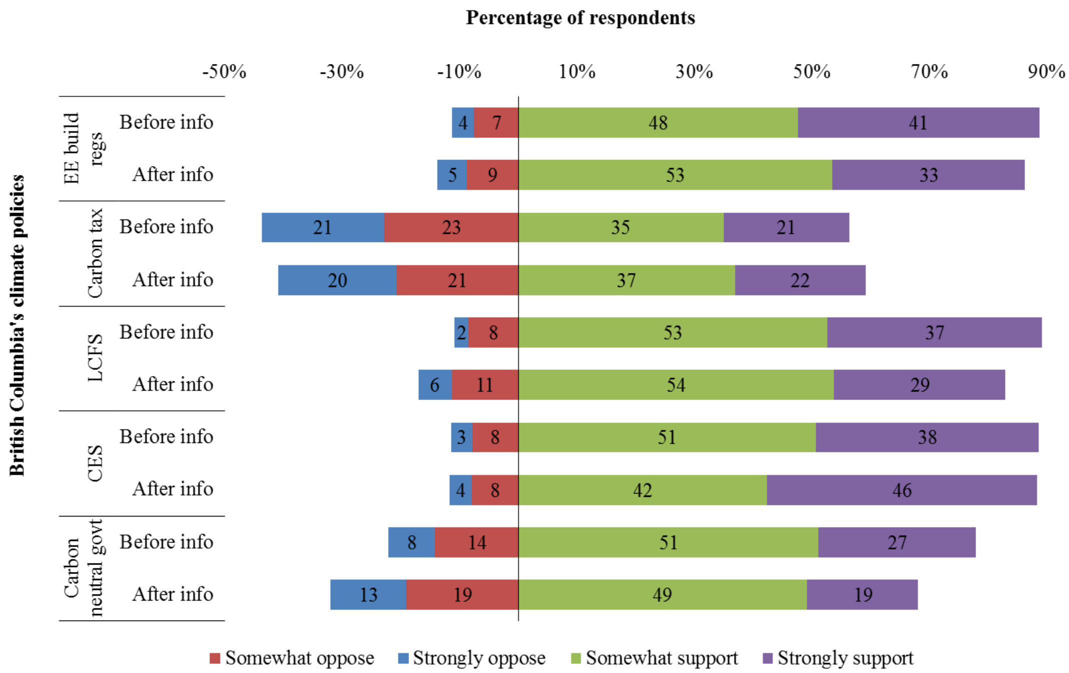


**Figure 3.7. Support/opposition to BC's climate policies before and after providing policy GHG effectiveness information**

## 3.6. Discussion and conclusion

There are several shortcomings of our findings that can be addressed in future research. First, the results are location-specific in that they apply to BC's unique climate policies in their current design, which could limit the generalizability of our results. Second, our study is based on a general sample of BC citizens, who are unlikely to have as much interest in and influence on policy-making as would active members of key interest groups. Complementary research is needed to assess climate policy perceptions of various stakeholder groups and institutions – and how their perceptions may in turn influence policy implementation and even general public views. Third, we did not test how information provision by actors other than climate policy experts (as communicated through our survey instrument) can shape citizen support for climate policies, and recognize that the results might have been affected by the lack of trust in our sources of information. The influence of different cultural groups and their social networks, of industry, and of media on citizen perceptions of climate policies should be tested in future research. Fourth, the quasi-experimental method of measuring the effect of GHG information provision on policy support lacked the element of random assignment of respondents to treatment and control groups, and therefore might have negatively affected our ability to detect a significant increase in stated support after the information provision. Future research could employ an experimental design method with large treatment and control groups to test for the robustness of our findings. Finally, survey-based responses might have been affected by a social desirability bias (i.e., measures of policy support might have been over-reported), a questionnaire design bias (i.e., question framing and ordering might have had an impact on responses), and by the time respondents spent answering questions in an ‘artificial’ survey environment. Different frames and research methods, including semi-structured interviews and focus groups, could be employed to test the overall robustness of our study results.

Despite these limitations, we believe our study offers important insights into climate policy support by providing a challenge to assumptions that there is a strong linkage between the level of citizen policy knowledge and its relationship to citizen support for effective climate policy. The results suggest that most citizens are unaware of climate policies, even after more than two decades of political debate on climate policy in most industrialized countries, and an intensive three years of aggressive climate policy debate and implementation in British Columbia from 2006 to 2009, and are just as likely to incorrectly identify non-existing policies as being in place. The low levels of policy awareness and knowledge appear to be consistent with the public good theory suggesting that a significant number of citizens will free-ride on the policy interest and knowledge of a few (Olson, 1971; Caplan, 2007). But the results are also consistent with arguments that climate science and climate policy are simply too complex and distant from everyday lives for most people to invest much effort in better understanding them (Cvetkovich et al., 2002). A future research path might be to explore how these and other possible factors may influence citizen awareness and knowledge of climate policies.

Among the five policies tested in this study, BC's carbon tax stands out as the best-known policy both in terms of its existence and expert-consistent ratings of GHG emission reduction effectiveness. All three of BC regulations and the carbon neutral government policy appear to be almost entirely unknown. These findings imply that without the carbon tax, the survival of which was the focal point of a provincial election campaign in 2008–2009, British Columbians are almost completely unaware of their government's aggressive climate policies. When people are made aware of these climate policies, BC's carbon tax achieves the lowest support (56%) in contrast to the strong support for energy efficiency regulations for buildings, the Low Carbon Fuel Standard, and the Clean Electricity Standard (up to 90%). These results are consistent with the patterns observed in recent public opinion polls in Canada and BC (Borick et al., 2011; Environics, 2011). They are also consistent with some behavioural research that explains the high awareness and low support for carbon taxes by their significant cost visibility compared to that of regulations, and an anti-tax bias among citizens (Harrison, 2012; Caplan, 2007). The salience argument is further reinforced by the idea that humans value highly visible losses (i.e., the carbon tax) greater than otherwise-equivalent gains (i.e., income tax returns and GHG reductions), and thus might see the carbon tax as mostly a loss (Kahneman et al., 1991). Extensive, negative media coverage of BC's carbon tax might also be a contributor to low citizen support. These explanations could be probed through future comparative research of citizen perceptions of costs of different policy types, as well as content analysis of media effects (if any) on support for various types of climate policies.

Our results indicate that awareness of policy existence and knowledge of policy effectiveness are not associated with greater citizen support for most climate policies. Only support for energy efficiency regulations is associated with expert-consistent knowledge of policy effectiveness. Furthermore, the provision to the public of climate policy details does not elicit a statistically significant increase in citizen support for any of the policies we tested, implying that the lack of information (at least in regards to policy effectiveness) is not a barrier to policy support. These findings seem to challenge a key premise of the knowledge deficit model, which suggests that more public knowledge and support is essential for effective climate policy implementation.

Instead, our findings are at least consistent with research suggesting that other individual characteristics have stronger associations with climate policy support, such as values, trust in environmental non-government organizations and the renewable energy industry, and beliefs about the negative consequences of climate change. We also observe that beliefs in policy effectiveness, unlike the expert-consistent knowledge of policy effectiveness, are consistently associated with higher support for all tested policies. The strength of these predictor variables suggests the importance of pre-defined ideals and socio-psychological valuation processes in forming citizen perceptions. Although we did not test for this explicitly, our findings are consistent with the cultural cognition theory that points to the socio-psychological basis of human cognition of public policies and policy information (Kahan and Braman, 2006). The results are also consistent with research stressing the importance of pre-conceived values, trust, and social networks in shaping policy support (Dietz et al., 2007; Shwom et al., 2010). Future research could explore how different socio-psychological mechanisms (e.g., biased assimilation and trust) are formed, what role they play in climate policy support (which mechanisms have the strongest predictive power), and how they can be changed over time to gain policy support (e.g., how trust can be altered).

Our findings may have significant implications for climate policymaking, once combined with some of the other research to which we refer. First, the divergence of support by policy type implies that regulations might have higher chances of political acceptability than carbon taxation, at least in some jurisdictions. Second, while more effective efforts at informing citizens about climate science and policy may help at some level, this strategy alone is likely to be inadequate for achieving implementation of effective climate policies. Those seeking such a policy outcome need to be aware of other factors in the policy-making process. We suspect that one significant factor is the trust citizens have in key individuals, groups and institutions who are promoting and implementing climate policies. More research in this area may prove fruitful.

## 3.7. Acknowledgements

This research was funded by the Pacific Institute for Climate Solutions and the Social Sciences and Humanities Research Council (Vanier Canada Graduate Scholarships programme).

# Chapter 4. Gauging citizen support for a low carbon fuel standard[11]

## 4.1. Abstract

Since 2007, several variations of a low carbon fuel standard (LCFS) have been implemented around the world. While emerging research tends to focus on greenhouse gas emission reductions from an LCFS, no studies have assessed the policy's political acceptability—a critical component of implementation. We elicit public support for an existing LCFS in British Columbia and a hypothetical (proposed) LCFS for the rest of Canada using survey data collected from a representative sample of Canadian citizens (n = 1,306). Specifically, we assess: (1) citizen awareness of British Columbia's LCFS, (2) stated citizen support for the LCFS, and (3) how individual characteristics relate to levels of citizen support. We find that British Columbia's LCFS is almost unknown among British Columbia respondents, but once explained, 90% of respondents support it. We refer to this combination of low knowledge and high support as "passive support." We find similarly broad support in all other Canadian provinces, implying that citizen opposition is unlikely in jurisdictions considering an LCFS. Statistical analysis identifies some individual characteristics associated with LCFS support, including attitudes, demographics, and contextual factors. Results indicate where policymakers might anticipate opposition if it arises due to increased policy stringency or media coverage.

[11] This paper was published as Rhodes, E., Axsen, J., and Jaccard, M. (2015). Gauging citizen support for a low carbon fuel standard. *Energy* Policy, 79, 104-114.

## 4.2. Introduction

Various jurisdictions around the world have recently implemented or are considering implementing a low carbon fuel standard (LCFS) — a performance-based climate policy that aims to decarbonize transportation by reducing average greenhouse gas (GHG) intensities in transportation fuels (Farrell and Sterling, 2007). Versions of an LCFS have been implemented in California, the European Union, and in British Columbia, Canada. This study explores public support of the LCFS existing in British Columbia, and public support of a proposal to implement such a policy across Canada.

Emerging research tends to focus on GHG emission reductions from an LCFS, with some consideration of whether such a policy is an economically efficient way to reduce GHG emissions. However, it is arguable that a "good" climate policy is not only effective and efficient—but also politically acceptable. For example, political acceptability is thought to be the main impediment to implementing a strong carbon tax in most jurisdictions—no matter how effective or efficient the policy is on paper. Here we explore the political acceptability of an LCFS, focusing on public support. To date, no published research has explored public support relating to an LCFS.

There is little consensus in policy literature on what type or level of public support is required for a given climate policy to be deemed acceptable. We consider three constructs: citizen awareness, perceived effectiveness, and stated support. Awareness is the basic knowledge that the policy exists. Perceived effectiveness is the citizen's beliefs regarding the policy's expected GHG reductions in the period from 2008 to 2020. Citizen support is measured as a citizen's stated position in support of, or opposition to, an LCFS. Research suggests that citizen awareness is not necessarily related to public support of climate policy, but perceived effectiveness can be positively associated with support (Rhodes et al., 2014). We anticipate that supplier-focused climate policies like the LCFS are likely to receive broad "passive support," where citizens are unaware of the policy, but express support when the policy is explained.

We empirically explore citizen perceptions of an LCFS using survey data collected from a representative sample of Canadian citizens (n = 1,306), including an oversample in British Columbia (n = 475), where an LCFS has been approved for almost five years (at the time of data collection in 2013 - 2014). Our research objectives are to assess:

1. citizen awareness and perceived effectiveness of British Columbia's LCFS (for British Columbia's sub-sample only);
2. citizen support for the LCFS in British Columbia, Canada as a whole, and by Canadian region; and
3. how individual characteristics relate to citizen support in British Columbia and Canada.

The paper is organized as follows. First, we provide a background of LCFS-like policies existing in the world, followed by a literature review of the trends and characteristics of climate policy support. Second, we describe our research methodology, including survey data collection, operationalization of variables, and data analysis techniques. Then, we present the study results and discuss how they relate to the existing literature on climate policy support. Finally, we conclude with the key implications for future climate policy-making.

## 4.3. Overview of low carbon fuel standards

The transportation sector predominately relies on petroleum fuels, accounting for one-fourth of global and one-third of North America's GHG emissions (Intergovernmental Panel on Climate Change, 2014). An LCFS seeks to reduce average carbon intensities in transportation fuels measured in grams of carbon dioxide equivalent ($CO_2e$) per megajoule of energy used. The idea behind this performance-based standard is to give fuel providers the freedom to select the lowest-cost low-carbon alternatives to comply with the policy. A typical LCFS differentiates fuels based on their carbon intensity values and targets lifecycle GHGs emitted in the process of extraction, processing, distribution, and fuel use (Yeh and Sperling, 2013). Therefore, the policy stimulates fuel providers to switch to lower carbon alternatives, such as biofuels, hydrogen, and electricity, or to reduce the upstream carbon intensity of petroleum production. While 'fuel' is commonly defined as "a product that is burned to produce heat or power" (Merriam-Webster Dictionary, 2014), the originators of the LCFS policy have been clear from the outset that electricity, if produced with few emissions and used in transportation, can also be considered as a ‘low carbon fuel.’ We follow this convention in stipulating fuel options within the LCFS.

Several variations of an LCFS policy were adopted around the world in 2007 – 2010. Here we briefly outline versions implemented in California (U.S.), the European Union (EU) and British Columbia (Canada). Each version has unique design characteristics, and has met with different degrees of political controversy.

The state of California was the lead jurisdiction to propose an LCFS in 2007 and to implement it in 2010. The policy obliges fuel providers to reduce the carbon intensity of their fuel mix by 10% by 2020 from 2010 levels, starting with a 0.25% reduction in 2011 (California Air Resources Board, 2009). California’s LCFS has market flexibility features that allow fuel suppliers to bank and trade GHG reduction credits. Since its implementation, the policy is estimated to have prevented 2.8 Mega tonnes (Mt) of $CO_2$ and is projected to achieve 25 Mt $CO_2$ in annual lifecycle reductions from fuel production to combustion by 2020, contributing about 14% to the achievement of the state’s 2020 GHG reduction target (California Air Resources Board, 2009; Yeh et al., 2013). California’s LCFS has faced multiple legal challenges from the oil, trucking, ethanol, and agricultural industries claiming that the policy discriminates against out-of-state commerce and fuels by incorporating the distance a fuel travels to California into the calculation of carbon intensity values (Kasler, 2014). However, most of these claims have been rejected by California state courts because the policy distinguishes fuels based on real differences in their carbon intensities resulting from transportation, and therefore motivates out-of-state industries to reduce emissions rather than restricts activities of those industries (Brisson et al., 2014). Washington, Oregon, and several states in the Midwest and the Northeast / Mid-Atlantic region are considering adoption of California’s LCFS policy approach (Yeh et al., 2012).

The European Union proposed an LCFS policy at about the same time as California in 2007. In 2009, the European Commission revised the existing Fuel Quality Directive (FQD) to incorporate LCFS features into the policy. The FQD requires a 6% reduction in the carbon intensity of transportation fuels by 2020, which is less stringent than California's LCFS target (EU Parliament, 2009). However, the FQD is broader in that it establishes sustainability criteria for biofuels (Yeh and Sperling, 2013). Specifically, the policy does not allow biofuels where the land use effects of production would cause high carbon emissions or lead to reduced biodiversity. Although the policy was ratified in 2008 - 2009, it is still not in force due to the delays in approving implementation measures, which include the ranking methodology for carbon intensity of fuels. If the original intensity values for unconventional oils are kept in the FQD, the policy is projected to result in up to 19 Mt $CO_2$ savings per year, in addition to the annual 50 - 60 Mt $CO_2$ reductions from supplying alternative fuels to meet the FQD target (Kampman et al., 2012).

In 2010, British Columbia was the first and only province in Canada to enact its own LCFS policy – the Renewable and Low Carbon Fuel Requirements Regulation (RLCFRR). The policy consists of two components: (1) the Renewable Fuel Requirement, which sets a 5% renewables target for gasoline and 3% for diesel starting in 2010 (with the target for diesel increasing to 4% in 2011), and (2) the Low Carbon Fuel Requirement, obliging fuel suppliers to reduce the carbon intensity of transportation fuels by 10% by 2020, consistent with California's LCFS target (BC Ministry of Energy and Mines, 2014). Unlike California's LCFS, British Columbia's policy cannot be met through reductions of carbon intensity of upstream petroleum production because it does not differentiate between the carbon intensity of different sources of crude oils. Although Bailie et al. (2007) estimate the impact of British Columbia's LCFS at 0.7 Mt $CO_2$ by 2020 (which contributes about 2% to the achievement of the provincial GHG reduction target), the British Columbia government reported a reduction of 0.9 Mt $CO_2$ in 2012 due to the use of renewable and low carbon fuels (BC Ministry of Energy and Mines, 2014). However, as with many policies, it is difficult to estimate the marginal effects of British Columbia's LCFS, especially when other climate policies are in place, such as a carbon tax of $30 per tonne of $CO_2$ on all fossil fuel based transport fuels, and the fact that the compliance period began in only 2010.

In contrast to the policies in California and the EU, British Columbia's LCFS has received little attention from industry and media. Other climate policies have garnered much more media attention. The LCFS has been mentioned only 21 times in British

Columbia's two most widely circulated newspapers between 2007 and 2014—in contrast, British Columbia's carbon tax was been mentioned 1,714 times in that same time period (Factiva, 2014). British Columbia's LCFS thus provides an interesting case study to assess citizen awareness of an existing policy, and also to explore the notion of "passive support"—that is, to assess if the policy is both relatively unknown and generally acceptable when explained to citizens. No previous research has explored citizen perceptions regarding LCFS type policies.

## 4.4. Citizen support for climate policy: trends and individual characteristics

One indicator of public acceptance of a climate policy is whether the policy was implemented in the first place. Price-based instruments, such as a carbon tax, tend to face political resistance due to strong negative reactions by some segments of the public and various interest groups (Caplan, 2007; Harrison, 2012). This resistance is particularly strong in North America (relative to Europe), where only the province of British Columbia has successfully implemented a carbon tax, and even there it is controversial (Rhodes et al., 2014). Cap-and-trade policy also works as a pricing mechanism, but can be seen as more acceptable in some contexts because it avoids the visibility ('salience') challenges associated with taxes (Chetty et al., 2009). However, even cap-and-trade has been difficult to implement in North America. Instead, jurisdictions acting to reduce emissions in North America have thus far relied mostly on regulations—policies that put requirements on fuel providers, electric utilities, auto manufacturers, and other upstream agents. Thirty U.S. states have adopted some form of renewable portfolio standard which requires electricity providers to source a minimum percentage of their electricity from renewables (U.S. Energy Information Administration, 2012). Eight U.S. states have adopted the Zero-Emissions Vehicle mandate (initiated by California). Similarly, the LCFS has already been enacted in California and British Columbia, and is increasingly becoming a central part of the national and state discussions in the U.S., with several states considering implementation of the policy in the near future.

Empirical survey research also supports the notion that supplier-focused climate regulations tend to be more politically acceptable than price-based climate policies in North America. A representative survey of Canadian citizens (n = 2,000) conducted by the Environics Institute (2011) found that although most respondents support setting limits on GHG emissions (74 to 80%), support for a carbon tax was low (46 to 58%). Similarly, national surveys of Canadian (n = 1,214) and American (n = 916) citizens conducted by the Brookings Institute in 2010 - 2011 revealed that both Canadian and American citizens show broader support for climate regulations than carbon taxes and cap-and-trade systems (Borick et al., 2011). In Canada for example, this study elicited high levels of citizen support for vehicle fuel efficiency standards (88%) and renewable portfolio standards (89%), and lower support for carbon taxes (52%) and cap-and-trade systems (72%). Although these studies did not include questions about an LCFS, it seems reasonable to hypothesize that stated support for an LCFS would be relatively high, as the focus of such a policy is similar to that of vehicle- and electricity-based climate regulations.

This notion of policy salience holds important implications for how we define public support. Here we introduce the concepts of active and passive support. A carbon tax may be less politically acceptable in part because it is more salient—citizens feel directly impacted and are more likely to become aware of the policy. In contrast, some regulations like the LCFS may be more acceptable because they are less salient—the policy sets requirements for industry that the end consumer is not aware of. Citizens may thus indicate support for a policy like the LCFS when asked on a survey, but they might not be aware of the policy otherwise. We define this as passive support: awareness of the policy is very low, but when citizens are informed about the policy, they indicate high levels of support. In contrast, active support is present if citizens are both well-informed and supportive of the policy. Arguably, even if citizen awareness of the policy is low, it is important to measure and understand levels of passive support to help policymakers anticipate how public support may change if awareness were to increase (e.g., through increased policy stringency or media coverage).

Public support—whether active or passive—is likely to also be affected by factors other than policy design. In particular, support can vary among citizens due to a variety of individual characteristics. Identifying these patterns of support or opposition can help policymakers to understand citizen motivations and to anticipate reactions to changes in the policy or in the political climate. There are a variety of conceptual frameworks that can be used to describe and categorize patterns of citizen support (Jackson, 2005). We presently draw from Stern's (2000) Attitude-Behaviour-Context (ABC) framework, which is among the few integrative models that incorporates some of the 'internal' and 'external' determinants of pro-environmental behaviour, which he refers to as attitudinal, contextual, and personal capability variables. Some theories focus only on 'internal' factors of behavior, such as cognitive, affective, and moral motivations (Ajzen, 1991; Schwartz, 1992; Stern et al., 1999). These 'internalist' models tend to be weak predictors of difficult and costly behaviours that might be restricted by multiple contextual factors, e.g., financial, infrastructure, and social constraints (Bamberg and Schmidt, 2003). Other theories focus only on 'external' factors of behaviour such as cultural, political, and economic factors—such as Cultural Theory (Thompson et al., 1990) and Symbolic Interactionism (Blumer, 1969)—and tend to ignore many attitudinal factors in explaining pro-environmental behaviour (Leiserowitz, 2006). Stern's ABC model attempts to integrate insights from both approaches, providing a broader perspective on citizen support for a policy like the LCFS.

We summarize and define in Table 4.1 some of the key variables that we expect to predict citizen support for an LCFS, drawing from Stern's ABC framework. We organize the table to show several attitudinal variables in the top section, contextual in the middle, and personal capability variables in the bottom. For each variable, we show the hypothesized effect on policy support in the right column based on past empirical research.

