net-zero atlantic

BEHAVIOURAL INTERVENTIONS FOR A NET-ZERO TRANSITION IN ATLANTIC CANADA

RESEARCH INSIGHTS

A summary report on the methods and findings from the Pro-Climate Behaviours in Atlantic Canada research project.

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DAVIS PIER

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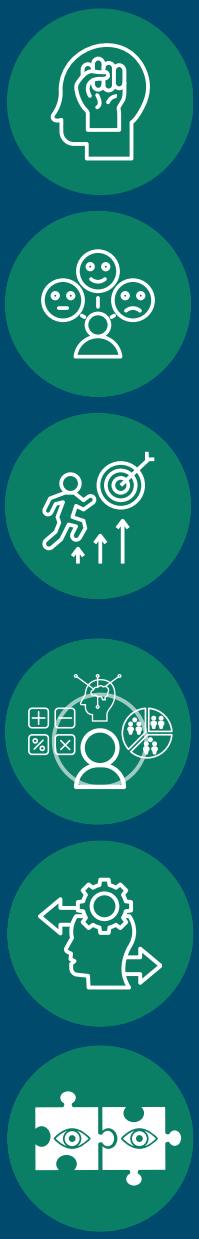
Executive Summary

Atlantic Canada, like much of the world, requires substantial change from government, organizations, and individuals to facilitate their transition to net-zero emissions. This white paper summarizes the findings from research projects authored by five research teams exploring behavioural science interventions relating to pro-climate behaviours. The research focuses on individual-level carbon reduction opportunities in areas such as transportation, energy efficiency, and infrastructure. Projects embedded equity, diversity, and inclusion (EDI) principles to identify more inclusive and equitable pathways for diverse groups in the area, such as First Nations, rural communities, lower-income households and new immigrants.

The five projects applied key behavioural science theories and methodological frameworks, such as the Self-Determination Theory, the Theory of Planned Behaviour, the Capability, Opportunity, and Motivation Model (COM-B), the Decision-Science Approach, the Behavioural Design Framework, and Two-Eyed Critical Sensemaking. The work was conducted at universities across the region, including Cape Breton University, Dalhousie University, Memorial University of Newfoundland, University of New Brunswick, and University of Prince Edward Island. Researchers employed methods including literature reviews, surveys, qualitative interviews, and experimental studies to explore barriers and enablers to pro-climate behaviours across diverse groups in the four provinces.



The preliminary findings of these five studies show promise for the effective use of a variety of behavioural science methods. They noted a variety of common barriers, reflective of existing literature, including knowledge gaps, habitual behaviours, cost and convenience concerns, infrastructure limitations, and perceived or actual lack of control. They also noted enablers, often related to barriers, such as financial incentives, social norms, personalized interventions, and combining multiple behavioural insights. Their findings also largely support the idea that individual-level behaviour change is driven by carefully developed, scalable policy interventions.

Across sectors, context specific barriers were identified. Transportation is one of the highest emitting sectors in the region, largely tied to personal vehicle use. This reliance is linked to concerns relating to the inaccessibility of reliable and affordable public or active transport alternatives. Notably, rural communities feel the impacts, sometimes having no infrastructure at all. When considering housing infrastructure and residential energy efficiency, researchers noted that adoption is limited by high upfront costs and a lack of autonomy for populations who do not own their homes. Additionally, those who adopt often see significant increases in energy consumption due to rebound effects and moral licensing theory. The findings suggest that some interventions, like community engagement, play a role in reinforcing sustainable behaviours across sectors.

The findings of these projects showcase opportunities to integrate behavioural science insights into climate policy, such as infrastructure planning and financial incentives. The work highlights the importance of equity-forced and community driven approaches to expand targeted information, awareness and action. Future research should expand to understand long-term behaviour change, scalable policy interventions, and the impact on underrepresented populations.

Introduction

Context and Background

As a pressing global crisis that threatens ecosystems, economies, and communities worldwide, tackling climate change and progressing towards a net-zero future requires more than technological and policy solutions—it demands a deep understanding of human behaviours and decision-making processes in order to drive significant individual and collective action for climate mitigation and adaptation. This document is the second deliverable of the initiative 'Determining critical behavioural interventions for enabling an effective transition to net-zero emissions in Atlantic Canada,' selected by the Net-Zero Advisory Body to receive support through the Environmental Damages Fund's Climate Action and Awareness Fund, administered by the Department of Environment and Climate Change Canada.

Project Objective

This deliverable aims to summarize the research projects led by the project team of this initiative, outlining methods and findings from five distinct research lines that explore behavioural interventions aimed at facilitating Atlantic Canada's transition to net-zero emissions in key sectors.

As highlighted in the first published White Paper under this initiative, individual- and household-level behaviours are accountable for nearly three-quarters of the global carbon footprint, with changes in transportation, building and housing energy use, and agriculture and dietary choices as actions with the greatest potential to reduce emissions. Particularly in Atlantic Canadian provinces, transportation, infrastructure, and energy efficiency are three of the main contributing sectors for carbon-related emissions—making them the key sectors for targeting behaviour change in the research projects developed under this initiative.

Focusing on Transportation

Aligning with Atlantic Canada's heavy reliance on private vehicles rather than sustainable alternatives, transportation is one of the main targeted sectors.

- Research from the University of Prince Edward Island, led by Dr. Xiao Chen and Dr. Lena Liang, aims to understand enablers and barriers to the adoption of eco-friendly driving behaviour. This work synthesizes existing behavioural science research on interventions promoting eco-friendly driving behaviours and analyzes the experiences, beliefs, and attitudes of key parties in PEI.

- Research from the University of New Brunswick, led by Dr. David Foord, expands on these findings by identifying strategies to promote sustainable transportation practices. Leveraging envisioned futures constructed through shared narratives and expectations, this work also seeks to understand how people in Fredericton picture the future of individual transportation behaviours.

- Research from Cape Breton University, led by Dr. Mary Beth Doucette, focuses on identifying barriers and opportunities for First Nations populations in rural Nova Scotia to adapt to pro-climate transportation choices, expanding into key interventions to improve infrastructure and residential energy policies available to First Nations communities.

Transitioning to Energy Efficiency

Research from Dalhousie University led by Dr. Stanley Asah investigates the adoption, diffusion and effective use of energy-efficient household upgrades, including solar energy appliances and heat pumps.

Pro-Climate Behaviours in Atlantic Canada

Multi-sectorial Focus

In addition to occasional individual-level changes such as upgrading household energy utilities, regular individual decisions and behaviours are also demonstrated to contribute to climate change mitigation (Shukla et al., 2022).

- In this scope, research from Memorial University of Newfoundland led by Dr. Martin Day explores the behavioural impact of tailored individual carbon feedback on altering carbon-intensive yet short-term changeable behaviours involving transportation, food consumption, and general consumption (clothing and technology).

