Public perceptions of Carbon Capture and Storage technology in Alberta: Applying an integrative framework

by

Karen Leila Mascarenhas

B.A. (Mathematical Economic Analysis), Rice University, 2004

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Name:	**Karen Mascarenhas**
Degree:	**Master of Resource and Environmental Management**
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Examining Committee:	**Chair:** Lejla Uzicanin Master's Candidate, REM

Dr. Jonn Axsen
Senior Supervisor
Assistant Professor

Dr. Mark Jaccard
Supervisor
Professor

Jacqueline Sharp (M.R.M)
Supervisor
Managing Partner
Navius Research

Date Defended: October 3, 2014

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Abstract

Carbon capture and storage (CCS) has emerged as a technological option for meeting greenhouse gas emissions reduction targets in the Canadian province of Alberta. Public support is likely to affect the feasibility of widespread implementation of CCS projects. This study explores citizens' perceptions of CCS, including knowledge, and stated support, and develops a method to characterize their attitudes towards CCS using a framework that includes psychological perceptions, values, environmental concerns, and socio-demographic variables. A web-based survey was conducted with a representative sample of Alberta citizens (n=1076) in 2013. The data suggest that respondents' knowledge of CCS has increased over the last decade, though climate change knowledge remains limited. The majority (53%) of respondents support the use of CCS, and 85% consider CCS at least "somewhat important" for inclusion in the province's emissions-reduction strategy. A minority of respondents (18%) are opposed to CCS. Regression analysis reveals that respondent support for CCS is associated with perceptions of outcome efficacy (belief that CCS is a useful climate change mitigation strategy), trust in the regulator and industry, and distributive fairness. Respondent support is also associated with beliefs of several benefits of CCS implementation, including the ability to balance economic development with emissions reductions, the continued ability to use fossil fuels, and the potential to export CCS technology to other countries in the future. On the other hand, respondent opposition to CCS is associated with perceptions of risk, including concern about potential groundwater contamination and that CCS would potentially displace investments in renewable energy. These empirical insights suggest that CCS outreach and engagement efforts could be enhanced by carefully considering citizen perceptions.

Keywords: Carbon Capture and Storage; Carbon Dioxide Mitigation; Climate Change Policy; Climate Change Technology; Carbon sequestration

To my dad who always inspires me to look ahead and to never give up the lifelong pursuit of knowledge and excellence.

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List of Acronyms

AB	Alberta
CC	Climate change
CCS	Carbon Capture and Storage
CO_2	Carbon Dioxide
EOR	Enhanced Oil Recovery
GHG	Greenhouse Gas
ICO2N	Integrated CO_2 Network
Mt	Megatonnes
NGO	Non-Governmental Organization
SPEED	Socio-political evaluation of energy deployment
TAF	Technology Acceptance Framework

Chapter 1.

Introduction and Background

Carbon Capture and Storage (CCS) has emerged as a technology that could help to reduce climate change and ultimately meet greenhouse gas (GHG) emissions targets in Canada. During the process of CCS, carbon dioxide (CO_2) is captured from large point sources such as fossil fuel power plants and compressed. The CO_2 is then transported to storage facilities, thereby preventing it from entering the atmosphere.

Both the federal government of Canada and the Alberta government have committed to meeting GHG emissions reduction targets by the year 2020. In July 2008, the Alberta Government announced a $2 billion initiative to reduce GHG emissions by implementing new CCS projects. The federal government of Canada has also committed over $800 million to support CCS demonstration projects through Canada's Economic Action plan (Government of Canada, 2011). This significant investment highlights both governments' commitment to incorporate CCS as a component of federal and provincial climate change strategies. In the longer term, Alberta has committed to reducing its emissions by 200 million metric tonnes by 2050 (emissions reduction of 14% below 2005 levels) and expects 70% of this reduction to be achieved as a direct result of CCS initiatives (Government of Alberta, 2008).

As with many novel large-scale energy projects, public support or opposition can influence whether or not a CCS project gains approval. Public opposition has already derailed the funding and implementation of CCS projects in some countries. For example, the Barendrecht Project in the Netherlands had originally received approval by the Dutch government and was eligible for government funding provided that the project obtained the necessary permits and industry investment (Terwel et al., 2012). However, in November 2010 the government cancelled the project, largely due to local opposition resulting from negative attitudes towards CO_2 storage in the area. Since then, the Dutch

Government has completely rejected on-shore CO_2 storage as an option for reducing CO_2 in the Netherlands (Markusson et al., 2012). This example illustrates that public support is likely necessary for the successful implementation of CCS projects, and ought to be carefully researched and addressed in Alberta if the Provincial Government seriously intends to deploy CCS on a large scale.

My study is designed to (1) assess Alberta citizens' knowledge of CCS and changes in knowledge over the last decade;(2) characterize citizen perceptions, attitudes and behavioral responses regarding CCS technology development and implementation in Alberta; and (3) explore the individual factors associated with support of or opposition to CCS in Alberta, and determine if any regional differences exist.

My study incorporates insights from existing research to create a framework for CCS acceptance in Alberta. Consequently, I employ and build upon the technology acceptance framework (described in Section 1.3), which considers several psychological factors that can influence citizens' perceptions and attitudes towards CCS projects (Huijts et al., 2012). Understanding which key factors are associated with CCS attitudes can help to improve the design and implementation of CCS technology and communication about CCS with the public. The results of my study could provide guidance on how to inform future CCS design and public engagement efforts throughout Canada and could inform future studies about CCS both in Canada and internationally.

This paper is divided into four sections. Chapter One provides background information on citizen acceptance and the conceptual framework used to guide the study. Chapter Two describes the details of the Alberta survey sample and study methodology. Chapter Three explains the results of the survey and the results of the statistical analysis of the Alberta survey data. Chapter Four discusses the results, the study limitations, and presents suggestions for future research. Chapter Five provides recommendations for future CCS policymaking and concludes the study.

1.1. Carbon Capture and Storage (CCS) Overview

Through the CCS process, CO_2 from industrial units is captured and separated from flue gasses before being compressed into a form suitable for transportation

(Jaccard, 2005). Compressed CO_2 is then transported to suitable storage facilities through a system of pipelines and pumping stations (Jaccard, 2005). Sites identified as suitable for long term CO_2 storage include terrestrial and underwater deep saline aquifers, deep unmineable coal seams, and depleted oil and gas fields (Dooley et al. 2004).

CCS is a technology that could help Alberta meet emissions reductions targets, while continuing the extraction and use of fossil fuel energy in the province. In Alberta, the fossil fuel industry is the driving economic force, with CCS proposed as a climate mitigation technology due to the ideal circumstances surrounding capture and storage that include both technology experience and Alberta's geology. Alberta industry has considerable experience with injecting CO_2 underground to increase the amount of crude oil extraction (a process called Enhanced Oil Recovery), which creates an economic opportunity for captured CO_2. Furthermore, western Canada's geology is particularly suitable for CO_2 storage due to the existence of depleted oil and gas reservoirs, coal beds, deep aquifers, and salt caverns (Bachu, 2007).

Currently, twelve large-scale CCS projects are in operation around the world, including one in Saskatchewan, Canada. The world's first power production plant CCS installation was recently established at Saskatchewan's largest coal-fired power plant at Boundary Dam in Weyburn. Many other large CCS projects are under development in Canada, including two that the Government of Alberta is partially funding: (1) The Alberta Carbon Trunk Line, which will transport captured CO_2 to oil and gas fields where it can be used for enhanced oil recovery operations, and (2) The Quest CCS project, which will capture and store CO_2 from oil sands operations.

While CCS has the potential to significantly reduce CO_2 emissions, it also carries safety risks and high financial costs for society that may influence public support. Important risks include potential leakage from CCS storage facilities, which could harm plants, humans and wildlife, and underground pressure changes that could trigger seismic activity. Further, salt water or CO_2 could mix with fresh water, and CO_2 may release contaminants from subterranean geology that could be pushed upwards towards the surface. Therefore, CCS can be associated with both positive (CO_2 reductions) and negative (local environmental risks) societal impacts.

1.2. Previous Research into CCS Public Perceptions

Research into public attitudes towards CCS can utilize a number of methods, including in-person qualitative interviews, focus groups, and surveys. Qualitative interviews and focus groups provide wide-ranging ideas about the factors driving attitudes, but they typically involve small sample sizes that are not sufficient for deriving generalisations about a given population. Surveys, in contrast, can be administered to much larger groups, thereby providing a more representative sample that allows for statistical inferences about the population as a whole (Dillman, 2011).

A few studies conducted in Canada and Alberta on the public's perceptions of CCS show that the public tends to support the inclusion of CCS in the country's climate change strategy (Sharp et al. 2009; Ecoenergy CCS Task Force, 2007; Sharp, 2008; IPAC-CO_2, 2012; Project Pioneer, 2011). Respondents' stated support (or lack of resistance) has been steady in these regions. Canadian respondents in 2005 were on average slightly supportive of CCS (Mean=4.44/7 on a 1 oppose-7 support scale) (Sharp et al., 2009). Those opposed to CCS were largely concerned about its potential environmental risks rather than being fundamentally opposed to the technology itself (Sharp et al., 2009). A later 2007 survey found that 62% of Canadian respondents supported CCS while regionally, the province of Alberta showed the highest support (69%) compared to Saskatchewan/Manitoba (67%) and Atlantic Canada (53%) (Sharp, 2008). Similarly, in a 2010 study of Alberta, 64% of respondents indicated that they either strongly or somewhat supported CCS in the province (Project Pioneer, 2011).

Various factors are shown to be influential in determining attitudes towards application of CCS technologies in Alberta. A 2005 survey of 1150 Canadians found that gender, belief in climate change, awareness of CCS, certainty of opinion about CCS, education level, and household income were all individual factors that had statistically significant associations with public attitudes towards CCS (Sharp et al., 2009). A 2012 survey of 1550 Canadians found that compared to residents of other provinces, Alberta residents are most likely to believe that they would benefit from the use of CCS in their province, with job creation as the most commonly cited benefit of CCS (IPAC-CO_2, 2012). Boyd (2013) used the framework of interactional field theory in order to examine perceptions of CCS at different stages of implementation, and how community related

factors are associated with residents' perceptions of CCS in their area. Through interviews, participant observation, and secondary 2011 data collection in three Alberta communities, three factors were identified as influential to community perceptions of CCS: (1) place-based knowledge and experience, (2) demographic and community sustainability characteristics, and (3) relationships among residents of the community. A different study, which examined the views of a focus group in 2012 on CCS as a technology to address GHG emissions, found that Alberta participants' assessments are influenced by a combination of social, political, institutional, and economic factors, including public trust of industry and government, and consideration of CCS within a larger mix of energy system solutions to climate change (Einsiedel et al., 2013).

Similar to Alberta, numerous studies have been conducted across a range of countries, which generally find opinions of CCS to be somewhat supportive and shaped by a wide variety of influential factors. In Japan, surveys found that majority of respondents expressed support for CCS, especially when respondents were provided with contextual information (Itaoka et al., 2004; Tokushige et al., 2006). When Itaoka et al. (2004) applied factor analysis and regression analysis to 2003 survey data, four factors were identified as influential in predicting CCS attitudes: (1) respondent understanding of the effectiveness of CCS as a mitigation method for climate change, (2) concerns about environmental risks and CO_2 leakage, (3) concern that CCS would foster the continued use of fossil fuels, and (4) respondent awareness of human responsibility to reduce CO_2 emissions. A few years later, Itaoka et al. (2009) replicated these findings in another survey conducted in 2007, with the exception of respondent awareness of human responsibility to reduce CO_2 emissions.

Similarly, in the Netherlands, respondents showed modest support for CCS, and respondents were slightly positive about the suitability of CCS as a solution to the climate change problem (De Best-Waldhober et al., 2009; Huijts et al., 2007). In a 2003 survey, perceived risks, perceived benefits, trust, positive effects, negative effects, trust in environmental NGOs, and trust in industry were found to influence attitudes toward CCS (Huijts et al., 2007). Furthermore, in a survey conducted in 2009, Chinese respondents (n= 534 in one Chinese city) were slightly supportive of the use of CCS as a technology for CO_2 emission reductions (Duan, 2010). The factors influencing attitudes towards CCS included socio-demographics; Chinese respondents' satisfaction with their

current living conditions; perceptions of China's environmental condition and development pathway; public awareness of climate change; public knowledge of CCS; and four characteristics of CCS technology: maturity, uncertainties and risks, capability in cutting CO_2 emissions, and CCS policy.

Whereas these studies show support for CCS, some studies are not as positive. In Australia, a survey conducted in 2005 (*n*=1273) found that 53% of respondents showed a neutral attitude towards underground carbon storage with the majority (85%) of respondents stating that more information was necessary to form a clear opinion about CCS (Miller et al., 2007). In France, after information about CCS technology uncertainty was provided, French respondents' opposition rates rose from 21% to 42% (Hu-Dong et al., 2009).

Although general levels of CCS support may exist in a country, NIMBYism (not in my backyard) undoubtedly plays a role in negative attitudes towards CCS (Huijts et al., 2007; Uno et al., 2004). NIMBYism is generally defined as a pattern where opposition or negative reactions are higher among citizens that live closer to an undesirable facility in an area (Dear, 1992). I designed my study in general terms, and did not provide any location information that could lead to (or test for) these NIMBY attitudes.

Support or opposition towards a technology can also be significantly influenced by the specific context within which the energy choice is placed (Bickerstaff et al., 2008; Asolabehere, 2007). Framing CCS solely in the context of GHG emissions or CO_2 reduction focuses on tangible problems and solutions that many Canadians agree on and consequently need to be tackled by policymakers (Einsiedel et al., 2013). My research intentionally frames CCS as one of several climate change mitigation measures because Alberta's climate change strategy (2008) includes efforts to reduce energy consumption, improve energy efficiency, and increase the use of renewable energy, alongside the use of CCS to reduce GHG emissions (Government of Alberta, 2008).

I use data from a large scale survey (*n*=1076) of Albertans to elicit details of individual perceptions, support and other characteristics in order to create a CCS

acceptance framework that could contribute to improving policymakers' understanding of CCS perceptions in Alberta. The research objectives of my study are to:

1. assess Alberta citizens' knowledge of CCS and changes in knowledge over the last decade;

2. characterize citizen perceptions, attitudes and intention to act (behavioral responses) regarding CCS technology development and implementation in Alberta; and

3. explore knowledge, psychological perceptions, perceived benefits and risks, NEP (environmental concern),values, socio demographic , and situational variables associated with support of or opposition to CCS in Alberta, and determine if any regional differences exist.

1.3. Theoretical Frameworks: Explaining citizen acceptance

A framework is necessary to guide policy makers' understanding of public opinion at an early stage of technology introduction as well as adapting public engagement strategies to match the level of understanding and concerns of the public. In addition to policy makers, other stakeholders involved with CCS implementation (e.g. industry, non-profit organizations) can benefit from understanding the factors underlying public attitudes towards CCS. NGO's and interest groups can use these insights to inform and influence citizen's perceptions. This section briefly describes a few other frameworks, describes the framework applied in my study, and accounts for both excluded and additional variables.

Researchers have proposed different theoretical approaches and frameworks for assessing energy project acceptability (Huijts et al., 2012; West et al., 2010; Stephens et al., 2008). One study applied a culture theory framework to develop a deeper understanding of how individuals' worldviews influence their opinions and behaviors surrounding renewable energy (West et al., 2010). This study found that opposition to renewable energy projects is influenced by a wide range of personal and social factors. The authors apply four citizen categories - individualist, hierarchist, egalitarian, and

fatalist- to their qualitative interviews on citizen perceptions of renewable energy technology. ‘Egalitarian’ citizens were most likely to support renewable energy projects, provided that local environmental impacts were minimized. In contrast, ‘individualist’ citizens only supported projects with clear economic benefits and no impact on lifestyle. This implies that citizens’ acceptance of energy projects can be constructed from a variety of viewpoints, beliefs, and processes.

Another framework is the socio-political evaluation of energy deployment (SPEED) framework, which highlights the socio-political context of energy projects, focusing on the influence and power of different institutions and stakeholders. This framework assesses and compares regional readiness for and deployment of alternative energy technologies according to technical, institutional, and social factors (Stephens et al., 2008). Theoretically, the SPEED framework fosters integrated analysis of two sets of variables that influence deployment of technology: (1) the actors involved in deployment, and (2) the socio-political context in which the deployment process must occur. This SPEED framework was applied to assess CCS communication in the U.S.A. using five categories of benefits (positive) or risks (negative) associated with CCS: economics, environment, health and safety, politics, and technology (Ragland et al., 2011). This study found that the economic, technical, and political system functions present the greatest barrier to CCS deployment. Other applications of SPEED can use methods such as policy review, media analysis, focus groups, and stakeholder interviews to assess and anticipate the likelihood of successful deployment of energy technology in a given region.