**Table 4.1. Individual characteristics expected to predict citizen support for a low carbon fuel standard[a]**

| Variable name | Hypothesized effect on LCFS support |
|---|---|
| **Attitudinal variables** | |
| Values - mental orientations toward collective and private benefits (Dietz et al., 2005) | |
| • altruistic and biospheric (orientations toward other human beings, species, and the biosphere) | + |
| • egoistic and openness-to-change (orientations toward self) | - |
| General environmental concern (ecological worldviews) - beliefs in human impacts on nature, resource scarcity, and other species (Bord et al., 1998) | + |
| Beliefs in human causes and adverse consequences of climate change (O'Connor et al., 1999) | + |
| Trust in the federal and provincial governments, fossil fuel and renewable energy industries, environmental groups, and university scientists in assessing and solving climate change (Cvetkovich et al., 2002) | + |
| Ascription of responsibility (personal, joint, industry, and government) for climate change mitigation (Steg et al., 2005; Dietz et al., 2007) | + |
| Personal norms - beliefs in guilt and moral obligation to reduce climate change (Steg et al., 2005) | + |
| Perceived policy effectiveness - beliefs in GHG effectiveness of British Columbia's LCFS in the period from 2008 to 2020 | + |
| **Contextual variables** | |
| Region by province (Shwom et al., 2008; Matisoff and Edwards, 2014) | |
| • Regions heavily reliant on carbon intensive industries or fossil fuel production | - |
| • Regions less reliant on carbon intensive industries or fossil fuel production | + |
| Region by living area type (Freudenburg, 1991; Elliott et al., 1997) | |
| • Urban and suburban | + |
| • Rural | - |
| Political ideology - citizen affiliation with, or support for, federal political parties (Lyon and Yin, 2010) | |
| • Left-liberal perspectives | + |
| • Conservative perspectives | - |
| Social networks - discussion of climate change with families and friends and participation in environmental activities (Lubell et al., 2007) | + |
| Number of vehicles in a household | - |
| Daily commute time to work or school | - |
| Commute mode to work or school | |
| • drive myself | - |
| • other modes (e.g., carpool, public transit, bicycle) | + |
| **Personal capability variables** | |
| Age (Elliott et al., 1997; Klineberg et al., 1998) | - |
| Gender (Elliott et al., 1997; Klineberg et al., 1998) | |
| • Male | - |
| • Female | + |
| Education (Elliott et al., 1997; Klineberg et al., 1998) | + |
| Income (Elliott et al., 1997; Klineberg et al., 1998) | + |
| Awareness of LCFS existence in British Columbia (Rhodes et al., 2014; Lorenzoni et al., 2007) | + |

[a] + positive effect, - negative effect.

Attitudinal variables, including values, beliefs, and personal norms, have been among the most stable predictors of citizen support for climate policies. While egoistic and openness-to-change values tend to be associated with higher policy opposition, altruistic and biospheric values, general environmental concern, beliefs in responsibility to reduce climate change, and personal norms are associated with higher support (Dietz et al., 2005; Bord et al., 1998; Steg et al., 2005). Further, risk perception studies show that people who believe in human causes and adverse consequences of climate change are more likely to adopt behaviours mitigating climate change and to be willing to pay the cost of climate policy (O'Connor et al., 1999). However, in the cases of individuals who lack knowledge or other means to assess causes or consequences of environmental problems, trust in governments, industry, and scientists appears to play an important role in shaping policy support (Cvetkovich et al., 2002).

Although attitudes tend to be strong predictors of policy support, they are shaped by complex socio-psychological processes and thus difficult to change (Kahan and Braman, 2006; Dietz et al., 2005). Alternatively, it can be possible for policy-makers to influence the social, institutional, and situational contexts that shape moral choice and social identity (Egmond and Bruel, 2007). Therefore, we include measures of some of contextual explanatory variables including the citizen's regional location, political ideology, and social networks. Past research shows that climate policy support varies by region (Shwom et al., 2008; Environics Institute, 2012). Regional differences are typically explained by the regions' different degrees of economic reliance on carbon intensive industries or fossil fuel production (Matisoff and Edwards, 2014). Given that Alberta has the most abundant fossil fuel resources in Canada (Statistics Canada, 2011), we expect to see lower support for an LCFS in this province. Moreover, Freudenburg (1991) and Elliot et al. (1997) find that rural residents are less likely to be concerned about environmental issues and less likely to express policy support than urbanites who are exposed to higher emission concentrations (for air pollutants) and less directly dependent for income on the extraction of natural resources. Therefore, we anticipate that rural residents are less likely to support an LCFS than residents of urban and suburban areas. Further, left-liberal political perspectives are hypothesized to be associated with higher policy support than conservative ideologies (Lyon and Yin, 2010). Finally, participation in social networks that regularly discuss environmental issues and engage in environmental activities is anticipated to predict support for an LCFS (Lubell et al., 2007).

We also test several contextual variables that have not received much attention in previous research, including the number of vehicles in a household, daily commute time to work or school, and the commute mode. Because an LCFS policy is likely to result in the increased cost of transportation using personal vehicles, we expect that households relying on these (i.e., those that drive to work or school and / or own or lease many vehicles) are less likely to support the policy.

Personal capability characteristics are typically assessed using socio-demographic variables as proxies. Stern (2000) defines personal capability as "the knowledge and skills required for particular actions, the availability of time to act, and general capabilities and resources such as literacy, money, and social status and power." Younger age, female gender, higher education and income tend to positively influence climate policy support, and thus are tested in our study (Elliott et al., 1997; Klineberg et al., 1998). In British Columbia, we also test the effect of citizen awareness and perceived effectiveness of the existing LCFS on policy support (detailed description of these questions is provided in the Methods section). While emerging research suggests that the level and role of policy knowledge in shaping citizen support is limited (Rhodes et al., 2014), we test the traditional assumption that higher citizen awareness translates into broader policy support (Lorenzoni et al., 2007).

It is important to note that there is inevitably some instability in the perceptions and support stated by respondents in a survey. Respondents may be influenced by a subset of the policy's characteristics that are most immediately accessible, so statements of support from a given individual may change in different contexts (Zaller and Iyengar, 1992). Perceptions and stated support may be influenced by the wording of the survey, as well as other external sources such as media coverage (Zaller, 1992). However, research does suggest that despite this instability of support at the individual level, aggregate patterns of support can remain fairly stable (Zaller and Iyengar, 1992).

In summary, due to the supplier-focused, regulatory nature of the LCFS, we expect citizen awareness to be low. At the same time, we expect "passive support" to be high—citizens are likely to be generally supportive of the policy when it is described to them. We also expect that there will be heterogeneity in this “passive support”—where some citizen characteristics relating to attitude, context, and personal capability will help to explain such variations.

## 4.5. Methods

### 4.5.1. Data collection

To assess citizen perceptions of a low carbon fuel standard, we conducted a web-based survey with a representative sample of Canadian citizens (aged 19 and over) in January 2013. We hired a market research company, Harris Interactive, to recruit respondents through a web-panel of Canadian citizens to complete the survey. This Web-based panel includes a large distribution of citizens that are recruited and maintained in order to produce samples that represent the general population. A total of 1893 respondents were invited from this panel to complete the survey. Of the 1401 respondents that completed the survey, 95 were removed due to incomplete responses, leaving a total of 1,306 for the nationwide sample. As part of this national survey, we separated and oversampled citizens residing in British Columbia (n = 475) to perform an additional analysis of citizen awareness, perceived effectiveness, and support for British Columbia’s LCFS.

The average time to complete the survey was 25 minutes. To establish trust and increase the perceived benefits of participation, respondents received personalized survey invitations explaining how survey results could benefit them and others, and were given survey participation points by the research company. We used simple language and short questions to minimize the expected cost and difficulty of completing the survey. All survey questions were carefully pre-tested by volunteers of different ages, occupations, education, and genders, to ensure the clarity and simplicity of the questionnaire design.

The survey instrument contained extra questions for the representative sub-sample of British Columbia’s citizens (n = 475) to examine respondent perceptions of

British Columbia's existing LCFS, including awareness of the policy's existence, beliefs in GHG reduction effectiveness, and policy support. We assessed respondent awareness using two questions. In the first open-ended question, we explained what is meant by the term "climate policy" and asked respondents to name up to five climate policies currently implemented in British Columbia, or choose the option "I cannot think of any climate policies currently being implemented." The second question was closed-ended, where we provided the names and brief definitions of a mix of fourteen actual and fictional climate policies in British Columbia in a random order, and asked respondents to choose policies currently implemented in the province. British Columbia's actual policies (listed in the British Columbia Climate Action Plan) included a LCFS (called a "cleaner fuel regulation or low carbon fuel standard" in the survey), a clean electricity standard (called a "clean electricity regulation or renewable portfolio standard" in the survey), energy efficiency regulations for buildings (called "energy efficiency regulations for lighting, heating, and cooling systems in buildings" in the survey), a carbon tax, and a carbon neutral government policy. We defined the LCFS as "a requirement that fuels have lower carbon emissions (also sometimes called a low carbon fuel standard)." Nine other fictional policies were taken from the climate policy literature and included: a cap on provincial emissions, energy efficiency regulations for public transportation fleet, carbon offsets for converting methane gas into electricity, and education programs on energy efficiency for residential landlords. For each policy on the list, respondents were asked to choose one of the following answers:

- I know that this policy is in place in British Columbia, or
- I know that this policy is NOT in place in British Columbia, or
- I do not know about this policy.

The survey next elicited the perceived effectiveness of British Columbia's LCFS. Even if the respondent demonstrated that they were completely unaware of the LCFS, we still sought to measure citizen perceptions and "passive" support of the policy. We explained that British Columbia does currently have an LCFS in place (still defined as a "requirement that fuels have lower carbon emissions") and asked respondents to assess its effectiveness in terms of expected GHG emission reductions in the period from 2008 to 2020. We used a five-point qualitative scale ranging from "not effective at all" to "very effective" with an option "I do not know." We defined the response option "very effective" as if the respondent believes that the policy will "reduce the most greenhouse gas emissions in British Columbia over the time period from 2008 to 2020" (compared to other existing climate policies).

Then, the survey measured respondent support for British Columbia's LCFS by asking, "If there were a referendum on maintaining a cleaner fuel regulation (or low carbon fuel standard) in British Columbia, how much would you support or oppose this policy?" We used a four-point scale ranging from "strongly oppose" to "strongly support" with no neutral response category. The survey instrument used for the "rest of Canada" sample (n = 831) did not include questions on awareness or support of the existing LCFS in BC.

For the entire sample (n = 1306), support was assessed for a hypothetical low carbon fuel standard that could be implemented in Canadian regions other than British Columbia, or in Canada as a whole. We defined the term "climate policy" for respondents from regions other than British Columbia (British Columbia respondents received this definition earlier) and asked, "How much would you support or oppose regulations that require fuels to have lower carbon emissions by 20% by the year 2020?" We explained to British Columbia respondents that this question is different from the previously asked support question for British Columbia's LCFS in that it asks about a hypothetical LCFS that may be implemented in other regions or Canada as a whole. We used the same four-point answer scale as for British Columbia, ranging from "strongly oppose" to "strongly support" with no neutral response category.

To explore the association between individual characteristics and citizen support for the LCFS existing in BC and for a hypothetical LCFS proposed for the rest of Canada, we collected data on the most common predictors of climate policy support summarized in Table 4.1 and described in Section 4.4. We used the following measurement scales and ranges to assess the explanatory variables:

1. Attitudinal variables:

- Values: five-point scale ranging from “not important at all” to “extremely important” (Schwartz, 1992).
- General environmental concern: five-point scale ranging from “strongly disagree” to “strongly agree” (Dunlap et al., 2000).
- Trust: five-point scale ranging from “very low” to “very high” (Dietz et al., 2007).
- Ascription of responsibility: five-point scale ranging from “strongly disagree” to “strongly agree” (Steg et al., 2005; Dietz et al., 2007).
- Personal norms: five-point scale ranging from “strongly disagree” to “strongly agree” (Steg et al., 2005).

2. Contextual variables:

- Region: by province (seven Canadian regions) and type of living area ( “urban,” “suburban,” and “rural” categories).
- Political ideology: seven response categories with names of federal parties and an option “no / undecided.”
- Social networks: five-point scale ranging from “never” to “very often” (Zahran et al., 2006).
- Number of vehicles in a household: five categories ranging from “none” to “4 or more.”
- Daily commute time to work or school: five categories ranging from “less than 30 minutes” to “more than two hours” with an option “do not commute.”
- Commute mode to work/school: seven categories with an option “do not commute.”

3. Personal capability variables:

- Age: six categories ranging from “19 to 24 year” to “65 years and over.”
- Gender: two categories “male” and “female.”
- Education: two categories “secondary or less” and “post-secondary.”

- Income: twelve categories ranging from “without income” to “$80,000 and over” with an option “I prefer not to answer.”

### 4.5.2. Data analysis

We performed most of the statistical analyses in the IBM SPSS Statistics software. We used descriptive statistics (i.e., frequencies) to assess our first two research objectives: (1) respondent awareness of the existence of British Columbia’s LCFS in both open- and closed-ended questions, and (2) support for British Columbia’s LCFS and a hypothetical Canada-wide LCFS.

We used inferential statistics to assess regional differences in support for an LCFS, as well as to assess individual characteristics of support to achieve our third research objective. Specifically, we employed a one-way analysis of variance (ANOVA) and an independent t-test to determine if there are any significant differences between the means of support levels in Canadian provinces and in urban, suburban, and rural areas. For comparisons by province, we measured support differences for the following groups: between all Canadian regions (ANOVA); British Columbia compared to Alberta (where support is the lowest) and the rest of Canada (ANOVA); and British Columbia compared to the rest of Canada (independent t-test). To assess the association between individual characteristics and support, we performed two binary logistic regressions — one for British Columbia and another for Canada as a whole. We grouped responses to the LCFS support questions into two categories – “oppose” (an aggregate of “strongly oppose” and “somewhat oppose”) and “support” (an aggregate of “somewhat support” and “strongly support”). All variables were entered into the regressions in a single step to assess all significant and non-significant characteristics of LCFS support.

## 4.6. Results

### 4.6.1. Survey sample

Table 4.2 depicts the distributions of the British Columbia and nationwide samples relative to Census data. The samples are slightly biased in that they are more educated, older, and under-represent Asian and Aboriginal citizens. We applied corrective weights (calculated by the sample recruiting company, Harris Interactive) to ensure that analysis of sample data aligns with Canada's and British Columbia's actual distributions of income, education, age by sex, ethnic composition, and region (for Canada only) according to the Census data.

**Table 4.2. Socio-demographics of the Canadian and British Columbian samples compared to the Census data[a]**

| Socio-demographic variables | British Columbia (n=475) | | Canada (n=1,306) | |
|---|---|---|---|---|
| | Sample, % | Census, % | Sample, % | Census, % |
| Income | | | | |
| Less than $15,000 | 8 | 7.9 | 6.1 | 7.7 |
| $15,000 to $34,999 | 18.5 | 17.4 | 16.9 | 17.3 |
| $35,000 to $49,999 | 14.5 | 13.6 | 12.6 | 13.8 |
| $50,000 or over | 47.7 | 50.1 | 52.6 | 49.3 |
| Education | | | | |
| Secondary or less | 68.4 | 82.6 | 61.2 | 83.4 |
| Post-secondary | 31.6 | 17.4 | 38.8 | 16.6 |
| Age by sex | | | | |
| Male 19-39 | 8.8 | 18.8 | 11.4 | 19.6 |
| Male 40-64 | 30.1 | 21.8 | 28 | 21.7 |
| Male 65+ | 9.7 | 7.8 | 9.8 | 7.1 |
| Female 19-39 | 13.7 | 19.5 | 13.5 | 20.1 |
| Female 40-64 | 29.2 | 22.7 | 28.1 | 22.4 |
| Female 65+ | 8.5 | 9.4 | 9.2 | 9.1 |
| Race | | | | |
| First Nation or Aboriginal | 2.1 | 3.4 | 1.2 | 2.5 |
| South / Southeast Asian | 7.8 | 14.3 | 6.6 | 6.3 |
| Black and other | 5.1 | 6.3 | 5.1 | 6.2 |
| White | 82.1 | 76.0 | 84.7 | 85.0 |
| Region | | | | |
| Atlantic provinces (NL, PEI, NS, NB) | | | 4.9 | 7.7 |
| Quebec | | | 14.2 | 24.6 |
| Ontario | N/A | | 37.2 | 38.0 |
| Manitoba and Saskatchewan | | | 3.4 | 6.7 |
| Alberta | | | 3.9 | 9.7 |
| British Columbia | | | 36.4 | 13.3 |

[a] N/A = not applicable.

### 4.6.2. Perceptions of British Columbia's low carbon fuel standard

Only one of the 475 British Columbia respondents (0.3% when corrective weights are applied) could identify British Columbia's LCFS as an existing climate policy in the open-ended question without any prompts. Indeed, the policy is the least frequently named compared to all of British Columbia's actual climate policies (in contrast, 26% of respondents mentioned the carbon tax, making it the most frequently named policy). In the subsequent, closed-ended question, which involved providing the list of policies with their definitions, 32% of respondents correctly identified the LCFS as a policy currently in place in British Columbia. In other words, the majority of respondents are not aware of the policy even after being prompted with its definition.

Figure 4.1 shows how respondents perceive British Columbia's LCFS in terms of expected emission reductions from 2008 to 2020. Although initially unaware of the LCFS, once the basic definition is provided most respondents (66%) rate the policy as at least "somewhat effective," and a minority (9%) believe the LCFS is "not effective" (an aggregate of "not effective at all" and "not effective") in reducing emissions. A quarter of respondents answered "I do not know," which is not surprising given the limited awareness of the existence of the LCFS as discussed above.

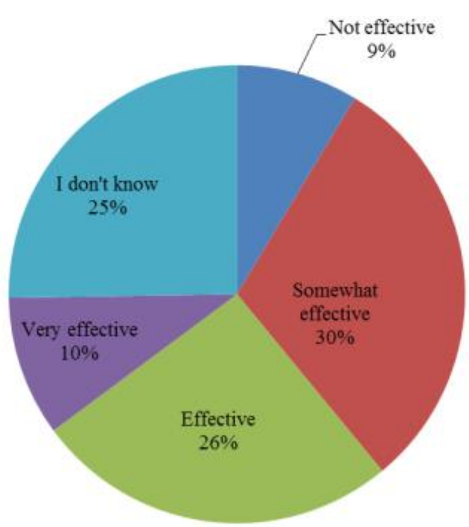


**Figure 4.1. Perceived effectiveness of British Columbia's low carbon fuel standard (n = 475)**

Figure 4.2 shows that the vast majority of respondents (90%) state support for British Columbia's LCFS (53% "somewhat support" and 37% "strongly support"). Only 2% "strongly oppose" and 8% "somewhat oppose" the policy. In short, we see a strong level of passive support for the LCFS—as defined in Section 4.4 as the combination of low initial awareness, and high stated support.

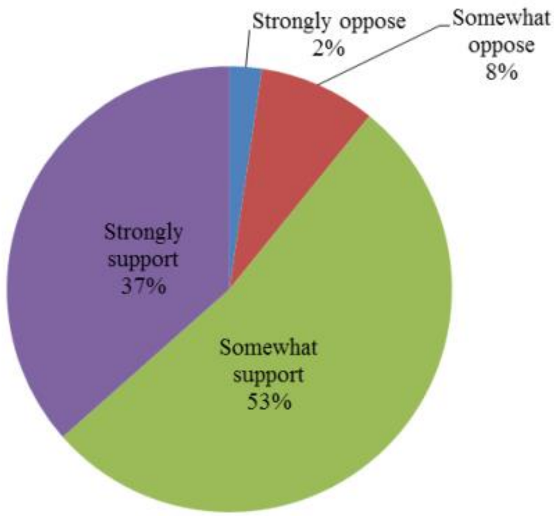


**Figure 4.2. Support for British Columbia's low carbon fuel standard (n = 475)**

Figure 4.3 shows respondent support for British Columbia's LCFS by the type of living area. Although in all areas the majority of respondents support the policy, the highest support is observed among suburban respondents (94%), and the lowest among rural (80%). Indeed, the one-way ANOVA ($F$ (2, 472) = 5.639, $p$ = 0.004) and a Tukey post-hoc test ($p$ = 0.003) revealed that the level of support is statistically significantly higher in suburban areas than in rural. There were no statistically significant differences in support between urban and suburban ($p$ = 0.260), and urban and rural areas ($p$ = 0.071).

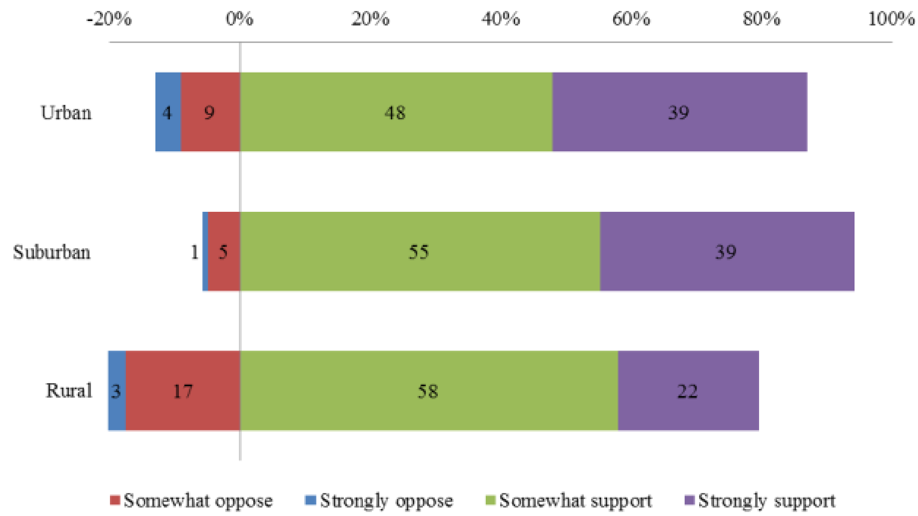


**Figure 4.3. Support for British Columbia's low carbon fuel standard by the type of living area (n = 475)**

### 4.6.3. Regional differences in support for a low carbon fuel standard in Canada

The majority of the full Canadian sample (n = 1,306) stated support (88%) for a hypothetical LCFS that could be implemented in Canadian regions outside British Columbia or across Canada as a whole (36% "somewhat support" and 52% "strongly support"). Only 12% of Canadian respondents oppose the LCFS (3% "strongly oppose" and 9% "somewhat oppose").

Figure 4.4 shows respondent support for a hypothetical LCFS by Canadian region. In all regions, the majority of respondents show broad support (82 to 92%) and low opposition to the policy (8 to 18%). The highest support is observed in the Atlantic region, Manitoba, Saskatchewan (92%), and British Columbia (90%), and the lowest in Alberta (82%). In contrast to our hypothesis, the one-way ANOVA and an independent t-test showed no statistically significant differences between the levels of support in (1) all Canadian regions ($F$ (6, 1299) = 1.222, $p$ = 0.292), (2) British Columbia in comparison to Alberta and the rest of Canada ($F$ (2, 1303) = 2.240, $p$ = 0.107), and (3) British Columbia in comparison to the rest of Canada only ($t$ (1304) = 0.303, $p$ = 0.762).