Acknowledging the critical role of behavioural science in supporting climate change adaptation and mitigation efforts, this article showcases insights from contemporary Atlantic Canadian evidence-based research from diverse sectors seeking to pave the way for human-centered and behaviourally sustained pro-climate solutions

Overview of Research Projects

Understanding and influencing pro-climate actions requires a multifaceted approach that considers behavioural science, equity, and policy gaps. Pro-climate behaviours refer to actions that individuals can take to help reduce their impact on the environment, aiming to lower the carbon-related emissions released into the atmosphere, which are primarily responsible for global warming and climate change. Under the coordination of Net Zero Atlantic, the following five research projects aimed to characterize barriers and enablers for pro-climate behaviours within key sectors responsible for greenhouse gas (GHG) emissions in Atlantic Canada. These research pieces specifically focus on individual-level emissions – namely, those related to transportation, buildings

and energy use, agriculture (including food consumption), and multiple sectors. These studies leverage behavioural science principles to analyze antecedents of behaviour and explore interventions for behavioural change, offering insights into how Atlantic Canadians adopt and adapt to low-carbon alternatives.

Eco-friendly Driving Behaviours

RESEARCH INSTITUTION: UNIVERSITY OF PRINCE EDWARD ISLAND (UPEI)

Research Topic:
Promoting eco-friendly driving behaviour in Prince Edward Island

Sector Focus:
Transportation

Primary Methods:
Systematic literature review; In-depth interviews

Behavioural Focus:
Intrinsic and extrinsic motivators; Psychological and structural barriers; Community influence

This research employs a systematic literature review (e.g., behavioural science studies and government reports), along with in-depth interviews, to examine the factors influencing eco-friendly driving behaviour, namely, personal fuel-efficient driving practices (e.g., smooth driving, maintaining proper tire pressure, and minimizing idling). Local insights were gathered from diverse stakeholders in Prince Edward Island, including individual drivers and consumers, academics and educators, professionals and practitioners, policymakers, and community leaders. Grounded in Self-Determination Theory (Deci & Ryan, 2000), the study explores intrinsic (e.g., personal values) and extrinsic motivators (e.g., monetary incentives) that shape eco-friendly driving behaviour. It also identifies psychological (e.g., limited cognition, knowledge and awareness gaps), structural barriers (e.g., financial constraints, government inaction), and their interplay that impede adoption (Gifford, 2011). Using an adaptive governance approach (Folke et al., 2005), the research further examines how community-level interventions can enhance eco-friendly driving practices. While this study aimed to integrate equity, diversity, and inclusion (EDI) perspectives by engaging rural PEI, Indigenous, and newly landed immigrant communities, its qualitative nature and limited access to these populations posed challenges in fully documenting their unique motivators and barriers. Geographic isolation, socio-economic constraints, and cultural norms continue to shape these groups' eco-friendly driving practices. By uncovering both internal (psychological) and contextual factors, this research contributes to the development of more inclusive and effective interventions, advancing eco-friendly driving practices in PEI and beyond (Folke et al., 2005; Gifford, 2011; Ryan & Deci, 2000).

Sustainable Transportation and Envisioned Futures

RESEARCH INSTITUTION: UNIVERSITY OF NEW BRUNSWICK (UNB)

Research Topic:
Barriers and interventions for sustainable transportation and pro-climate behaviours in civic transitions

Sector Focus
Transportation

Primary Methods:
Quantitative analysis; In-depth interviews

Behavioural Focus:
Intrinsic and extrinsic factors of behaviour adoption

Integrating the Theory of Planned Behaviour (Ajzen, 1991) with the Sociotechnical Transition Framework (Sovacool & Griffiths, 2023), research from UNB provides a multi-level perspective on transportation behaviours in Fredericton and explores envisioned futures from both government and citizens on how individual behaviour can look in the sustainability transition within a socio-technical system. The first study in this research examines the role of intrinsic factors (attitudes, subjective norms, and perceived control) and extrinsic factors (infrastructure limitations, financial constraints, and habitual car use) in shaping sustainable transportation adoption. The second study further embeds behavioural science by utilizing the COM-B model (which affirms that capability, opportunity and motivation are needed in order to engage in a behaviour) to identify behavioural barriers, building upon a set of interventions presented in the published literature review (first published White Paper) to explore their potential to tackle those obstacles. Leveraging envisioned futures as a method of understanding what future transitions could look like, this approach provides insights into how personal, systemic, and technical elements shape perceptions of sustainability. With a strategic approach to collecting data from diverse groups, their dual-approach research presents a holistic representation for driving behavioural change.

Transportation & Infrastructure Transition Policies for First Nations Communities

RESEARCH INSTITUTION: CAPE BRETON UNIVERSITY (CBU)

Research Topic:
Positioning rural populations in net-zero change policies

Sector Focus
Transportation; Infrastructure

Primary Methods:
Literature review; In-depth interviews; Qualitative analysis (inductive analysis); Quantitative analysis

Behavioural Focus:
Two-Eyed Critical Sensemaking; Culturally relevant gender-based analysis

Research from CBU focuses on identifying socio-demographic and socio-political factors of sub-populations in Atlantic Canada, with particular emphasis on First Nations people living on reserve. Acknowledging the role of geography in shaping one's sense of agency by creating social cues which people rely on to navigate and make sense of change, this work addresses energy transitions related to transportation and infrastructure. It seeks to understand and identify gaps in behavioural policy interventions related to transportation and residential energy that fail to recognize the unique political, social, cultural, and geographic influences on the choice architecture of First Nations communities living on reserve. A critical component of this research is the adoption of research processes, such as the use of secondary census data from Statistics Canada, to minimize the burden on Indigenous people. The application of the Two-Eyed Critical Sensemaking approach, combining Culturally Relevant Gender-Based analysis with Critical Sensemaking, intends to better understand conditions that facilitate or hinder someone's ability and willingness to change behaviours and to analyze organizational responses to government policy changes. Though often left out of climate change discussions, this research focuses on groups who benefit least from climate-related research findings and outcomes.

Household-focused Energy Transitions

RESEARCH INSTITUTION: DALHOUSIE UNIVERSITY (DAL)

Research Topic:
Adoption, effective use, and diffusion of household heat pumps and solar energy applications

Sector Focus
Energy

Primary Methods:
Literature review; In-depth interviews

Behavioural Focus:
Adoption, diffusion and maladaptation

Within the scope of residential energy, research from Dal explores Atlantic Canadian motivations, constraints, and strategies used to negotiate constraints to adopting, using, and diffusing household solar energy applications and heat pumps. A major focus of this research is addressing behavioural maladaptation that may explain rebound effects, reflecting instances where people might not maximize the efficiencies of adopted solar energy applications and heat pumps. This work helps to promote equitable access and long-term adoption by considering potential inequities associated with the following socioeconomic and demographic groups: immigrants, African Nova Scotians, and people of different socioeconomic backgrounds.