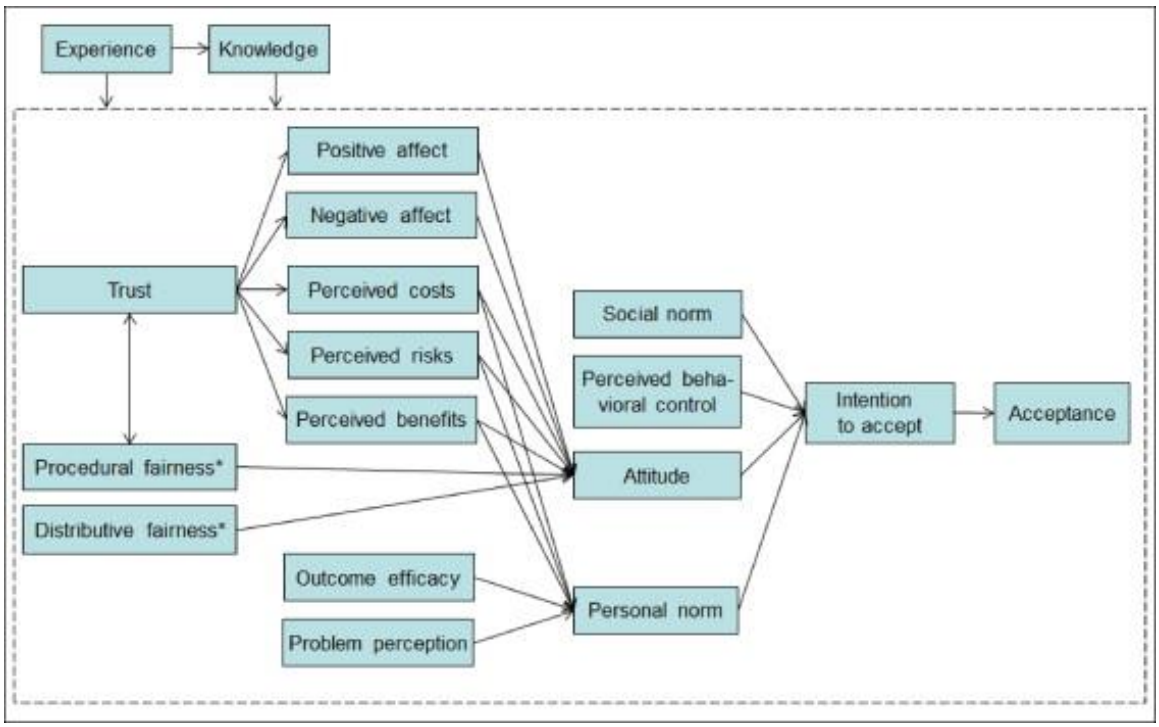
The technology acceptance framework (TAF) was developed through comprehensive research, and draws from theories to explain acceptance of energy technology projects (Huijts et al., 2012). This TAF combines several established theories including Schwartz's norm activation model and the theory of planned behavior to determine key factors affecting attitudes, and how they are related, in order to improve technology design, implementation, and communication to citizens (Schwartz, 1977; Steg et al., 2010; Ajzen, 1991). Based on these theories the proposed framework states that:

> "individuals can base their acceptance on (1) the overall evaluation of costs, risks and benefits; (2) moral evaluations, depending on the extent to which the technology has a more positive or negative effect on the environment and society; and (3) on positive or negative feelings related to the technology, such as feelings of satisfaction, joy, fear, or anger." (Hujits et al., 2012, p.4)

The framework focuses on several influential psychological factors introduced by Gupta et al., (2011), which are more situation-specific beliefs (as opposed to more stable psychological characteristics) affecting technology acceptance (Huijts et al., 2012). These TAF variables include experience and knowledge relating to the project, trust in the actors relating to the project, perceptions of fairness in the project's implementation, beliefs about the benefits, risks, and costs of the project, perceptions of equitable distribution of benefits, risks, and costs, and personal and social norms about taking action regarding the project. In particular, the TAF describes the causal relationship between these variables in the model as depicted in Figure 1.

This TAF was subsequently applied to hydrogen technology acceptance in the Netherlands (Huijts et al., 2014). By estimating structural equation models separately for both supporters and opponents, the study found that the three strongest determinants of intention to act in support of the technology are personal norms (e.g. I feel morally obliged to voice my opinion), positive affect (e.g. satisfaction, pride etc.), and the perceived effects of the technology (perceived benefits, risks, and costs). On the other hand, the three strongest determinants of intention to act against the technology are personal norm, negative affect (e.g. stress, fear etc.), and respondent's trust in the industry (Huijts et al., 2014).

Figure 1. Schematic Representation of the Technology Acceptance Framework (TAF)



In my study, I evaluate attitudes towards CCS and behavioral responses towards CCS, because both are important to improve the understanding of public attitudes (Ajzen, 1991). Attitudes towards CCS include support of or opposition to CCS. Behavioral responses involve actions taken in support of or against CCS implementation. In the TAF, 'acceptability' is defined as an evaluative judgment towards new technologies, as well as attitudes towards possible behaviors in response to the technology. In contrast, 'acceptance' is defined as behavioral response in support of or against energy technologies (e.g. CCS, nuclear power etc.). In my study, I employ the terms 'attitudes' for the TAF definition of acceptability (citizen support or opposition) and 'behavioral responses' for the TAF definition of acceptance (anticipated behavioral response to the project).

Huijts et al., (2012) recommended the further evaluation of other factors that could affect technology acceptance, which may include individual traits (e.g. values, worldviews, and socio-demographic variables) and situational factors (proposed location,

media attention, and oil price etc.). In keeping with this recommendation, I decided to include values, environmental concern, socio-demographic characteristics, and situational factors relating to personal dependence on the industry in Alberta in my study.

Attitudes towards CCS are entrenched in broader values and worldviews such as how people believe the environment should be treated. In other words, personal beliefs and pre-existing core values affect citizens' opinions and how they perceive a certain technology. In this paper I adopt the definition of values as "concepts or beliefs about desirable end states or behaviors, that transcend specific situations, guide selection or evaluation of behavior and events, and are ordered by relative importance" (Schwartz and Bilsksy, 1987). My conceptual framework also draws from the value-belief-norms theory which depicts how an individual's ascription to egoistic, altruistic, or biospheric values influences their beliefs about the environment, which in turn influences their awareness of consequences and feelings of responsibility (Stern et al., 1999). This value-belief-norms theory states that people's values affect their general beliefs (worldviews) about human-environmental relations, which affect specific beliefs about the environment. The New Environmental Paradigm (NEP) scale is used to measure the environmental worldviews of respondents (Schwartz & Bilsky, 1990).

Table 1 includes brief definitions of the TAF factors along with their hypothesized relationship with support of or opposition to CCS (support represented by '+' and opposition represented by '-'). When applied to the CCS context, definitions for some factors are adjusted to make them relevant to the current Alberta landscape. In contrast with the TAF analysis, the causal order of the variables has not been analyzed, i.e. I have not used a structural equation modeling approach. Variables which could influence support or opposition indirectly through other variables in the framework could not be determined due to the nature of the methodology used in my analysis. Socio-demographic factors, such as age, gender, income, and education have not made a substantial contribution to explaining public attitudes towards CCS (Duan, 2010; Sharp et al., 2009).

Table 1. Factors Adapted in my Study (Support represented by '+' and Opposition represented by '-')

Factors from the Technology Acceptance Framework (TAF; Huijts et al.,2012) included in my study with hypothesized effect:
+ Knowledge: awareness, familiarity, having heard of CCS
+ Outcome efficacy: CCS as an effective climate change mitigation strategy
+ Environmental problem perception: Perceived size of environmental problems associated with fossil fuel use
+ Trust: Public trust in CCS proponents such as the municipality and industry
+ Perceived benefits
- Perceived risks and costs
+ Distributive Fairness: Fairness of the distribution of benefits, risks and costs amongst citizens
+/- Personal norms (related to actions): feeling of moral obligation to act in support of or against CCS
+/- Outcome efficacy (related to actions): extent to which the seven actions in support or against a CCS storage facility are perceived to influence policy making
Factors from TAF excluded from my study:
Experience, Procedural Fairness, Positive and negative affect, Social norm and Perceived behavioral control
Additional factors (non-TAF) included in my study with hypothesized effect:
+ New Environmental Paradigm (NEP; Environmental concern)
Core values: + altruism, + biospheric, - egoistic (self-enhancement), and -traditional (conservative)
Socio-demographic characteristics: +Age, +Income, +Gender: Male and +Education
+ Situational factor (Alberta industry affiliation)

In the TAF, intention to act (behavioral responses) was evaluated using variables from the Norm Activation Model and the Theory of Planned Behavior. The Norm Activation Model (moral considerations) includes personal norm and outcome efficacy, while the Theory of Planned Behavior model (self-interest) includes subjective norm and perceived behavioral control. When applied to hydrogen technology acceptance, the Norm Activation Model variables explained intention to act more strongly than the Theory of Planned Behavior variables, for both the supporters and opponents (Huijts et al., 2013). Hence, I chose to include in my study only the Norm Activation Model variables I deemed applicable for intention to act in Alberta, which includes personal norm and outcome efficacy related to actions.

The moral framework (represented here by personal norm and outcome efficacy) is more applicable to countries with greater opposition and stronger groups of opponents as compared to those countries that have more support with stronger groups of supporters (De Groot & Steg, 2010). For this reason, I expect that the moral framework

is not applicable to Alberta, due to general support for CCS shown in previous studies. However, I included questions on both personal norm and outcome efficacy in my survey because I was not certain of the current level of support of CCS in Alberta. I also omitted other TAF variables, such as experience with CCS, procedural fairness, and positive and negative affect, which are applicable to a community where a CCS facility has been proposed and community members have been involved in the decision process leading up to implementation. The next section describes the sample and survey methodology applied to measure the relevant factors.

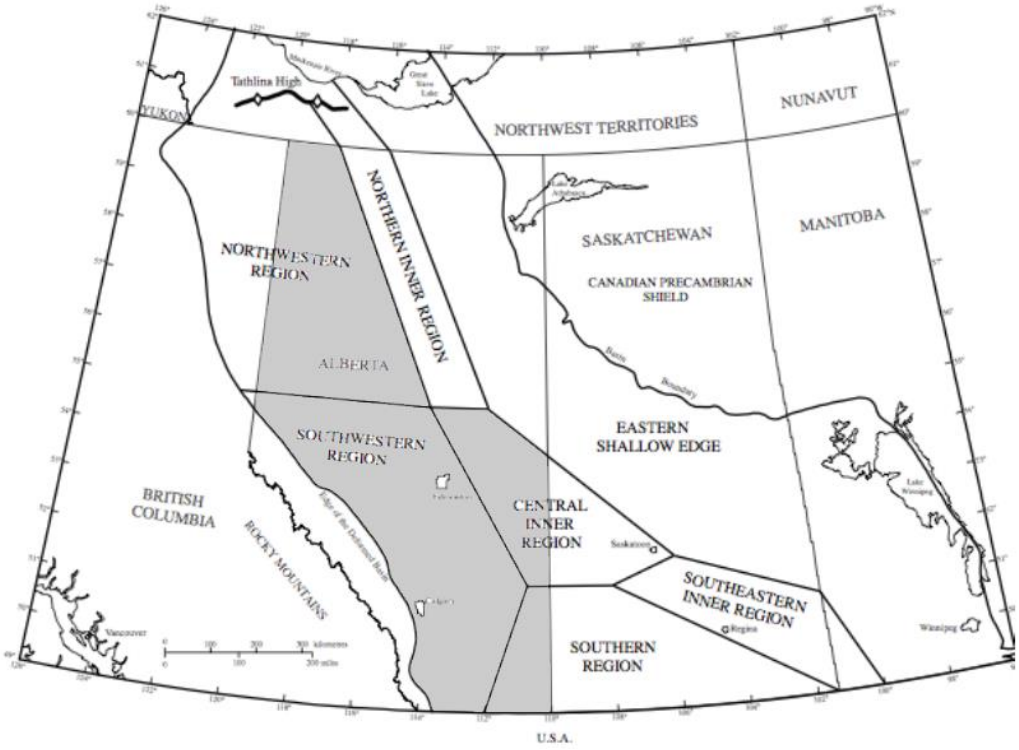
Chapter 2.

Research Methods

2.1. Data Collection

I designed and implemented a web-based survey to elicit citizen attitudes towards CCS from Albertans living in areas suitable for CCS, which I divided into four regions: the City of Calgary, the City of Edmonton, Northern Alberta (excluding Edmonton) and Southern Alberta (excluding Calgary) The capital city, Edmonton, is located near the geographic center of the province and is the primary supply and service hub for Canada's crude oil, the oil sands, and other northern resource industries (National Energy Board of Canada, 2008). Calgary is Alberta's largest city and the location of corporate headquarters for oil and gas corporations and the many small and large companies that provide upstream and downstream products and services for these corporations. All four regions lie within the area of Alberta which is suitable for CO_2 storage, as shaded in grey in Figure 2. The Alberta and Williston basins, covering most of Alberta and southern Saskatchewan, were ranked as highly suitable storage basins. The southwestern, southern, and northwestern regions within these basins were ranked as either suitable or highly suitable for CO_2 sequestration (Bachu, 2002).

Figure 2. Suitability of the Western Sedimentary Basin for CO_2 Storage



Note: Adapted from Bachu and Stewart, 2002

I employed the survey research firm Research Now to program and deliver the online survey. Survey respondents were offered reward points by Research Now's system. Respondents were screened out of the survey if they did not live in the targeted areas of Alberta described earlier. As with online surveys, the survey sample is biased towards respondents with internet access and some computer knowledge, although the rate of internet usage in Canada was estimated at 83% in 2011 close to the time of the survey (International Telecommunications Union, 2013).

When an issue is relatively unknown, such as CCS, there is a risk that information provided in the survey questions will influence respondents and thus bias the results. While this risk cannot be eliminated, I aimed to reduce it by providing basic and brief information on CCS to all respondents at the beginning of the survey (see Appendix1), regardless of the respondents' prior level of knowledge of CCS (CCS

description sources: Sharp et al., 2009; Alberta Energy,2008; ICO$_2$N,2009; Government of Alberta site)

In August of 2013, a pilot test was conducted with 100 respondents. I reviewed the results to ensure that the initial responses were logical, accurately recorded, and that respondents found the CCS information in the survey to be clear. Based on the pilot test analysis, I edited the CCS description slightly to include a brief paragraph on the risks of CCS and a list of current CCS projects in Alberta, and then had Research Now launch the survey to the rest of the sample.

In order to ensure a significant sample size within each region, the survey sample was stratified by region and subject to quotas. The data were reviewed throughout the launch to ensure that the overall sample's age, gender, and regional composition reflected that of the actual Alberta population aged 18 or older, according to the most recent 2006 Alberta Census data. With a sample size of 1076, the final results are considered to be an accurate representation with a margin of error of +/-3% (Dillman, 2011).

I cross-checked all respondents' data (including the 100 respondents from the pilot test) for different types of errors. Some respondents were removed from the sample due to inconsistent responses and unusually short completion times. To ensure data quality, I eliminated respondents who completed the survey in less than ten minutes (because pre-testing indicated that the survey should require at least 10 minutes to be completed in a thorough manner) and respondents who clearly selected the same option regularly throughout the survey. The final data, after removing all incomplete respondents, made up the sample size of 1076 respondents.