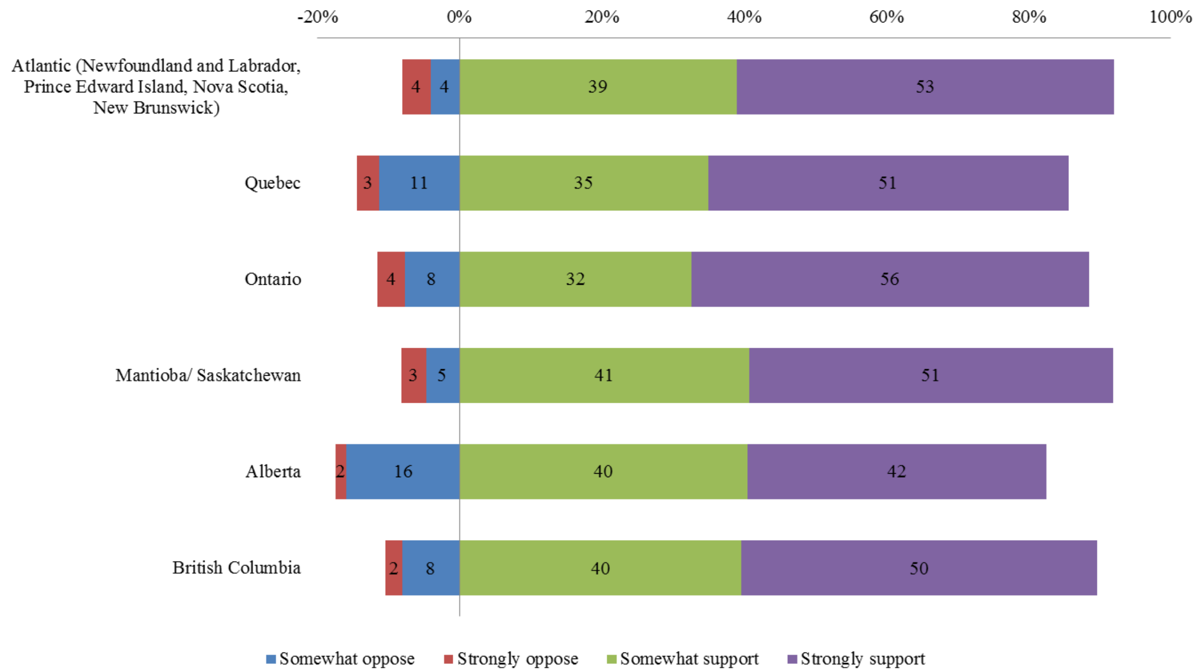


**Figure 4.4. Support for a hypothetical low carbon fuel standard by Canadian region (n = 1,306)**

Unlike the British Columbia sub-sample, we did not observe any statistically significant differences in support for a hypothetical LCFS across urban, suburban, and rural areas in the nationwide sample ($F$ (2, 1303) = 1.875, $p$ = 0.154).

### 4.6.4. Individual characteristics of support for a low carbon fuel standard

Table 4.3 shows the results of binary logistic regressions conducted to assess how individual characteristics relate to respondent support for British Columbia's LCFS and a hypothetical LCFS in Canada. Consistent with our hypothesis (Table 4.1), several attitudinal variables are strong predictors of support for an LCFS both in British Columbia and Canada as a whole. Altruistic values, followed by beliefs in human causes of climate change, and personal norms, are associated with respondent support for an LCFS, while egoistic and openness-to-change values are associated with opposition. Although not tested in Canada as a whole, perceived effectiveness of British Columbia's LCFS is a significant predictor of support for the provincial policy, implying the importance of respondent beliefs in the potential policy effect on GHG emissions.

**Table 4.3. Binary logistic regression results for British Columbia and Canada[a]**

| Explanatory variables | British Columbia's LCFS (n = 475) | | Hypothetical LCFS in Canada (n = 1,306) | |
|---|---|---|---|---|
| | B | Odds Ratios | B | Odds Ratios |
| **Attitudinal variables** | | | | |
| Values | | | | |
| • biospheric | -0.892 (ns) | 0.410 | 0.266 (ns) | 1.305 |
| • altruistic | 0.913* | 2.493 | 0.654** | 1.924 |
| • egoistic | -0.562 (ns) | 0.570 | -0.439* | 0.645 |
| • openness-to-change | 0.496 (ns) | 1.643 | -0.450* | 0.638 |
| Ecological worldviews (NEP) | 0.050 (ns) | 1.051 | 0.050 (ns) | 1.052 |
| Beliefs in | | | | |
| • human causes of climate change | 0.277* | 1.319 | 0.238** | 1.268 |
| • adverse consequences of climate change | 0.060 (ns) | 1.061 | -0.010 (ns) | 0.990 |
| Ascription of responsibility for mitigating climate change | -0.143 (ns) | 0.867 | 0.057 (ns) | 1.059 |
| Personal norms | 0.155** | 1.168 | 0.060** | 1.061 |
| Perceived effectiveness of British Columbia's LCFS | 1.196** | 3.308 | N/A | |
| **Contextual variables** | | | | |
| Region by province (reference "British Columbia") | | | 0.789 (ns) | 2.201 |
| • Atlantic provinces (NL, PEI, NS, NB) | | | -0.209 (ns) | 0.811 |
| • Quebec | | | -0.135 (ns) | 0.874 |
| • Ontario | N/A | | -0.367 (ns) | 0.693 |
| • Manitoba and Saskatchewan | | | 0.251(ns) | 1.285 |
| • Alberta | | | 20.03 (ns) | 5E+08 |
| • Other territories | | | | |
| Region by living area type (reference "rural") | | | | |
| • urban | | | | |
| • suburban | -0.202 (ns) | 0.817 | -0.074 (ns) | 0.928 |
| | 1.579* | 4.848 | -0.315 (ns) | 0.730 |
| Number of vehicles in a household | -0.344 (ns) | 0.709 | -0.409** | 0.664 |
| Daily commute time to work or school | -0.071 (ns) | 0.932 | -0.006 (ns) | 1.006 |
| Commute mode (reference "drive myself") | | | | |
| • carpool | | | | |
| • public transit | 3.601* | 36.65 | 0.066 (ns) | 1.068 |
| • bicycle | 1.869 (ns) | 6.482 | 1.041* | 2.831 |
| • walk | 0.307 (ns) | 1.359 | 3.226** | 25.17 |
| • taxi and other | -1.025 (ns) | 0.359 | -0.471 (ns) | 0.625 |
| • do not commute | -0.213 (ns) | 0.808 | 0.763 (ns) | 2.145 |
| | -0.622 (ns) | 0.537 | -0.004 (ns) | 0.996 |
| **Personal capability variables** | | | | |
| Age | 0.288 (ns) | 1.334 | 0.211* | 1.234 |
| Gender: male (reference "female") | -1.183* | 0.306 | -0.271 (ns) | 0.763 |
| Education: post-secondary (reference "secondary or less") | -0.253 (ns) | 0.776 | -0.274 (ns) | 0.760 |
| Income | 0.099 (ns) | 1.104 | 0.154* | 1.166 |
| Awareness of British Columbia's LCFS | 15.339 (ns) | 4.6E+06 | N/A | |
| Model summary (goodness of fit measures) | • Nagelkerke $R^2$ 57.5%<br>• Hosmer-Lemeshow test $\chi^2$=9.160, *df*=8, *p*=0.329<br>• Classificat. accuracy 93.7% | | • Nagelkerke $R^2$ 46.3%<br>• Hosmer-Lemeshow test $\chi^2$=19.732, *df*=8, *p*=0.011<br>• Classific. accuracy 90.7% | |

[a] (ns) = no significant association with policy support, * sig. p < 0.05, ** sig. p < 0.01, N/A = not applicable.

In addition to the tested attitudinal characteristics, several contextual factors appear to be strongly associated with policy support. In particular, respondents that are less reliant on single occupancy vehicles are more likely to support the LCFS, i.e. those that carpool (in the British Columbia regression), those that use public transit or cycle, or those that own or lease less vehicles (in the Canada-wide regression). Other contextual factors, including the province of residence and type of living area, are not associated with support for an LCFS in Canada, consistent with the ANOVA results discussed in the previous section. However, in British Columbia, the area type (i.e., urban, suburban, and rural) has a statistically significant effect on policy support, supporting our hypothesis that residents of densely populated areas are more likely to favour environmental policies than rural residents (even when controlling for measures of reliance on a single occupancy vehicle). Specifically, British Columbia respondents living in suburban areas are almost five times more likely to support the existing LCFS than rural respondents. We also tested the effects of trust, social networks, and political ideology on support for an LCFS but none of these variable coefficients were statistically significant.

Finally, personal capability variables appear to play a role in shaping policy support. Being female (in British Columbia only), older, and having higher income (in Canada only) are significant predictors of support for an LCFS. However, awareness of the existence of the LCFS in British Columbia is not associated with policy support.

## 4.7. Discussion

This study explores public support for an LCFS policy, versions of which have been implemented in California, the European Union, and British Columbia, Canada. Using Canada as a case study, we elicit citizen perceptions using a survey conducted with a representative sample of Canadian citizens (n = 1,306), including an oversample of British Columbians (n = 475). Specifically, we assess citizen awareness, perceptions, and stated support regarding the British Columbia LCFS, and regarding a hypothetical LCFS proposed for the rest of Canada.

We anticipated that citizen awareness would be low—given that the LCFS is a type of regulation that targets fuel providers, not consumers, and is thus unlikely to be salient among citizens. Our results show that the vast majority of British Columbia respondents are unaware of the existence of the LCFS and are unlikely to identify it as a current policy even after being prompted with a definition of the policy. In the open-ended survey question about climate policies, only one respondent in 475 could name the LCFS. Despite this lack of awareness, there is value in assessing "passive support"—where initially unaware citizens state support for the policy once it is briefly described to them. This knowledge is useful for (1) policy-makers in British Columbia who might decide to make the policy more stringent, which might generate more media attention, (2) policy-makers in other jurisdictions that consider implementing an LCFS and want to assess the potential for public controversy, and (3) the academic community that has not yet studied citizen support for an LCFS, especially in regards to the existing LCFS in British Columbia.

In the case of British Columbia, we find that most British Columbia respondents believe that the LCFS is effective in reducing GHG emissions (66%) and the vast majority support the policy (90%). These results were generally expected, as climate regulations that set requirements for industry (e.g., a renewable portfolio standard for electric utilities, or fuel economy standards for auto manufactures) typically received greater public support than a carbon tax or cap-and-trade system—at least in North America (Environics Institute, 2011; Borick et al., 2011). In short, we find evidence that there is broad "passive support" for the LCFS among British Columbia citizens—citizens are not aware, but are highly supportive when made aware.

We cannot be certain that the passive support observed in British Columbia will be identically observed in other jurisdictions with an LCFS, such as California and the European Union. The British Columbia LCFS has distinctive design features, perhaps most notably is the equal treatment of the carbon intensity for all upstream petroleum production (which does not discriminate against Canadian oil sands). This, in turn, might explain the little industry and media attention around British Columbia's LCFS, in contrast to California and the EU where some oil companies have lobbied against the established (or proposed in the case of the EU's Fuel Quality Directive) rankings of carbon intensities for different types of upstream oils. That said—other studies do show that supplier-focused climate regulations in general tend to receive public support in the

U.S. and in Canada (Environics Institute, 2011; Borick et al., 2011). Future empirical research is needed to determine if different design features of an LCFS might indeed influence citizen support.

Our survey also assessed citizen support for a hypothetical LCFS that would be implemented across Canada. Respondent support for a hypothetical LCFS are similar to those in British Columbia (82 - 92%), with the highest support observed in the Atlantic region, Manitoba, and Saskatchewan (92%). We do not observe any statistically significant regional differences in support. Thus, we see no evidence that any Canadian regions considering an LCFS should be concerned about citizen opposition—even in a relatively fossil-fuel dependent region like the province of Alberta.

Interestingly, while policy support between respondents living in urban, suburban, and rural areas for all of Canada does not differ at a 95% confidence level, it does in British Columbia. When controlling for other factors, suburbanite respondents are five times more likely to support British Columbia’s LCFS than residents of rural areas. Future research might explore how these and other possible factors, such as vulnerability to climate change in areas with different population densities, may influence citizen support, and why the suburban-rural split is significant in British Columbia but not across Canada.

The final objective of this study is to explore how levels of “passive support” may vary across individuals in the population. In particular, it seems important to identify individual characteristics and motivations that may be associated with citizen opposition—as these patterns may provide guidance to policymakers if the LCFS becomes more prevalent in the media and in citizen consciousness. Our analysis draws from Stern’s (2000) attitude-behaviour-context model to provide an integrative perspective on patterns of support or opposition. Consistent with previous research (Dietz et al., 2005; Steg et al., 2005), the logistic regression analysis suggests that attitudinal factors such as altruistic values and beliefs in human causes of climate change are strong predictors of support for an LCFS in both British Columbia and Canada as a whole. We also found that several contextual factors are important, where respondents that are less reliant on single occupancy vehicles, i.e. those that carpool, use public transit or cycle, or those that own or lease a lower number of vehicles, are more likely to support the LCFS. While it is likely impossible to change attitudinal factors such as citizen values (Egmond and Bruel, 2007; Kahan and Braman, 2006), it might be possible for policymakers to anticipate LCFS resistance among some more vehicle-dependent citizens, perhaps implementing complementary policies that induce the availability of low carbon transportation choices. And even where these patterns of opposition cannot be changed, it still is useful for policymakers to identify where opposition may occur.

We recognize that our study has a number of limitations that should be explored in future research:

1) Our definition of an LCFS in the survey was fairly limited. For example, we did not explain what low carbon fuels are available to comply with the policy (e.g., electricity as a 'fuel'), and how the policy may affect fuel costs and personal incomes. Future research could explore how citizen support changes after receiving a broader definition and other information about an LCFS, or how support might be affected when this information is received from different sources, such as media, governments, and environmental groups.

2) Given the limited definition and low initial awareness of the LCFS, some survey responses may be unduly influenced by the wording provided in the survey, or by a subset of information that was immediately available to the respondent—meaning the perceptions and support stated by a given respondent may be relatively unstable (Zeller and Iyengar, 1992). Future research could more carefully explore how survey responses are formed in climate opinion surveys where limited knowledge exists before education, and how an individual-level instability bias might affect survey responses about an LCFS and other climate policies.

3) We employed Stern's (2000) attitude-behavior-context model as a guide to choose from potential factors of citizen support, but did not systematically test this framework to determine a full set of factors and relationships between them. Future research could test Stern's and other behavioural theories to determine a more complete set of predictors, such as willingness to pay for climate change mitigation and perceived costs and benefits of climate policies, and interactions between them (e.g., how attitudinal variables may affect or may be affected by contextual and personal capability variables).

4) We acknowledge that a representative survey sample is just one way to measure citizen support — other research methods, such as focus groups

and semi-structured interviews, could be employed to test the robustness of our results.

5) Finally, other interest groups, such as the fuel providers that are directly affected by an LCFS, could have more influence on the political acceptability and ultimate implementation of an LCFS than the public more generally. Complementary research is needed to assess perceptions and influence of various stakeholders and interest groups.

## 4.8. Conclusions and policy implications

Not matter how effective or economically efficient a climate policy will be, it will not be implemented if it is not politically acceptable. One element of political acceptability is public support. We find evidence that there is broad "passive" citizen support for the low-carbon fuel standard (LCFS) already implemented in British Columbia, and for a hypothetical LCFS proposed to be implemented across Canada. By "passive" support, we mean that citizens are largely unaware of the policy to start with, but once a simple explanation is provided, stated citizen support is very high. Our present empirical evidence is consistent with previous research indicating that North American citizens are more supportive of climate regulations that target industry (e.g., a fuel economy standard for vehicles, or a renewable portfolio standard for electric utilities) and less supportive of a carbon tax or similar policy that is by nature more salient to consumers and citizens. Our evidence is also supported by the recent history of policy implementation—North American jurisdictions have had more success implementing climate regulations such as the LCFS in California and British Columbia, and little success in implementing a carbon tax (aside from British Columbia—though even that is controversial). In this way, an LCFS seems to be a fairly acceptable climate policy, with consistently high stated support across all the Canadian regions that were sampled (82 to 92%)—including Alberta, a province with strong ties to the fossil fuel industry. Jurisdictions considering an LCFS do not need to be overly concerned about citizen opposition to the policy.

Moreover, citizen awareness of the policy does not seem to be necessary. Awareness of the LCFS is not statistically associated with policy support. In fact, the passive support observed in British Columbia may be desirable—citizens are likely unaware of the policy because it is not controversial to begin with. A climate policy that is perceived as generally innocuous to citizens is not likely to enter the public's consciousness. We might say that such a policy is implied to be politically acceptable, even though citizen awareness is essentially non-existent. While it is important for governments to remain transparent about the climate policies they implement in order to foster public trust (as British Columbia continues to do), in reality, citizens are unlikely to access such information if the policy is not particularly controversial. General information campaigns are thus not likely to be effective (or necessary) in garnering citizen support. Though, decisions to implement an LCFS could be framed around its real and perceived effects on GHG emissions, given that citizen beliefs in policy effectiveness appear to be strong predictors of support.

While stated support for the LCFS seems to be broad and consistent across the regions tested, it is still important for policymakers to anticipate where opposition may arise. Media coverage and citizen awareness may increase, for example if policymakers aim to increase the stringency of the LCFS, or if the regulated fuel providers organize a campaign against the policy. Our regression analysis identifies citizen segments that might be more likely to support and oppose an LCFS. Older, wealthier, and female citizens, as well as those with altruistic values and beliefs in human causes of climate change are more likely support an LCFS. LCFS opposition may be stronger in rural areas, and among citizens that are more dependent on driving passenger vehicles. While little can be done about attitudinal characteristics such as citizen values, contextual factors associated with opposition can perhaps be addressed, e.g. by offering complementary policies that stimulate improvements in vehicle fuel economy, adoption of low carbon transportation alternatives, and reduction in vehicle use, minimizing the impact of an LCFS on fossil-fuel dependent households.

## 4.9. Acknowledgements

This research was funded by the Pacific Institute for Climate Solutions and the Social Sciences and Humanities Research Council (Vanier Canada Graduate Scholarships program).

# Chapter 5. Explaining citizen support for different types of climate policy[12]

## 5.1. Abstract

Citizen support for climate policies is considered an important criterion in climate policy-making. While there is a growing body of literature exploring factors of citizen support, most studies tend to use climate policy support as an aggregate variable, overlooking differences in support for different climate policy types. This study examines citizen support for several market-based, regulatory, and voluntary climate policies using survey data collected from a representative sample of Canadian citizens (n=1306). Specifically, the research objectives are to (1) assess citizen support for different types of climate policies, (2) identify the key factors of citizen support for different policy types, and (3) explore heterogeneity across respondents based on policy support patterns. Results indicate that most regulatory and voluntary policies receive high levels of support (83-90% of respondents), while a carbon tax receives the highest levels of opposition (47%). Regression analysis identifies several factors associated with citizen support, including values, trust, and household characteristics. However, only a few factors are consistent predictors across policy types, including being concerned about climate change, having trust in scientists, and being female. Other significant factors are unique to different policy types. Cluster analysis identifies four distinct respondent clusters based on policy support.

[12] This paper was revised and resubmitted for publication as: Rhodes, E., Axsen, J., and Jaccard, M. (under review). Explaining citizen support for different types of climate policy. *Ecological Economics*.

## 5.2. Introduction

Policy analysts recommend that several key criteria be considered when choosing among climate policy options (Goulder and Parry, 2008). First, the policy should be effective and efficient in order to meet greenhouse gas emission targets at the lowest cost to society. Second, the policy should be politically acceptable in a way that does not provoke strong opposition, thereby enabling its implementation and endurance. This paper explores one key component of political acceptability: citizen support. In particular, our goal is to help policy-makers understand citizen preferences and motivations behind climate policy choices in order to design climate policies that are both effective and politically acceptable.

The first objective of this study is to assess citizen support for different types of climate policies. Climate policies can be categorized based on their degree of compulsoriness, i.e. the extent to which emission reducing actions are required by government or some other external agent (Jaccard, 2006). More compulsory policies typically include regulations that mandate specific requirements for emissions or technologies, and carbon taxes that set unit charges for emissions. Less compulsory policies include voluntary measures such as educational programs and subsidies to purchase low-carbon technologies (Goulder & Parry, 2008). While carbon taxes are generally considered more efficient and effective in reducing emissions, empirical research suggests that they tend to be the least popular type of climate policy (Drews & van den Bergh, 2015). In contrast, regulatory and voluntary policies appear to receive relatively high support (Lachapelle, Borick, & Rabe 2014). This paper aims to contribute to this line of research by assessing levels of citizen support for different types of climate policy in Canada.

The second objective of the paper is to identify individual characteristics of citizen support for different policy types. In this context, researchers look at a variety of individual characteristics. Some studies focus on psychological aspects of policy support, such as personal values and beliefs regarding causes and threats of climate change (Harring & Jagers, 2013; Lam, 2014). Others focus mostly on contextual characteristics, including economic, social, and geographic factors (Franzen & Vogl, 2013; Bernauer & Gampfer, 2013; Owen, Conover, Videras, & Wu, 2012). However, most studies do not distinguish between policy types when studying individual characteristics of policy support. Instead, researchers tend to construct a composite index that amalgamates policies and emission-reducing actions (Dietz, Dan, & Shwom, 2007; Shwom, Bidwell, Dan, & Dietz, 2010; Zahran, Brody, Grover, & Vedlitz, 2006). As a result, individual characteristics of the support for various policy types may be overlooked. Nilsson and Biel (2008), Lam (2014), and Tobler et al. (2012) are among a few studies that examined factors of support for different types of climate policies. However, these studies used non-representative samples and focused mostly on psychological aspects of policy support, without accounting for contextual forces which may have unique effects across policy types. This paper employs a more comprehensive theoretical perspective—the Attitude-Behaviour-Context (ABC) framework—that combines some of the attitudinal, contextual, and socio-demographic predictors of support (Stern, 2000). We test how these variables might be associated with support for various policy types using a representative sample of Canadian citizens (n=1,306).

The third objective of this study is to explore heterogeneity across respondents based on climate policy support patterns. Most studies in this area tend to focus on overall associations between individual characteristics and policy support. This paper tests explores the degree of heterogeneity in citizen support using cluster analysis.

The study is organized as follows. Section 5.3 reviews the literature pertaining to public perceptions of different policy types and conceptual frameworks that can be used to describe patterns of citizen support. Section 5.4 describes the employed research method, including the survey sample and data analysis techniques. Section 5.5 presents the study results, and Section 5.6 discusses their relevance to the existing climate policy literature, and provides conclusions.

## 5.3. Literature review

### 5.3.1. Understanding types and perceptions of climate policies

Climate policies vary in their degree of compulsoriness (Jaccard, 2006). Compulsory policies require emission reductions via regulation of technologies or fuels, or financially penalize emissions to such an extent that many firms and households are bound to take emission-reducing actions. Regulatory policies include vehicle efficiency regulations, building efficiency standards, and renewable portfolio standards that set electricity generation requirements for industry. Policies that can significantly increase the cost of emitting include carbon taxes and emission caps with tradable emission permits (also called ‘cap-and-trade’). These policies do not prescribe specific actions but compel businesses and individuals to either pay emission charges (i.e., unit charges or permit price) or invest in emission reduction technologies to lower their charges (Goulder & Parry, 2008). In contrast, non-compulsory policies encourage voluntary behaviour to reduce emissions without entailing any negative consequences for non-compliance. Some examples include subsidies to purchase low-carbon technologies, educational and informational programs, and direct government investments.