Carbon Feedback for Individual-level Behaviours

RESEARCH INSTITUTION: MEMORIAL UNIVERSITY OF NEWFOUNDLAND (MUN)

Research Topic:
Impact of personalized feedback on intentions and carbon-intensive behaviours

Sector Focus
Multi-sectoral, including transportation (driving), food consumption, clothing, and technology consumption)

Primary Methods:
Large Experimental (Carbon feedback vs. Control) and Longitudinal (2 months) Online Study; Pilot Study; Quantitative Analysis; Stakeholder Interviews; Literature Review

Behavioural Focus:
Combined behavioural insights; Personalized behaviour feedback; Knowledge-behaviour gap; Intentions-behaviour gap

In the scope of individual-level behaviours, research from MUN investigated whether a tailored, brief carbon feedback intervention (e.g., 15 mins) as compared to a control condition can increase intentions to reduce everyday carbon-intensive behaviours and decrease actual behaviours over a 2-month time period. Around 800 participants from all four Atlantic provinces completed the study at Time 1 and Time 2 (2 months later). This research was grounded in a Decision Science approach (Chapman, 2019) to behavioural change and relied on the systematic Behavioural Design framework (Datta & Mullainathan, 2015) for identifying the most likely psychological barriers that could be addressed by intervention design. While prior research showcased carbon footprint calculators as increasing intentions to act, the effect on actual behaviours is unclear. Thus, this work focused on encouraging behavioural change by leveraging a combined behavioural insights approach to carbon feedback (over 10 psychologically-informed design factors aimed to address potential barriers to carbon-related behaviour change). For example, the carbon feedback condition included personalized carbon-behaviour feedback, corrected misunderstandings about carbon behaviours, boosts to self and collective efficacy, positivity, habit change, customized behavioural examples, social norms, and freedom-preserving framing to increase individual pro-climate

intentions and subsequent actions related to reducing carbon-emitting behavioural patterns (the control condition received no extra feedback). This study found converging evidence through objective and subjective indicators of a reduction effect of the carbon feedback condition on carbon behaviour totals after two months, compared to the control condition. An equity, diversity, and inclusion approach in this research also considered demographics (in particular, geographic location) in feedback recommendations and incorporated inclusive language and open textboxes for self-identification within data collection procedures. This work provides valuable insights into how personalized interventions and using multiple behavioural insights without any financial incentives can encourage and empower individuals to make more sustainable choices.

Tackling Atlantic Canadian Biggest Emitting Sectors

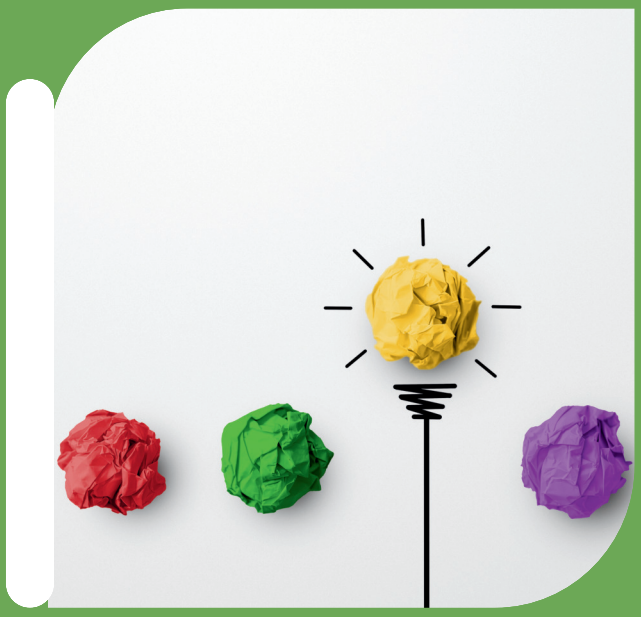
The findings of these studies contribute to a broader understanding of how individual and systemic factors shape pro-climate behaviours relating to key emission sectors in Atlantic Canada. Individual-level considerations and regional differences in emissions require thoughtful strategies for reduction. In Atlantic Canada, for example, key drivers of GHG emissions include transportation, energy use, and infrastructure. Transportation is the largest area for emissions in Atlantic Canada (33.3%), considering a heavy reliance on personal vehicles. With 40-54% of the population in the region residing in rural communities, transportation habits are deeply shaped by geographic and socio-economic realities (Statistics Canada, 2022a). Additionally, the vast majority (91-94%) of Atlantic Canadians own at least one, typically gasoline or diesel-powered, vehicle (90-93%; Statistics Canada, 2024). Other common sources of GHG emissions in the region relate to individual choices relating to energy use and building infrastructure. Behaviours such as overusing heating and cooling, leaving lights or devices on unnecessarily, and using energy-intensive appliances result in excessive and inefficient energy use (Natural Resources Canada, 2011).

These research projects share common interests as well as some approaches, as they leverage behavioural science principles to improve our understanding of climate change adaptations in Atlantic Canada. Building on current state literature, the leading researchers of this project team creatively designed and implemented their projects, integrating a more equitable and inclusive application of behavioural science across demographics, including diverse socio-economic and socio-political groups. Their findings underscore the need for targeted and contextualized interventions, recognizing the unique beliefs, attitudes, available resources, and context-specific realities of distinct communities.

These projects identify potential pathways to more inclusive, equitable, and effective climate adaptation and mitigation solutions.

> Together, they contribute to Canada's overarching goal of achieving net-zero emissions by 2050 by addressing not only industrial and organizational emissions but also individual-level decision-making and behavioural shifts.

Approaches Behind the Research: Uncovering Behavioural Insights



Within the scope of the main contributors of GHG emissions in Atlantic Canada, these research studies focused on the most emission-intensive sectors of transportation, energy use, and buildings to explore how attitudes, beliefs, motivations, contextual cues, and other variables can serve as barriers to or enablers of decision-making and human behaviour.

1. Atlantic Canadian Carbon Emitting Sectors
2. Behavioural Science Approaches
3. Applied Methodologies

Atlantic Canadian Carbon Emitting Sectors

Currently, transportation is the sector leading GHG emissions in two of the four provinces in the Atlantic region (Newfoundland and Labrador-NL, 43%; Prince Edward Island-PEI, 42%). Electricity generation is the main contributor in New Brunswick (NB; 28%) and Nova Scotia (NS; 39%), with buildings in the top sectors for PEI (19%) and NS (14%) and agriculture accounting for 24% of PEI's GHG emissions (Canada Energy Regulator, 2024). To effectively guide pro-climate actions in these high-emission contributors, each research project within this initiative applied specific behavioural science frameworks tailored to the unique challenges and decision-making processes in these sectors. The following section outlines the key theoretical models and approaches that informed these studies, providing insight into how behavioural drivers were analyzed and leveraged to promote sustainable choices.