2.2. Alberta Survey Design

I designed the survey to focus on attributes specific to the region of Alberta. Respondents first completed a consent form outlining the research, confidentiality, risks, and contact information for the researchers and ethics department. The median survey completion time across all participants was 20 minutes, which corresponded with what I expected after observing pre-testers. The survey was divided into six sections: (i)

experience with CCS, (ii) feelings about CCS in Alberta, (iii) opinion of CCS, (iv) global issues, (v) values and activities, and vi) household details. My study utilizes CCS attitudinal data from questions in section (i), CCS perceptions from sections (ii) and (iii), climate change beliefs from section (iv), values from section (v), and socio-demographic and situational information from section (vi). I used the quantitative data obtained from this survey to characterize citizens' attitudes, perceptions and beliefs about CCS:

Factors from the technology acceptance framework (TAF; Huijts et al., 2012)

1. **Knowledge of CCS:** (adapted from Sharp et al., 2009)

   First the survey asked whether respondents have heard or read about CCS. In order to test respondents' stated knowledge, the survey asked which environmental concern is the main issue that CCS addresses. I provided nine answer categories listed in random order, which included (1) climate change; (2) the hole in the ozone layer; (3) water quality; (4) air pollution from cars and trucks; (5) oil and gas pipeline safety; (6) toxic waste; (7) acid rain; (8) none of the above; and (9) I don't know.

2. **Attitudes towards CCS:** (adapted from Sharp et al., 2009)

   To assess attitudes towards CCS, I measured respondents' support of or opposition to CCS in Alberta through a single question: "Based on what you know about CCS, or what you have read or heard about the technology, do you support the use of CCS in Alberta?" The six response categories were: strongly oppose, somewhat oppose, neutral, somewhat support, strongly support and I don't know.

3. **Psychological perceptions:**

- Outcome efficacy (adapted from Sharp et al., 2009): I measured respondents' perceived importance of including CCS in Alberta's strategy to reduce emissions. The five response categories were: not at all important, somewhat important, important, very important, and I don't know.

- Environmental problem perception (adapted from Sharp et al., 2009; Curry, 2004): I provided respondents with four statements on the seriousness of climate change, which included: (1) climate change has been established as a serious problem and immediate action is necessary; (2) there is enough evidence that climate change is taking place and some action should be taken; (3) we don't know enough about climate change and more research is necessary before we take any actions; (4) concern about climate change is unwarranted; and I don't know and no opinion response categories.

- Trust in regulator and industry (adapted from Huijts et al., 2012): I provided respondents with five statements related to decision making, safety, and monitoring, in order to measure trust in the Alberta Energy Regulator (AER) and the carbon storage facility operator. The five response categories were: I have no trust, I have little trust, I have some trust, I have a lot of trust, and I don't know. Responses to the five trust statements were combined into a single composite variable for the analysis.

- Perceived effects of CCS- Benefits (adapted from Sharp et al., 2009): I provided respondents with eight statements representing the perceived benefits of CCS (in random order). Responses were evaluated on a five-point scale ranging from "strongly disagree" to "strongly agree", with an "I don't know" response category.

- Perceived effects of CCS- Risks (adapted from Sharp et al., 2009): I provided respondents with seven statements representing the perceived risks and cost of CCS (in random order). Responses were evaluated on a five-point scale ranging from "strongly disagree" to "strongly agree", with an "I don't know" response category.

- Distributive Fairness (adapted from Huijts et al., 2012): I measured perceptions of the fairness of distribution of benefits, risks, and costs of CCS implementation between the respondent personally and other Albertans. The five response categories were: very unfair, somewhat unfair, somewhat fair, very fair, and I don't know.

4. **Intention to Act** (behavioral responses; adapted from Huijts et al., 2012)

- **Actions:** Supporters and opponents received the same seven questions about willingness to take actions relating to CCS: (1) sign a petition; (2) give a donation to an interest group; (3) hang a poster in the window; (4) write a letter to a newspaper or magazine; (5) participate in a public meeting for citizens of the community; (6) vote for a party in the local elections that shares my opinion; and (7) participate in a demonstration or public event. All respondents evaluated the likelihood of taking these seven actions in support of or against a CCS storage facility with five response categories: definitely not, unlikely, somewhat likely, very likely, and I don't know.

  These actions were focused on either action in support of or against a CCS storage facility—each respondent was categorized either as a supporter or opponent. A CCS storage facility is considered here because it is expected that storage specifically would cause the greatest concern. In order to obtain 'willingness to take action' response data from all respondents, another question (Firestone & Kempton, 2007) was posed to those who answered "neutral" or "I don't know" to the main support/opposition question: "Even though you are unsure of your opinion about CCS, towards which way are you leaning?" with two response categories: "support" or "oppose" CCS in Alberta. These supporters or opponents were grouped together with the other respondents, who were strongly or somewhat supported/opposed CCS.

- **Personal Norm and Outcome Efficacy (related to actions):** Respondents evaluated three statements on personal norm and two statements on outcome efficacy related to the seven actions using a five-point scale ranging from "strongly disagree" to "strongly agree" with "neutral" and "I don't know" response categories.

<u>Additional factors (non-TAF)</u>

5. **Values** (adapted from Stern et al., 1995):
   I provided respondents with a total of nine statements (in random order) i.e. three statements each, to assess altruism, biospheric, egoistic (self-enhancement),

and traditional (conservative) values (Stern et al., 1995). The five response categories were: not at all important, a little important, somewhat important, very important, and I don't know.

6. Beliefs:

- I adapted the abbreviated version (8-statements in random order) of the New Ecological Paradigm to measure pro-environmental attitudes (Dunlap et al., 2000). Response categories ranged from "strongly disagree" to "strongly agree", with an "I don't know" response category.

- My survey defined four climate change strategies: (1) energy efficiency regulations for lighting, heating, and cooling systems in buildings; (2) carbon tax; (3) CCS; and (4) clean electricity regulation (or renewable portfolio standard), and measured respondents' perceptions with two response categories: a support and an oppose option.

- I measured respondents' perceptions about the responsibility for environmental protection in Alberta. The four response categories were: not responsible at all, somewhat responsible, responsible, and highly responsible.

7. Socio-demographic and situational variables:

- The survey asked respondents about their age, income, education and gender.

- Situational variable: I provided five statements on whether the respondent or someone they know work in the energy industry, the respondent or someone they know has an oil injection well on their property, and whether the oil and gas industry has a significant presence in their community. Dependence on the fossil fuel industry in Alberta was measured by combining the 'yes' responses for each respondent into a single composite score.

2.3. Analysis Methodology

The survey data were analyzed in two ways. First, I used descriptive statistics (i.e. frequencies) to address the first research objective related to knowledge of CCS and changes in that knowledge in Alberta. I also used descriptive statistics to analyze: attitudes towards CCS, intention to act (behavioral responses), trust in stakeholders involved in CCS, perceived riskiness of CCS, perceived benefits and risks, support for climate change strategies, and responsibility for environmental protection in Alberta.

Second, I employed a multiple regression analysis model to explore the relationship between the factors (detailed below) and attitudes towards CCS. In other words, the multiple regression analysis was carried out to identify relationships between the independent variables (factors) that may have an impact on the value of the dependent variable (attitude towards CCS). The basic model form for a linear multiple regression is represented by the equation:

$Y=a + b_1X_1 + b_2X_2 + b_3X_3$ where Y = attitude towards CCS, a = the intercept, each X is a factor, and each b is the slope, or Beta coefficient for that variable.

A multiple regression analysis probes the connection (described in the framework) between the independent variables (psychological perceptions, NEP, values, and socio-demographic characteristics), and the dependent variables (respondents' support of or opposition to CCS in Alberta). The influence of the factors is demonstrated by the values of the standardized coefficients. The regression analysis was conducted in three steps using IBM SPSS Statistics: First, I estimated a full regression model containing the independent variables which include factors from the framework, in order to evaluate the predictive significance of each variable:

Knowledge of CCS

Psychological perceptions:

- Outcome efficacy
- Environmental problem perception
- Trust
- Perceived effects (benefits, risks and costs)

- Distributive Fairness

NEP (Environmental concern)

Values

Socio-demographic Characteristics

- Age
- Income
- Gender
- Education
- Situational variable: Alberta industry affiliation

Second, I estimated the (stepwise analysis) 'reduced' regression model in order to determine the best combination of independent (predictor) variables that predict the dependent variable (i.e. support/opposition towards CCS in Alberta). During this process, variables are not added to the regression equation unless they are statistically significant when added to the analysis. Therefore, all of the independent variables selected for inclusion in the stepwise analysis will have a statistically significant relationship to the dependent variable. Finally, I estimated a full regression model for each of the four regions in Alberta to determine the existence of any regional differences in patterns of support or opposition.

Survey respondents expressed their level of support of CCS in Alberta through a single question: "Based on what you know about CCS, or what you have read or heard about the technology, do you support the use of CCS in Alberta?" The six response categories were: strongly oppose, somewhat oppose, neutral, somewhat support, strongly support and I don't know. I condensed the "I don't know" and "neutral" responses into the same category for purposes of the regression analysis. The resulting five response categories were converted to a continuous scale and serve as the dependent variable in the analysis. The following section describes the survey sample, and presents the results of the descriptive analysis and the multiple regression analysis (full and reduced model) for the Alberta-wide model and the four regional models.

Chapter 3.

Survey Results

3.1. Alberta Survey Sample

The final sample consists of 1076 respondents who are adult citizens of Alberta, with a response rate of 18%. Table 2 shows the representativeness of the survey sample demographics compared to the Alberta Census. The distribution of the sample matches the Alberta census data closely, with only a few differences. When compared to the Alberta census data, the Alberta sample contains slightly more women than men, is slightly older, earns slightly lower income, and is slightly more educated.

Table 2. Sample Representativeness: Socio-demographics of the Alberta Sample Compared to the Alberta Census Data

	Alberta sample% *n*=1076	**Alberta Census%** N=2,818,960
Gender		
Male	44%	50%
Female	56%	50%
Age		
18 to 29	15%	23%
30 to 39	17%	19%
40 to 49	18%	19%
50 to 59	19%	18%
60 to 69	17%	11%
70 or older	13%	10%
Education		
Grade School or Some High School	4%	20%
High School Completed	16%	28%
Technical or Trade School/Community College	27%	31%
Some Community College or University, Not Completed	17%	
University Degree, such as a Bachelor's Degree	26%	15%
Post-Graduate Degree, such as a Master's or Ph.D. Degree	10%	7%
Income level		
Less than $10,000	0%	4%
$10,000 to $19,999	2%	5%
$20,000 to $29,999	5%	6%
$30,000 to $39,999	6%	7%
$40,000 to $49,999	8%	7%
$50,000 to $59,999	10%	7%
$60,000 to $69,999	9%	7%
$70,000 to $79,999	8%	7%
$80,000 to $89,99	7%	6%
$90,000 to $99,999	8%	6%
$100,000 to $124,999	10%	11%
$125,000 to $150,000	5%	8%
Greater than $150,000	7%	18%

Table 3 shows the distribution of respondents among the four regions: the City of Calgary, the City of Edmonton, Northern Alberta (excluding Edmonton) and Southern Alberta (excluding Calgary). The first two regions, Calgary and Edmonton, are two of the biggest cities in Alberta, each with populations of over 1 million. The other two regions Northern Alberta and Southern Alberta represent populations living in these two regions according to the CCS regional criteria described in Section 2.1.

Table 3. Distribution of 1076 Respondents Between the Four Alberta Regions

REGION	Number of Respondent's surveyed
Edmonton	354
Calgary	354
Northern Alberta	152
Southern Alberta	216
Total	**1076**

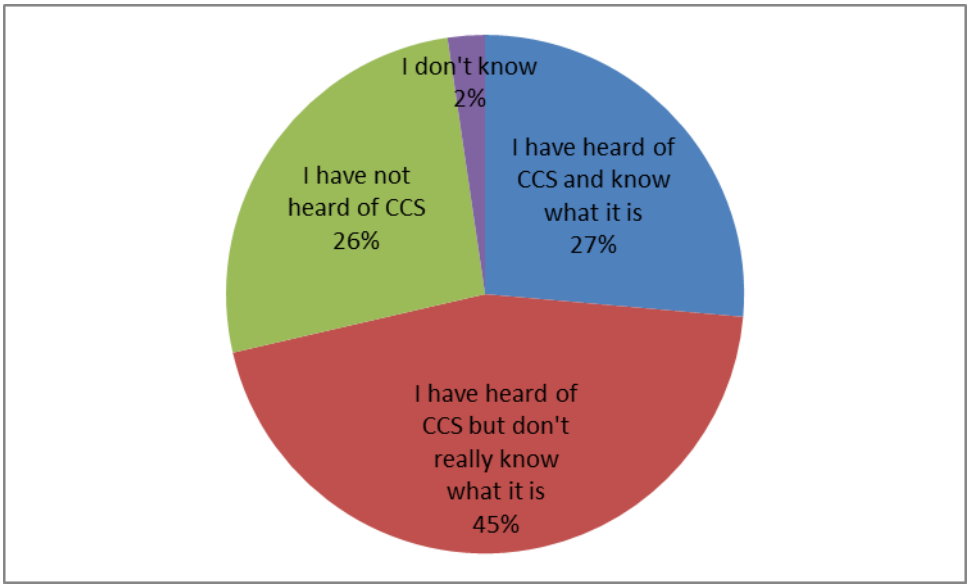
3.2. Descriptive Statistics Results

This section presents the descriptive statistics results of some important variables in the analysis, which help improve our understanding of attitudes towards CCS and addresses the first and second research objectives.

3.2.1. Knowledge of CCS and climate change

As shown in Figure 3, 27% of respondents have heard of CCS and know what it is, 45% have heard of CCS but do not really know what it is, while 28% of the sample have not heard or do not know if they have heard of CCS. Around 48% of respondents correctly identified that climate change is the main issue that CCS addresses.

Figure 3. Knowledge of CCS in Alberta



I compared these findings to a 2005 Canadian survey conducted with citizens in the Alberta and Saskatchewan region (AB/SK sample grouped together, *n*=775) (Sharp et al., 2009). This 2005 study found that 15% of respondents had heard of the geological disposal of carbon dioxide (GDC term used in this study instead of CCS), while only 6% of respondents could identify the purpose of CCS, which is to reduce climate change (Sharp et al., 2009). Another 2007 survey found that Albertan respondents were the most aware of CCS among Canadians (39%) (Sharp, 2008). A more recent 2012 Alberta survey (*n*= 502) found that 73% of respondents have heard of CCS, which is similar to my study findings (Seigo et al., 2014). These results reinforce the fact that knowledge of CCS has increased over the last decade, but is still not universal in Alberta.

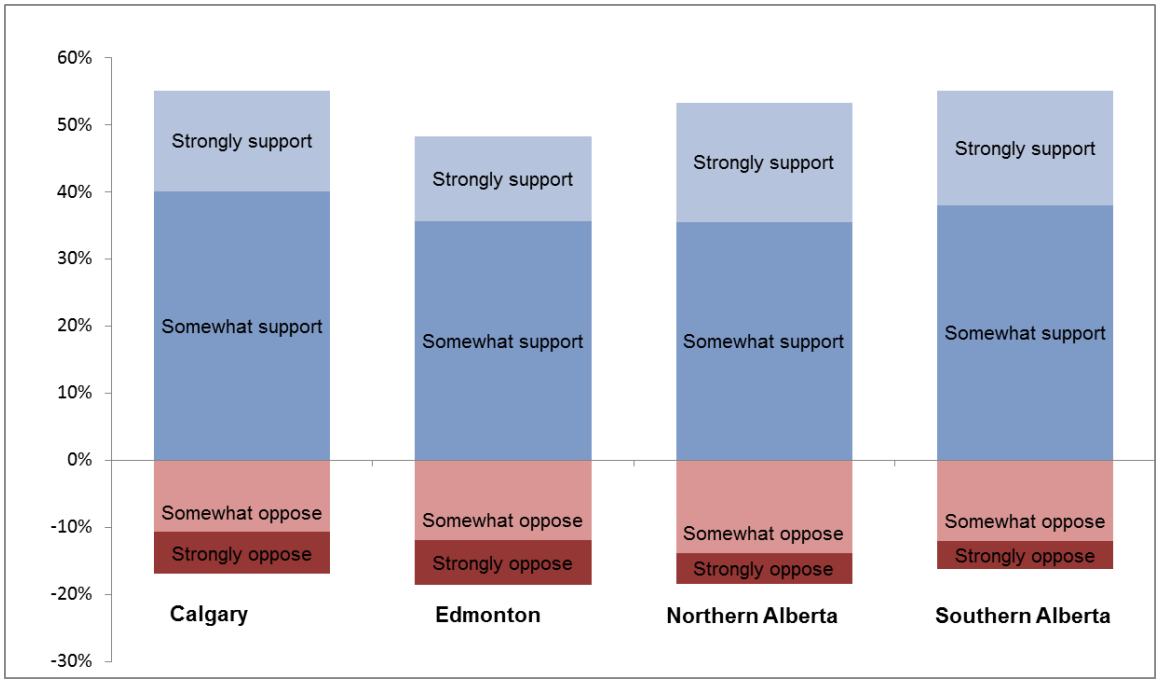
The majority of respondents (68%) believe that there is enough evidence that climate change is a problem and action is necessary. 10% of respondents claimed to know a lot about climate change while 86% know only some or a little. When I tested respondents' knowledge of climate change, I found that the majority of respondents correctly understand that cars and trucks (83%), burning fossil fuels for heat and electricity (82%), and deforestation (87%) are a significant cause of climate change.