Empirical survey evidence suggests that citizen support for carbon taxes and cap-and-trade is limited, while regulatory and voluntary policies tend to receive relatively high support (Drews & van den Bergh, 2015). For example, Lachapelle et al. (2014) conducted national surveys on public attitudes toward climate policies in Canada (n=1,502, margin of error +/-2.5%) and the U.S. (n=984, margin of error +/-3.5%) in 2013, and found that in both countries carbon tax receive the highest opposition (41% of Canadian and 71% of U.S. respondents ‘somewhat oppose’ and ‘strongly oppose’ the policy), while a renewable portfolio standard the highest support (82% in Canada and 72% in the U.S.). Similar trends are observed in Switzerland, where a national survey (n=916) showed that citizens are more likely to approve subsidies for renewable electricity, sustainable buildings and heating systems rather than carbon taxation (Tobler, Visschers, & Siegrist, 2012). Studies of policy support suggest similar patterns in Asia. Lam (2014) finds that Taiwanese citizens (n=394) prefer subsidies for renewable energy (85% ‘support’ and ‘strongly support’) over increases electricity prices (29%

‘support’ and ‘strongly support’) or implementation of a gas guzzler tax (59% ‘support’ and ‘strongly support’).

Other studies explore the role of individual characteristics in citizen support of climate policy. However, most of these studies combine all policy types into a composite dependent variable, commonly referred to as an ‘index of policy support’--amalgamating or averaging responses to a variety of policy and behaviour questions (Dietz et al., 2007; O'Connor, Bord, Yarnal, & Wiefek, 2002; Shwom et al., 2010; Steg, Dreijerink, & Abrahamse, 2005; Zahran et al., 2006). In the remainder of the paper, dependent variables consisting of several policy measures are referred to as ‘composite variables’ or ‘composite indices.’ The composite indices often include (a) policies at different levels of government, (b) international agreements, and (c) actions to reduce emissions, all of which vary considerably in their nature. For instance, Zahran et al. (2006) constructed a composite variable of ‘climate policy support’ that included support for carbon taxes on industries and individuals, for fuel efficiency regulations, and for public education about climate change actions. The same scale also included climate-related actions such as the development of renewable energy sources, reduction of methane in agriculture, and the protection of coastal settlements and water supplies. While the use of composite indices can provide general insights into common factors of policy support, they may overlook potential differences in individual characteristics of support for individual policy types.

Only a few studies have examined factors of support for different types of climate policies, i.e. without the use of composite dependent variables. Nilsson and Biel (2008) studied four types of policies varying in their compulsoriness--informational programs, subsidies, taxes, and regulations. They found that support for all policy measures (other than subsidies) was positively associated with environmental values. However, the study focused primarily on the effect of values and personal norms using a non-representative sample of Swedish decision-makers in private companies (n=236). Thus, the results might not be broadly applicable to the general public and do not account for other contextual and socio-demographic predictors which may have unique effects across policy types. Similarly, Lam (2014) used a non-representative sample of Taiwanese citizens (n=394) to test a psychological model of policy support focusing specifically on the beliefs of negative consequences of climate change as explanatory variables, without consideration of individual values and contextual factors. Tobler et al. (2012) studied citizen support for nine policy items, which were combined into two dependent variables: subsidies, and CO2 restrictions such as carbon taxes and vehicle emission regulations. Similar to these studies, Tobler et al. (2012) used a non-representative sample (n=916) and did not account for contextual factors.

In short, previous literature exploring citizen support for climate policies has tended to focus on overall support for different policy types (without exploration of explanatory factors), or to identify explanatory factors for climate policies and actions combined into composite dependent variables. The few studies that have taken an explanatory approach with multiple climate policies have followed a limited theoretical approach and relied on non-representative samples for data analysis. Our present effort seeks to fill this apparent gap in the literature by exploring citizen support for multiple climate policies, using a comprehensive framework (theory) to guide our selection of explanatory variables, applied to data collected from a representative sample of citizens (residing in Canada). We next explore several theories of citizen support for climate policy and then explain our present conceptual framework.

### 5.3.2. Explaining citizen support for climate policies

The notions of saliency and self-serving bias provide one perspective on citizen policy support. Long before climate change mitigation was a policy concern, economists suggested that support for public policies can be influenced by small groups, including those who already wield significant political power by virtue of their economic and social significance, on the one hand, and groups who face concentrated costs from specific policies focused on specific objectives like GHG reduction, on the other (Galbraith, 1952; Olson, 1971). Consistent with this explanation, Caplan (2007) noted that a self-serving bias (i.e., believing in or supporting things or ideas that appear to be beneficial to oneself) contributes to the discrepancy between citizen and expert assessments of policy effectiveness and ultimate policy support. Consequently, highly salient policies with visible costs, such as carbon taxes, tend to attract strong opposition from interests who believe the policies to be especially disadvantageous to them, whereas less salient policies, such as regulations, appear to avoid such opposition (Chetty, Looney, & Kroft, 2009; Harrison, 2012).

Policy support is also likely to be affected by factors other than perceived costs and individual impacts. Specifically, some social psychologists suggest that support among individuals can vary in association with multiple characteristics, including individual values, social norms, and other contextual factors (e.g., Dietz et al., 2007; Shwom et al., 2010; Semenza et al., 2008). To study climate policy support, researchers draw from various models of pro-environmental behaviour. The models are typically divided into three major categories: internalist, externalist, and integrative models (Jackson, 2005). Internalist frameworks treat pro-environmental behaviour mainly as a function of attitudinal motivations that are considered 'internal' to the individual, such as values, beliefs, emotions, and habits (Ajzen, 1991; Schwartz, 1992; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). These models tend to be weak predictors of difficult and costly behaviours that might be influenced by various contextual forces including social processes (e.g., community expectations, trust in governments), financial constraints (e.g., income, cost of low-carbon technologies) and institutional factors (e.g., availability of public transit, building design) (Bamberg & Schmidt, 2003). In contrast, externalist theories focus mostly on cultural, political, and economic factors, and tend to ignore many attitudinal characteristics explaining pro-environmental behaviour (Leiserowitz, 2006; Thompson, Ellis, & Wildavsky, 1990). Integrative models combine insights from the 'internalist' and 'externalist' approaches to offer a broader perspective on determinants of pro-environmental behaviour. Stern's (2000) Attitude-Behaviour-Context framework is among a few integrative models that account for multiple 'internal' and 'external' factors, while being parsimonious and practical enough to facilitate empirical testing.

Specifically, Stern (2000) suggests three categories of predictors of pro-environmental behaviour: attitudinal, contextual, and personal capability variables. Attitudinal variables typically include values, general environmental concerns, and specific concerns about climate change. Dietz et al. (2005) and Steg et al. (2005) find that altruistic and biospheric values are associated with higher citizen support, while egoistic and openness-to-change values are associated with higher opposition. Further, people that are generally concerned about environmental problems (as measured through New Ecological Paradigm (NEP)) and/ or concerned about climate change in particular, are more likely to adopt low-carbon behaviours and pay the cost of climate policy (Clark, Kotchen, & Moore, 2003; Dietz et al., 2007; O'Connor et al., 2002; Zahran et al., 2006). Tobler et al.'s (2012) study in Switzerland suggests that specific concerns about climate change are not associated with higher support for carbon taxes and regulations but appear to be unique predictors of support for voluntary measures such as subsidies for low-emission buildings, renewable electricity generation, and climate research.

The second category of variables in the ABC model is contextual variables, which includes social, political, and economic factors. Social and political variables are typically measured through trust. 'Trust theory' suggests that when people do not possess sufficient knowledge or time to assess environmental issues, their trust in entities assessing and solving those issues tends to influence their individual policy support (Castelfranchi & Falcone, 2010; Cvetkovich et al., 2002). Trust in governments tends to be one of the most important predictors of support for carbon taxes, likely because governments are directly responsible for the collection and use of tax revenues (Harring & Jager, 2013; Kallbekken & Sælen, 2011). However, trust in government does not seem to predict citizen support for climate policies when combined in a composite index (Dietz et al., 2007). Trust in the fossil fuel industry tends to have a negative effect on support for climate policies (Shwom et al., 2010), while trust in university scientists tends to have a positive effect (Dietz et al., 2007). Economic factors are typically measured through household variables including area of residence, home type, mode and duration of commute to work, and ownership of a personal vehicle. Consistent with the notions of a self-serving bias and policy salience (Caplan, 2007; Chetty et al., 2009), these economic factors might be barriers to citizen support if they are associated with the highest impacts of the policy. Some evidence suggests that urban residents are likely to show higher environmental policy support because they are exposed to highly visible effects of air pollution and less directly dependent for income on the extraction of natural resources (Elliott et al., 1997; Shwom et al., 2010). Also, urban areas have more transportation options which make driving less of a necessity (Kallbekken & Sælen, 2011). In contrast, people relying on a personal vehicle are more likely to oppose climate policies that increase the cost of driving (Shwom et al., 2010).

The final category in the ABC model is personal capability, which includes variables generally assessed through socio-demographic characteristics (Stern, 2000). Younger, wealthier, more educated and female citizens tend to support environmental policies (Elliott et al., 1997; Klineberg et al., 1998). In addition, a citizen's regional location tends to affect policy support. Regions heavily dependent on carbon intensive industries (e.g., fossil fuel production) typically show lower support for climate policies (Shwom et al., 2008; Matisoff and Edwards, 2014).

### 5.3.3. Variables hypothesized to predict climate policy support

This study draws from Stern's (2000) ABC model discussed in the previous section. This paper does not test the model but rather uses it as a framework of potential independent variables that may predict citizen support (or opposition) for different types of climate policy. Therefore, the framework is used primarily to inform our second and third research objectives, that is, to improve our understanding of patterns of citizen support (or opposition) for different climate policies, with an ultimate goal of providing practical advice to policy-makers and analysts. Table 5.1 summarizes some of these explanatory variables and their hypothesized effects on citizen support for climates policies.

**Table 5.1. Variables hypothesized to predict citizen support based on Stern's (2000) framework**

| Variable name | Hypothesized effect and references |
|---|---|
| *Attitudinal variables* | |
| Values | |
| Biospheric and altruistic | Positive (Dietz, Fitzgerald, & Shwom, 2005; Harring & Jagers, 2013) except for no effect of biospheric values for voluntary policies (Nilsson & Biel, 2008) |
| Egoistic and openness to change | Negative (Dietz et al., 2005; Nilsson & Biel, 2008) |
| General environmental concern (NEP) | Positive (Attari et al., 2009; Dietz et al., 2007) |
| Climate change concern | Positive (Clark et al., 2003; O'Connor et al., 2002; Zahran et al., 2006) |
| *Contextual variables* | |
| Trust | |
| Government | Positive for a carbon tax only (Harring & Jagers, 2013; Kallbekken & Selen, 2011) |
| Fossil fuel industry | Negative (Dietz et al., 2007) |
| Renewable industry | Positive for a clean electricity standard only (Rhodes, Axsen, & Jaccard, 2014) |
| Scientists | Positive (Dietz et al., 2007) |
| Living area | |
| Urban (city centre with dense housing) | Positive for a carbon tax and LCFS (Freudenburg, 1991; Elliott et al., 1997) |
| Suburban (just outside a city, with more spread out housing) and rural (far away from a city, with very spread out housing) | Negative for a carbon tax and LCFS (Freudenburg, 1991; Elliott, Seldon, B., & Regens, 1997) |
| Home type | |
| Attached | Positive for building regulations (Guerra Santin, Itard, & Visscher, 2009) |
| Detached | Negative for building regulations (Guerra Santin et al., 2009) |
| Commute mode | |
| Drive myself | Negative for a carbon tax and LCFS (Rhodes et al., 2015) |
| Other modes (public transit, bike, carpool) | Positive for a carbon tax and LCFS (Rhodes et al., 2015) |
| Daily commute time to work/ school | Negative (Rhodes, Axsen, & Jaccard, 2015) |
| Number of vehicles in a household | Negative for a carbon tax and LCFS (Rhodes et al., 2015) |
| *Personal capability variables* | |
| Age | Negative (Elliott et al., 1997; Klineberg, McKeever, M., & Rothenbach, 1998) |
| Gender | |
| Female | Positive (Elliott et al., 1997; Klineberg et al., 1998) |
| Male | Negative (Elliott et al., 1997; Klineberg et al., 1998) |
| Education | Positive (Elliott et al., 1997; Klineberg et al., 1998) |
| Income | Positive (Elliott et al., 1997; Klineberg et al., 1998) |
| Region by province | |
| Regions heavily reliant on carbon intensive industries or fossil fuel production (e.g., Alberta, Ontario) | Negative (Shwom, Dan, & Dietz, 2008; Matisoff & Edwards, 2014) |
| Regions less reliant on carbon intensive industries or fossil fuel production (e.g., British Columbia, Quebec) | Positive (Shwom et al., 2008; Matisoff & Edwards, 2014) |

Among attitudinal variables, altruistic and biospheric values, general environmental and specific climate change concerns are expected to predict citizen support for most policies (Dietz et al., 2005; Steg et al., 2005) with the exception of voluntary policies, support for which was not explained by biospheric values in the past (Nilsson & Biel, 2008).

For contextual variables, trust in governments is expected to predict support only for a carbon tax (Harring and Jager, 2013), while trust in the renewable energy industry is only expected to predict support for a clean electricity standard (Shwom et al., 2010). Trust in university scientists is hypothesized to predict support for all policies, while trust in the fossil fuel industry is expected to explain opposition to all policies (Dietz et al., 2007). Respondents living in urban areas with many available transportation options are expected to show higher support for policies that increase the cost of driving, such as carbon taxes and low carbon fuel standards, while residents of rural and suburban areas are more likely to oppose them. This relationship has not been explored in past research, but is consistent with the self-serving bias (Caplan, 2007). For the same reason, these policies are expected to receive more opposition from vehicle-dependent households driving to work or school and/ or owning several vehicles. Also, residents of detached homes are hypothesized to oppose building regulations based on the study of Guerra Santin et al. (2009).

Among personal capability variables, younger age, higher income, education, and being female is hypothesized to have a positive effect on support for most policies (Elliott et al., 1997; Klineberg et al., 1998). Finally, citizens residing in fossil fuel abundant jurisdictions (which we explore at the provincial level) are expected to show lower support for most climate policies (Shwom et al., 2008).

## 5.4. Methods: data collection and analysis

### 5.4.1. Survey data and measurement

We conducted a web-based survey of Canadian citizens (n=1,306) aged 19 or older in January 2013. As part of this national survey, we separated and oversampled

British Columbia respondents (n=475) for the purpose of conducting another study on citizen awareness of British Columbia's climate policies (Rhodes et al., 2014). We hired a market research company, Harris Interactive, to recruit respondents through a web-panel of Canadian citizens to complete the survey. This web-based panel includes a large distribution of people recruited to provide samples that represent the general population. All respondents in the sampling frame had an equal chance of being selected, making it a random probability sample. A total of 1893 respondents were invited from this panel to complete the survey. Of those, 1401 respondents completed the survey. Ninety-five were removed due to incomplete responses, leaving a total of 1,306 for the nationwide sample.

Table 5.2 shows the distributions of the sample relative to census data. Compared to the Census data for the entire Canadian population, our sample was slightly wealthier, more educated, and older (first column in Table 5.2). The hired market research company applied a common weighting adjustment procedure to minimize these demographic differences and to ensure that the sample is representative of Canada's actual income, education, age, gender, and regional composition (second column in Table 5.2). The corrective procedure assigned an adjustment weight to each respondent in a way that under-represented respondents receive a weight larger than one, and over-represented respondents receive a weight smaller than one.

The median time to complete the survey was about 25 minutes. To establish trust and increase the perceived benefits of participation, respondents received personalized survey invitations explaining how survey results could benefit them and others, and were given survey participation points by the research company which could be exchanged for gift cards or $10 per 1250 points. We used simple language and short questions to minimize the expected cost and difficulty of completing the survey. All survey questions were pre-tested with a wide range of volunteers of different occupations, ages, genders, and education.

**Table 5.2. Socio-demographics of the sample: unweighted and weighted sample distributions**

| Socio-demographic variables | Canada (n=1,306) | |
|---|---|---|
| | Unweighted sample distributions, % | Weighted sample distributions (according to Canada Census), % |
| Income | | |
| Less than $49,999 | 35.6 | 38.8 |
| $50,000 to $99,999 | 34.5 | 33.3 |
| $100,000 or over | 18.1 | 16.0 |
| Education | | |
| Secondary or less | 61.2 | 83.4 |
| Post-secondary (bachelor's or postgraduate degree) | 38.8 | 16.6 |
| Age | | |
| 19-39 | 25.0 | 39.7 |
| 40-64 | 56.0 | 44.1 |
| 65+ | 19.0 | 16.2 |
| Gender | | |
| Male | 49.2 | 48.4 |
| Female | 50.8 | 51.6 |
| Region | | |
| Atlantic provinces (NL, PEI, NS, NB) | 4.9 | 7.7 |
| Quebec | 14.2 | 24.6 |
| Ontario | 37.2 | 38.0 |
| Manitoba and Saskatchewan | 3.4 | 6.7 |
| Alberta | 3.9 | 9.7 |
| British Columbia | 36.4 | 13.3 |

The survey questionnaire consisted of four sections (see Appendix for full survey questions). First, respondents were asked questions about their concerns regarding causes and consequences of climate change. Using questions from Dietz et al. (2007) and Steg et al. (2005), respondents were asked to indicate their agreement on a five-point scale from ‘strongly disagree’ to ‘strongly agree’ (with an option ‘I do not understand’) with general statements about carbon emissions, scientific certainty about climate change, causes and threats of climate change to human health, environmental quality, finances, and standard of living (Cronbach’s α = 0.93).

Second, respondents were required to indicate their level of support on a four-point scale from ‘strongly oppose’ to ‘strongly support’ (with no neutral response category) for nine hypothetical climate policies, as if there were a referendum on implementing them in Canada. Prior to asking these questions, climate policies were defined as 'actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change/ global warming.'

Third, attitudinal questions assessed respondents' values and general environmental concerns. Using Schwartz's modified value scale (Stern, Dietz, & Guagnano, 1998), respondents were asked to rate the importance of biospheric, altruistic, egoistic, and openness-to-change values in their life, on a five-point scale ranging from 'not important at all' to 'extremely important.' Biospheric value questions included statements about respecting the earth, unity with nature, and environmental protection (Cronbach's α = 0.90), and altruistic value questions included statements pertaining to social justice, equality, and helping others (Cronbach's α = 0.86). Egoistic value questions focused on the role of authority, social power, influence, and wealth (Cronbach's α = 0.76). Finally, openness-to-change values included statements about novelty, change, new experiences, and curiosity (Cronbach's α = 0.81). To examine respondents' general environmental concerns about human-environment relationships, eight worldview items were adapted from the revised New Ecological Paradigm (NEP) scale (Dunlap, Van Liere, Mertig, & Jones, 2000). Using a five-point scale from 'strongly disagree' to 'strongly agree,' respondents were asked to indicate their level of agreement with statements about human impacts on nature, ethical considerations toward non-human life, and resource scarcity (Cronbach's α = 0.85).

The final section of the questionnaire focused on contextual aspects of climate policy support, including household characteristics, socio-demographic attributes, and degree of trust in various individuals, corporations and governments involved in addressing climate change. On a five-point scale ranging from 'very low' to 'very high,' with an option 'I do not know,' respondents were asked to indicate their level of trust in governments, the fossil fuel and renewable energy industries, and scientists associated with the climate change threat and its solutions. Trust in governments consisted of questions measuring trust in the federal and trust in the provincial governments (Cronbach's α = 0.80). Trust in the fossil fuel industry included questions about trust in the industry and trust in scientists employed by the industry (Cronbach's α = 0.84).Trust in scientists was measured through questions about trust in scientists working for universities and trust in scientists working for the International Panel on Climate Change (IPCC) (Cronbach's α = 0.66). Household characteristics were assessed through questions about the area of residence (i.e., urban, suburban, or rural), home type (i.e., detached or attached), number of vehicles in a household, the length and mode of daily commute to work/ school (i.e., driving, taking transit, biking, or carpooling). Finally, to assess socio-demographic characteristics of the sample, respondents were asked questions about their age, gender, education, income, and the province of residence.

### 5.4.2. Statistical analyses

This study employed the IBM SPSS statistical software (version 21) to perform all statistical analyses. First, descriptive statistics were used to assess levels of citizen support for nine hypothetical climate policies, including:

- Market-based policies:

1. a carbon tax applying to all individuals and businesses, and
2. a cap for businesses with tradable emission permits (cap-and-trade).

- Regulatory policies:

3. a clean electricity standard that requires electric utilities to generate at least 50% of new electricity from zero-emission sources,
4. vehicle efficiency regulations that require vehicles to be 30% more fuel efficient by the year 2020,
5. a low carbon fuel standard that requires fuels to have lower carbon emissions by 20% by the year 2020, and
6. building efficiency regulations that require new buildings, appliances, and equipment to be more energy efficient.

- Voluntary policies:

7. subsidies (such as tax rebates) to households/ businesses that purchase energy efficient appliances/ equipment, fuel efficient vehicles, or use solar and wind energy,
8. educational programs for citizens about climate change and actions to reduce it, and

9. government investments into research into clean energy sources, such as hydro, solar, or wind (called ‘research and development (R&D)’ in the remainder of the paper).

Second, binary logistic regressions were run to estimate how independent variables from Table 5.1 are associated with respondent support for climate policies. Because binary logistic regressions measure the probability of a binary response, responses to policy support questions were recoded to have two aggregate categories – ‘oppose’ (a composite of ‘oppose’ and ‘strongly oppose’) and ‘support’ (a composite of ‘support’ and ‘strongly support’). The reliability analysis and the exploratory factor analysis of policy support indicated that support variables for vehicle efficiency regulations, building efficiency regulations, and the low carbon fuel standard were inter-correlated (Cronbach’s $\alpha = 0.75$). Therefore, these policies were grouped into a new support variable called ‘supply-focused regulations,’ implying that they set emission reduction requirements for industry rather than consumers. Similarly, inter-correlation was observed among variables measuring support for all voluntary policies, including subsidies, education, and research and development programs (Cronbach’s $\alpha = 0.67$). Hence, these policies were combined into a new variable called ‘voluntary policies.’ As a result of these modifications, a total of five binary logistic regressions were run to explain support for the carbon tax, cap-and-trade, clean electricity standard, supply-focused regulations, and voluntary policies.

To represent heterogeneity across the sample, the K-means cluster analysis was performed based on standardized citizen support data for the reduced five policy variables discussed above. We used the same five policy variables to ensure consistency and comparability of our regression results with the findings of the cluster analysis. The policy support variables were kept as dummy variables for the purpose of this analysis. The key objective of cluster analysis is to identify groups (called ‘clusters’) of respondents that are more similar to each other than respondents in other groups (Kinnear & Gray, 2004). Working in an iterative fashion, the K-means algorithm allocates each respondent to a cluster based on the criterion of minimizing the distance from the individual respondent data points. The selection of the number of clusters in this study was based on the goal of finding the most interpretable solution that has (1) appropriate sample sizes for each cluster that are smaller than 50% but greater than 5% of the entire sample, and (2) at least the number of clusters where inter-cluster variability exceeds the intra-cluster variability. We described each cluster in terms of attitudinal, contextual, and personal capability variables from Table 5.1, using cross-tabulations along with chi-square tests for categorical data and ANOVA analysis for continuous data.