Behavioural Science Approaches

The Theory of Planned Behaviour (Ajzen, 1991), used in the research from UNB, is one of the most frequently cited models to help predict social behaviour. In this work, the Theory of Planned Behaviour was applied to investigate how perceived control and subjective norms shape transportation choices. Sociotechnical transition approaches (Jasanoff, 2015) were also integrated to understand policy-based enablers of change from a system perspective, as well as the COM-B framework to map required self-identified enablers on multiple behaviours for civic transitions. Research from Dal added to these frameworks by examining whether other key behavioural science concepts, such as the Moral Licensing and the Rebound Effect, helped to explain solar energy and heat pump adoption and use (Blanken, et al., 2015; Simbrunner & Schlegelmilch, 2017; Urban et al., 2019; Velez-Henao et al., 2020).

The Self-Determination Theory (Datta & Mullainathan, 2014) was applied to the work conducted at UPEI, focusing on the intrinsic and extrinsic motivators to understand and predict eco-friendly driving behaviours. Research from MUN leveraged a combined behavioural insights approach, such as including both self-efficacy and collective self-efficacy, personalized carbon-behaviour feedback, corrected misunderstandings, positivity, habit change prompts, customized behavioural examples, social norms, and freedom-preserving framing to address the knowledge-behaviour gap and prompt change on personal carbon-intensive behaviours. This work also involved a Decision Science approach (Chapman, 2019) and the Behavioural Design framework (Define, Diagnose, Design, and Test; Datta & Mullainathan, 2014) to enable a targeted and informed behavioural intervention. Related to the impact of social context, contextual cues, and self-identity, research from CBU leveraged the Two-Eyed Critical Sensemaking approach (Doucette, 2023), including Culturally Relevant Gender-Based Analysis (Native Women's Association of Canada, 2022) and Critical Sensemaking, for understanding change identifying social context, identity building, cues, sensemaking, and plausibility as explaining factors for behaviour.

Applied Methodologies

For the development of behaviourally informed research, these projects employed diverse methodologies. Secondary research practices – including systematic literature reviews (UPEI), reviews of academic and grey literature (CBU and Dal), and analyses of Statistics Canada data (CBU) - enabled a foundational and evidence-based understanding of the current state of the art on the application of behavioural science to the different contributing sectors of GHG emissions. Primary research practices – including quantitative surveys (UNB and MUN) and qualitative in-depth interviews (UPEI, UNB, and Dal) – allowed for a broader assessment of motivators and barriers for behavioural change. These methodologies were implemented with distinct designs, from cross-sectional studies (UPEI, UNB, and Dal) to longitudinal and experimental studies (MUN). Ongoing work from CBU and Dal will further allow us to refine the understanding of current findings.

Pro-Climate Behaviours in Atlantic Canada

Connecting Behavioural Insights Across Research Projects

Across this portfolio of research, several common behavioural challenges that hinder pro-climate actions were identified. Nonetheless, given each research team's behavioural focus and unique research approaches, diverse key behavioural barriers were reflective of that singularity. Specific commonalities in terms of behavioural challenges include knowledge gaps, habitual behaviours, structural barriers, and attitudes. To better understand and address these challenges, a diverse array of theories, frameworks, and models from behavioural science were used across both research design and implementation. While the methodologies and research questions of interest differed, a variety of cross-sectoral insights reveal how behavioural change strategies and interventions may benefit a variety of sectors towards the shared goal of pro-climate behavioural change.

Common Behavioural Barriers

KNOWLEDGE GAP

A barrier commonly identified across projects is the knowledge gap affecting individuals' awareness of the climate impact of their habitual actions and other possible behaviours. Both research from MUN and Dal emphasize that a lack of understanding of the impact of individual-level behaviours can weaken the translation of awareness into action. This means that, while many people are aware of climate change and calls to action, individuals often overestimate the impact of low impact behaviours while underestimating the importance of high impact behaviours, such as overestimating the impact of using reusable grocery bags compared with reducing air travel (Wynes, Zhao, & Donner, 2020) In addition, people often may not understand the impact of their actions on climate. For example, the literature review undertaken by the UPEI team highlights that a common misconception around the meaning of eco-friendly driving, with the general population believing that it requires the use of electric or hybrid vehicles rather than the improvement of current driving behaviours aiming to increase efficiency.

INTENTION-ACTION GAP

Beyond awareness and understanding, individuals also need to feel they are capable of taking on those pro-climate behaviours to move from intention into action. On barriers for behavioural change, research from both UNB and CBU identifies that individuals feel limited in their ability to take climate-positive actions due to external constraints. As demonstrated in the Theory of Planned Behaviour, people are more likely to engage in behaviours when they feel as though they have control over the behaviour to be performed. CBU's research noted that more than 80% of First Nations households in Unama'ki (Cape Breton Island) live in government-provided housing, restricting not only their perceived self-control but also their ability to implement energy-efficient modifications.

HABITS

Many of the pro-climate behaviours examined in these studies align with habits, which shape expectations for appropriate actions through socialization (Verplanken & Whitmarsh, 2021). Habit formation also plays a critical role in predicting climate-relevant behaviours, as automatic and memory-based tendencies influence decision-making. While sustainable habits can promote pro-climate behaviours, many challenges stem from entrenched unsustainable habits. Moreover, energy consumption patterns in Nova Scotia and New Brunswick remain heavily reliant on high-emission sources such as natural gas and coal (Canada Energy Regulator, 2024).

In Fredericton, interviews with city managers found that incentive and choice architecture interventions are used to encourage positive public transportation habits. For example, city transit offers reduced-price transit passes and route tours to newly landed immigrants, encouraging use of public transportation before individuals purchase and adapt to personal vehicle use. Similarly, choice architecture decision structure is used to make U-Pass fees included in college and university tuition by default, introducing new riders to the system every year, with the hope that they maintain positive transit habits after graduation and into adulthood.

COST AND CONVENIENCE

Another factor related to the ability to implement change comes from the available resources to put the desired behaviour into practice. A common finding across some of these studies demonstrates that perceptions related to cost and convenience were both enablers and barriers to performing pro-climate behaviours. Studies from the majority of the institutions noted that financial resources and available time limited the adoption of climate-friendly behaviours.

Insights from UNB and CBU also show that reliably using public transportation is challenged by external resources such as weather conditions, time constraints, infrequent schedules, limited routes, and inadequate infrastructure. Nonetheless, these external factors can also play a role as enablers of climate-friendly behaviours. For example, UPEI research highlights that drivers in rural settings can often optimize their routes to reduce fuel consumption and save money.

ATTITUDES AND PERCEPTIONS

Negative attitudes and perceptions toward specific pro-climate behaviours further limit their adoption, as people can perceive barriers as greater than they may be or think their actions have no positive impact on expected outcomes. UNB's research, for example, found that students and early-career professionals develop unfavourable views of public transportation due to service inefficiencies. This critical mismatch between user expectations and service availability reinforces skepticism toward sustainable choices.

A similar concept is the attitude-behaviour gap. Several studies indicate that while people express pro-climate beliefs, these attitudes do not necessarily translate into action. Dal's review of the literature on solar panel adoption found that while households reduce consumption of electricity from the grid, their overall energy consumption increased by 16% due to the rebound effect (Nguyen et al., 2024). This effect also appears in studies related to heat pump adoption and electric vehicle use (Hamamoto, 2019; Liang, Qiu, & Xing, 2022; Raynaud et al., 2016; Seebauer, 2018).