The majority of respondents, however, incorrectly believe that the hole in the ozone layer (74%), toxic wastes (74%), acid rain (60%), volcanic eruptions (53%), and aerosol spray cans (51%) are significant causes of climate change. Approximately a quarter of respondents (22%) incorrectly believe that the space program contributes to climate change. Thus, gaps in knowledge and misconceptions about climate change still exist in the province of Alberta.

3.2.2. Attitude towards CCS

Among the 1076 Alberta respondents, over half the sample (53%) expressed some support for CCS (15% strongly support and 38% somewhat support). 18% of respondents oppose CCS (12% somewhat oppose and 6% strongly oppose), while 26% are neutral and 4% don't know. Figure 4 shows that this result is consistent across the four regions: around half of respondents show some support for CCS, with low opposition (19% or less). I conducted an independent-samples t-test to compare these attitudes towards CCS across all four regions. Results showed no statistically significant differences in attitudes towards CCS at the 95% confidence level. Regional differences in the factors affecting support of or opposition to CCS are evaluated in the regression analysis in Section 3.3.

Figure 4. **Based on this information, as well as anything you have read or heard about the technology, do you oppose or support the use of CCS in Alberta?**

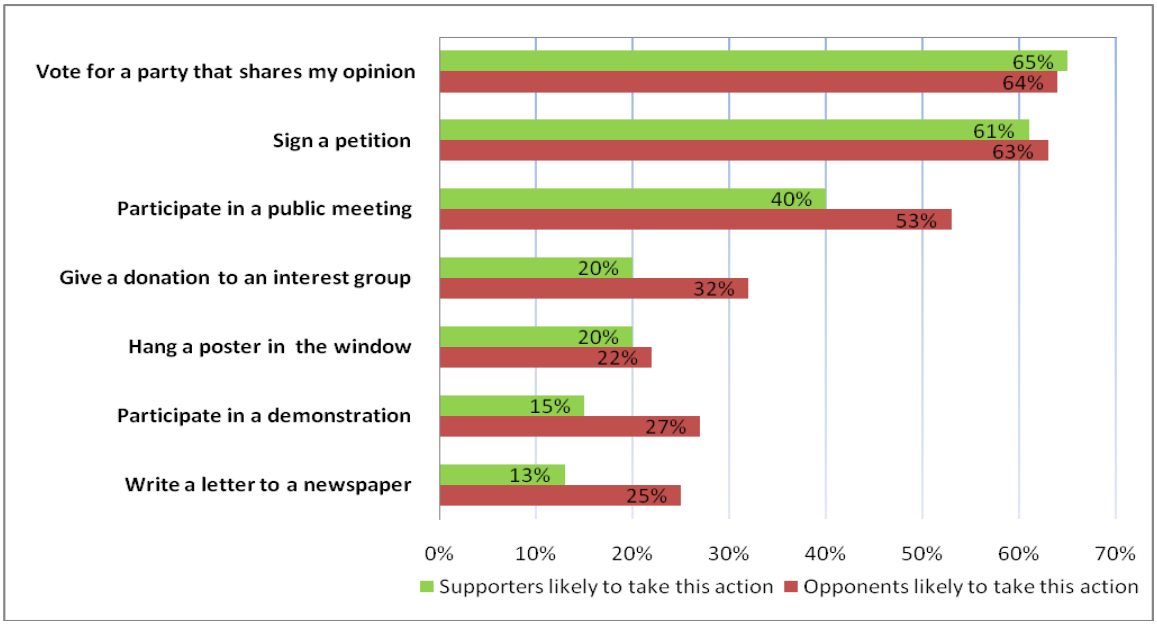


3.2.3. Intention to Act (behavioral responses)

In order to evaluate behavioral responses towards a CCS facility, respondents were grouped into support or oppose categories. Of the 1076 total respondents, potential supporters made up 814 (75%) and potential opponents made up 262 (25%) of the sample. Respondents evaluated the likelihood of taking seven actions in support of or against a CCS storage facility. I computed the mean score, standard deviation (SD), and Cronbach's alpha (α) on the seven items for behavioral response in support of CCS (mean = -0.33, SD = 0.82, α = 0.862) and the seven items for behavioral responses against CCS (mean = -.12, SD = 0.98, α = 0.88). In order to calculate this mean and SD, I created a composite variable based on coding the response categories ranging from -2 (very unlikely to take action) to +2 (very likely to take action), and 0 (I don't know). These results indicate that on average, respondents who are supporters of CCS are slightly less willing to take action than respondents who are opponents of CCS.

Figure 5 shows the seven actions that both supporters and opponents are likely to take to show their support of or opposition to a CCS facility. Two types of actions i.e. vote for a political party that shares their opinion, and sign a petition in support of or against CCS are most likely to be taken by both supporters and opponents in response to a proposed CCS facility. While supporters are less likely to participate in public demonstrations and meetings or write a letter to a newspaper to show their support of CCS, opponents seem more likely to take these participatory actions. These results provide useful insight into how actively supporters and opponents are likely to respond to a proposed CCS facility.

Figure 5. Actions Likely to be Taken by Supporters in Support of and Opponents Against a CCS Facility

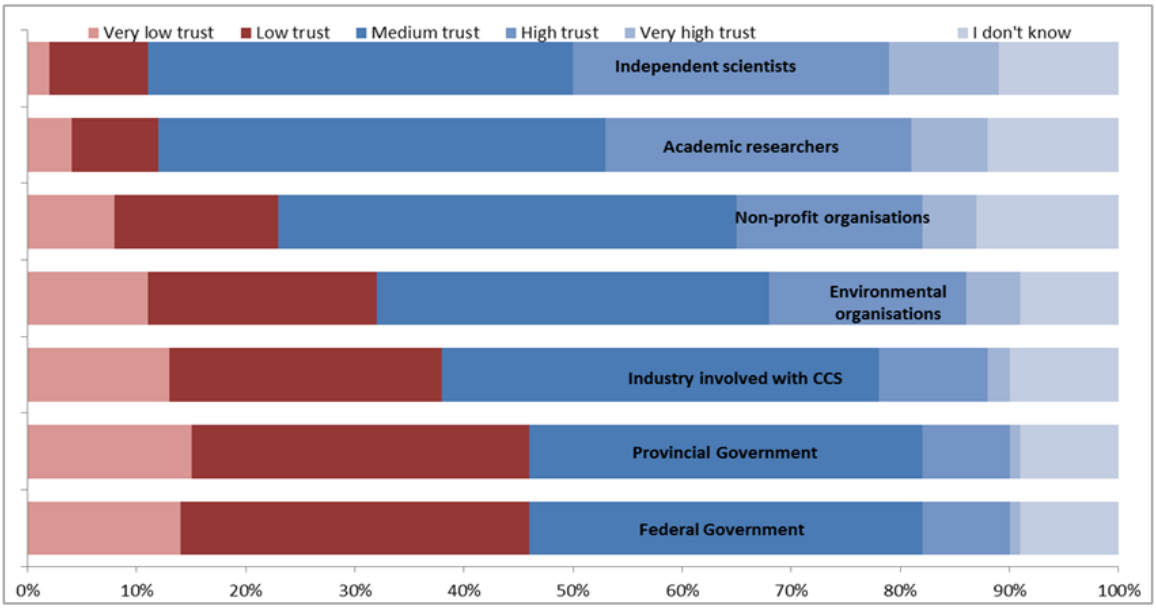


3.2.4. Trust

The survey measured trust in CCS stakeholders involved in CCS, such as the federal government, the provincial government, industry associations and companies developing CCS projects, environmental organizations, non-profit organizations, academic researchers, and independent scientists. Responses were collected using a five-point scale ranging from “very low trust” to “very high trust” for each stakeholder, with an “I don’t know” response category. Of these stakeholders, respondents show

higher trust in academic researchers (Mean=3.31) and independent scientists (Mean=3.40), than in the federal government (Mean=2.44), the provincial government (Mean=2.45), and industry associations and companies developing CCS (Mean=2.57). Figure 6 shows that trust in environmental organizations (Mean=2.82) and non-profit organizations (Mean=2.95) is at an intermediate level. This question was not included as a factor in the regression analysis.

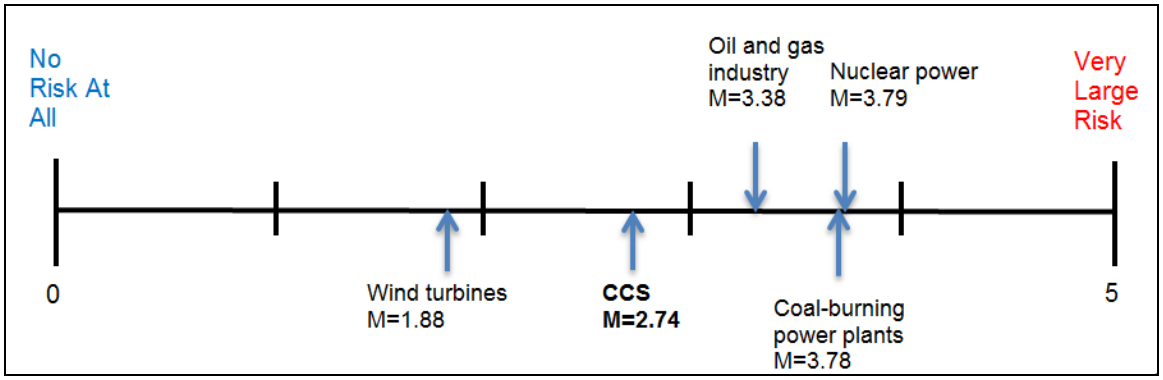
Figure 6. Trust in Stakeholders Involved in CCS



3.2.5. Perceived riskiness of CCS

In order to explore the perceived riskiness of CCS, respondents rated CCS and four other energy technologies on a scale of 1 to 5, where 1 is not at all risky, and 5 is extremely risky. The mean values (calculated by dividing the sum of responses by number of respondents) are shown in Figure 7. Consistent with the results of the 2005 Canadian study from which the question was taken, respondents view wind turbines as having very low risk (Sharp et al., 2009). Further, respondents on average consider CCS to be less risky than conventional oil and gas industry operations, nuclear power, or coal-fired power plants.

Figure 7. Perceived Risk of CCS Compared to Other Energy Technologies (Sharp et al., 2009)



3.2.6. Perceived effects: Benefits, Risks and Costs

The statements related to perceived benefits, risks, and costs of CCS were measured using a five-point scale of agreement. Figure 8 shows that on average, the most frequently perceived benefit of CCS is that implementation of the technology could create jobs and contribute to economic development in Alberta, while the least frequently perceived benefit is that CCS is the only technology available to reduce emissions from some industrial and electricity production sources.

Figure 8. Perceived Benefits of CCS in Alberta

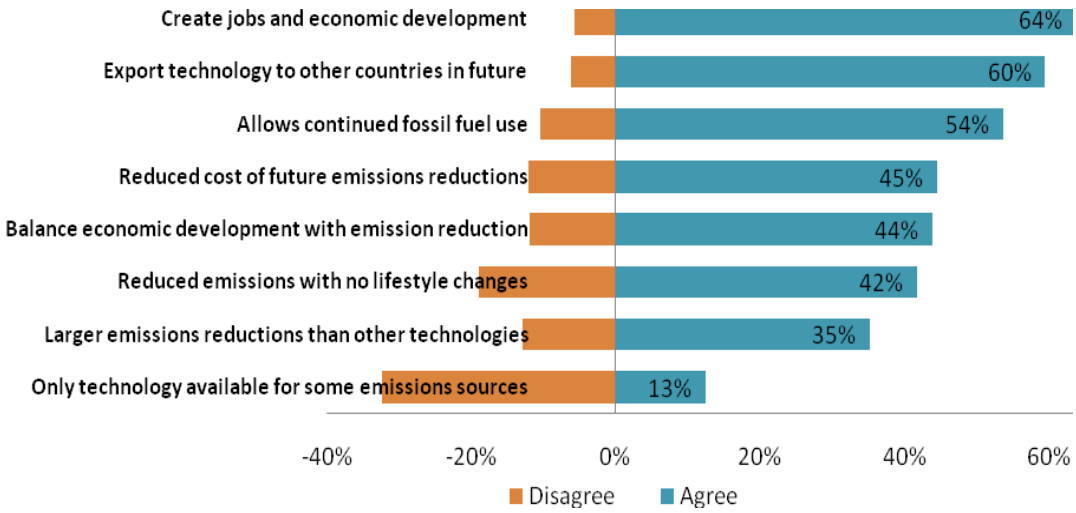
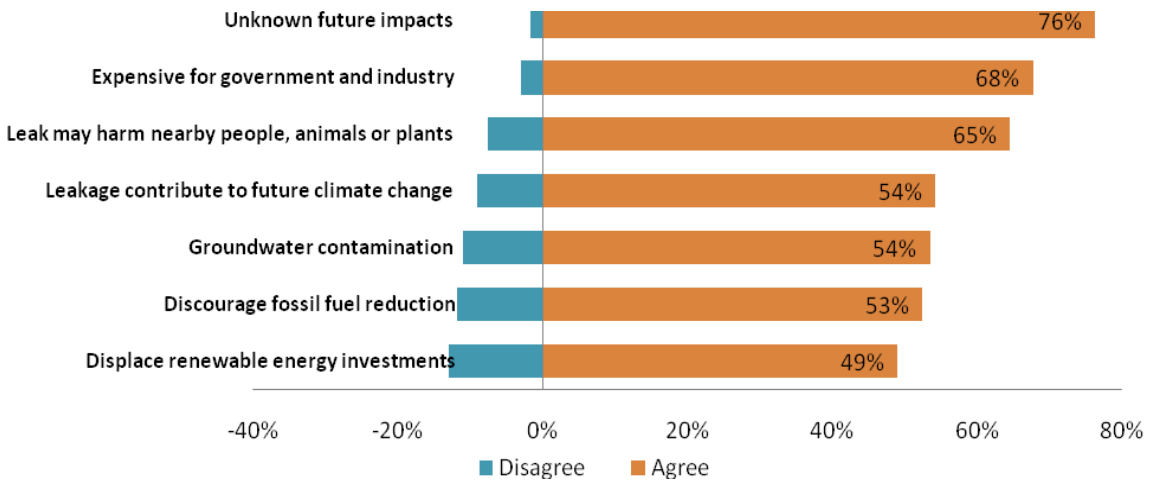


Figure 9 shows that on average, the most frequently selected risk of CCS is the potential for unknown future impacts from CCS projects, followed by concern about high costs for government and industry. However, the least frequently selected risk is that CCS would potentially displace investments in renewable energy. These perceived benefits, risks, and costs are evaluated in the regression model in Section 3.2.

Figure 9. Perceived Risks of CCS in Alberta



3.2.7. Support for climate change strategies

In order to assess respondents' support or opposition for climate change strategies, I provided a list of four strategies with their simplified definitions. In contrast to the other three defined climate policies, the definition for CCS here was limited, as it did not explain the policy (regulation or subsidy) through which CCS would be implemented in Alberta. The survey asked how respondents would vote if there was a referendum on adopting these strategies in Alberta. I did not provide an option for respondents to stay neutral-they could choose either the support or the oppose response category.

- Energy efficiency regulation - a requirement that new buildings, appliances, and equipment are more energy efficient.
- Carbon tax - a tax on carbon pollution from burning gasoline (government may commit to return all tax revenues as other tax cuts - called revenue-neutral carbon tax).

- CCS- a technology that captures the carbon pollution released from industrial facilities, and stores it so that it does not enter the atmosphere.
- Clean electricity regulation- a requirement that a certain percentage of new electricity is generated from zero-emission sources, such as hydro, solar, or wind.