## 5.5. Results

### 5.5.1. Citizen support for climate policies

Figure 5.1 shows the results of descriptive analysis of climate policy support levels. All regulations and voluntary policies are supported (i.e., an aggregate of ‘support’ and ‘strongly support’) by the majority of respondents (83-90%). The highest support is observed for building efficiency regulations (90%) among regulatory measures, and educational programs (90%) among voluntary policies. The carbon tax achieves the lowest support (53%) followed by the cap with emission permits (70%).

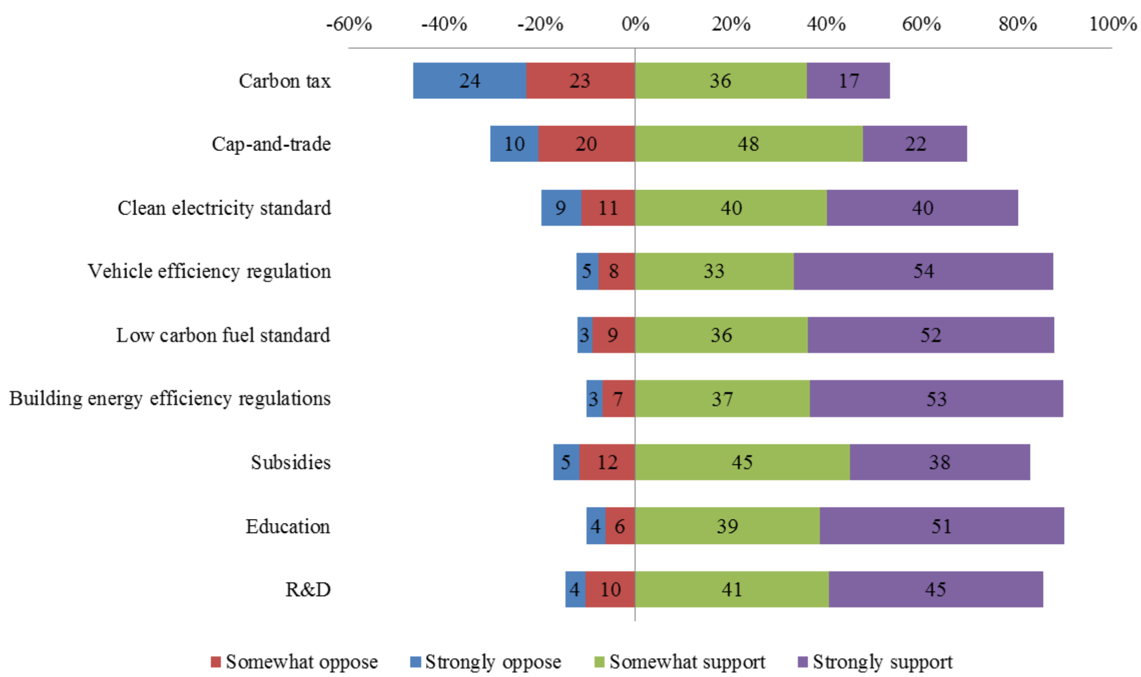


**Figure 5.1. Support for climate policies (%)**

### 5.5.2. Explaining citizen support for climate policies

Table 5.3 shows the results of binary logistic regressions explaining citizen support for five climate policy variables: the carbon tan tax, cap-and-trade, clean electricity standard, supply-focused regulations, and voluntary policies. The classification results show that all models correctly classify the outcome for 72% to 93% of the cases.

Due to the nature of logistic regressions, the coefficients in Table 5.3 are presented in the form of log-relative odds (representing an expected change in log odds for a one-unit increase in continuous independent variables) or a log odds ratio between response categories for categorical independent variables. The coefficients are presented in the unstandardized form, which is typical in the logistic regression context (Hosmer, Lemeshow, & Sturdivant, 2013). Because unstandardized regression coefficients indicate the average change in the dependent variable associated with a one-unit change in the independent variable, we cannot compare the relative strength of the coefficients. Instead we interpret the coefficients in terms of their overall statistical significance for shaping climate policy support.

The regression results suggest that only three variables are consistent predictors of support across different policy types (being significant predictors for four of the five policy types): climate change concerns, trust in university and IPCC scientists, and female gender. Trust in the fossil fuel industry is the only common strong predictor of opposition to all policies ($\beta$ >-0.2 at $p < 0.01$) except for cap-and-trade. Other attitudinal and contextual characteristics are unique to different types of climate policies.

**Table 5.3.Binary logistic regression results (unstandardized β coefficients presented in the form of log-relative odds)**

| | Carbon tax | Cap-and-trade | CES | Supply focused-regulations | Voluntary policies |
|---|---|---|---|---|---|
| *Attitudinal variables* | | | | | |
| Values | | | | | |
| Biospheric | 0.578** | 0.235 | 0.129 | 0.711** | -0.228 |
| Altruistic | -0.041 | 0.016 | 0.271 | 0.489* | 0.847** |
| Egoistic | 0.049 | 0.203 | -0.218 | -0.724** | -0.870** |
| Openness to change | -0.193 | -0.050 | 0.327* | 0.037 | 0.386 |
| General environmental concern (NEP) | 0.004 | 0.024 | 0.063* | -0.022 | 0.113** |
| Climate change concern | 0.071** | 0.038** | 0.038** | 0.081** | 0.017 |
| *Contextual variables* | | | | | |
| Trust | | | | | |
| Government | 0.220* | -0.120 | 0.114 | 0.046 | 0.169 |
| Fossil fuel industry | -0.246** | -0.067 | -0.659** | -0.558** | -0.584** |
| Renewable industry | 0.023 | 0.125 | 0.550** | -0.293 | 0.145 |
| Scientists | 0.267* | 0.271* | 0.069 | 0.509* | 0.679** |
| Living area (reference 'urban') | | | | | |
| Suburban | -0.274 | 0.234 | -0.548** | 0.409 | 0.679* |
| Rural | -0.686** | 0.143 | 0.153 | 0.801 | -0.275 |
| Home type 'attached' (reference 'detached') | 0.138 | 0.305* | 0.100 | -0.079 | 0.163 |
| Commute mode 'other (public transit, bike, carpool)' (reference 'drive myself') | 0.447** | 0.061 | 0.081 | 0.545 | 1.136** |
| Daily commute time | 0.185 | 0.162 | -0.035 | 0.136 | 0.045 |
| No of vehicles in a household | 0.001 | 0.146 | 0.141 | 0.527* | 0.289 |
| *Socio-demographics* | | | | | |
| Age | -0.082 | -0.165 | -0.158 | 0.882** | -0.106 |
| Gender 'female' (reference 'male') | 0.541** | 0.822** | 0.849** | 0.467 | 0.825** |
| Education | 0.189 | -0.153 | 0.375 | -0.236 | 0.705 |
| Income | 0.184 | 0.160 | 0.187 | 0.023 | 0.466* |
| Region (reference 'Ontario') | | | | | |
| Atlantic (NL, PE, NS, NB) | -0.363 | 0.050 | 0.920* | 1.799* | 0.586 |
| Quebec | 0.088 | 0.216 | 1.074** | -0.094 | 0.674* |
| Alberta | 0.775** | 0.095 | 0.693* | 0.394 | 2.200** |
| Manitoba/Saskatchewan | 0.621* | 0.521 | -0.191 | 0.768 | 2.533* |
| British Columbia | 0.400 | -0.074 | 0.787** | -0.025 | -0.231 |
| Constant | -4.425** | -2.869** | -3.203** | -3.034* | -4.346* |
| Model summary (goodness of fit measures) | • Nagelkerke $R^2$ 33.1%<br>• H-L test $\chi^2$=17.490, *df*=8, *p*=0.025<br>• Class. accur. 71.9% | • Nagelkerke $R^2$ 22.5%<br>• H-L test $\chi^2$=9.504, *df*=8, *p*=0.302<br>• Class. accur. 75.4% | • Nagelkerke $R^2$ 38.6%<br>• H-L test $\chi^2$=8.508, *df*=8, *p*=0.385<br>• Class. accur. 85.0% | • Nagelkerke $R^2$ 42.8%<br>• H-L test $\chi^2$=33.683, *df*=8, *p*<0.01<br>• Class. accur. 93.3% | • Nagelkerke $R^2$ 39.4%<br>• H-L test $\chi^2$=19.429, *df*=8, *p*=0.013<br>• Class. accur. 92.2% |

*Significant association at 95% confidence level.

** Significant chi-square association at 99% confidence level.

Among attitudinal variables, biospheric values are positively associated with support for the carbon tax and supply-focused regulations (i.e., low carbon fuel standard, vehicle and building efficiency regulations), while altruistic values are positively associated with higher support for supply-focused regulations only. General environmental concern (as measured via the NEP scale) is a positive predictor of support for voluntary policies (i.e., subsidies, educational program, and R&D) and a clean electricity standard.

In terms of contextual characteristics, trust in governments is only a predictor of support for the carbon tax, which might be explained by the government's direct responsibility for the collection and use of tax revenues. Trust in the renewable energy industry is associated with higher support for the clean electricity standard—this might be explained by the policy's requirement to generate electricity from zero-emission sources, as defined in the survey. Interestingly, the area of residence and the degree of a respondent's dependence on driving has contrasting effects on support for a carbon tax and supply-focused regulations. Respondents living in urban areas and not relying on personal vehicles are more likely to support the carbon tax, while the opposite is true for supply-focused regulations. Voluntary policies, including subsidies, educational and R&D programs, are more likely to be supported by suburbanites and less-vehicle dependent respondents. As part of the contextual variables, we also tested for the effect of political ideology on climate policy support. (In Canada, these are the Conservative Party, the Liberal Party, the New Democratic Party, the Bloc Quebecois, and the Green Party). However, the variable caused multicollinearity among the independent variables and did not appear to have a statistically significant effect on support for any of the tested policies. For these reasons, we removed the variable 'political ideology' from the regression models.

Among personal capability variables, age is a predictor of support only for supply-focused regulations, while income is a predictor only for support of voluntary policies. Regional location has an effect on support for most policies except for cap-and-trade. Controlling for all other factors in the models, the carbon tax is more likely to be supported by residents by the Canadian Provinces of Alberta, Manitoba and Saskatchewan. Supply-focused regulations are more likely to be supported in Atlantic provinces. Finally, voluntary policies are more likely to receive support from residents of Quebec, Alberta, Manitoba and Saskatchewan.

### 5.5.3. Characterizing heterogeneity across respondents

Cluster analysis yielded four homogenous clusters of respondents based on their support for the five different policy categories. Table 5.4 shows cluster centre values for each policy category. The cluster centre indicates where the cluster's level of support compares to the average across the entire sample—a positive center indicates higher support than average, while a negative center indicates lower support. Figure 5.2 shows the levels of citizen support for the studied policies in each cluster. The four cluster solution was ideal, producing clusters with: appropriate sample sizes (i.e., smaller than 50% but greater than 5% of the entire sample), inter-cluster variability that exceeds the intra-cluster variability, and categorical and interpretable difference from one another.

**Table 5.4. Cluster descriptions and centre values (standardized; values less than +/-0.15 are removed)**

| Cluster name / Cluster variables: 'citizen support for...' | Pro-Policy | | | |
|---|---|---|---|---|
| | 1 'Universal Strong Support' | 2 'Universal Moderate Support' | 3 'Regulations Support Only' | 4 'Anti-Policy' |
| Carbon tax | 0.91 | 0.29 | -1.04 | -1.07 |
| Cap-and-trade | 0.65 | | | -1.25 |
| Clean electricity standard | 0.66 | -0.23 | 0.29 | -1.52 |
| Supply-focused regulations (vehicle and building efficiency, LCFS) | 0.80 | -0.41 | 0.30 | -1.51 |
| Voluntary policies (subsidies, education, R&D) | 0.77 | -0.30 | 0.18 | -1.47 |
| Number of respondents | 446 | 375 | 293 | 192 |
| % of total sample (n=1,306) | 34.1 | 28.7 | 22.4 | 14.7 |

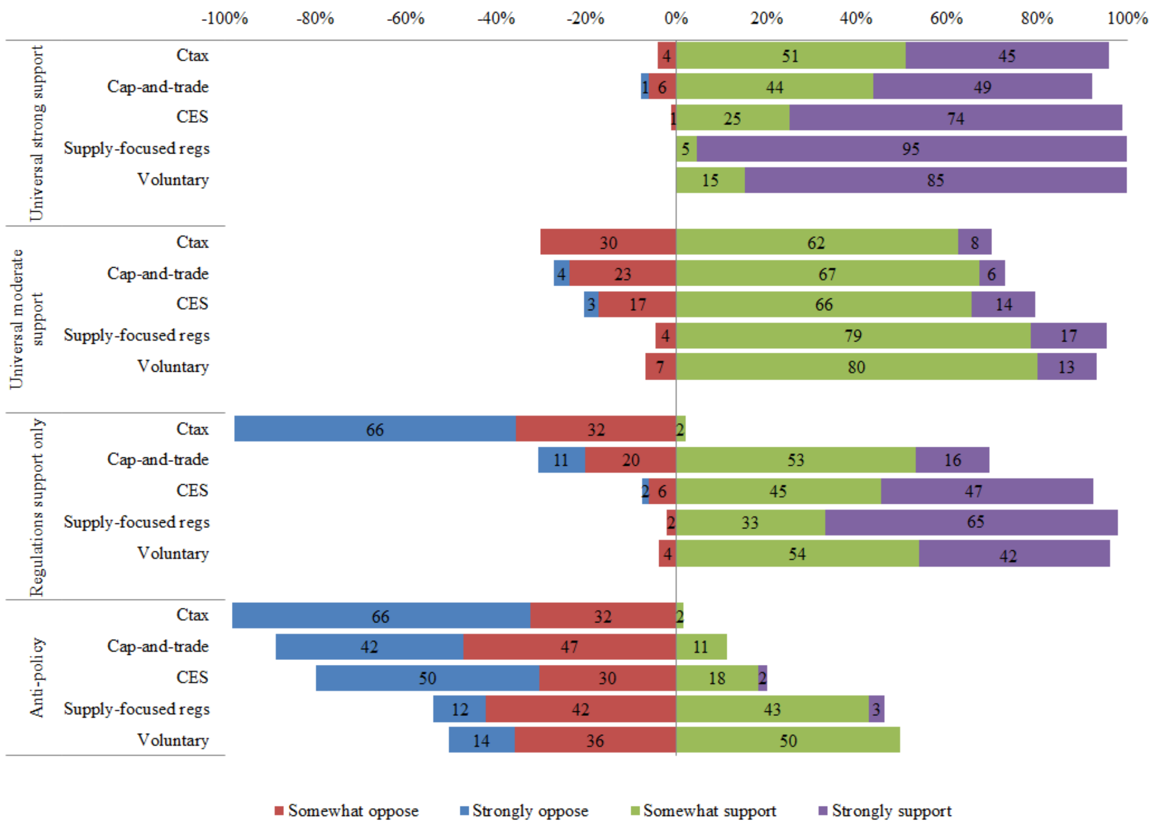


**Figure 5.2. Climate policy support in each cluster (%)**

The first three clusters are all in the ‘Pro-Policy’ category, with different variations of support for different policy types. Respondents in cluster 1 ‘Universal Strong Support’ (34.1%) show broad support for all climate policies, as indicated by the high positive cluster centres in Table 5.4 and high levels of support (92-100%) in Figure 5.2. Cluster 2 ‘Universal Moderate Support’ (28.7% of respondents) is characterized by a positive cluster centre for the carbon tax but negative cluster centres for all regulations and voluntary policies. This cluster shows moderate support for all policies as demonstrated by the relatively high number of ‘somewhat support’ responses (62-80%), and the second highest levels of support for a carbon tax (70% ‘somewhat support’ and ‘strongly support’). Cluster 3 ‘Regulations Support Only’ (22.4%) has positive cluster centres for regulations and voluntary policies but a high negative cluster centre for a carbon tax. Respondents in this cluster are broadly supportive of all regulations and voluntary policies (92-98% ‘somewhat support’ and ‘strongly support’) but are opposed to a carbon tax (98% ‘somewhat oppose’ and ‘strongly oppose’). Finally, respondents in cluster 4 ‘Anti-Policy’ (14.7%) do not show support for any climate policies as demonstrated by high negative cluster centres. This cluster shows resistance to all policies, especially a carbon tax (98%), cap-and-trade (89%), and a clean electricity standard (80%).

Table 5.5 summarises attitudinal, contextual, and demographic characteristics of each cluster. Consistent with the regression results, respondents in all three ‘Pro-Policy’ clusters are more likely to be females, to have high climate change concerns, and to have strong trust in university and IPCC scientists. These variables were consistent predictors of support across different policy types. Other attitudinal and contextual characteristics are unique descriptors of each cluster.

**Table 5.5. Characteristics of each respondent cluster**

| | Pro-Policy | | | Anti-Policy | Sample average |
|---|---|---|---|---|---|
| | 1 ‘Universal Strong Support’ | 2 ‘Universal Moderate Support’ | 3 ‘Regulations Support Only’ | | |
| *Attitudinal variables* | | | | | |
| Values (1 to 5 rating) | | | | | |
| Biospheric** | 4.4 | 3.7 | 3.9 | 3.0 | 3.9 |
| Altruistic** | 4.4 | 3.8 | 4.1 | 3.2 | 4.0 |
| Egoistic | 2.8 | 2.9 | 2.8 | 2.7 | 2.8 |
| Openness to change** | 3.8 | 3.5 | 3.7 | 3.1 | 3.6 |
| General environmental concern (NEP) (-15 to 16 rating)** | 9.3 | 4.7 | 6.3 | -0.4 | 5.9 |
| Climate change concern (-30 to 30 rating)** | 16.5 | 10.1 | 8.6 | -2.6 | 10.1 |
| *Contextual variables* | | | | | |
| Trust (1 to 5 rating) | | | | | |
| Fossil fuel industry** | 1.9 | 2.3 | 2.0 | 2.5 | 2.1 |
| Scientists in the fossil fuel | 2.1 | 2.5 | 2.1 | 2.6 | 2.3 |
| industry** | 3.4 | 3.0 | 2.9 | 2.7 | 3.1 |
| Renewable industry** | 3.1 | 3.1 | 2.7 | 2.9 | 3.0 |
| Federal government** | 3.0 | 2.9 | 2.6 | 2.7 | 2.8 |
| Provincial government** | 3.7 | 3.3 | 3.3 | 3.0 | 3.4 |
| University scientists** | 3.5 | 3.1 | 2.9 | 2.5 | 3.1 |
| IPCC scientists** | | | | | |
| Living area (%)** | | | | | |
| Urban | 51.6 | 49.5 | 40.4 | 47.9 | 47.9 |
| Suburban | 35.4 | 35.8 | 36.3 | 38 | 36.4 |

| | Pro-Policy | | | Anti-Policy | Sample average |
|---|---|---|---|---|---|
| | 1 'Universal Strong Support' | 2 'Universal Moderate Support' | 3 'Regulations Support Only' | | |
| Rural | 13 | 14.7 | 23.3 | 14.1 | 16 |
| Home type (%)* | | | | | |
| Detached | 53.4 | 46.7 | 59 | 52.8 | 52.6 |
| Attached (townhouse, apartment) | 46.6 | 53.3 | 41 | 47.2 | 47.4 |
| Commute mode (%)** | | | | | |
| Drive myself | 34.3 | 30.1 | 42.3 | 46.4 | 36.7 |
| Other (public transit, bike, carpool) | 65.7 | 69.9 | 57.7 | 53.6 | 63.3 |
| Daily commute time (%)** | | | | | |
| Not applicable | 37.8 | 35.2 | 31.7 | 24.9 | 33.8 |
| Less than an hour | 51.2 | 46.9 | 53.9 | 61.1 | 52.1 |
| An hour or longer | 11.0 | 17.9 | 14.3 | 14.0 | 14.2 |
| No of vehicles in a household (%)** | | | | | |
| None | 18.8 | 14.4 | 7.5 | 7.8 | 13.4 |
| One | 44.8 | 42.7 | 51.2 | 43.0 | 45.4 |
| Two or more | 36.3 | 42.9 | 41.3 | 49.2 | 41.2 |
| Political ideology (%)** | | | | | |
| Conservative Party | 8.3 | 15.0 | 15.4 | 33.7 | 15.6 |
| Liberal Party | 18.0 | 16.3 | 14.3 | 10.9 | 15.6 |
| New Democratic Party | 18.0 | 13.9 | 5.5 | 9.8 | 12.8 |
| Bloc Quebecois | 3.6 | 5.6 | 1.4 | 8.8 | 4.4 |
| Green Party | 6.1 | 2.7 | 1.4 | 3.6 | 3.7 |
| Other or no affiliation | 45.9 | 46.5 | 62.1 | 33.2 | 47.9 |
| *Socio-demographics* | | | | | |
| Age (%)* | | | | | |
| <40 | 35.7 | 47.5 | 36.9 | 40.9 | 40.1 |
| 40-64 | 45.3 | 37.9 | 45.7 | 45.6 | 43.3 |
| 65 or older | 19.1 | 14.7 | 17.4 | 13.5 | 16.6 |
| Gender (%)** | | | | | |
| Male | 40.8 | 44.8 | 50.9 | 73.4 | 49.0 |
| Female | 59.2 | 55.2 | 49.1 | 26.6 | 51.0 |
| Education (%) | | | | | |
| Below bachelor's | 87.2 | 86.1 | 90.1 | 91.1 | 88.1 |
| Bachelor's degree | 7.4 | 8.3 | 6.5 | 5.2 | 7.1 |
| Graduate degree | 5.4 | 5.6 | 3.4 | 3.6 | 4.7 |
| Income | | | | | |
| <$75k | 70.3 | 71.7 | 68.3 | 62.0 | 69.0 |
| $75k to $100k | 11.2 | 12.5 | 14.7 | 19.8 | 13.6 |
| $100k or more | 18.4 | 15.7 | 17.1 | 18.2 | 17.3 |
| Region (% by province)** | | | | | |
| Atlantic (NL, PE, NS, NB) | 6.3 | 5.6 | 13.7 | 5.8 | 7.7 |
| Quebec | 23.3 | 27.1 | 23.5 | 23.6 | 24.5 |
| Alberta | 7.6 | 11.7 | 7.5 | 13.6 | 9.6 |
| Manitoba/Saskatchewan | 8.3 | 7.4 | 6.5 | 2.1 | 6.7 |
| British Columbia | 13.7 | 15.2 | 13.3 | 10.5 | 13.6 |
| Ontario | 40.8 | 33.0 | 35.5 | 44.5 | 37.9 |

*Significant association at 95% confidence level (chi-square for categorical and ANOVA for continuous data).
** Significant chi-square association at 99% confidence level (chi-square for categorical and ANOVA for continuous data).

As expected, respondents in the 'Universal Strong Support' cluster compared to other clusters score the highest on biospheric and altruistic values, general environmental and climate change concerns, trust in scientists and the renewable industry, and the use of alternative modes of transportation (e.g., transit, bike, carpool). Most respondents in this cluster are of older age (64% are above 40), females (59%), and urbanites (52%). The 'Anti-Policy' cluster exhibits the opposite characteristics of the 'strong climate support' cluster. The anti-policy respondents are not concerned about the environment and climate change, distrust environmentalists and scientists, but show high trust in the fossil fuel industry. Most of these respondents are less educated, males, and residents of Alberta and Ontario.