These findings reinforce the importance of designing interventions that consider individuals' attitudes and their potential behaviour-attitude gap.

GROUP DIFFERENCES

Demographic differences also play a role in knowledge and behaviour. Insights from UNB research indicate that vulnerable groups face greater barriers to accessing sustainable transportation due to capability limitations and safety concerns. Research led by UPEI noted that older drivers tend to have a lower awareness of eco-friendly driving principles, which younger drivers often inherited through learned behaviour. Additionally, this work emphasizes the reliance on personal vehicle use among residents from rural communities as a barrier.

The importance of demographic considerations is further highlighted by the work from CBU, which analyzed First Nations communities in rural Nova Scotia. Only one community was identified as having public transportation, with most community members relying on personal vehicles to complete their daily commutes. Existing climate action frameworks are limited as they overlook rural and marginalized populations' specific constraints, emphasizing that climate solutions must be tailored to diverse socio-economic and geographic realities.

ADDITIONAL BARRIERS

Many other prominent barriers may exist and be more relevant to some behaviours than others. For example, insights from MUN indicate that to reduce everyday carbon-intensive behaviours, additional obstacles may include insufficient motivation, insufficient feelings of responsibility, a need for positivity, and a need to maintain behavioural freedom. Careful consideration of the potential barriers that may be common or unique to a specific targeted behaviour is thus an important step to pro-climate behaviour change.

Behavioural Theories and Approaches

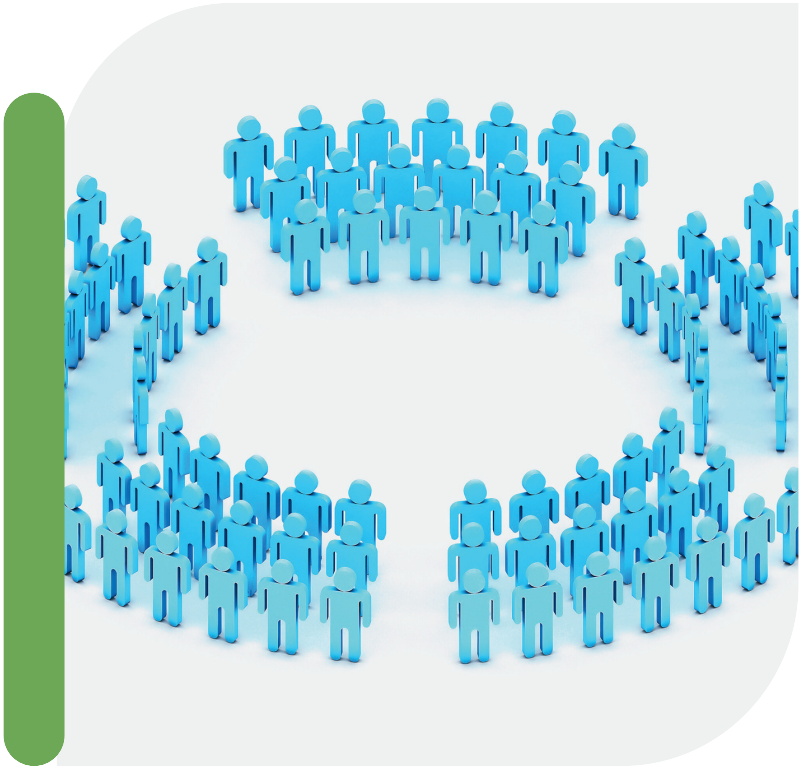
Across all research projects, a diverse set of enablers and barriers for pro-climate behaviours has been identified, highlighting the complexity of decision-making in climate-relevant contexts and sectors. These enablers and barriers are shaped by psychological, social, and structural factors, demanding multi-theoretical approaches to understanding and influencing behaviour. To address these challenges, all the research teams have drawn on well-established behavioural science models and frameworks to examine the underlying drivers of individual and collective action.

The research team from UPEI applied the Self-Determination Theory (Deci & Ryan, 2000) to examine the role of intrinsic and extrinsic motivators in predicting eco-friendly driving behaviours. Subsequently, to the elaboration of a systematic literature review on interventions aimed at promoting eco-friendly driving behaviours, this project leveraged this theoretical approach to seek a better understanding and prediction of eco-driving practices. From a different lens, the Theory of Planned Behaviour (Ajzen, 1991) was utilized by the UNB research team to explore how attitudes, social norms, and perceived control shape sustainable transportation choices. An integration of the COM-B framework (Michie, van Stralen, & West, 2011) in this study enabled the mapping of required strategies to act upon Aself-identified pro-climate behaviours. The research team from CBU plans to use the Two-Eyed Critical Sensemaking approach to analyze responses to climate policy, acknowledging that individuals interpret information through cultural and institutional lenses which influence their perceived agency. Dal's researchers used qualitative approaches, particularly key-informant interviews (Tongco, 2007), to assess how individuals adopt, diffuse and maintain household energy technologies – namely, heat pumps and solar energy applications. The research team from MUN incorporated a combined behavioural insights approach, implementing strategies concerning social norms, self-efficacy, framing and customized feedback to promote behavioural change and a Decision Science approach and the Behavioural Design framework to enable informed behavioural interventions.

The multiple theoretical approaches used across these studies underscore the need for multi-faceted and integrated strategies with diverse empirical backgrounds to leverage behavioural insights for systemic change, while also illustrating the complexity of pro-climate behaviours. The following section delves into the importance of cross-sectoral synergies, emphasizing how insights and findings from distinct studies can potentially inform or reinforce behavioural change in other sectors.

Cross-Sectoral Synergies

UPEI's study on eco-friendly driving suggests that feedback mechanisms and goal-setting strategies may mitigate behaviours that induce potential household energy-inefficiencies (observed in the research from the Dal's team) into energy-inefficient behaviours. This also connects to the core premise of MUN's intervention in that relevant feedback may be a strong motivator in behaviour change, such as when one's current carbon behaviours (e.g., high emitter) don't match one's attitudes. UNB's envisioned futures concerning a transportation revolution and a 15-minute city, where public and active transit can quickly and easily get you to common destinations, align with insights from CBU. Social norms also emerged as key drivers of climate-related behaviours. UPEI's findings indicate that community influence plays a role in promoting eco-driving behaviour. This finding can be applied to broad civic transitions, such as public transportation use and sustainable housing practices. Making pro-climate behaviours easy, financially viable, and socially normalized is shown across studies to enhance effective adoption in diverse targeted sectors.



Pro-Climate Behaviours in Atlantic Canada

Key Insights and Breakthroughs from Net-Zero Behaviour Research

Understanding human behaviour is key to shaping effective and impactful interventions. The research projects under this initiative have explored related yet unique behavioural drivers and barriers.