Figure 10. Support/Opposition towards Climate Change Strategies for Alberta

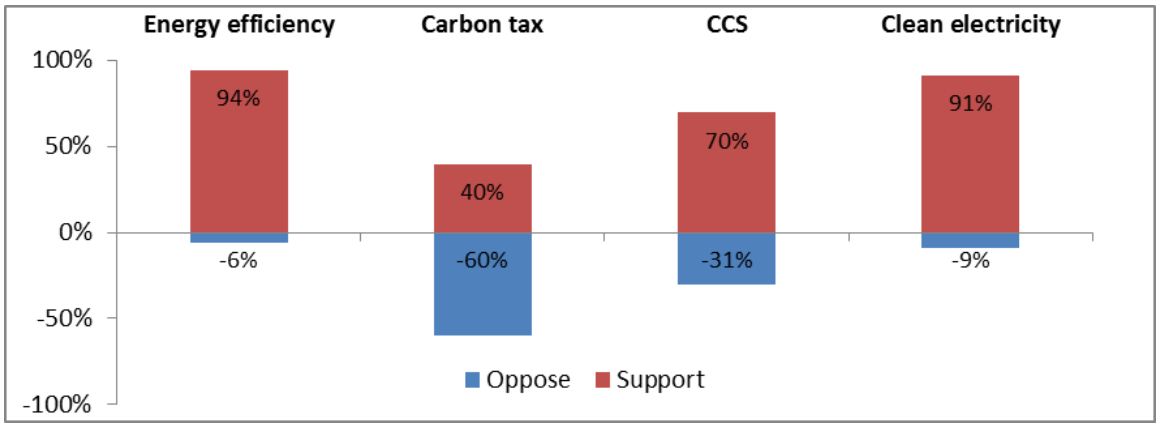


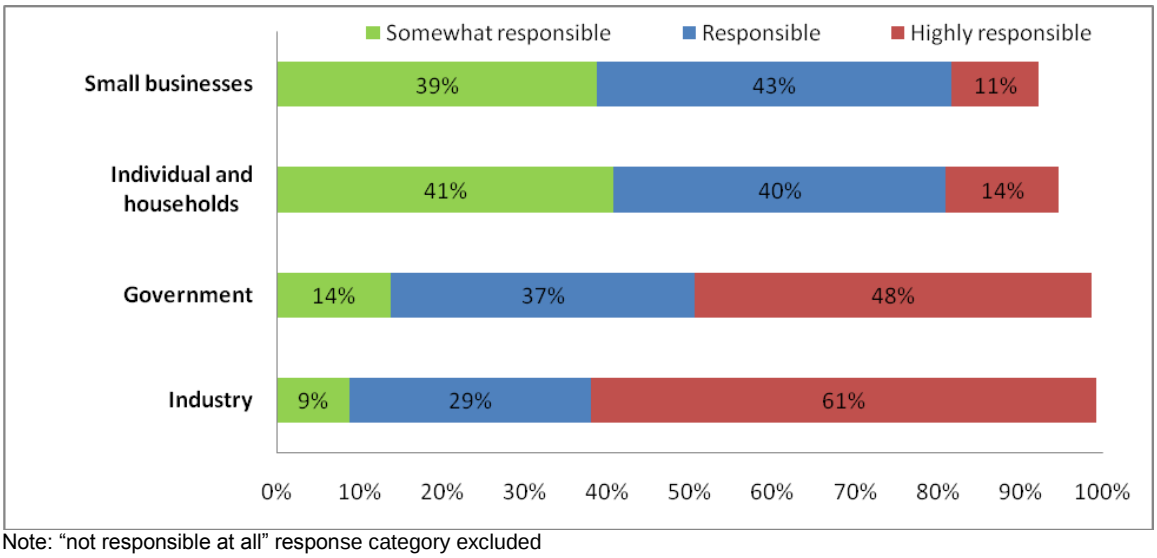
Figure 10 shows that CCS is supported more than a carbon tax, but not as highly as energy efficiency and the clean electricity regulation. When respondents do not have an option to stay neutral on CCS, support for CCS, as previously ascertained, remains high. My results are consistent with a British Columbia study that showed public support for regulatory policies, such as energy efficiency and clean electricity standards ("high") , was higher than for market-based initiatives such as the carbon tax ("medium to low") (Rhodes and Jaccard, 2013). Similarly, CCS is being perceived like other technological regulations, and garners similar levels of support. These results could contribute to policy analysis research (i.e. Alberta's Climate Change Strategy), which could potentially have "public support" as one of the criteria for evaluation.

3.2.8. Responsibility for environmental protection

I evaluated respondents' views on responsibility for environmental protection in Alberta. Figure 11 shows that respondents consider both industry (61%) and the

government (48%) to be highly responsible for environmental protection. To a lesser extent, respondents assign responsibility to business, individuals, and households.

Figure 11. Responsibility for Environmental Protection in Alberta



Note: "not responsible at all" response category excluded

3.3. Multiple Regression Analysis Results

After coding all the variables into my data set, I examined the data structure of the dependent variable, by observing the histograms to determine whether or not the dependent variable was normally distributed - a requirement for regression analysis. The histograms represent a normal distribution, which fulfills this requirement as shown in Appendix B.

3.3.1. Regression Results- Alberta Model

I conducted a regression analysis to evaluate the relationship between the factors and attitudes towards CCS in Alberta. Table 4 shows both the full model (all significant and non-significant independent variables), and the reduced model (using stepwise regression to determine significant independent variables only). This reduced model shows ten independent variables that were statistically significant at the 95% confidence level or higher. The Tolerance (> 0.1) and Variance Inflation Factor (<10) values for all the variables confirmed that there were no issues with multicollinearity

among the independent variables in the model. The model R-square is 0.48, indicating that in total, my model explains about 48% of the variability in the dependent variable.

Table 4. Multiple Regression Analysis on Attitudes Towards CCS- Standard (full model) and Stepwise (reduced model) Analysis

Variables (Factors)	Full Model		Reduced Model	
	Beta (Std coeff.)	P-value	Beta (Std coeff.)	P-value
CCS knowledge (dummy)	-.022	.384		
Psychological perceptions				
Environmental problem perception (dummy)	-.037	.138		
Outcome efficacy	.291**	.000	.305**	.000
Trust (Regulator + CCS industry)	.123**	.000	.129**	.000
Distributive Fairness	.122**	.000	.117**	.000
Perceived benefits				
continued ability to use fossil fuels	.100**	.002	.114**	.000
reduced emissions with no lifestyle changes	.021	.457		
only available tech some emissions sources	-.013	.603		
balance economic development with emiss.reduction	.119**	.000	.128**	.000
large reductions quicker than other technologies	.003	.933		
jobs creation and economic development	.046	.131		
export technology to other countries in future	.125**	.000	.120**	.000
reduced cost of future emission reductions	.061	.070		
Perceived risks and costs				
Leakage	-.008	.805		
groundwater contamination	-.089**	.009	-.103**	.000
leak harm people, animals, or plants	-.017	.609		
unknown future impacts	-.049	.112		
displace renewable energy investments	-.065*	.016	-.061*	.010
discourage fossil fuel reduction	-.003	.898		
Costs –Expensive for industry	.038	.142		
Socio-demographic and situational factors				
Age (continuous)	.019	.450		
Gender: Male (dummy)	.058*	.020	.051*	.023
Education: university degree or higher (dummy)	.043	.067		
Income (continuous)	.035	.129		
AB industry affiliation (dummy)	.021	.346		
NEP (pro-environmental)	.067*	.028		

Variables (Factors)		Full Model		Reduced Model	
		Beta (Std coeff.)	P-value	Beta (Std coeff.)	P-value
Values					
	Traditional values	.024	.404		
	Biospheric values	-.073*	.027		
	Egoistic values	-.080**	.001	-.083**	.000
	Altruistic values	.044	.142		
Regions					
	Calgary (Ref case: Northern Alberta)	.073	.050		
	Edmonton (Ref case: Northern Alberta)	.034	.359		
	Southern Alberta (Ref case: Northern Alberta)	.032	.295		
Adjusted R-square			0.491		0.483

*Significant at p<0.05 **Significant at p<0.01

While most of the psychological perceptions and some of the benefits and risk perceptions are significant, few of the demographics, values, or regions are significant. Table 5 shows the factors (from the technology acceptance framework and the additional factors) along with their confirmed effect.

Table 5. Factors from the Multiple Regression Analysis with Confirmed Effect

Factors from the TAF:	Hypothesized effect: Relationship with dependent variable (Attitude toward CCS)	Hypothesis supported
Knowledge: awareness, familiarity, having heard of CCS	+	No
Outcome efficacy: CCS as an effective climate change mitigation strategy	+	Yes
Environmental problem perception: Perceived size of environmental problems associated with fossil fuel use	+	No
Trust: Public trust in CCS proponents i.e. municipality and industry	+	Yes
Perceived benefits:		
continued ability to use fossil fuels	+	Yes
reduced emissions with no lifestyle changes	+	No
only available tech some emissions sources	+	No
ability to balance economic development with emissions reductions	+	Yes
large reductions quicker than other technologies	+	No
jobs creation and economic development	+	No
export CCS technology to other countries in future	+	Yes
reduced cost of future emission reductions	+	No
Perceived risks and costs:		
leakage	-	No
groundwater contamination	-	Yes
leak harm people, animals, or plants	-	No
unknown future impacts	-	No
displace renewable energy investments	-	Yes
discourage fossil fuel reduction	-	No
Costs –Expensive for industry	-	No
Distributive Fairness: Fairness of the distribution of benefits, risks and costs amongst citizens	+	Yes
Additional factors (non-TAF):		
New Environmental Paradigm (NEP; Environmental concern)	+	No
Core values:		
Altruism	+	No
Biospheric	+	No
Traditional (conservative)	-	No
Egoistic (self-enhancement)	-	Yes
Socio-demographic characteristics:		
Gender: Male	+	Yes
Age, Income, Education, Situational factor (Alberta industry affiliation)	+	No

Consistent with my hypothesis, the following psychological perceptions are statistically significant at a 95% confidence level: outcome efficacy (belief that CCS is a useful climate change mitigation strategy for Alberta), trust in the Alberta Energy Regulator and CCS industry, and distributive fairness.

The perceived benefit variables that are statistically significant include: the ability to balance economic development with emissions reductions, the continued ability to produce and use fossil fuels while reducing GHG emissions, and the potential to export CCS technology to other countries in the future. On the other hand, the perceived risks influencing opposition include concerns about potential groundwater contamination and that CCS would potentially displace investments in renewable energy.

Being male is the significant socio-demographic variable positively associated with support while egoistic values are associated with respondent opposition to CCS. The remaining variables are not statistically significant in the Alberta model.

In contrast with my hypothesis, respondents' knowledge of CCS (prior to completing the survey) is not a statistically significant factor. Among the psychological perceptions variables, respondents' perception of climate change as a problem is not statistically significant. As shown in Table 4, most of the perceived benefits and perceived risks prove insignificant in this model. Furthermore, NEP, biospheric values, traditional values, and altruistic values are not significant in this model. Most of the socio-demographic factors, such as age, income, education, and the situational factor are not significant factors. Finally, region of residence (of the four regions) is not significant in the Alberta wide model. The next section evaluates a model for each of these four regions to determine significant factors associated with support or opposition.

3.3.2. Regression Results- Regional Models

I estimated a full regression model for each of the four regions in Alberta to determine the existence of any regional differences in patterns of support or opposition and determine the robustness of the Alberta regional regression model across the four regions. Table 6 shows all the independent variables in the four regions at the 95% and

99% confidence level. The adjusted R-square is 0.54 for Calgary, 0.43 for Edmonton, 0.48 for Northern Alberta, and 0.51 for Southern Alberta.

Some factors are significant in one or more regional models, while some factors are insignificant across all four regions. Specifically, outcome efficacy (belief that CCS is a useful climate change mitigation strategy for Alberta) is consistently associated with respondent support across all four regional models. Psychological perceptions such as trust and distributive fairness, and perceived benefits, such as ability to balance economic development with emissions reductions, and the potential to export CCS technology to other countries in the future, are also fairly consistently associated with respondent support across two or more regions. These results show robustness of the significant factors included in the regression analysis.

Moreover, while some factors proved significant in only one of the regional models, they are not significant in all the regions. These factors include belief that climate change is a serious problem (associated with opposition in Northern Alberta model), perceived benefit of the continued ability to use fossil fuels (associated with support in Edmonton model), perceived risks such as concern about potential groundwater contamination, the potential for a leak to harm nearby people, animals or plants, and the unknown future impacts of CCS technology (associated with opposition in Edmonton model). Other significant perceived risks include CCS would potentially displace investments in renewable energy (associated with opposition in the Calgary model) and CCS may be very expensive for the government and industry (associated with opposition in the Northern Alberta model). Finally, NEP (environmental concern) is associated with support in the Calgary model, egoistic values are associated with opposition in the Edmonton model, and higher education is associated with opposition in the Southern Alberta model.

Table 6. Regional Model Showing Significant Variation Between the Independent variables in each of the Four Regions

REGIONAL MODEL (Significant factors)	***Calgary*** **Std.Coeff**		***Edmonton*** **Std. Coeff.**		***Northern Alberta*** **Std. Coeff.**		***Southern Alberta*** **Std. Coeff.**	
Sample size (*n*=1076)	354		354		152		216	
	Beta	**P-value**	**Beta**	**P-value**	**Beta**	**P-value**	**Beta**	**P-value**
CCS knowledge (dummy)	-.058	.191	-.057	.202	-.003	.966	.012	.844
Psychological perceptions								
Environmental problem perception (dummy)	-.063	.145	-.013	.772	**-.157**	**.028***	.004	.949
Outcome Efficacy	**.323**	**.000****	**.197**	**.000****	**.376**	**.000****	**.311**	**.000****
Trust (AER+ industry)	**.102**	**.040***	.095	.077	.124	.166	**.128**	**.041***
Distributive Fairness	**.112**	**.012***	**.155**	**.001****	.109	.119	**.155**	**.006****
Perceived benefits								
continued ability to use fossil fuels	.081	.142	**.160**	**.012***	.025	.782	.010	.896
reduced emissions with no lifestyle chgs	-.004	.940	.023	.675	.166	.050	-.055	.391
only available tech some emiss sources	.011	.814	-.051	.301	.029	.717	.003	.960
balance econ. dev. with emissions reducs	**.115**	**.052***	**.172**	**.013***	.076	.438	.166	.026*
large reductions quicker than other techs	-.024	.667	.019	.771	-.063	.453	.058	.485
jobs creation and economic development	-.017	.744	-.080	.172	-.021	.805	-.108	.126
export CCS to other countries in future	**.126**	**.031***	**.132**	**.027***	.127	.152	**.216**	**.005****
reduced cost of future emission reduction	.092	.127	-.029	.671	.089	.349	.078	.277
Perceived risks and costs								
leakage	-.045	.463	.077	.239	.017	.878	-.086	.267
groundwater contamination	-.083	.135	**-.171**	**.008****	-.028	.830	.044	.582
leak harm	-.039	.500	**-.151**	**.018***	-.020	.863	-.004	.956
unknown future impacts	.011	.834	**-.134**	**.024***	-.102	.293	-.051	.459
displace renewable energy investment	**-.098**	**.044***	-.042	.373	.076	.380	-.115	.067
discourage fossil fuel reduction	.019	.671	-.061	.258	-.074	.369	.092	.164
Costs (high)	.028	.525	-.034	.498	**.199**	**.016***	.011	.856
Socio-demographic variables								
Age (continuous)	.004	.931	.012	.790	.074	.319	-.030	.587
Gender Male (dummy)	.083	.056	.084	.064	.003	.964	.001	.990
Education (dummy)	.035	.407	.075	.091	.100	.171	**-.109**	**.037***
Income (continuous)	.041	.301	.017	.697	-.009	.896	.085	.111
AB industry affiliation	.018	.637	-.010	.816	.109	.091	.022	.670

REGIONAL MODEL (Significant factors)	***Calgary*** **Std.Coeff**		***Edmonton*** **Std. Coeff.**		***Northern Alberta*** **Std. Coeff.**		***Southern Alberta*** **Std. Coeff.**	
Sample size (*n*=1076)		354		354		152		216
	Beta	**P-value**	**Beta**	**P-value**	**Beta**	**P-value**	**Beta**	**P-value**
NEP (pro-environmental)	**.123**	**.032***	.033	.547	-.036	.663	.051	.475
Values								
Traditional values	.020	.686	.067	.218	.011	.900	-.039	.578
Biospheric values	-.048	.393	-.121	.055	-.136	.167	-.070	.349
Egoistic values	-.056	.179	**-.109**	**.020***	-.130	.093	-.012	.817
Altruistic values	.033	.544	.068	.226	-.002	.978	.087	.190
Sample size (*n*=1076)		354		354		152		216
Adj. R-square	**0.536**		**0.43**		**0.482**		**0.505**	

*Significant at p<0.05 **Significant at p<0.01

Chapter 4.