Compared to the 'Universal Moderate Support' cluster, respondents in the 'Regulations Support Only' cluster have higher altruistic and biospheric values, show less concern about climate change but greater concern about the environment in general. Most of these respondents live in rural areas and single-family homes, own at least one vehicle, and drive personal vehicles to work. In contrast, the 'Universal Moderate Support' cluster is characterized by living in an urban location, lower dependence on a single occupancy use of a vehicle, and higher trust in the federal and provincial governments. Respondents in this cluster show higher concern about climate change but lower concern about the environment in general, implying that citizens seem to link the carbon tax directly with climate change, but do not necessarily see the carbon tax as associated with environment issues in general. One explanation could be that some or all of the studied regulations are more likely to be associated with environmental benefits other than climate change mitigation, including reduced land impacts or improved air quality due to the use of lower-emission fuels and technology (e.g., biofuels, solar panels, energy efficient technologies) (Clark et al., 2003). Future research could explore why addressing the risks associated with climate change might not equate to addressing broader environmental concerns. Most of these characteristics align with the regression results on support for the carbon tax and supply-focused regulations.

Finally, Table 5.5 characterizes respondents in each cluster in terms of their political affiliation with the key parties in Canada (this characteristic was removed from the regression analysis for the reasons of multicollinearity and non-significance). The significant chi-square test indicates that political ideology is associated with cluster membership. Respondents in the 'Anti-Policy' cluster are more likely to be affiliated with the Conservative party of Canada (34%) or have no affiliation (33%). However, most respondents in each 'Pro-Policy' cluster do not have any political affiliation (46-62%). One explanation for why our regression models did not estimate significant coefficients for political affiliation could be due to the high proportion of respondents with 'no political affiliation.' Another is that the policy platforms of all Canadian federal parties except the Conservative party are similar in arguing for strong policy efforts to reduce CO2 emissions.

## 5.6. Discussion and conclusion

Understanding citizen perceptions of climate policies can help policy-makers design and implement effective and acceptable climate policies. This study provides insights into how and why people support various types of climate policies using survey data collected from a representative sample of Canadian citizens. Our findings indicate that supply-focused regulations and voluntary policies receive the highest support (83-90%), while market-based instruments such as carbon taxes and cap-and-trade receive the highest opposition (47 and 30% respectively). These overall results are consistent with several survey-based studies in North America, Europe, and Asia suggesting that carbon taxes face higher opposition than voluntary and regulatory measures that set requirements for industry (Lachapelle et al., 2014; Tobler et al., 2012; Lam, 2014).

We further assess individual characteristics of support and opposition for these policies. This knowledge is useful for (1) policy-makers that want to assess the potential for public controversy of climate policies under consideration, (2) policy-makers in jurisdictions where similar climate policies already exist and can be affected by changes in the political climate or changes in stringency, which might generate more media attention, and (3) the academic literature which has not yet studied factors influencing citizen support for individual types of regulatory and voluntary climate policies.

Regression analyses suggest that the only consistent predictors of support across different types of policies are concern about climate change, higher trust in scientists, lower trust in the fossil fuel industry, and being female. All four relationships have been found in previous research that used composite indices for measuring policy support (Dietz et al., 2007; Elliott et al., 1997; O'Connor et al., 2002; Zahran et al.; 2006). The effects of other variables, including values and specific contextual factors, are unique to different policy types. Specifically, support for a carbon tax is explained by higher biospheric values and trust in government. The strong effect of biospheric values might be explained by positive perceptions of a given policy's beneficial impact on the environment (Nilsson & Biel, 2008), or by a strong prioritization of the environment over other values. Trust in the federal government may be important due to citizens' concerns regarding the use of revenues from carbon taxes, as suggested by Hsu et al. (2008) and Kallbekken and Selen (2011). Opposition to the carbon tax lies primarily with segments of the public who reside in rural areas, as well as those who rely on personal vehicles for commuting to work. Elliot et al. (1997) explain that rural residents have less public transportation options and are more directly dependent for income on the extraction of natural resources. These results are consistent with notions of a self-serving bias and cost saliency, where those that are the most likely to bear higher costs of a carbon tax (relative to the rest of the population) are statistically less likely to support it.

In contrast, support for three supply-focused regulations (the low carbon fuel standard and vehicle and building efficiency regulations) is higher among vehicle-dependent respondents. Support for these regulatory policies is also associated with higher biospheric and altruistic values, older age, and residence in Atlantic provinces. While Dietz et al. (2007) and Zahran et al. (2006) point to the significance of some of these characteristics for policy support, the authors do not differentiate the effects of these variables by policy type.

For the clean electricity standard, regression results indicate that trust in the renewable energy industry is a unique predictor of support—it is not significant for any other policy type. The significance of trust might be related to the requirement of the clean electricity standard to generate new electricity from zero-emission sources, such as hydro, solar, and wind (Rhodes et al., 2014; Shwom et al., 2010). The clean electricity policy is also more likely to be supported by residents of Quebec and British Columbia. In these regions the vast majority of electricity is currently generated from renewable energy sources and therefore people in these jurisdictions are likely to see renewable electricity as a realistic possibility in future as it was in the past. Observations of higher support in these provinces is thus consistent with the notion of a self-serving bias. Finally, voluntary policies, including subsidies, information and research and development programs, are more likely to be supported by wealthier, suburban respondents with higher altruistic values and general environmental concerns, as well as by those not relying on a single occupancy use of a vehicle.

To explore heterogeneity among citizens, cluster analysis identifies four groups of respondents based on their stated support for the different policy types: those that strongly support all climate policies (34% of respondents), those that are moderately supportive of all policies including the carbon tax (28%), those that support policies other than the carbon tax (22%), and those that strongly oppose most climate policies (14%). Respondents that strongly support all policies are more likely to be urbanites and female, and score higher than other clusters in terms of biospheric and altruistic values, general environmental concern (NEP score), climate change concerns, trust in scientists and the renewable industry, and present use of 'greener' modes of transportation including public transit, biking, and carpooling. The opposite characteristics describe respondents that strongly oppose climate policies. Respondents who oppose most climate policies are also likely to be affiliated with the Conservative party of Canada. Consistent with the regression results, most respondents that are moderately supportive of all policies, including carbon taxation, show high trust in government, live in urban areas, and do not rely on personal vehicles. In contrast, respondents supportive of regulations and voluntary policies live in rural areas and single-family homes, and show higher dependence on personal vehicles for commuting to work/ school. These findings provide important insights into heterogeneity across respondents, including how framing different policies according do different motives and impacts may resonate uniquely with different citizen segments. Such insights could also be used to generate hypotheses for future research in other regions.

Both the regression and cluster analysis suggest that when implementing climate policies, policy-makers should consider individual characteristics of support for each policy separately and prepare targeted proposals. Our present analysis indicates that while it may be reasonable to create composite variables of policy support for relatively similar policies (e.g., building and vehicle efficiency regulations), the levels and patterns of support for different policy types are categorically different. Namely, we find unique patterns for the five policy categories we construct: carbon tax, cap-and-trade, clean electricity standard, supply-focused regulations, and voluntary policies. While carbon taxes are presumed by economists and policy experts to reduce total emissions at the lowest possible cost to society, they are likely to face opposition in Canada, particular from citizen segments that are vehicle-dependent and rural. Given that most citizens, including those who reside in rural areas and drive personal vehicles, are supportive of regulations, policy-makers might need to prioritise effective regulatory approaches over market-based policies. That being said, policy-makers should be aware that relatively high levels of policy support and low levels of opposition do not necessarily imply successful policy implementation—further attention should be paid to the strength and nature of opposition. Groups that exercise significant political power by virtue of their economic and social significance, and those who face concentrated costs from specific policies, may have strong influence on policy implementation (Galbraith, 1952; Olson, 1971). More research in this area can prove fruitful.

This study has several limitations. First, several attitudinal and contextual variables suggested by Stern (2000) were removed from the study in the interest of simplicity, including perceived responsibility for climate change mitigation, personal norms, social networks, and political ideology. These variables need to be incorporated and analysed as part of a more comprehensive framework on climate policy support. Second, while this study identified several unique predictors of support for different policy types, the reasons for their unique effects were not investigated. Future research can assess why some individual characteristics matter for certain types of climate policies. Third, the survey questionnaire had fairly limited definitions of climate policies. For instance, there was no information about the different methods or actions to comply with certain regulations, the expected emission reductions or the expected distributional impacts of each policy. As a result, some responses may have been influenced by the wording presented in the survey. Future research should investigate how broader policy definitions and different ways of framing survey questions could affect citizen support. Finally, while citizen support is one of the key components of political acceptability of climate policies, other interest groups and institution could also have a strong influence on climate-policy making. Complimentary research could explore how stakeholder perceptions may affect climate policy decisions.

## 5.7. Acknowledgements

This work was funded by the Pacific Institute for Climate Solutions and the Social Sciences under Grant no. 31-641048, and Social Sciences and Humanities Research Council (Vanier Canada Graduate Scholarships program) under Grant no. 201211DVC-236457-303356.

# Chapter 6. Conclusions

My thesis aims to help policy-makers design acceptable and effective policies to reduce GHG emissions in their jurisdiction. I do this by critically assessing different types of climate policy using the criteria of policy effectiveness, economic efficiency, administrative feasibility, and political acceptance. In the first paper, I focus mainly on the evaluation of policy effectiveness and economic efficiency using a comparison of British Columbia's carbon tax and its clean electricity standard as a case study. In the other three papers, I focus on political acceptability by exploring its one key component, that being citizen implicit and explicit support. In particular, I assess citizen support for different types of climate policies and identify the key factors predicting policy support, using a representative sample of Canadian citizens.

Several findings emerge from my research. First, while carbon taxes are often shown by economists to be the most efficient climate policy, they are the least popular type of climate policy among the general public. In contrast, regulatory policies, including clean electricity standards, low carbon fuel standards, and efficiency regulations, receive relatively high citizen support while also being highly effective in reducing GHG emissions. These findings are observed through all of the four Ph.D. papers. In the first paper (chapter 2), I find that British Columbia's clean electricity standard is estimated to reduce four to six times more emissions per year by 2020 than the carbon tax, but at an average cost per tonne of $CO_2$ reduced that is significantly higher than the carbon tax at its current level. In the other three papers, I find that all regulatory policies, including British Columbia's clean electricity standard and low carbon fuel standard, achieve significantly higher levels of public support (89-90%) than the carbon tax (56%), even though the economic efficiency of regulations is likely to be lower than that of the carbon tax. Similar patterns of citizen support are observed for hypothetical climate policies in Canada as a whole. In particular, the fourth paper shows that most regulatory and voluntary policies receive high levels of support (83-90%), while carbon taxes receive the highest levels of opposition (47%). Olson (1971) and Caplan (2007) suggest that citizen opposition to a policy may sometimes be more important than citizen support. My research shows that only the carbon tax is likely to face high and strong citizen opposition. For example, British Columbia's carbon tax is "strongly opposed" by 21% and "somewhat opposed" by 23% of respondents. In contrast, all regulations, including B.C.'s building efficiency regulations, low carbon fuel standard, and the clean electricity standard are "strongly opposed" by 2-4% of respondents and "somewhat opposed" by 7-8%.

Second, from the responses in the survey, it appears that citizen knowledge of climate policy, including knowledge about policy effectiveness, is unlikely to translate into higher policy support (chapters 3 and 4). Using British Columbia's climate policies as a case study, I find that that most B.C. citizens are unaware of any of that province's climate policies, including any understanding of the potential effect of these on reducing greenhouse gas emissions. When people are made aware of these current policies, it is the regulatory policies, namely the low carbon fuel standard, clean electricity standard, and energy efficiency regulations for buildings, that receive the highest support (up to 90%). I refer to this combination of low knowledge and high support as "passive support." Given the absence of a statistical relationship between citizen knowledge and policy support, passive support may be sufficient to implement effective climate policies.

Third, several individual characteristics are more likely to be associated with citizen support for climate policies, including people's personal values, their degree of trust, and some key household characteristics. However, only a few factors are consistent predictors across policy types. These are concern about climate change, having trust in scientists, and being female. Other significant factors are unique to different policy types. For example, support for a carbon tax is associated with higher biospheric values, living in an urban area, and not relying on single occupancy vehicle use. In contrast, respondents relying on single occupancy vehicle use are more likely to be in favour of regulations, including vehicle and building efficiency regulations. These results suggest the importance of targeted policy proposals.

My findings may have important implications for climate policy-making. First, the divergence of support by policy type implies that regulations might have higher chances of political acceptability than carbon taxation, at least in some jurisdictions. Second, while some efforts at informing citizens about climate science and policy may be helpful, this approach alone is unlikely to be sufficient for achieving implementation of effective climate policies. Those seeking such a policy outcome need to be aware of other determinants of citizen support, including attitudinal and contextual factors. While attitudes are difficult to change, contextual factors associated with opposition may perhaps be addressed by offering complementary policies.

In conclusion, my research suggests that only the carbon tax has substantial opposition among the general public. Other policies, including regulations seem to be more acceptable to citizens. Future research should explore if citizen support (or the lack of citizen opposition) for the various regulatory policies would still hold, if government were to increase their stringency. A possible direction for future research could be to focus on jurisdictions like California, where GHG emissions have been reduced through a mild emissions pricing policy (i.e., cap-and-trade with a low floor price, which is not projected to rise significantly for some time) and various regulatory policies. In particular, it would be interesting to survey California citizens to assess (1) if rising policy stringency has led to a greater policy awareness, and (2) if the minimal levels of opposition to regulatory policies still hold when the stringency (effectiveness) of California's compulsory policies continues to increase.

# References


Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211. doi: 0749-5978/91.

Attari, S. Z., Schoen, M., Davidson, C. I., DeKay, M. L., Bruine de Bruin,W., Dawes, R., & Small, M. J. (2009). Preferences for change: Do individuals prefer voluntary actions, soft regulations, or hard regulations to decrease fossil fuel consumption? *Ecological Economics, 68,* 1701–1710. doi:10.1016/j.ecolecon.2008.10.007.

Bagozzi, R., Gürnao-Canli, Z., & Priester, J. (2002). *The Social Psychology of Consumer Behaviour.* Buckingham: Open University Press.

Bailie, A., Horne, M., Campbell, K., Jamison, A., MacNab, J., Picketts, I., & Wong, R. (2007) *Mind the Gap: A Blueprint for Climate Action in British Columbians.* Vancouver, BC: Pembina Institute.

Bamberg, S., & Schmidt, S. (2003). Incentives, morality or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz and Triandis. *Environment and Behavior, 35*, 264–285. doi: 10.1177/0013916502250134.

BC Government. (2007). *BC Energy Plan: A Vision for Clean Energy Leadership.* Victoria, BC: Government of British Columbia.

BC Government. (2008). *Climate Action Plan.* Victoria, BC: Government of British Columbia.

BC Government (2010). *Clean Energy Act, Bill 17-2010.* Victoria, BC: Government of British Columbia.

BC Hydro. (2000). *Integrated Electricity Plan: An Update to the 1995 IEP*. Vancouver, BC: BC Hydro.

BC Hydro. (2006). *F2006 Open Call for Power: Report on the Call for Tenders (CFT) Process.* Vancouver, BC: BC Hydro.

BC Hydro. (2008). *2008 Long-Term Acquisition Plan, Appendix D*. Vancouver, BC: BC Hydro.

BC Hydro. (2012). *2012 Integrated Resource Plan*, Chapter 6. Vancouver, BC: BC Hydro.

BC Ministry of Energy and Mines. (2004). *B.C. Clean Electricity Guidelines.* Victoria, BC: BC Government.

BC Ministry of Energy and Mines. (2012). *Clean or Renewable Electricity.* Retrieved from: http://www.empr.gov.bc.ca/EPD/Electricity/supply/CRE/Pages/default.aspx.

BC Ministry of Energy and Mines. (2014). *Renewable and Low Carbon Fuel Requirements Regulation: Summary for 2012. Information Bulletin RLCF-007-2012.* Victoria, BC: BC Government.

BC Ministry of Finance. (2010). *B.C. Budget and Fiscal Plan 2010/2011–2012/2013.* Retrieved from: http://www.bcbudget.gov.bc.ca/2010/bfp/2010_Budget_Fiscal_Plan.pdf.

BC Ministry of Finance. (2011). *B.C. Budget and Fiscal Plan 2011/2012– 2013/2014.* Retrieved from: http://www.bcbudget.gov.bc.ca/2011/bfp/2011_Budget_Fiscal_Plan.pdf.

BC Ministry of Finance. (2012). B.C. *Budget and Fiscal Plan 2012/2013– 2014/2015.* Retrieved from: http://www. bcbudget.gov.bc.ca/2012/bfp/2012_Budget_Fiscal_Plan.pdf.

BC Ministry of Finance. (2013). *B.C. Budget and Fiscal Plan 2013/2014– 2015/2016.* Retrieved from: http://www. bcbudget.gov.bc.ca/2013/bfp/2013_Budget_Fis-cal_Plan.pdf.

BC Ministry of Mines, Energy, and Petroleum Resources. (2007). *B.C. Energy Plan.* Victoria, BC.

BC Sustainable Energy Association; Sierra Club of Canada, BC Chapter; Dogwood Initiative; Wildsight; One Sky; David Suzuki Foundation; Living Oceans Society; Federation of BC Naturalists; GSX Concerned Citizens Coalition. (2006). *Princeton Wood Residue and Coal Power Generation Project (Compliance Energy Corporation), and Wapiti Power Development Project (AESWapiti Energy Corporation). Letter to Premier Gordon Campbell, 8 September*. Retrieved from: http://www.sqwalk.com

BCTC (BC Transmission Corporation). (2007). *Tumbler Ridge Coal Plant Project: Interconnection Facilities Study*. Vancouver, BC: BCTC.

Bernauer, T., & Gampfer, R. (2013). Effects of civil society involvement on popular legitimacy of global environ- mental governance. *Global Environmental Change*, 23, 439–449. doi:10.1016/j.gloenvcha.2013.01.001.

Blumer, H. (1969). *Symbolic Interactionism – Perspective and Method*. Berkeley, CA: University of California Press.

Bord, R.J., Fisher, A., & O'Connor, R.E. (1998). Public perceptions of global warming: United States and international perspectives. *Climate Resources, 11*(1), 75–84.

Borick, C.P., E. Lachapelle, & Rabe, B.G. (2011). *Climate Compared: Public Opinion on Climate Change in the United States and Canada*. Issues in Government Studies. Washington, DC: Brookings.

Bostrom, A., O'Connor, R.E., Böhm, B., Hanss, D., Bodi, O., Ekström, F., Halder, P., Jeschke, S., Mack, B., Qu, M., Rosentrater, L., Sandve, A., & Sælensminde, I. (2012). Causal thinking and support for climate change policies: International survey findings*. Global Environmental Change: Human and Policy Dimensions, 22*, 210-222.

Brisson, J.P., Bledsoe, J., & Dreibelbis, M. (2014). *U.S. Supreme Court Denied Certiorari Regarding the Constitutionality of California's Low Carbon Fuel Standard. Latham's Clean Energy Law Report.* Retrieved from http://www.cleanenergylawreport.com/environmental-and-approvals/by-jp-brisson-joshua-bledsoe/.

Brulle, R.J., Carmichael, J., & Jenkins, J.C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. *Climate Change, 114*(2), 169-188.

Bruvoll, A., & Larsen, B.M. (2004). Greenhouse Gas Emissions in Norway: Do Carbon Taxes Work? *Energy Policy, 32*, 493-505.

California Air Resources Board. (2009). *Proposed Regulation to Implement the Low Carbon Fuel Standard — Initial Statement of Reasons. Volume 1: Staff Report.* Sacramento, CA : California Air Resources Board.

Caplan, B. (2007). *The Myth of the Rational Voter: Why Democracies Choose Bad Policies.* Princeton: Princeton University Press.

Chetty, R., A. Looney, & Kroft, K. (2009). Salience and Taxation: Theory and Evidence. *American Economics. Review, 99*(4), 1145-1177. doi: 10.1257/aer.99.4.1145.

Clark, C. F., Kotchen, M. J., & Moore, M. R. (2003). Internal and external influences on proenvironmental behavior: Participation in a green electricity program. *Journal of Environmental Psychology, 23*(3), 237–246. doi:10.1016/S0272-4944(02)00105-6.

Cohen, G.L., Aronson, J., & Steele, C.M. (2003). When beliefs yield to evidence: Reducing biased evaluation by affirming the self. *Personality and Social Psychology Bulletin, 26*(9), 1151-1164.

Compliance Energy Corporation. (2006). *Princeton Wood Residue and Coal Power Generation Project*. Vancouver, BC: Compliance Energy Corporation.

Cvetkovich G., & Löfstedt, R. (2000). *Social Trust and the Management of Risk: Advances in Social Science Theory and Research*. London: Earthscan.

Cvetkovich, G., Siegrist, M., Murray, R., & Tragesser, S. (2002). New information and social trust: asymmetry and perseverance of attributions about hazard managers. *Risk Analysis 22,* 359–67. doi: 10.1111/0272-4332.00030.

Dietz, T. , Dan, A. , & Shwom, R. (2007). Support for Climate Change Policy: Social Psychological and Social Structural Influences. *Rural Sociology*, *72*(2), 185-214. doi:10.1526/003601107781170026.

Dietz, T., Fitzgerald, A., & Shwom, R. (2005). Environmental Values. *Annual Review of Environment and Resources, 30,* 335–372. doi: 10.1146/annurev.energy.30.050504.144444.

Drews, S., & van den Bergh, J. C. J. M. (2015). What explains public support for climate policies? A review of empirical and experimental studies. *Climate Policy*, 1–22. doi:10.1080/14693062.2015.1058240.

Dunlap, R.E., Van Liere, K.D., Mertig, A.G., & Jones, R.E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425‑442.

Egmond, C., & Bruel, R. (2007). *Nothing is as Practical as a Good Theory: Analysis of Theories and a Tool for Developing Interventions to Influence Energy-Related Behaviour.* Pikermi Attiki, Greece: Centre for Renewable Energy Sources and Savings.

Elgie, S. (2012). *British Columbia's Carbon Tax Shift: The First Four Years*. Ottawa, ON: Sustainable Prosperity.

Eliasson, J., & Jonsson, L. (2011). The unexpected 'yes': Explanatory factors behind the positive attitudes to congestion charges in Stockholm. *Transport Policy, 18,* 636–647. doi:10.1016/j.tranpol.2011.03.006.

Elliott, E., Seldon, B., & Regens J. (1997). Political and economic determinants of individuals' support for environmental spending. *Journal of Environmental Management, 51*, 15–27.

Environics. (2011). *Canadians Continue to Voice Strong Support for Actions to Address Climate Change, Including an International Treaty and Carbon Taxes*. Ottawa, ON: Environics.

Environics Institute (2012). *Climate Change: Do Canadians Still Care?* Ottawa, ON: Environics Institute.

EU Parliament. (2009). Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009. *Official Journal of the European Union, 140*, 88-113.

Factiva. (2014). Academic Dow Jones Factiva.com: Media Coverage of "Carbon Tax" and "Low Carbon Fuel Standard" in the Vancouver Sun and the Province from January 1, 2007 to July 15, 2014.