- Considering Internal and External Factors
- Removing Behavioural Barriers
- Tackling Knowledge-Action Gaps
- Targeting Beliefs and Self-Perceptions
- Providing Feedback
- Leveraging Incentives
- Accounting for Convenience
- Identifying Challenges and Limitations

Pro-Climate Behaviours in Atlantic Canada

Considering Internal and External Factors

Behavioural enablers, including intrinsic (e.g., personal values) and extrinsic (e.g., monetary incentives) motivational sources, were discussed by all researchers as primary factors influencing action and inaction. This is highlighted in the Self-Determination Theory (Deci & Ryan, 2000) which identifies the impact of both intrinsic and extrinsic motivators on behaviour. Personal values, a sense of autonomy, and internal beliefs play a key role in intrinsic motivation, while external incentives like financial rewards and social pressures can also shape behaviour. The interplay between motivators highlights the complexity of fostering sustained change. Values and beliefs emerged as critical components in shaping attitudes and as facilitators of change, with behavioural interventions demonstrating the importance of aligning behaviours with existing values and identitarian features (intrinsic motivators). Learnings from the conducted research showcase how encouraging pro-climate behaviours, such as the adoption and effective use of renewable energy sources for homeowners, can be more effective if individuals already identify themselves as pro-environmental agents. As demonstrated by the findings, providing relevant information is a key aspect of prompting behaviours; however, change may be further driven by fostering a sense of self-efficacy and social normalcy. These actions can be further encouraged by personalized feedback mechanisms that reinforce positive actions while addressing knowledge and attitudinal gaps.

Removing Behavioural Barriers

Research findings also showed that behaviour change needs to be simple and relatively obstacle-free. Structural barriers, such as limited access to resources and institutional constraints, often inhibit actions even in the presence of pro-climate motivation and values. Research from UNB found that a lack of supportive infrastructure was a barrier to sustainable transportation use, reported by 36% of participants. Similarly, it is noted that factors like commute distance and weather conditions influence transportation behaviour. Psychological factors, like perceived control over outcomes or unclear priorities, can also complicate the process of change in either adopting desired behaviours or inhibiting undesirable ones. Whether examining energy technology adoption or low to zero-emission transportation options, the findings reinforce the importance of context-sensitive approaches. By recognizing diverse motivations and challenges people face, these studies contribute valuable insights into designing more effective and equitable interventions.

Tackling Knowledge-Action Gaps

A few studies identified knowledge gaps that impacted motivation for change. In PEI, participants stated they did not understand eco-driving principles beyond purchasing electric or hybrid vehicles. As a result, they suggested incorporating eco-driving principles into licensing procedures so new drivers could become more knowledgeable not only on the meaning of eco-friendly driving but also on practicing the concept in the real world. This aligned with systematic review findings that identified eco-driving training programs as effective interventions. Awareness strategies can reach current drivers through partnerships with local media and gas station receipts to accomplish knowledge dissemination. Researchers at Dal also noted that barriers to adopting eco-technologies at home often stem from a lack of information or technical concerns. In general, misinformation or lack of information is a recurring theme in these studies.

Targeting Beliefs and Self-Perceptions

Evidence indicates that psychological factors, such as emotions and attitudes, are associated with pro-environmental behaviours (Ágoston et al., 2022; Ogunbode et al., 2022; Orlove et al., 2020). In Fredericton, for example, they found that 77% of participants envisioned a net-zero future with transformative changes like a 15-minute city where basic needs could be achieved by active transportation alone, a transportation revolution with public and active transportation as the default and electric vehicles used exceptionally, and decreased consumption portraying a slower and simpler way of life with less overall consumption and travelling. Nonetheless, attitudes can also encourage undesired behaviours. For example, UNB researchers noted that some participants had concerns about climate action in the future – with these concerns leading to negative future perceptions, including increased crime, food insecurity, and unreliable power supplies. Concepts such as the rebound effect and social licensing captured in these research projects also demonstrate how self-perceptions and inaccurate beliefs can result in increased energy consumption and inhibition of pro-climate behaviours.

Providing Feedback

Diverse streams of research also showcased how awareness, relevant knowledge, and attitudes can be altered using feedback strategies. The systematic review conducted by UPEI found that feedback strategies can be impactful in improving eco-driving behaviours. This idea was further expanded by the research team at MUN, who found that 25% of participants who received carbon feedback reported learning new carbon reduction strategies (compared to 10% in the control group). These strategies can also be prompted indirectly from social contexts. Researchers at UPEI learned that participants felt that community discussions could be a significant driver of behavioural change and lead to a wider adoption of eco-driving behaviours.

Leveraging Incentives

Within extrinsic enablers, these research projects also demonstrated that adequate and meaningful incentives are a key mechanism in behaviour change. Monetary incentives, such as rebates and reduced insurance premiums from eco-driving, were reported to be influential motivators for target behaviours. Conversely, penalties for environmentally harmful behaviours like idling and speeding may also be effective interventions. It is important to note, however, that perceived control and self-efficacy remain important mediators of change in the context of external motivators. For lower-income households, for example, high upfront costs will be a barrier to adopting energy-efficient technologies even with generous rebates. Context also matters, such as initiating a new behaviour or boosting an existing one, and monetary incentives may not always be sufficient on their own or necessary. For example, research from MUN detected a reduction in carbon-intensive behaviours without the direct use of financial incentives among individuals who received the carbon feedback intervention as compared to those who did not.

Accounting for Convenience

Overall, the findings emphasize that showcasing environmental concerns alone is not sufficient to address the important goal of reducing carbon-emitting behaviours. This is partially because many behaviours have become habits, often aligning with convenience, efficacy, and practicality. Research from both UPEI and UNB echoed this finding, noting that pro-climate intentions are aligned with convenience. Individual-level interventions must be complemented by societal and policy changes that make pro-climate decisions the simple and smart decision.

Research from UNB, for example, found that 20% of participants felt inadequate infrastructure was the most pressing issue in these behaviours. Researchers also find that rural and First Nations communities had either poorer or no accessibility to public transit, along with insufficient active transport infrastructure, increasing their dependency on cars. This further requires consideration of equity-seeking groups, as highlighted by the research teams at CBU and Dal.

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Identifying Challenges and Limitations

Although providing insightful findings, all research faces challenges and limitations. Namely, challenges related to recruitment processes and logistical constraints in implementing their research projects. In recruitment and sampling, some researchers struggled to find representative samples of their populations of interest. For example, project teams from UPEI and UNB were challenged to find government policymakers to participate in their research. Researchers additionally expressed dissatisfaction with representation from equity-deserving groups in their research due to things like geographic isolation or a lack of trust. The UPEI project team stated that cultural and language barriers may have further impacted research in the stages of recruitment and interviewing participants. Another identified challenge was recruiting participants with firsthand knowledge of the topics addressed by the projects, as evidenced by the UNB project team. Ethical and logistical constraints further complicated research processes, as timelines for project teams did not align with institutional research ethics boards.