Discussion and Limitations

4.1. Discussion

This study is designed to (1) assess Alberta citizens' knowledge of CCS and changes in knowledge over the last decade;(2) characterize citizen perceptions, attitudes and behavioral responses regarding CCS technology development and implementation in Alberta; and (3) explore the individual factors associated with support of or opposition to CCS in Alberta, and determine if there are any regional differences in how individual factors are associated with CCS support or opposition. This chapter reviews my key findings as they relate to my research objectives, considers these in light of other studies on public attitudes toward CCS, and discusses the implications of my research for policy.

My analysis indicates that respondents' knowledge of CCS in Alberta is substantial but not universal. 48% of respondents correctly identify CCS as a technology that addresses climate change. However, in comparison with a similar previous study, knowledge of CCS has greatly increased over the past eight years. A 2005 survey found that only 6% of respondents could identify the purpose of CCS (Sharp et al., 2009). While Sharp at al. (2009) and Duan (2010) found that higher knowledge of CCS resulted in higher support, my regression results suggest that this factor is not a significant predictor of citizen support in Alberta when controlling for other explanatory factors. One reason for this result could be because current awareness in Alberta is now much higher than it was when these studies were conducted. When CCS awareness was much lower in Canada in 2005, a much smaller proportion (10%) had heard about the technology. It is possible this group had experience with CCS or characteristics that influenced their level of support. Over the past decade, CCS knowledge has moved far beyond the initial

niche group to a large portion of the overall population, which includes a number of different sub-groups with different perspectives.

Although the effect of citizen knowledge on policy support has been widely studied in the literature, it is still a subject of debate, due to differences in research and analysis methodologies, information provided, and the types of knowledge and technologies studied. Indeed, a recent study suggests that citizen awareness of policy existence is not associated with citizen support for climate policies more generally (Dietz et al., 2007; Rhodes et al., 2014). Similarly, my study shows no evidence that CCS knowledge is a limiting factor in public support, leading to ambiguity over whether efforts to increase citizen awareness by providing CCS information to citizens is the best strategy for policy makers wanting to bolster support in Alberta.

My second objective is to characterize citizen perceptions and attitudes towards CCS technology development and implementation in Alberta. The results show that about half of the sample (53%) supports the implementation of CCS in Alberta, while less than a quarter is opposed (18%), and a slightly higher number remain "neutral/I don't know" (30%). The results show similar support across all four regional subsamples: the City of Calgary (55%), the City of Edmonton (48%), Northern Alberta (53%) and Southern Alberta (55%). This general level of support (or lack of resistance) is consistent with the observations from recent CCS survey studies of Alberta (Sharp et al 2009; IPAC-CO_2, 2012; Project Pioneer, 2011). In addition, supporters are less willing to take actions (e.g. sign a petition, hang a poster in a window, participate in a demonstration etc.) in support of CCS compared to opponents' willingness to take action against CCS. With a lack of resistance on a general level towards CCS in Alberta, the results do not show strong evidence that there will be massive protests/resistance across the province. All energy technologies, including CCS, involve risks and potentially harmful effects on the environment. Consistent with Sharp at al.'s (2009) findings based on their 2005 survey, our 2013 survey respondents consider CCS to be less risky than conventional oil and gas industry operations, nuclear power, or coal-fired power plants.

The final and most important research objective of my study is to identify the key determinants associated with support of or opposition to CCS in Alberta. In other words, I explore how individual factors are associated with support or opposition in the four

Alberta regions. In particular, I find that respondents' stated support of or opposition to CCS is associated with perceptions of outcome efficacy, trust, distributive fairness, benefits and risks, egoistic values and being male.

Consistent with previous research, the regression analysis suggests that respondents' perceptions of outcome efficacy are a significant predictor of support for CCS— a result that was consistent across all four regions. This fairly robust result implies the importance of respondents' perceptions of CCS as a useful climate change mitigation strategy in Alberta (Itaoka et al., 2004 and 2009; Reiner et al 2007 and 2009; Duan, 2010). Further, the regression analysis results show that outcome efficacy is statistically significant at a 99% confidence level or greater. However, contrary to Sharp at al. (2009), my regression analysis indicates that respondents' perceptions of climate change as a problem are not associated with support for CCS. An explanation for this result could be the survey design employed by Sharp et al. (2009), in which comprehensive information on CO_2 and climate change (risks and consequences) was provided to respondents prior to eliciting responses. In contrast, the present study provided brief and basic information about CCS, and very limited information about climate change. Perhaps this difference could have prompted some respondents in the Sharp et al. (2009) survey to make an evaluative judgment about the seriousness of climate change, thereby affecting their attitudes towards CCS.

Another important factor associated with CCS support is respondents' trust in the stakeholders involved in CCS implementation. As expected, the present results are consistent with other studies that show that higher levels of trust in the regulator and industry responsible for CCS are significantly associated with higher support for CCS (Huijts et al., 2007; Midden et al., 2009; Terwel et al., 2009).

Consistent with a previous 2012 CCS study of Alberta, respondent support is associated with beliefs in several specific CCS benefits, including the ability to balance economic development with emissions reductions, the continued ability to use fossil fuels, and the potential to export CCS technology to other countries in the future (significant in Calgary, Edmonton and the Southern Alberta models), while the perceived risk associated with opposition is the concern about potential groundwater contamination (IPAC-CO_2, 2012). Although respondents who support CCS perceive a significant benefit

from continuing to produce, use, and export fossil fuels while reducing emissions, opponents are worried that CCS might displace investments in other technologies, such as renewable energy. Perhaps these concerns could be alleviated if CCS is framed as being considered alongside renewables and energy efficiency as part of a broader climate change strategy portfolio.

The province-wide regression also indicates that respondents' stated support is associated with perceptions of fair distribution of benefits, risks, and costs related to CCS amongst citizens, which were also significant in the Calgary, Edmonton and the Southern Alberta regression models. This result aligns with many studies that have found strong positive relationships between perceived fairness and policy and technology acceptance (Schuitema et al., 2011; Bamberg et al., 2003; Eriksson et al., 2006). For this reason, the perceptions of the distribution of benefits and risks between groups for reducing collective problems (such as climate change) is important for increasing acceptance of technologies such as CCS (Schuitema et al., 2011).

When controlling for the factors mentioned above, socio-demographic variables such as age, income, education, and dependence on the fossil fuel industry in Alberta are not significant factors in predicting CCS support, but gender is: men are more likely to support CCS than women. The significance of gender in the model echoes findings in CCS surveys conducted in Canada (Sharp et al., 2009), France (Ha-Duong et al., 2009) and Australia (Miller et al., 2007).

Finally, I compared citizen support for CCS among the four regions, and identified any regional differences in how individual factors are associated with CCS support or opposition. Significant regional differences associated with the other factors were found mostly in Northern Alberta and Edmonton. Future research on these regional differences could benefit from increasing the number of regions surveyed and dividing the regions according to specific pre-determined characteristics.

4.2. Limitations and Suggestions for Future Research

This section acknowledges my study's limitations and makes suggestions for future research. First, time and resources available for this study necessarily limited its scope. My study suggests that psychological perceptions are more likely to influence respondents' attitudes towards CCS than knowledge. I did not test citizens' knowledge before and after providing information about CCS, nor did I provide extensive information on CO_2, climate change, and the risks and consequences of climate change prior to eliciting responses. While providing information may assist respondents in forming opinions, my aim was not to over-guide the formation of respondents' opinions to obtain as accurate a representation of respondents' current views and perceptions as possible. Future surveys could include testing CCS knowledge, and the effect of providing more information.

Second, I employed variables from the Huijts (2012) framework as a guide, but did not systematically test the causal order of the variables and the relationships between them (i.e. I did not develop a structural equation model similar to that employed by Huijts, 2014, or a similar tool that would estimate relationships among independent variables). I also excluded certain variables that I assumed would be less applicable to the Alberta landscape. Future research could benefit from testing the Huijts (2012) framework using a different statistical analysis methodology to determine the relationships between a comprehensive set of predictors.

Third, my study collected data from four broad regions in Alberta, which may have limited my ability to tease out subtle differences in CCS support and perceptions between specific Alberta communities. Although my study's survey sample included respondents who live in areas of the province that are suitable for CO_2 storage, the survey itself did not address issues related to NIMBYism. I did not inform respondents where CCS projects may be located nor did I elicit their opinions related to having a project located near them. While support of or opposition to a CCS proposal in a particular community could influence the development and implementation of CCS projects in Alberta, this aspect was not addressed in my study.

In order to guide a more detailed regional analysis, future research could include surveying more regions or focus on a few communities that would obviously be directly affected by a particular CCS proposal. For example, the recent Boyd (2013) study examined how community related factors are associated with residents' perceptions of CCS in their area. Similarly, community characteristics, local place based contexts and experience with CCS could also be tested as potential explanatory variables. My study could also be applied to other regions in Canada, such as British Columbia, where CCS implementation has been proposed.

A fourth limitation is related to the survey methodology employed in my study. Future research could explore other ways to elicit public opinions on CCS in Alberta such as focus groups and in-person qualitative interviews. These methodologies are able to provide a more thorough picture of the factors driving attitudes towards CCS. For instance, these methods might help to identify other geographic and experiential factors such as local sense of empowerment, population density, the role of the media, project fit with place identity, local relationships and history regarding other developments, especially if there has been past opposition or recent unwelcome development in the area. These factors could then be incorporated in a survey that segments the sample in a way that provides greater geographical resolution, and these factors could then be included into the framework. The resulting comprehensive framework would provide valuable insights into policy development at a regional level as well as CCS public outreach and engagement efforts.

Chapter 5.

Policy Recommendations and Conclusions

5.1. Policy Recommendations

My study is designed to enrich CCS stakeholders' understanding of the factors associated with citizens' perceptions of CCS in Alberta. If the Alberta government seeks to gain broad social support for CCS, they should consider these recommendations that are developed from the present empirical study:

First, perceptions of environmental risk deserve special attention. Because one of the significant perceived risks associated with opposition includes concern about potential groundwater contamination, both Government and industry involved in CCS operations must be vigilant in implementing and following the rules, regulations and protocols for site selection, operations, monitoring, and closure. Expected risks should be consistently and adequately communicated with communities in order to maintain support for CCS.

Second, because public trust is important for CCS support, campaigns and messaging should seek to build and sustain the public's trust in the Alberta Energy Regulator and CCS industry. For example, the regulator can build trust by conducting its affairs with openness and transparency, and regularly informing communities of its activities. High levels of public trust in academic researchers and independent scientists suggest these professionals should be engaged in providing accurate, up-to-date information on CCS research, experience, current projects, and objective assessments of environmental risks.

Third, communications from CCS proponents should highlight important economic benefits associated with CCS support, such as the ability for Alberta to

balance economic development with emissions reductions, the continued ability to use fossil fuels, and the potential to export CCS technology to other countries in the future.

Finally, perceptions of fairness are consistently associated with support for CCS. Fairness in implementing CCS is important because the benefits, risks, and costs for one community may not be the same as for another community. Government should make every effort, early in the public engagement process, to evaluate the needs of the community where a CCS facility will be placed, while realizing a fair distribution of expected benefits, risks, and costs amongst citizens.

5.2. Conclusions

Public support is likely to affect the feasibility of widespread implementation of CCS projects in the Canadian province of Alberta. This study explores citizens' perceptions of CCS, including knowledge and stated support, and develops a method to characterize attitudes towards CCS as a technological option for meeting greenhouse gas emissions reduction targets. The framework employed by this study to understand citizen perceptions includes psychological perceptions, environmental concerns, values and socio-demographic and situational variables. This framework was applied to data collected through a web-based survey of a representative sample of Alberta citizens (*n*=1076) in 2013.

The data suggest that respondents' knowledge of CCS has increased over the last decade, though climate change knowledge remains limited. Although awareness of CCS is increasing in Alberta, it is not significant in predicting attitudes towards CCS. The majority (53%) of respondents support the use of CCS, 18% of respondents oppose CCS, and 85% consider CCS at least "somewhat important" for inclusion in the province's emissions-reduction strategy. Further, respondents view CCS as less risky than conventional oil and gas industry operations, or coal-fired power plants, both of which are generally accepted in Alberta. This result suggests that policy makers will not currently face the challenge of public opposition (potentially manifested through the previously outlined actions) towards CCS at a general level in Alberta. However, opposition is still likely to emerge in response to a specific local CCS project-siting

proposal, although the impact of location on respondent support was not evaluated in this study. When evaluating attitudes towards a locally sited project, a number of significant factors that were identified through the results of the regression analysis could be incorporated along with local concerns.

Regression analysis reveals that respondent support for CCS is associated with perceptions of outcome efficacy (belief that CCS is a useful climate change mitigation strategy), trust in the regulator and industry, and distributive fairness. Outcome efficacy is consistently a significant predictor of support for CCS in the Alberta model as well as in all four regional models. Respondent support is associated with perceptions of several benefits of CCS implementation, including the ability to balance economic development with emissions reductions, the continued ability to use fossil fuels, and the potential to export CCS technology to other countries in the future. On the other hand, respondent opposition to CCS is associated with perceptions of risk, including concern about potential groundwater contamination and concerns that CCS would potentially displace investments in renewable energy.

By taking these significant factors into account, effective communication strategies can be developed through the outlined recommendations. These recommendations can help to improve the ongoing design and implementation of CCS technology, thus enhancing public outreach and engagement efforts related to CCS in Alberta.

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Appendix A.

Survey Instrument

This consent form outlines your rights as a participant in the study of “Public perceptions of Carbon Capture and Storage technologies in Alberta, Canada” conducted by Karen Mascarenhas, Master’s Candidate, School of Resource and Environmental Management, Simon Fraser University, Burnaby, B.C. This research is being supervised by Dr. Jonn Axsen, School of Resource and Environmental Management, Simon Fraser University, Burnaby, B.C.

ABOUT THIS RESEARCH

This research is aimed at learning more about what influences the support or opposition to Carbon Capture and Storage technologies (CCS) in Alberta, Canada. Your participation will help inform the academic community, social researchers, and policymakers. This online survey will explore your opinions through asking questions related to your experience with CCS and your perspectives on various policies, preferences and global issues. The survey will take about twenty minutes to complete. Participating in this research is voluntary. If you decide to take part, you can change your mind at any time and leave the study without penalty.

CONFIDENTIALITY AND RISKS

There is minimal risk to participating in this study. Our study is designed to keep your personal information confidential. The researchers themselves will not keep your contact information on file; you will be assigned a participant number, so your name and contact information will not be associated with your responses. The market research company hired to deliver this survey is based in Canada, and they will have your contact information on file. Their servers are encrypted, however we cannot guarantee that access to this information is impossible. A breach of confidentiality is unlikely, but in the case that such a breach occurs, it would be extremely difficult to match your information with your data. Data from this survey will be stored on password-protected servers for five years at Simon Fraser University. We do not believe that the data we collect from you during this survey will put you at any risk.

QUESTIONS ABOUT THE STUDY?

Any questions, concerns, or complaints about this survey may be directed to Karen Mascarenhas, Simon Fraser University via email at [...]

Concerns or complaints may also be directed to Dr. Hal Weinberg, Director of the Office of Research Ethics at Simon Fraser University, at […] or […]

AGREEMENT

I agree to be surveyed for the purposes of the project named above. The purpose and nature of the survey have been explained to me. I have had a chance to ask questions concerning the purpose and nature of the survey, the project, and my questions have been answered to my satisfaction. I understand that taking part in this study is entirely voluntary. It is my right to decline to answer any questions and to choose not to complete the survey. I understand that there are minimal risks associated with my participation in this survey. My name will not be used in the project; rather, a number will be used to identify all respondents. The use of a secure and encrypted web server will increase confidentiality of my identity. I understand that I can obtain the study results in the form of a public report and academic paper from the investigator, Karen Mascarenhas (via email […]).

I HAVE READ THIS CONSENT FORM. I HAVE HAD A CHANCE TO ASK QUESTIONS CONCERNING ANY AREAS THAT I DID NOT UNDERSTAND. BY CLICKING THE "AGREE AND BEGIN THE SURVEY" BUTTON, I AM CONSENTING TO PARTICIPATE IN THIS STUDY

❍ Agree and Begin the survey (1)
❍ Disagree and Exit the Survey (2)

Please indicate your age group:

❍ Under 18 (1)
❍ 18 to 29 (2)
❍ 30 to 39 (3)
❍ 40 to 49 (4)
❍ 50 to 59 (5)
❍ 60 to 69 (6)
❍ 70 or older (7)
❍ I prefer not to answer (8)

What is your gender?