Farrell, A.E., & Sperling, D. (2007). *A Low-Carbon Fuel Standard for California, Part 2: Policy Analysis. Research Report UCD-ITS-RR-07-08.* Davis, CA: UC Davis Institute of Transportation Studies.

Festinger, L. (1962). *A Theory of Cognitive Dissonace.* Stanford: Stanford University Press.

Finkelstein, A. (2009). E-ztax: Tax Salience and Tax Rates. *Quarterly Journal of Economics, 124*(3): 969-1010.

Freudenburg, W.R. (1991). Rural – urban differences in environmental concern: A closer look. *Sociological Inquiry, 61*, 167–198. doi: 10.1111/j.1475-682X.1991.tb00274.x.

Galbraith, J.K. (1952). American Capitalist--The Concept of Countervailing Power. Boston: 743 Houghton Mifflin.

Gifford, R., Kormos, C., & McIntyre, A. (2011). Behavioral dimensions of climate change: drivers, responses, barriers, and interventions. Wiley Interdisciplinary Reviews: *Climate Change, 2*(6), 1757-7799.

Goulder, L. (1995). Environmental Taxation and the Double Dividend: A Reader's Guide. *International Taxation and Public Finance, 2*, 157-183.

Goulder, L.H., & Parry, I.W.H. (2008). Instrument Choice in Environmental Policy. *Review of Environmental Economics and Policy, 2*(2), 152-174.

Government of British Columbia. (2002). *Energy for our Future: A Plan for BC*. Victoria, BC: Government of British Columbia.

Government of British Columbia. (2008). *Climate Action Plan*. Victoria, BC: Government of British Columbia.

Government of British Columbia. (2010). *Clean Energy Act, Bill 17-2010.* Retrieved from: http://www.leg.bc.ca/39th2nd/1st_read/gov17-1.htm.

Guerra Santin, O., Itard, L., & Visscher, H. (2009). The effect of occupancy and building characteristics on energy use for space and water heating in Dutch residential stock. *Energy and Buildings*, *41*, 1223–1232. doi:10.1016/j.enbuild.2009.07.002.

Harring, N., & Jagers, S. C. (2013). Should we trust in values? Explaining public support for pro-environmental taxes. *Sustainability (Switzerland)*, *5*, 210–227. doi:10.3390/su5010210.

Harrison, K. (2010). Comparative Politics of Carbon Taxation. *Annual Review of Law and Social Science, 6,* 507-529.

Harrison, K. (2012). A Tale of Two Taxes: The Fate of Environmental Tax Reform in Canada. *Review of Policy Research, 29*(3), 383-407.

Hosmer, D.W., Lemeshow, S., & Sturdivant, R.X. (2013). Applied Logistic Regression. John 751 Wiley & Sons Inc.: Hoboken, NJ. doi: 10.1002/9781118548387

Horne, M. (2011). *Measuring British Columbians' Perspectives on Climate Change and Carbon Taxes*. Vancouver, BC: Pembina Institute.

Horne, M., Petropavlova, E., & Partington, P.J. (2012). *British Columbia's Carbon Tax: Exploring Perspectives and Seeking Common Ground.* Vancouver, BC: Pembina Institute.

Hosmer, D.W., Lemeshow, S., & Sturdivant, R.X. (2013). *Applied Logistic Regression.* John Wiley & Sons Inc.: Hoboken, NJ. doi: 10.1002/9781118548387.

Hsu, S.L., Walters, J., & Purgas, A. (2008). Pollution tax heuristics: an empirical study of willingness to pay higher gasoline taxes. *Energy Policy, 36,* 3612–3619. doi: 10.1016/j.enpol.2008.06.010.

IPCC (Intergovernmental Panel on Climate Change). (2007). The Physical Science Basis. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, & H.L. Miller (Eds.), *Fourth Assessment Report of the Intergovernmental Panel on Climate Change 2007.* New York: Cambridge University Press.

Intergovernmental Panel on Climate Change. (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* New York: Cambridge University Press.

Jaccard (2006). Mobilizing producers toward environmental sustainability: The prospects for market-oriented regulations. In G. Toner (Ed.), *Building Canadian capacity: Sustainable production and the knowledge economy.* Vancouver: UBC Press.

Jaccard, M. (2012a). The Political Acceptability of Carbon Taxes: Lessons from British Columbia. In J. Milne & M. Andersen (Eds.), *Handbook of Research on Environmental Taxation* (pp. 175-191). Northampton, MA: Edward Elgar Publishing, Inc.

Jaccard, M. (2012b). Energy Policies: Objectives and Instruments. In T. Johansson, A. Patwardhan, N. Nakicenovic, & L. Gomez-Echeverri (Eds.), *Global Energy Assessment: Toward a Sustainable Future* (pp. 1549-1602). Cambridge: Cambridge University Press.

Jackson, T. (2005). *Motivating Sustainable Consumption. SDRN Briefing One.* London, UK: Sustainable Development Research Network.

Jaffe, A.B., Newell, R.G. and Stavins, R.N. (1999). *Energy-Efficient Technologies and Climate Change Policies: Issues and Evidence.* Climate Issue Brief No. 19. Washington, DC: Resources for the Future.

Joskow, P. and Marron, D  (1992). What does a negawatt really cost? Evidence from utility conservation programs. *The Energy Journal, 13*(4), 41-74.

Kahan, D.M., & Braman, D. (2006). Cultural cognition and public policy. *Yale Law & Policy Review, 24*, 147-170.

Kahneman, D., Knetsch, J.L., & Thaler, R.H. (1991). Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias. *Journal of Economic Perspectives, 5*(1), 193-206.

Kallbekken, S., & Sælen, H. (2011). Public Acceptance for Environmental Taxes: Self-Interest, Environmental and Distributional Concerns. *Energy Policy, 39*(5), 2966-2973. doi: 10.1016/j.enpol.2011.03.006.

Kampman, B., Van den Berg, J., Otten, G., Kroon, P., Van Grinsven, A., & De Buck, A. (2012). *Oil Reporting for the FQD. An Assessment of Effort Needed and Cost to Oil Companies. Publication Code 12.4646.30.* Delft, the Netherlands: CE Delft.

Kasler, D. (2014). *California Low-Carbon Fuel Rule Survives Big Legal Challenge*. Retrieved from: http://www.sacbee.com/2014/06/30/6523178/california-low-carbon-rule-survives.html.

Kellstedt, P.M., Zahran, S., & Vedlitz, A. (2008). Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. *Risk Analysis, 25*(1), 113-126.

Kinnear, P.R., & Gray, C.D. (2004). *SPSS12 Made Simple.* New York: Psychology Press.

Klineberg, S.L., McKeever, M., & Rothenbach, B. (1998). Demographic predictors of environmental concern: It does make a difference how it's measured. *Social Science Quarterly, 79*, 734–753.

Lachapelle, E., Borick, C., & Rabe, B. G. (2014)*. 2013 Canada-US Comparative Climate Opinion Survey.* Montreal: Canada 2020.

Lam, S. P. (2014). Predicting support of climate policies by using a protection motivation model. *Climate Policy*, *14*, 321-338. doi:10.1080/14693062.2014.916599.

Lau, K.Y., & Dowlatabadi, H. (2011). *Lessons from British Columbia's "Carbon Neutral Government" Mandate.* Victoria, BC: Pacific Institute for Climate Solutions.

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change, 77*(1), 45-72. doi:10.1007/s10584-006-9059-9.

Lord, C.G., Ross, L., & Lepper, M.R. (1979). Biased assimilation and attitude polarization: The effects of prior theories on subsequently considered evidence. *Journal of personality and social psychology, 37*(11), 2098-2109.

Lorenzoni, I., Nicholson-Cole, S., & Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change, 17*, 445-459.

Lubell, M., Zahran, S., & Vedlitz, A. (2007). Collective action and citizen response to global warming. *Political Behaviour, 29*, 391-413.

Lyon, T.P., & Yin, H. (2010). Why do states adopt renewable portfolio standards? An Empirical Investigation. *The Energy Journal, 31*(3), 131-155.

Marx, S.M., Weber, E.U., Orlove, B.S., Leiserowitz, A., Krantz, D.H., & Roncoli, C. (2007). Communication and mental processes: Experiential and analytic processing of uncertain climate information. *Global Environmental Change, 17*(1), 47–58.

Matisoff, D., & Edwards, J. (2014). Kindred spirits or intergovernmental competition? The innovation and diffusion of energy policies in the American states (1990 – 2008). *Environmental Politics, 23*(5), 795-517. doi: 10.1080/09644016.2014.923639.

McKinsey & Company. (2009). *Unlocking Energy Efficiency in the U.S. Economy.* Retrieved from: http://www.mckinsey.com/client_service/electric_power_and_natural_gas/latest_thinking/~/media/204463A4D27A419BA8D05A6C280A97DC.ashx.

Menard, S. (2009) *Logistic Regression: From Introductory to Advanced Concepts and Applications*. Thousand Oaks, California: SAGE Publications Inc.

Merriam-Webster Dictionary, 2014. *“Fuel” Definition*. Retrieved from: http://www.merriam-webster.com/dictionary/fuel.

Ministry of the Environment, Sweden. (2008). *Towards a Low Carbon Society.* Retrieved from: http://www.sweden.gov.se/content/1/c6/11/66/69/f7b9ac55.pdf.

Murphy, R., & Jaccard, M. (2011). Energy Efficiency and the Cost of GHG Abatement: A Comparison of Bottom-up and Hybrid Models for the U.S. *Energy Policy, 39*(11), 7146-7155.

Nilsson, A., & Biel, A. (2008). Acceptance of Climate Change Policy measures: Role framing and value guidance. *European Environment*, *18*(4), 203–215. doi:10.1002/eet.477.

Nisbet, M.C., & Scheufele, D.A. (2009). What’s next for science communication? Promising directions and lingering distractions. *American Journal of Botany, 96*(10), 1767-1778.

Nussbaum, M.C. (2001). *Upheavals of Thought: The Intelligence of Emotions.* Cambridge: Cambridge University Press.

O’Brien, R.M. (2007). A Caution regarding rules of thumb for variance inflation factors. *Quality and Quantity, 41*(5), 673-690.

O’Connor, R.E., Bord, R.J., Fisher, A. (1999). Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk Analysis 19*(3), 461–471.

O’Connor, R.E., Bord, R.J., Yarnal, B., & Wiefek, N. (2002) Who wants to reduce greenhouse gas emissions? *Social Science Quarterly, 83*(1), 1–17. doi:10.1111/1540-6237.00067.

Ölander, F., & Thøgersen, J. (1995). Understanding Consumer Behaviour as Prerequisite for Environmental Protection. *Journal of Consumer Policy, 18,* 345-385. doi: 10.1007/BF01024160

Olson, M. (1971). *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.

Olson, M. (1982). *The Rise and Decline of Nations*. New Haven, CT: Yale University Press.

Owen, A. L., Conover, E., Videras, J., &Wu, S. (2012). Heat waves, droughts, and preferences for environmental policy. *Journal of Policy Analysis and Management, 31*, 556–577. doi:10.1002/pam.21599.

Peters, J. (2013). *Cost of the B.C. Carbon Tax.* Personal communication. Vancouver, BC.

Peters, J., & Melton, N. (2013). *Eating Your Greens: Is B.C.'s Carbon Tax Healthy for Households?* Working paper. Vancouver, BC: Navius Research.

Poonpun, P., & Jewell, W.T. (2008). Analysis of the Cost per Kilowatt Hour to Store Electricity. *IEEE Transactions on Energy Conversion, 23*(2), 529-534.

Reynolds, T.W., Bostrom, A., Read, D., & Morgan, M.G. (2010). Now what do people know about global climate change? Survey studies of educated laypeople. *Risk Analysis, 30*(10), 1520-1538.

Rivers, N., & Schaufele, B. (2012). *Carbon Tax Salience and Gasoline Demand.* Working Paper. Ottawa, ON: Graduate School of Public and International Affairs and Institute of the Environment, University of Ottawa.

Rhodes, E., Axsen, J., & Jaccard, M. (2014). Does effective climate policy require well-informed citizen support? *Global Environmental Change, 29*, 92-104. doi:10.1016/j.gloenvcha.2014.09.001.

Rhodes, E., Axsen, J., & Jaccard, M. (2015). Gauging citizen support for a low carbon fuel standard. *Energy Policy*, *79*, 104–114. doi:10.1016/j.enpol.2015.01.019

Rhodes, E., & Jaccard, M. (2013). A tale of two climate policies: political economy of British Columbia's carbon tax and clean electricity standard. *Canadian Public Policy, 39*, S37-51.

Sandler, T. (1996). A Game-Theoretic Analysis of Carbon Emissions. In R.D. Congleton (Ed.), *Political Economy of Environmental Protection: Analysis and Evidence*. Ann Arbor, IL: University of Michigan Press.

Schwartz, S.H., 1992. Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries. *Advances in Experimental Social Psychology, 25*, 1–65. *doi*: 10.1016/S0065-2601(08)60281-6.

Semenza, J.C., Hall, D.E., Wilsond, D.J., Bontempo, B.D., Sailor, D.J., & George, L.A. (2008). Public perception of climate change: Voluntary mitigation and barriers to behavior change. *American Journal of Preventive Medicine, 35*(5): 479–487.

Shwom, R., Bidwell, D., Dan, A., & Dietz, T. (2010). Understanding U.S. public support for domestic climate change policies. *Global Environmental Change, 20*(3), 472-482. doi:10.1016/j.gloenvcha.2010.02.003.

Shwom, R., Dan, A., & Dietz, T. (2008). The effects of information and state of residence on climate change policy preferences. *Climatic Change, 90*, 343–358. doi:10.1007/s10584-008-9428-7.

Statistics Canada. (2011). *Human Activity and the Environment: Economy and the Environment. Catalogue no. 16-201-X.* Ottawa, ON: Statistics Canada.

Stavins, R. (2001). Experience with Market-Based Environmental Policy Instruments. In K.G. Maler & J. Vincent (Eds.), T*he Handbook of Environmental Economics.* Amsterdam: North-Holland/Elsevier Science.

Simpson, J., Rivers N, & Jaccard M. (2007). *Hot Air. Meeting Canada's Climate Change Challenge.* Toronto, ON: McClelland & Stewart.

Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: testing VBN theory. *Journal of Environmental Psychology, 25*, 415–425. doi:10.1016/j.jenvp.2005.08.003.

Stern, P.C. (2000). New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3), 407-424. doi: 10.1111/0022-4537.00175

Stern, P., Dietz, T., Abel, T., Guagnano, G., & Kalof, L., (1999). A Value-Belief Norm theory of support for social movements: The case of environmental concern. *Human Ecology Review, 6*, 81-97. doi:10.1.1.195.5410.

Stern, P.C., Dietz, T., & Guagnano, G.A. (1998). A Brief Inventory of Values. *Educational and Psychological Measurement, 58,* 984-1001.

Stern, P. C., Dietz, T., & Kalof, L. (1993). Value orientations, gender, and environmental concern. *Environment and Behavior, 25*, 322–348.

Stoutenborough, J.W, Vedlitz, A. (2014). The effect of perceived and assessed knowledge of climate change on public policy concerns: An empirical comparison. *Environmental Science and Policy, 37*, 23-33.

Sumner, J., Bird, L., & Smith, H. (2009). *Carbon Taxes: A Review of Experience and Policy Design Considerations.* National Renewable Energy Laboratory, Technical Report. NREL/TP-6A2-47312.

Thaler, R.H., & Sustein, C.R. (2008). *Nudge: Improving Decisions about Health, Wealth, and Happiness.* Michigan, IL: Caravan Books.

Thompson, M., Ellis, R., & Wildavsky, A. (1990). *Cultural Theory*. Oxford: West View.

Tobler, C., Visschers, V. H. M., & Siegrist, M. (2012). Addressing climate change: Determinants of consumers' willingness to act and to support policy measures. *Journal of Environmental Psychology*, *32*(3), 197–207. doi:10.1016/j.jenvp.2012.02.001.

Triandis, H. (1977). *Interpersonal Behaviour.* Monterey, CA: Brooks/Cole.

U.S. Energy Information Administration. (2012). *Most States Have Renewable Portfolio Standards.* Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=4850.

Vancouver Island Energy Corporation. (2003). *Application to the B.C. Utilities Commission for a Certificate of Public Convenience and Necessity for the Vancouver Island Generation Project*. Burnaby, BC: Vancouver Island Energy Corporation.

Yeh, S., & Sperling, D. (2013). Low carbon fuel policy and analysis. *Energy Policy, 56*, 1–4.

Yeh, S., Sperling, D., Griffin, M., Khanna, M., Leiby, P., Msangi, S., Rhodes, J., & Rubin, J.D. (2012). *National Low Carbon Fuel Standard: Policy Design Recommendations. Research Report UCD-ITS-RR-12-10.* Davis, CA: UC Davis Institute of Transportation Studies.

Yeh, S., Witcover, J., & Kessler, J. (2013). *Status Review of California's Low Carbon Fuel Standard. Research Report UCD-ITS-RR-13-06.* Davis, CA: UC Davis Institute of Transportation Studies.

Zahran, S., Brody, S.D., Grover, H., & Vedlitz, A. (2006), Climate change vulnerability and policy support. *Society and Natural Resources, 19*(9), 771-789.

Zaller, J.R. (1992). *The Nature and Origins of Mass Opinion*. Cambridge, UK: Cambridge University Press.

Zaller, J.R., & Feldman, S. (1992). A simple theory of survey response: Answering questions versus preferences. *American Journal of Political Science, 36*, 579–616.

# Appendix.

# Global Issues Survey Questionnaire

## Section 1: Global environmental issues

1.1. What is your primary province of residence?

- Alberta
- British Columbia
- Manitoba
- New Brunswick
- Newfoundland
- Nova Scotia
- Ontario
- Price Edward Island
- Quebec
- Saskatchewan
- Northwest Territories
- Nunavut
- Yukon

1.2. All things considered, how worried are you about the future of our planet (on a scale of 0 to 10, where 0 is "not worried at all" and 10 is "extremely worried")?

| Not worried at all | | | | | | | | | | Extremely worried |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

1.3. How familiar are you with climate change or global warming?

- ○ Never heard of it
- ○ Heard of it, but know nothing about it
- ○ Somewhat familiar (I talk / read about it sometimes)
- ○ Very familiar (I study this / work in this area / talk about it regularly)

1.4. Regardless of whether you know much about climate change / global warming, to what extent do you agree or disagree with the following statements (please select "I don't understand" if you are not familiar with any issues or do not understand them).

| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree | I don't understand |
|---|---|---|---|---|---|---|
| 1) Carbon dioxide is a greenhouse gas | ○ | ○ | ○ | ○ | ○ | ○ |
| 2) Climate change / global warming is caused by excessive amounts of greenhouse gases | ○ | ○ | ○ | ○ | ○ | ○ |
| 3) The major cause of increasing atmospheric concentrations of greenhouse gases is burning of fossil fuels (such as gasoline) | ○ | ○ | ○ | ○ | ○ | ○ |
| 4) Climate change / global warming may lead to weather extremes, such as temperature increases, flooding, sea level rise, and extreme storms | ○ | ○ | ○ | ○ | ○ | ○ |
| 5) Climate change / global warming has been established as a serious problem for society and immediate action is | ○ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | |
|---|---|---|---|---|---|---|
| necessary | | | | | | |
| 6) Scientists do not know enough about climate change / global warming and more research is necessary before we take action | ○ | ○ | ○ | ○ | ○ | ○ |
| 7) Energy savings help reduce climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 8) More species will be lost in my province due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 9) More species will be lost in the world due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 10) Health problems in my province will increase due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 11) Health problems in the world will increase due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 12) The economy in my province will suffer due to climate change /global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 13) The world economy will suffer due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 14) The standard of living of many people in my province will decrease due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |
| 15) The standard of living of many people in the world will decrease due to climate change / global warming | ○ | ○ | ○ | ○ | ○ | ○ |

## Section 2: Climate actions in British Columbia

In this section, we would like to learn about your familiarity with climate policies in British Columbia and to know your opinion about them. By “climate policies” we mean any government actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change / global warming.

It is totally acceptable to not know the answers to any of the following questions and to answer “I don’t know.” Please feel free to be honest as these questions are anonymous.

2.1. Could you please list any climate policies that you think are currently implemented in British Columbia?

2.2. Please see below the list of potential climate policies and their brief definitions. By “climate policies” we mean any government actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change / global warming.

- Carbon tax – a tax on greenhouse gas emissions, such as carbon pollution from burning gasoline (government may commit to return all tax revenues as other tax cuts — called a revenue-neutral carbon tax).

- Cleaner fuel regulation – a requirement that fuels have lower carbon emissions (also sometimes called a low carbon fuel standard).

- Energy efficiency regulation – a requirement that new buildings, appliances, and/or equipment are more energy efficient.

- Clean electricity regulation (renewable portfolio standard) – a requirement that a certain percentage of new electricity is generated from zero-emission sources, such as hydro, solar, or wind.

- Emissions cap – emission permits that add up to a cap are allocated to businesses; the cap is reduced over time. If permit trading is allowed, this is called cap-and-trade.

- Carbon offsets – getting credit for emissions reduction by paying someone else to reduce emissions (for example, renewable energy offsets and forest carbon offsets).

- Carbon neutral government – government uses tax dollars to purchase carbon offsets that exactly equal public sector emissions (for example, from operation of provincial and local governments, schools, and hospitals) or reduces its actual emissions where possible.

- Subsidy – a grant, rebate, low-interest loan or other financial benefit given for actions that reduce emissions, such as buying an energy efficient device.

- Information and education – information that might induce individuals and businesses to voluntarily acquire technologies or change behaviour to reduce emissions (for example, information on the advantages of home retrofits and public transit).

- Government procurement – government directly invests in projects that reduce emissions, for example, investments in public transportation and building bike lanes.

Based on these definitions and your own knowledge, please indicate if each of the following climate policies listed in the table below is currently in place in British Columbia (BC)? For each policy, please choose one of the following answers:

- I know that this policy is in place in BC, or

- I know that this policy is NOT in place in BC, or

- I don't know about this policy.

Please feel free to be honest and answer "I don't know" as this question is anonymous.

| | I know that this policy is in place in BC | I know that this policy is NOT in place in BC | I don't know about this policy |
|---|---|---|---|
| 1) Energy efficiency regulations for lighting, heating, and cooling systems in buildings | ○ | ○ | ○ |
| 2) A cap on provincial emissions (businesses could trade emission permits that sum to the cap) | ○ | ○ | ○ |
| 3) Energy efficiency regulation for public transportation fleet, such as buses and trains | ○ | ○ | ○ |
| 4) Carbon offsets for converting methane gas (from landfills and manure) into electricity | ○ | ○ | ○ |
| 5) Carbon tax | ○ | ○ | ○ |
| 6) Subsidies to help | ○ | ○ | ○ |

| | | | |
|---|---|---|---|
| power producers (such as BC Hydro) capture carbon emissions from coal-fired or natural gas-fired power plants and store them underground (known as carbon capture and storage) | | | |
| 7) Carbon offsets for electricity generation from clean sources, such as hydro, solar, or wind | ○ | ○ | ○ |
| 8) Education programs on energy efficiency for residential landlords | ○ | ○ | ○ |
| 9) Cleaner fuel regulation (or low carbon fuel standard) | ○ | ○ | ○ |
| 10) Clean electricity regulation (or renewable portfolio standard) | ○ | ○ | ○ |
| 11) A cap on emissions from the electricity sector | ○ | ○ | ○ |
| 12) Carbon neutral government | ○ | ○ | ○ |
| 13) Government investment in the BC clean energy fund | ○ | ○ | ○ |
| 14) A cap on emissions from fuels exported from BC | ○ | ○ | ○ |

2.3. The table below includes a list of climate policies that are currently in place in British Columbia (their common definitions are provided below the table).