Ultimately, while different research projects employed various frameworks and methodologies, they shared a commitment to investigate cognitive and behavioural barriers and enablers for pro-climate behaviours. Key drivers of change included awareness, ideas, motivators, social influence, and practical incentives. Identified barriers, such as infrastructure limitations, resource constraints, and lack of awareness, were also flagged to be potentially addressed through well-designed community-driven strategies. Regardless of the scope of the desired pro-climate actions, these research findings reinforce the importance of designing thoughtful and equitable approaches that address individual-level behaviour.

Comparing Strategies for Net-Zero Success

The application of behavioural science frameworks across these projects has provided valuable insights into factors influencing the adoption and hesitation behind pro-climate behaviours. Many of these frameworks were addressed in the previous deliverable of this initiative (first published White Paper), which also refers to a classification system associating types of behavioural interventions according to specific behavioural determinants supporting the designed research projects. These determinants, such as beliefs, perceptions, attitudes, and emotions, mediate the effects of interventions. They have been explored through various theoretical lenses in this work, including the Theory of Planned Behaviour, Self-Determination Theory, the COM-B framework, and the Decision Science approach. This section details the application of these frameworks in the projects and the implications for understanding motivators and constraints, with the above-mentioned classification system informing ongoing and developed research at the five universities.

Behavioural Science Approaches

Self-Determination Theory

Motivators were a core focus across the research, with the UPEI team explicitly using the Self-Determination Theory to identify barriers to eco-driving in PEI. The idea of motivation continuously occurred in literature reviews and other research projects within this initiative. For example, it is known that motivators like cost savings and environmental benefits are key motivators for adopting energy-related applications such as heat pumps. These findings align with the classification system, reinforcing the role of external incentives and internal motivators in influencing behaviour change. Feedback mechanisms, which can be linked to motivation, were a key strategy across multiple research projects. The research led by UNB found that 15% of participants were interested in feedback as an intervention. Researchers from UPEI heard that real-time feedback from cars or smartphone applications could provide behavioural reinforcement. Similarly, the team at MUN found promising results for the use of personalized feedback tools. Though these findings support the implementation of feedback interventions, previous research clarifies that these strategies are more effective when obstacles are modest and benefits are high (Bergquist et al., 2023; Sanguinetti et al., 2020; Verplanken et al., 2008).

Theory of Planned Behaviour

Researchers additionally shared the idea that the Theory of Planned Behaviour, which looks into how attitudes, subjective norms, and perceived behavioural control have an impact on behaviour change, would apply. This theory is commonly used in a variety of domains, including pro-climate actions. Previous literature emphasizes the role of external barriers and personal attitudes on sustainable transportation (Ajzen, 1991; Lois, Moriano & Rondinella, 2015; Marsden et al., 2020). The research team at UNB assessed relationships between pro-climate attitudes, subjective and social norms, and actual transportation behaviours. Additionally, the Dal team investigates whether and how these factors relate to the adoption and use of heat pumps in Atlantic Canada. A person‘s sense of control over their actions is a key part of the Theory of Planned Behaviour, which has previously been linked to pro-climate action. In transportation, factors like reliability, affordability, and efficiency influence behaviour. This aligns with the findings of researchers at UPEI, UNB, and CBU.

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Critical Sensemaking

Finally, the team at CBU adapted Critical Sensemaking heuristic, which refers to Weick's Sensemaking theory (Helms Mills, Thurlow, & Mills, 2010; Weick, 1995), to explore behavioural adaptations in First Nations communities using the Two-Eyed Critical Sensemaking Approach (Helms Mills, Thurlow, & Mills, 2010; Weick, 1995). Their work highlights that behavioural change is dependent on a combination of factors and that the root causes of challenges must be addressed for sustainable adoption. The reference to sensemaking additionally suggests that when multiple changes are introduced all at once, individuals may not respond to new information and will rely on old scripts for sensemaking. This reinforces the idea that equitable solutions require process-oriented approaches, as outlined in previously published White Paper under this initiative. Additionally, inconsistency between messaging and social cues is likely to lead to no changes.

Social Norms

A variety of related behavioural enablers and barriers arose through these projects. Pro-climate behaviours were positively related to social norms. Research teams at UPEI, UNB, MUN, and Dal found that social influence could play a significant role in individual actions. Research from MUN, UPEI, UNB, and Dal leveraged social norms in their work, but social impacts can be indirect as well. For example, Dal identified that peer and neighbourhood influence can be a motivator for heat pump adoptions. This is evidenced by the fact that households more commonly adopt heat pumps when they see their peers doing the same (Kokoni & Leach, 2021; Nikolić-Ristić, 2022) .

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Approaches to EDI Principles

Researchers understood the importance of expanding their network and leveraging existing connections to recruit diverse people. For example, the research team at UNB took a purposive sampling approach and used popular social media to reach different demographic groups. The UPEI team chose to collaborate with local transportation-related organizations (e.g., car dealerships), support services (e.g., Immigration and Refugee Service Organizations) and other organizations that have established trust and rapport with these groups. This strategy helps to encourage culturally appropriate engagements while facilitating access to diverse participants. There were also times when researchers had to make decisions during the research projects to ensure the adequate reflection of EDI concepts. At MUN, for example, researchers identified potential equity issues in their project, improving their interventions by including inclusive language, text boxes, and personalized recommendations based on demographics.

Cultural differences exist in social norms and attitudes surrounding pro-climate behaviours. Population density was a key consideration for all the research projects, with impacts from populational density on the accessibility of sustainable options being uncovered from multiple perspectives. Findings from MUN and CBU, for example, showcase that public transportation is an unreliable, potentially fully unavailable option for rural communities. UPEI noted that newly immigrated participants had positive perceptions about the driving culture in PEI, notably those who came from more congested, high-stress conditions. This could impact their openness toward eco-driving practices. There are also evident differences in the capability to participate in pro-climate actions. UNB noted that vulnerable groups, such as people with disabilities and seniors, may have limited use of public and active transport due to concerns about inaccessible physical environments and safety. Researchers at Dal and CBU, focusing on housing infrastructure, noted that home ownership is impacted by socioeconomic and demographic differences.

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The research team at CBU successfully employed non-invasive strategies, such as the use of secondary research, to gather information about First Nations groups. That said, their research on housing upgrades was limited as there was little publicly available information about housing in on-reserve communities. Data from Indigenous peoples and First Nations communities can be limited from key resources like Statistics Canada (Statistics Canada, 2022b).

CBU will further expand these findings using culturally thoughtful interview processes shaped around culturally competent research frameworks. Other researchers, however, experienced difficulties, particularly time constraints, in meaningfully engaging with Indigenous populations. The researchers at UPEI and Dal recognized this shortcoming in their research and recognized the importance of partnerships with culturally diverse groups in future research.

These insights showcase the complexities of ongoing efforts required to integrate EDI principles in research, particularly research relating to pro-climate actions. While the different project teams integrated a variety of approaches to engage diverse audiences and thoughtfully gather findings, challenges persisted. These challenges shine light on the need for flexibility and inclusive strategies in this field to surpass the barriers on the integration of EDI principles. Moving forward, researchers will foster meaningful relationships with underrepresented groups and utilize culturally competent research frameworks to promote the inclusion of diverse people in Atlantic Canada.