❍ Male (1)
❍ Female (2)

What is your current postal code in Alberta?

Please use the format X1X1X1, with no space

Q1 Which of the following do you think are the three most important issues facing Alberta today? (Please select the top three)

- ❑ Health care (1)
- ❑ Education (2)
- ❑ Old age issues (3)
- ❑ Government spending (4)
- ❑ Jobs and the economy (5)
- ❑ Taxes (6)
- ❑ Crime (7)
- ❑ Climate change (global warming) (8)
- ❑ Environmental Issues (9)

SECTION 1: YOUR EXPERIENCE WITH CARBON CAPTURE AND STORAGE (CCS)

Q2 Have you heard of or read about a technology called "Carbon Capture and Storage", also referred to as CCS?

- ❍ I have heard of CCS and know what it is (1)
- ❍ I have heard of CCS but don't really know what it is (2)
- ❍ I have not heard of CCS (3)
- ❍ I don't know

Q3 Which of the following environmental concerns do you think is the main issue that carbon capture and storage (CCS) addresses? Please select one.

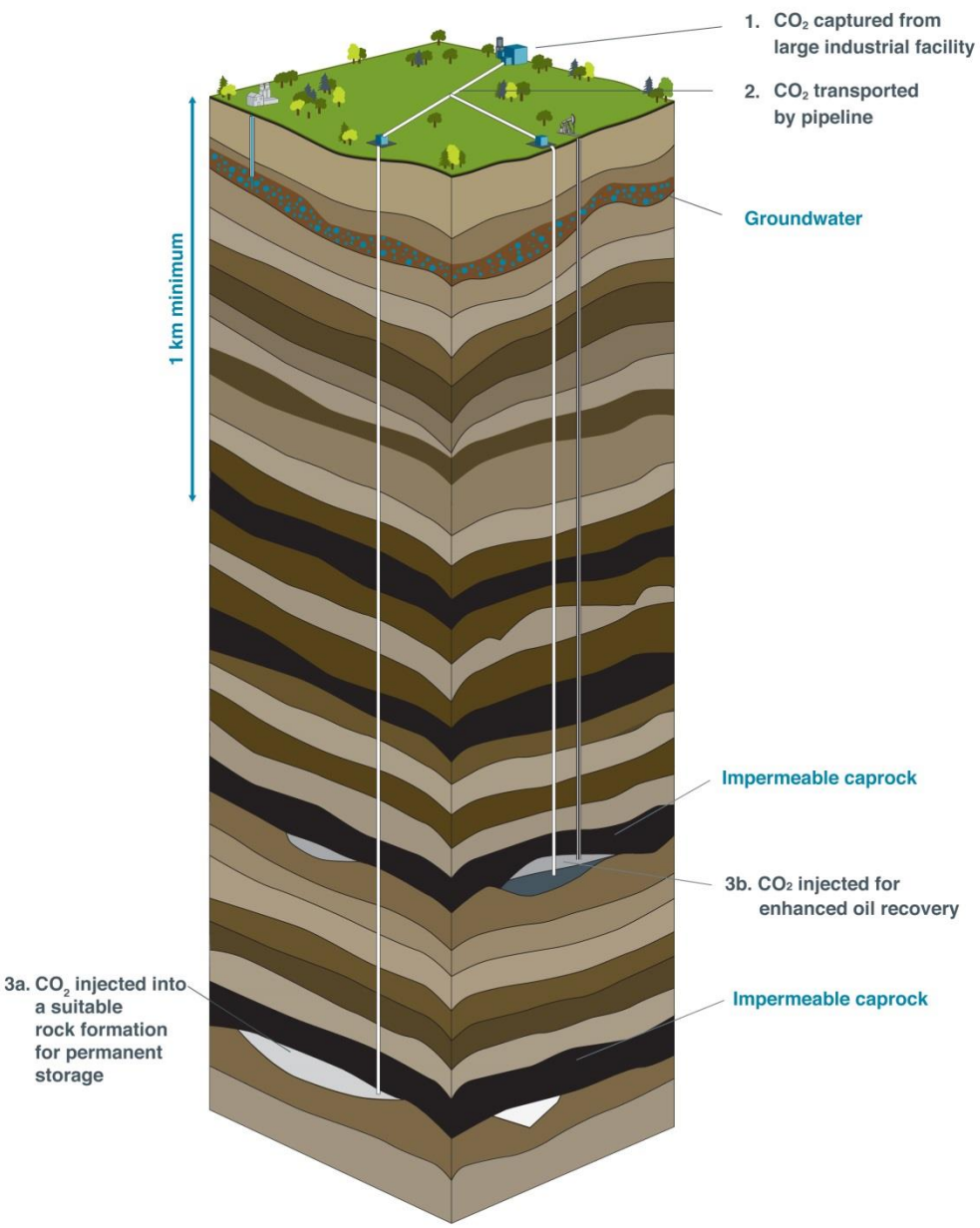
- ❍ Climate change (or global warming) (1)
- ❍ The hole in the ozone layer (2)
- ❍ Water quality (3)
- ❍ Air pollution from cars and trucks (4)
- ❍ Oil and gas pipeline safety (5)
- ❍ Toxic waste (6)
- ❍ Acid rain (7)
- ❍ None of the above
- ❍ I don't know

Please read the following information about a technology called Carbon Capture and Storage (CCS), which Alberta might use to reduce the threat of climate change (global warming).

Burning fossil fuels such as coal, oil, and natural gas releases extra carbon pollution (carbon dioxide or CO_2) into the atmosphere, which is believed to enhance the greenhouse effect and lead to climate change. Climate change could have a number of serious environmental, economic, and social consequences for Canada. Because of the significant risks posed by climate change, Alberta has committed to reducing emissions to 14% below 2005 emission levels by the year 2050.

A substantial part of Alberta's economy is currently related to the oil and gas industry. Additionally, Alberta's electricity is mostly generated by burning coal and other fossil fuels, which add CO_2 to the atmosphere. Scientists are developing ways to capture CO_2 from oil sands upgraders, oil and gas refineries, power plants and factories and safely store it underground so that it can't go into the atmosphere. There are currently eight full-size commercial CCS projects operating around the world, including one in Weyburn, Saskatchewan. Many additional large CCS projects are under development in Canada, including two that the Alberta government is partially funding: The Quest CCS project, which will capture and store CO_2 from oil sands operations, and The Alberta Carbon Trunk Line, which will transport captured CO_2 to oil and gas fields where it can be used to increase output. However, CCS is expensive and will not expand significantly until regulations or financial incentives make it mandatory or profitable to reduce CO_2.

HOW DOES CARBON CAPTURE AND STORAGE (CCS) WORK?
The major steps in CCS are shown in the diagram and are described below:
1. ***CAPTURE*** *CO_2 is separated and captured from the gases released by large industrial facilities so that CO_2 is not released into the atmosphere.*
2. ***TRANSPORT***
The captured CO_2 is transported through a pipeline to a place where underground rock formations can store the CO_2 permanently. CO_2 pipelines have been used in Alberta for over 20 years and across North America for more than 40 years, and are similar to those used for natural gas and oil.
3. ***INJECTION AND STORAGE***
The CO_2 is pumped down an injection well into rock formations deep underground. These rock formations are similar to the reservoirs that have held oil and natural gas for millions of years. In some cases, CO_2 is injected directly into oil and gas reservoirs to increase production through a process called Enhanced Oil Recovery. In Alberta, CO_2 storage sites must be at least one kilometer underground – far below agricultural land and groundwater. Above these storage reservoirs are several layers of solid rock. This rock, called cap rock, is different from the rock in the storage reservoirs because CO_2 cannot go through it. The cap rock keeps the CO_2 in the storage reservoir and away from the surface and drinking water.
SITE CLOSURE AND LONG TERM MONITORING
After CO_2 injection is finished at the storage site, the injection well is sealed and the site is closed and monitored over the long term. Scientists consider the risk of leaks from pipelines or storage sites to be very low, but monitoring will ensure that if there is a leak, it is detected so that it can be fixed. Other potential risks are that CCS may cause pressure changes underground that trigger weak earth tremors or push salt water or CO_2 into fresh water, or that CO_2 may release contaminants from rocks underground, which could then possibly move upwards. However, scientists consider these risks to be very low, and they can be minimized by careful site selection and management.


1. CO_2 captured from large industrial facility
2. CO_2 transported by pipeline
Groundwater
1 km minimum
Impermeable caprock
3b. CO_2 injected for enhanced oil recovery
3a. CO_2 injected into a suitable rock formation for permanent storage
Impermeable caprock

Q4 Based on this information, as well as anything you have read or heard about the technology, do you oppose or support the use of carbon capture and storage in Alberta?

❍ Strongly oppose (1)
❍ Somewhat oppose (2)
❍ Neutral (3)
❍ Somewhat support (4)
❍ Strongly support (5)
❍ I don't know (97)

Q5 Alberta's climate change strategy includes efforts to reduce energy use, improve energy efficiency, increase the use of renewable energy, and implement carbon capture and storage to reduce emissions (carbon pollution).
How unimportant or important do you think it is to include carbon capture and storage in the province's strategy to reduce emissions?

❍ Not at all important (1)
❍ Somewhat important (2)
❍ Important (3)
❍ Very important (4)
❍ I don't know (97)

SECTION 2: Your feelings about CCS in Alberta

You indicated that you have not yet made up your mind about CCS. Even though you are unsure of your opinion about carbon capture and storage, towards which way are you leaning?

❍ To oppose carbon capture and storage in Alberta (1)
❍ To support carbon capture and storage in Alberta (2)

Q6A If a carbon storage facility is proposed in your community, how likely would you be to take the following actions in support of carbon capture and storage (CCS)?

	Will definitely not take this action (1)	Unlikely to take this action (2)	Somewhat likely to take this action (3)	Very likely to take this action (4)	I don't know (5)
Sign a petition in support of CCS (1)	□	□	□	□	□
Give a donation to an interest group that aims to support CCS (2)	□	□	□	□	□
Hang a poster in the window, to support CCS (3)	□	□	□	□	□
Write a letter to a newspaper or magazine, in support of CCS (4)	□	□	□	□	□
Participate in a public meeting for citizens of the community to convince authorities to support CCS (5)	□	□	□	□	□

	Will definitely not take this action (1)	Unlikely to take this action (2)	Somewhat likely to take this action (3)	Very likely to take this action (4)	I don't know (5)
Vote for a party in the local elections that shares my opinion in support of CCS (6)	□	□	□	□	□
Participate in a demonstration or public event in support of the implementation of CCS (7)	□	□	□	□	□

Q6B To what extent do you disagree or agree with the following statements about actions 'in support of' a CCS storage facility?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
Taking the above actions 'in support of' CCS will influence the placement of a CCS storage facility (1)	□	□	□	□	□	□
The government and industry will take into account people voicing their opinions through the above actions (2)	□	□	□	□	□	□

Q7A If a carbon storage facility is proposed in your community, how likely would you be to take the following actions against carbon capture and storage (CCS)?

	Will definitely not take this action (1)	Unlikely to take this action (2)	Somewhat likely to take this action (3)	Very likely to take this action (4)	I don't know (5)
Sign a petition against CCS (1)	□	□	□	□	□
Give a donation to an interest group that aims to oppose CCS (2)	□	□	□	□	□
Hang a poster in the window to oppose CCS (3)	□	□	□	□	□
Write a letter to a newspaper or magazine, opposing CCS (4)	□	□	□	□	□
Participate in a public meeting for citizens of the community to convince authorities to oppose CCS (5)	□	□	□	□	□
Vote for a party in the local elections that shares my opinion against CCS (6)	□	□	□	□	□

	Will definitely not take this action (1)	Unlikely to take this action (2)	Somewhat likely to take this action (3)	Very likely to take this action (4)	I don't know (5)
Participate in a demonstration or public event against the implementation of CCS (7)	□	□	□	□	□

Q7B To what extent do you disagree or agree with the following statements about actions against' a CCS storage facility?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
Taking the above actions 'against' CCS will influence the placement of a CCS storage facility (1)	□	□	□	□	□	□
The government and industry will take into account people voicing their opinions through the above actions (2)	□	□	□	□	□	□

Q8 Please indicate to what extent you disagree or agree with the following statements about carbon capture and storage (CCS)?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
I would feel guilty if I did nothing to 'support'/oppose' a CCS storage facility (1)	□	□	□	□	□	□
I feel morally obliged to voice my opinion 'in support of'/'against' a CCS storage facility (2)	□	□	□	□	□	□
If I acted according to my principles, I would act 'in support of'/ 'against' a CCS storage facility (3)	□	□	□	□	□	□
I expect that people who are important to me believe that I should be 'in support of/' 'against'^ CCS (4)	□	□	□	□	□	□

SECTION 3: Your opinion on Carbon Capture and Storage (CCS)

Q9 In assessing Carbon capture and storage (CCS), please indicate your level of trust in each of the following stakeholders that might be involved in CCS? Please select "I don't know" if you are not familiar with any stakeholders or not sure about your level of trust in them.

	Very low trust (1)	Low trust (2)	Medium trust (3)	High trust (4)	Very high trust (5)	I don't know (6)
Federal Government (1)	□	□	□	□	□	□
Provincial Government (2)	□	□	□	□	□	□
Industry associations and companies developing carbon capture and storage projects (3)	□	□	□	□	□	□
Environmental organisations (4)	□	□	□	□	□	□
Non-profit organisations (5)	□	□	□	□	□	□
Academic researchers (6)	□	□	□	□	□	□
Independent scientists (7)	□	□	□	□	□	□

Q10 The Alberta Energy Regulator (AER) is authorized to make decisions on applications for energy development, oversee all other aspects of energy resource activities and monitor for compliance. The carbon storage facility is operated by industry participants involved in CCS. To what extent do you trust that..

	I have no trust (1)	I have a little trust (2)	I have some trust (3)	I have a lot of trust (4)	I don't know (5)
AER will adequately take the well-being of Alberta citizens into account before approving a carbon storage facility (1)	□	□	□	□	□
AER will make a responsible decision on whether or not to approve a carbon storage facility based on safety guidelines (2)	□	□	□	□	□
The carbon storage facility operator will have the knowledge and experience to ensure it is safe (3)	□	□	□	□	□
The carbon storage facility operator will ensure that a safe facility will be built (4)	□	□	□	□	□
The carbon storage facility operator will continuously monitor and perform safety checks to ensure it is safe (5)	□	□	□	□	□

Q11 How much of a risk do you believe that each of the following technologies poses to the environment and human health?

	Very low risk (1)	Low risk (2)	Moderate risk (3)	High risk (4)	Very High risk (5)	I don't know (6)
Nuclear power (1)	□	□	□	□	□	□
Oil and gas industry operations (production and refining) (2)	□	□	□	□	□	□
Coal-burning power plants (3)	□	□	□	□	□	□
Wind turbines (4)	□	□	□	□	□	□
Carbon capture and storage (CCS) (5)	□	□	□	□	□	□

Q12a Has a carbon storage facility ever been proposed near where you live?
No (1)
Maybe/ I don't know (2)
Yes (3)
When was the CCS project proposed? (1) _____
By whom was the CCS project proposed? (2) _____
Where was the CCS project proposed? (3) _____

Q13 Do you think that you would benefit from the use of carbon capture and storage technology in Alberta?
❍ I think I would benefit (1)
❍ I think I would not benefit (2)
❍ I don't know (3)

Q13A Why do you think that you would benefit?

Q13B Why do you think that you would not benefit?

Q14 To what extent do you disagree or agree with the following statements benefits of carbon capture and storage (CCS) to Alberta?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
CCS could allow Alberta to continue producing, using, and exporting fossil fuels while reducing emissions (carbon pollution) (1)	□	□	□	□	□	□
CCS could reduce emissions without relying on Albertans to achieve the same reductions solely by reducing their fuel and electricity use (2)	□	□	□	□	□	□
CCS is the only technology available to reduce emissions from some industrial and electricity production sources (3)	□	□	□	□	□	□
CCS would allow Alberta to balance economic development with reducing emissions (4)	□	□	□	□	□	□
CCS could allow Alberta to achieve large reductions in emissions more quickly than with other technologies (5)	□	□	□	□	□	□
CCS could create jobs in the province and contribute to economic development (6)	□	□	□	□	□	□
By developing expertise now, Alberta will be able to export CCS technology to other countries in the future (7)	□	□	□	□	□	□
By developing CCS technology now, the cost of future emission reductions can be substantially reduced (8)	□	□	□	□	□	□

Q15 To what extent do you disagree or agree with the following statements about the risks of carbon capture and storage technology to Alberta?