Please indicate to what extent you consider these policies effective in terms of expected greenhouse gas emissions reductions in the period from 2008 to 2020? By "very effective" we mean policies that reduce the most greenhouse gas emissions in BC over the time period from 2008 to 2020. Please feel free to select "I don't know" if you are not familiar with any policies or do not understand them as your answers are anonymous.

| | Not effective at all | Not effective | Somewhat effective | Effective | Very effective | I don't know |
|---|---|---|---|---|---|---|
| 1) Energy efficiency regulations for lighting, heating, and cooling systems in buildings | ○ | ○ | ○ | ○ | ○ | ○ |
| 2) Carbon tax | ○ | ○ | ○ | ○ | ○ | ○ |
| 3) Cleaner fuel regulation (or low carbon fuel standard) | ○ | ○ | ○ | ○ | ○ | ○ |
| 4) Clean electricity regulation (or renewable portfolio standard) | ○ | ○ | ○ | ○ | ○ | ○ |
| 5) Carbon neutral government | ○ | ○ | ○ | ○ | ○ | ○ |

*Note:* Climate policies are any government actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change / global warming.

- Energy efficiency regulation – a requirement that new buildings, appliances, and equipment are more energy efficient.

- Carbon tax – a tax on greenhouse gas emissions, such as carbon pollution from burning gasoline (government may commit to return all tax revenues as other tax cuts — called a revenue-neutral carbon tax).

- Cleaner fuel regulation – a requirement that fuels have lower carbon emissions (also sometimes called a low carbon fuel standard).

- Clean electricity regulation (renewable portfolio standard) – a requirement that a certain percentage of new electricity is generated from zero-emission sources, such as hydro, solar, or wind.

- Carbon neutral government – government uses tax dollars to purchase carbon offsets that exactly equal public sector emissions (for example, from operation of provincial and local governments, schools, and hospitals) or reduces its actual emissions where possible. Carbon offsets achieve emissions reductions by paying someone else (in this case, the private sector) to reduce their emissions.

2.4. The table below includes a list of climate policies that are currently in place in British Columbia (their common definitions are provided below the table).

If there were a referendum on maintaining these policies in BC, how much would you support or oppose these policies?

| | Strongly oppose | Somewhat oppose | Somewhat support | Strongly support |
|---|---|---|---|---|
| 1) Energy efficiency regulations for lighting, heating, and cooling systems in buildings | ○ | ○ | ○ | ○ |
| 2) Carbon tax | ○ | ○ | ○ | ○ |
| 3) Cleaner fuel regulation (or low carbon fuel standard) | ○ | ○ | ○ | ○ |
| 4) Clean electricity regulation (or renewable portfolio standard) | ○ | ○ | ○ | ○ |
| 5) Carbon neutral government | ○ | ○ | ○ | ○ |

*Note:* Climate policies are any government actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change / global warming.

- Energy efficiency regulation – a requirement that new buildings, appliances, and equipment are more energy efficient.
- Carbon tax – a tax on greenhouse gas emissions, such as carbon pollution from burning gasoline (government may commit to return all tax revenues as other tax cuts – called a revenue-neutral carbon tax).
- Cleaner fuel regulation – a requirement that fuels have lower carbon emissions(also sometimes called a low carbon fuel standard).
- Clean electricity regulation (renewable portfolio standard) - a requirement that a certain percentage of new electricity is generated from zero-emission sources, such as hydro, solar, or wind.
- Carbon neutral government – government uses tax dollars to purchase carbon offsets that exactly equal public sector emissions (for example, from operation of provincial and local governments, schools, and hospitals) or reduces its actual emissions where possible. Carbon offsets achieve emissions reductions by paying someone else (in this case, the private sector) to reduce their emissions.

2.5. In 2008, British Columbia (BC) established a target to reduce greenhouse gas emissions (such as carbon dioxide from burning gasoline) by 33% by 2020 below the emissions level of 2007. This means that BC needs to reduce its annual emissions by about 34 million tonnes by 2020. Please see below the list of climate policies that are currently implemented in BC, and their expected contribution to the achievement of the established emissions reductions target of 34 million tonnes.

| Climate policies currently in place in BC | Each policy's expected contribution to the achievement of BC's emissions reductions target of 34 million tonnes |
|---|---|
| 1) Energy efficiency regulations for lighting, heating, and cooling systems in buildings | 7% |
| 2) Carbon tax | 10% |
| 3) Cleaner fuel regulation (or low carbon fuel standard) | 2% |
| 4) Clean electricity regulation (or renewable portfolio standard) | 40% |
| 5) Carbon neutral government | 0-3% |

Based on the information provided, how much would you support or oppose these policies if there were a referendum on maintaining them in BC?

| | Strongly oppose | Somewhat oppose | Somewhat support | Strongly support |
|---|---|---|---|---|
| 1) Energy efficiency regulations for lighting, heating, and cooling systems in buildings | ○ | ○ | ○ | ○ |
| 2) Carbon tax | ○ | ○ | ○ | ○ |
| 3) Cleaner fuel regulation (or low carbon fuel standard) | ○ | ○ | ○ | ○ |
| 4) Clean electricity regulation (or renewable portfolio standard) | ○ | ○ | ○ | ○ |
| 5) Carbon neutral government | ○ | ○ | ○ | ○ |

*Note:* Climate policies are any government actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change (global warming).

- Energy efficiency regulation – a requirement that new buildings, appliances, and equipment are more energy efficient.

- Carbon tax – a tax on greenhouse gas emissions, such as carbon pollution from burning gasoline (government may commit to return all tax revenues as other tax cuts — called a revenue-neutral carbon tax).

- Cleaner fuel regulation – a requirement that fuels have lower carbon emissions (also sometimes called a low carbon fuel standard).

- Clean electricity regulation (renewable portfolio standard) – a requirement that a certain percentage of new electricity is generated from zero-emission sources, such as hydro, solar, or wind.

- Carbon neutral government – government uses tax dollars to purchase carbon offsets that exactly equal public sector emissions (for example, from operation of provincial and local governments, schools, and hospitals) or reduces its actual emissions where possible. Carbon offsets achieve emissions reductions by paying someone else (in this case, the private sector) to reduce their emissions.

## Section 3: Actions to reduce global warming

Governments often consider different climate policies - actions that are meant to reduce greenhouse gas emissions, such as carbon emissions from burning gasoline. The goal of such policies is to reduce climate change / global warming. We would like to know if you would support or oppose a referendum on such policies in Canada.

[For BC respondents only] In the previous section, we asked you similar questions in relation to climate policies that **are** currently implemented in British Columbia. We would now like to know your opinion about various climate policies that **could** be implemented not only in British Columbia, but also in other provinces or Canada as a whole.

3.1. How much would you support or oppose a tax on greenhouse gas emissions, such as carbon emissions from burning gasoline? The tax will apply to all individuals and businesses contributing to climate change / global warming.

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.2. How much would you support or oppose a tax on greenhouse gas emissions, such as carbon emissions from burning gasoline, *even if it cost about $10 per* *household per month*? The tax will apply to all individuals and business contributing to climate change / global warming.

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.3. How much would you support or oppose electricity regulations that require electric utilities to generate at least 50% of new electricity from clean sources, such as hydro, solar, or wind?

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.4. How much would you support or oppose electricity regulations that require electric utilities to generate at least 50% of new electricity from clean sources, such as hydro, solar, wind. *This program would raise the price of electricity, adding about $20 per month to the typical electric bill.*

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.5. How much would you support or oppose providing subsidies (such as tax rebates) to households / businesses that purchase energy efficient appliances / equipment, fuel efficient vehicles, or use solar and wind energy?

- Strongly oppose

- Somewhat oppose
- Somewhat support
- Strongly support

3.6. How much would you support or oppose providing subsidies (such as tax rebates) to households / businesses that purchase energy efficient appliances / equipment, fuel efficient vehicles, or use solar and wind energy? *Providing these subsidies would increase the average family's income tax bill by about $10 per month.*

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.7. How much would you support or oppose regulations that require new buildings, appliances, and equipment to be more energy efficient?

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.8. How much would you support or oppose regulations that require vehicles to be 30% more fuel efficient by the year 2020?

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.9. How much would you support or oppose regulations that require fuels to have lower carbon emissions by 20% by the year 2020?

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.10. How much would you support or oppose setting an emissions limit (cap) for businesses and allocating emissions permits to them (emission permits add up to the cap). If permit trading is allowed, this is called cap-and-trade.

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.11. How much would you support or oppose educating citizens about climate change / global warming and actions to reduce it?

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

3.12. How much would you support or oppose the government funding more research into clean energy sources, such as hydro, solar, or wind?

- Strongly oppose
- Somewhat oppose
- Somewhat support

- Strongly support

3.13. How much would you support or oppose the government's proposal to build a pipeline across northern British Columbia to connect Alberta's oil resources to foreign markets?

- Strongly oppose
- Somewhat oppose
- Somewhat support
- Strongly support

## Section 4: Your values and activities

4.1. Please rate the importance of each of the following values in your life.

| | Not important at all | Not important | Moderately important | Important | Extremely important |
|---|---|---|---|---|---|
| 1) Respecting the earth (living in harmony with other species) | ○ | ○ | ○ | ○ | ○ |
| 2) Unity with nature (fitting into nature) | ○ | ○ | ○ | ○ | ○ |
| 3) Environmental protection (preserving nature) | ○ | ○ | ○ | ○ | ○ |
| 4) Pollution prevention | ○ | ○ | ○ | ○ | ○ |
| 5) Social justice (correcting injustice, care for the weak) | ○ | ○ | ○ | ○ | ○ |
| 6) Equality (equal opportunities for all) | ○ | ○ | ○ | ○ | ○ |
| 7) Helping others (working for the welfare of others) | ○ | ○ | ○ | ○ | ○ |
| 8) A world of peace (free of war and conflict) | ○ | ○ | ○ | ○ | ○ |
| 9) Authority (the right to lead and command) | ○ | ○ | ○ | ○ | ○ |
| 10) Social power (control over others, dominance) | ○ | ○ | ○ | ○ | ○ |
| 11) Influence (having an impact on people and events) | ○ | ○ | ○ | ○ | ○ |
| 12) Wealth (material possessions, money) | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| 13) A varied life, filled with challenge, novelty, and change | ○ | ○ | ○ | ○ | ○ |
| 14) An exciting life, stimulating experiences | ○ | ○ | ○ | ○ | ○ |
| 15) Curiosity, many interests, desire to explore | ○ | ○ | ○ | ○ | ○ |

4.2. Please indicate to what extent you agree or disagree with the following statements about natural environments.

| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|
| 1) The so-called "ecological crises" facing humankind has been greatly exaggerated | ○ | ○ | ○ | ○ | ○ |
| 2) If things continue on their present course, we will soon experience a major ecological catastrophe | ○ | ○ | ○ | ○ | ○ |
| 3) Humans have the right to modify the natural environment to suit their needs | ○ | ○ | ○ | ○ | ○ |
| 4) Plants and animals have as much right as humans to exist | ○ | ○ | ○ | ○ | ○ |
| 5) Humans are severely abusing the environment | ○ | ○ | ○ | ○ | ○ |
| 6) When humans interfere with nature, it often produces disastrous consequences | ○ | ○ | ○ | ○ | ○ |
| 7) The balance of nature is very delicate and easily upset | ○ | ○ | ○ | ○ | ○ |
| 8) The earth is like a spaceship with limited room and resources | ○ | ○ | ○ | ○ | ○ |

4.3. In assessing the climate change / global warming issue and associated solutions, please indicate your level of trust in each of the following organizations. Please select "I don't know" if you are not familiar with any entities or not sure about your level of trust in them.

| | Very low | Low | Medium | High | Very high | I don't know |
|---|---|---|---|---|---|---|
| 1) Environment Canada (federal environmental agencies) | ○ | ○ | ○ | ○ | ○ | ○ |
| 2) Ministry of Environment in my province / territory (provincial environmental | ○ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | |
|---|---|---|---|---|---|---|
| agency) | | | | | | |
| 3) Scientists employed by government | ○ | ○ | ○ | ○ | ○ | ○ |
| 4) Oil and gas companies | ○ | ○ | ○ | ○ | ○ | ○ |
| 5) Renewable (clean) energy companies | ○ | ○ | ○ | ○ | ○ | ○ |
| 6) Scientists employed by industry | ○ | ○ | ○ | ○ | ○ | ○ |
| 7) Non-profit environmental groups, such as David Suzuki Foundation, Greenpeace, and the Pembina Institute | ○ | ○ | ○ | ○ | ○ | ○ |
| 8) Scientists employed by environmental groups | ○ | ○ | ○ | ○ | ○ | ○ |
| 9) Scientists working for the IPCC (International Panel on Climate Change) | ○ | ○ | ○ | ○ | ○ | ○ |
| 10) Academic journals and magazines | ○ | ○ | ○ | ○ | ○ | ○ |
| 11) Scientists employed by universities | ○ | ○ | ○ | ○ | ○ | ○ |
| 12) Mass media (non-academic journals, magazines, newspapers) | ○ | ○ | ○ | ○ | ○ | ○ |

4.4. Please indicate the frequency with which you engage in each of the following activities (please think of how you spend your waking hours in a given month).

| | Never | Rarely | Sometimes | Often | Very often |
|---|---|---|---|---|---|
| 1) I talk with family about climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 2) I talk with family about energy efficient or green technologies (such as energy efficient fridges, hybrid cars) | ○ | ○ | ○ | ○ | ○ |
| 3) I talk to friends about climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 4) I talk to friends about energy efficient or green technologies (such as energy efficient fridges, hybrid cars) | ○ | ○ | ○ | ○ | ○ |
| 5) People ask for my opinion on climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 6) People offer me their opinions on climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 7) I participate in environmental meetings, public lectures, or other events organized by | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| environmental groups | | | | | |
| 8) I participate in environmental campaigns or civil disobedience events | ○ | ○ | ○ | ○ | ○ |
| 9) I follow the news and most recent events on climate change / global warming | ○ | ○ | ○ | ○ | ○ |

4.5. Regardless of whether you know much about the economy and the government, please indicate to what extent you agree or disagree with the following statements.

| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|
| 1) The best government is the one that governs the least | ○ | ○ | ○ | ○ | ○ |
| 2) Decisions about development are best left to the economic market | ○ | ○ | ○ | ○ | ○ |
| 3) Most environmental problems can be solved by applying more and better technology | ○ | ○ | ○ | ○ | ○ |
| 4) Plants and animals exist primarily to be used by humans | ○ | ○ | ○ | ○ | ○ |
| 5) If carbon emissions are not reduced, costs of environmental catastrophes and adaptation could be significant | ○ | ○ | ○ | ○ | ○ |
| 6) Market-based programs, such as carbon taxes on burning gasoline, are inexpensive to society | ○ | ○ | ○ | ○ | ○ |
| 7) Regulations, such as energy efficiency requirements, are inexpensive to society | ○ | ○ | ○ | ○ | ○ |
| 8) Market-based programs, such as carbon taxes on burning gasoline, can reduce costs of adaptation and environmental catastrophes that would occur without these programs | ○ | ○ | ○ | ○ | ○ |
| 9) Regulations, such as energy efficiency requirements, can reduce costs of adaptation and environmental catastrophes that would occur without them | ○ | ○ | ○ | ○ | ○ |
| 10) Energy efficient technologies could reduce energy costs and result in savings | ○ | ○ | ○ | ○ | ○ |
| 11) Energy efficient technologies | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| are affordable | | | | | |
| 12) Government programs to reduce climate change / global warming could help to make energy efficient technologies more affordable | ○ | ○ | ○ | ○ | ○ |
| 13) Government programs to reduce climate change / global warming could create more jobs in green sectors, such as solar and wind energy generation | ○ | ○ | ○ | ○ | ○ |
| 14) The government of Canada takes adequate actions to reduce climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 15) The government in my province takes adequate actions to reduce climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 16) The government of Canada is sensitive to citizen pressures on environmental issues | ○ | ○ | ○ | ○ | ○ |
| 17) The government in my province is sensitive to citizen pressures on environmental issues | ○ | ○ | ○ | ○ | ○ |
| 18) The government of Canada is sensitive to pressures of environmental groups | ○ | ○ | ○ | ○ | ○ |
| 19) The government in my province is sensitive to pressures of environmental groups | ○ | ○ | ○ | ○ | ○ |
| 20) The government of Canada is sensitive to pressures of the fossil fuel (oil and gas) industry | ○ | ○ | ○ | ○ | ○ |
| 21) The government in my province is sensitive to pressures of the fossil fuel (oil and gas) industry | ○ | ○ | ○ | ○ | ○ |

4.6. If it is required to pay extra money each year to reduce climate change / global warming, how much would you be willing to pay?

- ○ $0 each year
- ○ $1-49 each year
- ○ $50-99 each year
- ○ $100-249 each year
- ○ $250-499 each year

- More than $500 each year

4.7. Please indicate to what extent you agree or disagree with the following statements about human responsibility for environmental problems:

| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|
| 1) I am jointly responsible for the environmental problems | ○ | ○ | ○ | ○ | ○ |
| 2) I feel jointly responsible for climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 3) My contribution to climate change / global warming is negligible | ○ | ○ | ○ | ○ | ○ |
| 4) Not only the government and industry are responsible for high carbon emissions and climate change / global warming, but I am too | ○ | ○ | ○ | ○ | ○ |
| 5) In principle, individuals on their own cannot contribute to the reduction of climate change / global warming | ○ | ○ | ○ | ○ | ○ |

4.8. Please indicate to what extent you agree or disagree with the following statements:

| | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|
| 1) I feel personally obliged to reduce my carbon emissions (for example, emissions from burning gasoline) as much as possible | ○ | ○ | ○ | ○ | ○ |
| 2) I feel personally obliged to reduce carbon emissions (for example, emissions from burning gasoline), regardless of what others think and do | ○ | ○ | ○ | ○ | ○ |
| 3) I feel guilty when I use fossil fuels in my daily life (for example, when I drive or heat my house with oil) | ○ | ○ | ○ | ○ | ○ |
| 4) I feel morally obliged to use green electricity (such as from wind and solar) instead of regular electricity (such as from coal) | ○ | ○ | ○ | ○ | ○ |
| 5) People like me should do everything they can to reduce their carbon emissions (for example, emissions from burning | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| gasoline) | | | | | |
| 6) If I would buy a new washing machine, I would feel morally obliged to buy an energy efficient one | ○ | ○ | ○ | ○ | ○ |
| 7) I would be a better person if I reduced my carbon emissions (for example, emissions from burning gasoline) | ○ | ○ | ○ | ○ | ○ |
| 8) I worry that the next generation will feel we did not do enough to prevent climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 9) There is no urgent need to take measures to prevent climate change / global warming today | ○ | ○ | ○ | ○ | ○ |
| 10) I consider how things might be in the future and try to influence those things with my day-to-day behaviour | ○ | ○ | ○ | ○ | ○ |
| 11) I think it is important to take warnings about negative outcomes seriously even if the negative outcome will not occur for many years | ○ | ○ | ○ | ○ | ○ |
| 12) I am willing to sacrifice my immediate happiness or well-being in order to achieve future outcomes | ○ | ○ | ○ | ○ | ○ |
| 13) My own actions will help reduce climate change / global warming | ○ | ○ | ○ | ○ | ○ |
| 14) My own actions will encourage others to reduce climate change / global warming | ○ | ○ | ○ | ○ | ○ |

## Section 5: Socio-demographic details

The information in this section will be used only for descriptive / statistical purposes.

5.1. Could you please indicate your age group?

- ○ 19 to 24 years
- ○ 25 to 34 years

- 35 to 44 years
- 45 to 54 years
- 55 to 64 years
- 65 years and over

5.2. Could you please indicate your gender?

- male
- female

5.3. Could you please indicate the highest level of education you have completed?

- No certificate, diploma or degree
- High school certificate or equivalent
- Apprenticeship or trades certificate or diploma
- College, CEGEP or other non-university certificate or diploma
- University certificate or diploma below bachelor level
- Bachelor’s degree
- University certificate or diploma above bachelor level
- Degree in medicine, dentistry, veterinary medicine or optometry
- Master’s degree
- Doctorate or PhD degree

5.4. Could you please indicate your approximate annual household income?

- Without income
- Under $5,000
- $5,000 to $9,999

- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 and over
- I prefer not to answer

5.5. Could you please indicate your work status?

- Employed or self-employed
- Unemployed
- Not in the labour force (students, homemakers, retired workers, seasons workers in an 'off' season who were not looking for work, and persons who could not work because of a long-term illness or disability)

5.6. Could you please indicate which of the following industries best describes your employment sector?

- Agriculture, forestry, fishing and hunting
- Mining and oil and gas extraction
- Utilities
- Construction
- Manufacturing
- Wholesale trade
- Retail trade
- Transportation and warehousing

- Information and cultural industries
- Finance and insurance
- Real estate and rental and leasing
- Professional, scientific and technical services
- Management of companies and enterprises
- Administrative and support, waste management and remediation services
- Educational services
- Health care and social assistance
- Arts, entertainment and recreation
- Accommodation and food services
- Public administration
- Other occupations

5.7. Could you please indicate the length of your total daily commute to work / school?

- Less than 30 minutes
- 30 minutes to less than an hour
- An hour to two hours
- More than two hours
- Not applicable (I don't commute to work / school)

5.8. Could you please indicate your primary mode of transportation to commute to work / school?

- Drive myself
- Carpool
- Public transit

- Bicycle
- Walk
- Taxi
- Other
- Not applicable (I don't commute to work / school)

5.9. Which of the following categories best describes the area where you live in?

- Urban (city centre with dense housing)
- Suburban (just outside a city, with more spread out housing)
- Rural (far away from a city, with very spread out housing)

5.10. Could you please indicate the size of your home?

- 0 to 1 bedrooms
- 2 to 3 bedrooms
- 4 or more bedrooms

5.11. How would you describe your home?

- Detached house
- Attached house (townhouse, duplex, triplex, etc.)
- Apartment
- Mobile home
- Other

5.12. How many people live in your household (including yourself)?

- Only myself
- 2 people

- 3 to 4 people
- 5 or more people

5.13. How many vehicles does your household currently own or lease that are driven regularly? By “vehicles” we mean cars, trucks, vans, minivans, sport utility vehicles - any of the sort of motor vehicles a household normally uses for day to day travel. Please do not include motorcycles, recreational vehicles, motor homes, or non-motorized vehicles (such as bicycles).

- None
- 1
- 2
- 3
- 4 or more

5.14. Are you associated with, or do you support, any of the following federal political parties?

- Conservative Party
- Liberal Party
- New Democratic Party
- Bloc Quebeqois
- Green Party
- Other
- No / Undecided

5.15. How often do you vote in elections?

- Never
- Sometimes

- Most of the time
- Always