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
Carbon pollution could leak out of the storage site, contributing to climate change in the future (1)	□	□	□	□	□	□

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
The carbon pollution could move underground and contaminate groundwater (2)	□	□	□	□	□	□
A leak may harm nearby people, animals, or plants. (3)	□	□	□	□	□	□
There may be unknown future impacts (4)	□	□	□	□	□	□
It might displace investments in other technologies, such as renewable energy (5)	□	□	□	□	□	□
It will allow us to continue using fossil fuels, when we should instead be developing ways to reduce our fossil fuel use (6)	□	□	□	□	□	□
It may be very expensive for the government and industry (7)	□	□	□	□	□	□

Q16 When you think of the implementation of Carbon capture and storage (CCS) in Alberta, what do you think of the distribution of benefits (positive impacts) and risks (negative impacts) between yourself and other Albertans?

- ❍ Very unfair (1)
- ❍ Somewhat unfair (2)
- ❍ Somewhat fair (3)
- ❍ Very fair (4)
- ❍ I don't know (5)

Q17 Below is a list of common climate policies. A climate policy is a government action that is meant to reduce emissions with the goal of reducing climate change (global warming). If there was a referendum on adopting these policies in Alberta, how would you vote on each of these policies?

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

Carbon tax - a tax on carbon pollution from burning gasoline (government may commit to return all tax revenues as other tax cuts - called revenue-neutral carbon tax).

Carbon Capture and Storage (CCS)- a technology that captures the carbon pollution released from industrial facilities, and stores it so that it does not enter the atmosphere.

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

	Support (1)	Oppose (2)
Energy efficiency regulations for lighting, heating, and cooling systems in buildings (1)	□	□
Carbon tax (2)	□	□
Carbon Capture and Storage (CCS) (3)	□	□
Clean electricity regulation (or renewable portfolio standard) (4)	□	□

SECTION 4: GLOBAL ISSUES

Q18A How much do you feel you know about climate change (global warming)?

Nothing (1)	A little (2)	Some (3)	A lot (4)
□	□	□	□

Q18B Regardless of your knowledge about climate change, please indicate whether you think each of the following is a significant cause or not a significant cause of climate change (global warming)

	A significant cause (1)	Not a significant cause (2)
Cows (1)	□	□
The space program (2)	□	□
Acid rain (3)	□	□
The sun (4)	□	□
Volcanic eruptions (5)	□	□
Aerosol spray cans (6)	□	□
Toxic wastes (7)	□	□
The hole in the ozone layer (8)	□	□
Deforestation (9)	□	□
Burning fossil fuels for heat and electricity (10)	□	□
Cars and trucks (11)	□	□

Q19 From what you know about climate change (global warming), which of the following statements comes closest to your opinion?

❍ Climate change has been established as a serious problem and immediate action is necessary. (1)

❍ There is enough evidence that climate change is taking place and some action should be taken. (2)

❍ We don't know enough about climate change and more research is necessary before we take any actions. (3)

❍ Concern about climate change is unwarranted. (4)

❍ No opinion (99)

❍ I don't know anything about this issue. (97)

Q20 Who do you think should bear most of the responsibility for curbing environmental damage?

	Not at all responsible (1)	Somewhat responsible (2)	Responsible (3)	Highly responsible (4)
Government (1)	□	□	□	□
Industry (2)	□	□	□	□
Small businesses (3)	□	□	□	□
Individual and households (4)	□	□	□	□

Q21 Please indicate to what extent you disagree or agree with the following statements about carbon capture and storage (CCS)

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	I don't know (6)
The risks of CCS are greater than those of climate change (global warming) (1)	□	□	□	□	□	□
It is better to accept CCS than to live with the consequences of climate change (2)	□	□	□	□	□	□
I am willing to accept the building of new CCS facilities if it would help to tackle climate change (3)	□	□	□	□	□	□
It doesn't matter what we think of CCS. CCS facilities will be built anyway. (4)	□	□	□	□	□	□
I am willing to support CCS provided that renewable energy sources are developed and used at the same time (5)	□	□	□	□	□	□

SECTION 5: YOUR VALUES AND ACTIVITES

Q22 Please indicate your level of agreement with the following statements:

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

	Strongly disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly agree (5)
Humans were meant to rule over the rest of nature. (8)	□	□	□	□	□

Q23 Consider each set of the values below and indicate how important they are as a guiding principle in your life.

	Not at all Important (1)	A little important (2)	Somewhat Important (3)	Very Important (4)
Family security, safety for loved ones. (1)	□	□	□	□
Honoring parents and elders, showing respect (2)	□	□	□	□
Self-discipline, self-restraint, resistance to temptation (3)	□	□	□	□
Respecting the earth, harmony with other species (4)	□	□	□	□
Protecting the environment, preserving nature (5)	□	□	□	□
Equality, equal opportunity for all (6)	□	□	□	□
Social justice, correcting injustice, care for the weak (7)	□	□	□	□
Unity with nature, fitting into nature (8)	□	□	□	□
A world at peace, free of war and conflict (9)	□	□	□	□
Influential, having impact on people and events (10)	□	□	□	□
Authority, the right to lead or command (11)	□	□	□	□
Wealth, material possessions, money (12)	□	□	□	□

Q24 We are interested in understanding how you use your time and what types of activities you are typically involved in. Think of how you spend your waking hours in a given month. How frequently do you engage in the following activities?

	Never (1)	Rarely (2)	Occasionally (3)	Frequently (4)	Very Frequently (5)
Your main career. (1)	□	□	□	□	□
Other sources of income. (2)	□	□	□	□	□
Developing career skills. (3)	□	□	□	□	□
Studying or taking post-secondary courses. (4)	□	□	□	□	□
Investing or managing your money. (5)	□	□	□	□	□

	Never (1)	Rarely (2)	Occasionally (3)	Frequently (4)	Very Frequently (5)
Travelling significant distances to and from work. (6)	□	□	□	□	□
Travelling for work. (7)	□	□	□	□	□
Travelling for purposes other than work. (8)	□	□	□	□	□
Taking care of family. (9)	□	□	□	□	□
Spending time with family. (10)	□	□	□	□	□
Spending time with pets or other animals. (11)	□	□	□	□	□
Shopping for food. (12)	□	□	□	□	□
Shopping at malls or stores. (13)	□	□	□	□	□
Preparing food for yourself or family. (14)	□	□	□	□	□
Spending time in nature. (15)	□	□	□	□	□
Outdoor sports or recreation. (16)	□	□	□	□	□
Indoor sports or recreation. (17)	□	□	□	□	□
Indoor hobbies (e.g., games, art, crafts) (18)	□	□	□	□	□
Reading for leisure. (19)	□	□	□	□	□
Watching T.V. or movies. (20)	□	□	□	□	□
Using the internet for leisure. (21)	□	□	□	□	□
Playing video games. (22)	□	□	□	□	□
Spending leisure time with friends. (23)	□	□	□	□	□
Personal development. (24)	□	□	□	□	□
Religious services or activities. (25)	□	□	□	□	□
Meditation. (26)	□	□	□	□	□
Exploring your spirituality. (27)	□	□	□	□	□
Volunteering. (28)	□	□	□	□	□
Giving to charity. (29)	□	□	□	□	□
Gardening flowers and plants. (30)	□	□	□	□	□
Gardening for food. (31)	□	□	□	□	□
Repairing or renovating your house. (32)	□	□	□	□	□
Doing housework. (33)	□	□	□	□	□
Decorating your home. (34)	□	□	□	□	□
Researching new technology. (35)	□	□	□	□	□
Shopping for new technologies. (36)	□	□	□	□	□
Using new technologies. (37)	□	□	□	□	□
Talking about new technologies. (38)	□	□	□	□	□

	Never (1)	Rarely (2)	Occasionally (3)	Frequently (4)	Very Frequently (5)
Working on or tinkering with technology. (39)	□	□	□	□	□
Following the news and current events. (40)	□	□	□	□	□
Taking part in political meetings. (41)	□	□	□	□	□
Discussing politics. (42)	□	□	□	□	□
Thinking about protecting the environment. (43)	□	□	□	□	□
Trying to help the environment through daily actions. (44)	□	□	□	□	□
Attending environmental meetings. (45)	□	□	□	□	□
Engaging in environmental conservation activities. (46)	□	□	□	□	□
Promoting environmental conservation (talking to people about the environment). (47)	□	□	□	□	□

Q25 Please indicate your thoughts on the following:

	Strongly disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly agree (5)
I often try new activities. (1)	□	□	□	□	□
My responsibilities usually keep me from trying new things. (2)	□	□	□	□	□
I have many different groups of friends. (3)	□	□	□	□	□
I am currently making a big transition in my life. (4)	□	□	□	□	□
I rarely make new friends. (5)	□	□	□	□	□
I have very little free time. (6)	□	□	□	□	□
My life has been the same for quite a while. (7)	□	□	□	□	□
I tend to do the same activities as my friends. (8)	□	□	□	□	□
I plan to make significant changes in my near future. (9)	□	□	□	□	□

Q26 To what extent do you see yourself as pursuing a “green” (i.e. environmentally-conscious) lifestyle? I see my overall lifestyle as..
Not green = environmental activities are not a priority (1)
Light green = environmental activities are sometimes a priority (2)
Medium green = environmental activities are generally a priority (3)
Dark green = environmental activities are a main lifestyle priority (4)

Q27 Please indicate to what extent you disagree or agree with the following statements about your community

	Yes (1)	No (2)
I work for a business associated with the energy industry in Alberta (1)	□	□
Someone in my family works for a business associated with the energy industry in Alberta (2)	□	□
I have an oil injection well or pipeline on my property (3)	□	□
Someone in my family has an oil injection well or pipeline on their property (4)	□	□
The oil and gas industry has a significant presence in my community (5)	□	□

SECTION 6: SOCIO DEMOGRAPHIC DETAILS

Q28 The information in this section will be used only for descriptive / statistical purposes. What is your employment status?

❍ Employed or self-employed (1)
❍ Unemployed (2)
❍ Not in the labour force (students, homemakers, retired workers, seasonal workers in an 'off' season who were not looking for work, and persons who can not work because of a long-term illness or disability) (3)

Q29 Please indicate which of the following industries best describes the industry you work in?

❍ Agriculture, forestry, fishing and hunting (1)
❍ Mining and oil and gas extraction (2)
❍ Utilities (3)
❍ Construction (4)
❍ Manufacturing (5)
❍ Wholesale trade (6)
❍ Retail trade (7)
❍ Transportation and warehousing (8)
❍ Information and cultural industries (9)
❍ Finance and insurance (10)
❍ Real estate and rental and leasing (11)
❍ Professional, scientific and technical services (12)
❍ Management of companies and enterprises (13)
❍ Administrative and support, waste management and remediation services (14)
❍ Educational services (15)
❍ Health care and social assistance (16)
❍ Arts, entertainment and recreation (17)
❍ Accommodation and food services (18)
❍ Other services (except public administration) (19)
❍ Public administration (20)
❍ Non profit sector (21)

Q30 What is the highest level of education you have completed?
This information is used only for statistical purposes.

❍ Grade School or Some High School (1)
❍ High School Completed (2)
❍ Technical or Trade School/Community College Completed (3)

❍ Some Community College or University, Not Completed (4)
❍ University Degree, such as a Bachelor's Degree (5)
❍ Post-Graduate Degree, such as a Master's or Ph.D Degree (6)

Q31 What pre-tax income category does your household fit into? My annual household income is...
❍ Less than $10,000 (1)
❍ $10,000 to $19,999 (2)
❍ $20,000 to $29,999 (3)
❍ $30,000 to $39,999 (4)
❍ $40,000 to $49,999 (5)
❍ $50,000 to $59,999 (6)
❍ $60,000 to $69,999 (7)
❍ $70,000 to $79,999 (8)
❍ $80,000 to $89,99 (9)
❍ $90,000 to $99,999 (10)
❍ $100,000 to $124,999 (11)
❍ $125,000 to $150,000 (12)
❍ Greater than $150,000 (13)
❍ I prefer not to answer (96)

Q32 Which political party best represents your views/did you support in the last Alberta provincial election?
❍ Alberta Liberal Party (1)
❍ Alberta New Democratic Party (2)
❍ PC Party of Alberta (3)
❍ Wildrose Party (4)
❍ I am not affiliated with any political party (5)
❍ Other (98)_____
❍ I prefer not to answer (99)

Q33 Which of the following best describes where you live?
Please select one response only.
❍ Acreage, ranch or farm (1)
❍ Town of less than 10,000 people (2)
❍ City of 10,000 to 39,999 people (3)
❍ City of 40,000 to 100,000 people (4)
❍ City of more than 100,000 people (5)
❍ I prefer not to answer (96)

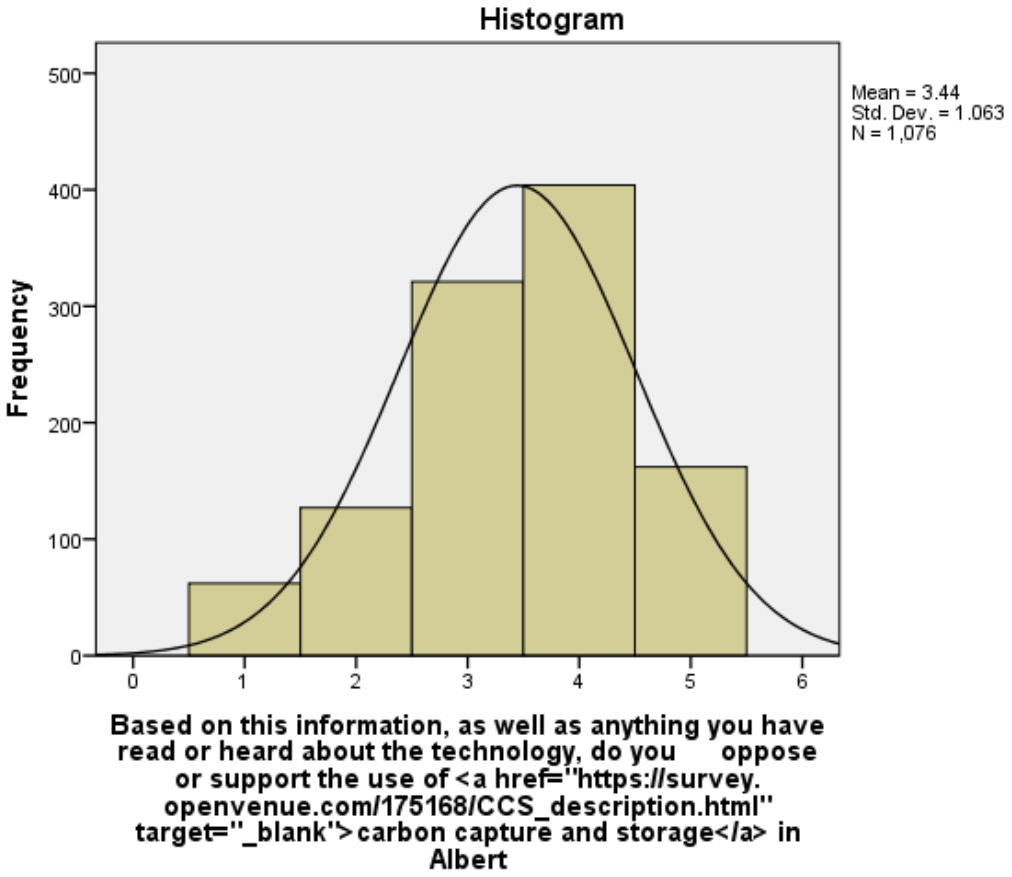
Thank you for completing the survey. Your participation has helped the academic community, energy researchers, businesses, policymakers and consumers.
Please click the 'Next' button below to continue.

If you have any final comments, please enter them in the box below:

Appendix B.

Supporting figure: Multiple Regression Analysis

After investigating the data structure of the dependent variable, the frequency distribution was estimated to be close enough to a normal distribution to proceed with the regression analysis.



The Tolerance (> 0.1) and VIF (<10) values for all the variables confirmed that there were no issues with multicollinearity among the variables in the model.