Current State vs. Cutting Edge

Across Atlantic Canada, both organizational and personal actions are required to reduce emissions. Prior research, shown in the previously published White Paper, highlights the highest impact areas for the region. In particular, sectors such as transportation and electricity are significant contributors, responsible for approximately 33 and 26% of emissions, respectively. This research analyzed sectors in alignment with critical sectors, with a strong focus on transportation, residential energy use, civic transformations, and feedback-based interventions. The current projects support and expand on these focus areas by identifying behavioural enablers and barriers across different populations and key sectors.

Focusing on Sustainable Transportation

Previous research addressed ways that individual-level behaviour change can reduce transportation-level emissions. Notable strategies in this regard include infrastructure improvements (e.g., bike lanes, transit signage), information sharing, and incentives for electric vehicle adoption. Social norms and nudging were also noted as significant interventions in encouraging public and active transportation use. Findings from UNB and UPEI reinforce these ideas, showing that perceived convenience, accessibility, and safety remain major barriers to public transit adoption. UNB's work does, however, highlight that participants see a future where the public (57%) and active (55%) transport is a norm complemented by electric vehicle use (39%). Nonetheless, there are some limitations. CBU and UPEI's work highlights the unique challenges faced by rural communities, where limited public transit options make personal vehicle use essential. UNB expanded upon this, noting that motivators differed for groups, whereas groups with short commutes (5-10km) were most motivated by environmental concerns and employer-sponsored programs. Commuters travelling over 10km were motivated by better infrastructure, cost savings, and incentives. Socio-economic status limits the possibility of switching personal vehicles from gas or diesel to electric, as the average Atlantic Canadian would be financially challenged to buy a new vehicle even with rebates. These findings indicate that it may be beneficial to invest in public and active transportation infrastructure, with careful consideration of rural communities and socio-economic status, rather than solely incentives for electric vehicles.

Improving Household Energy

Energy efficiency and relevant infrastructure changes were also identified as critical areas for reducing emissions. Existing strategies include financial incentives (e.g., rebates for energy-efficient appliances), default options (e.g., automatic enrollment in renewable energy programs), and social norm reinforcement. The findings indicate that knowledge-behaviour and attitude-behaviour gaps influence behaviour in this area. Research from Dal identifies behavioural maladaptation behaviors that help explain inefficiencies, related to rebound effect and moral licensing mechanisms. Additionally, self-efficacy and perceived behavioural control combine with actual control to impact energy-related decision-making, as CBU's research highlights constraints faced by Indigenous people living in government-provided housing on-reserve. Lower income individuals are less likely to own their homes (Al-Tawil, 2019), and less likely to have disposable income to complete upgrades even in the presence of intentions. In line with transportation, it is key that thoughtful strategies consider demographic and geographic differences. While the current state focuses on broad policy-driven interventions, current research emphasizes the need to target specific behavioural barriers, such as misconceptions of cost savings or the overuse of energy-efficient technologies.

Enhancing Food and Other Consumption Behaviours

Finally, these research projects addressed general behaviours surrounding consumption and sustainability. In the previously published White Paper related to this initiative, the role of choice architecture and social norms were discussed in the context of shifting food consumption. Prior research indicates that interventions such as labelling foods with carbon footprint information, financial incentives, and public commitment strategies are effective for increasing pro-environmental behaviours among consumers. While food consumption was not a primary focus of any of this work, decreasing overall consumption was addressed. MUN looked at providing personalized carbon-footprint feedback to decrease individual-level emissions related to food consumption and driving behaviours. This approach, including providing feedback on food consumption, has goals similar to those of labelling foods and commitment strategies. In addition, UNB identified that participants see a future with "decreased and conscious consumption." This indicates that people envision a future with pro-climate behaviours leading to a reduction of consumption overall, not just making sustainable changes. These visions were often driven by increased residential density, self-sustaining food and energy production, and slower lifestyles. The current research adds depth by considering how knowledge and attitudes about consumption can change decisions.

Previous research has identified key psychological barriers that are not sector-specific, such as habitual behaviour, knowledge gaps, perceived control, risk perception, and the intention-action gap. The current research streams confirm and expand on these behavioural insights, particularly highlighting the impact of knowledge-behaviour gaps, attitude-behaviour gaps, and perceived control and using a combined behavioural insights approach when designing interventions. They also recognize the importance of promoting personalized interventions that are accessible. This research provides real-world applications of behavioural strategies across different demographic groups, highlighting the need for tailored, multi-level interventions rather than generalized solutions.

Actionable Pathways: From Research to Real-World Stability

There are often gaps between the visions of policymakers and the perspectives of citizens when it comes to pro-climate transitions (Haarbosch, Kaufmann, & Veenman, 2021). Even within communities, individuals have different views on what the future should look like and whether society can implement that change. Many behaviours, such as driving habits, are deeply ingrained and based on convenience rather than environmental considerations. Disrupting these habits requires careful consideration of what motivates people to make sustainable choices. It also requires strong support from the government and policymakers to simplify decision-making. This section addresses how policies can address the practical concerns of citizens to encourage pro-climate action.

Engaging Community in Change

Government policy has been found to be the most important factor in pro-climate behaviour changes (McCarthy & Liu, 2022), reinforcing the idea that strong political action is needed for widespread shifts. Government policy plays a crucial role in shaping individual actions, particularly when considering practical factors such as convenience and costs. In regard to policy, community engagement is a key path to support the development of personalized, relevant interventions. The critical role of community engagement in driving sustainable behaviours is evidenced by these research projects as well as prior research (Parkins et al., 2018). Research shows that people feel more engaged in changing actions when they are involved in the discussions within their community. However, purposeful equity must be at the center of these efforts. Rural communities, First Nations people, and lower-income households are often excluded from decision-making, which leads to policies that do not match their specific needs. For example, researchers at UNB found that individuals with higher incomes and education levels are more likely to envision a net-zero future, whereas many rural and marginalized communities face barriers such as upfront costs for initiatives.

Leveraging Targeted Educational Strategies

Raising awareness through education and accessible messaging is a key strategy in promoting behavioural change. While factual knowledge alone does not always drive the adoption of pro-climate actions, targeted awareness campaigns can help bridge knowledge gaps and mediate other drivers of behaviour change. Possible approaches include integrating eco-driving education into driver's license training and sharing information about the rebound effect of new energy-efficient products. In addition, MUN found that personalized feedback about carbon footprints is a helpful approach for encouraging action, as it helped people be more aware of the true impact of their actions. If feasible to provide highly personalized feedback, governments could support targeted education programs to help individuals understand their personal impact and make more informed choices. Embedding climate literacy from an early age through schools and community programming could also foster long-term behavioural change.

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Incentivizing Pro-Climate Behaviours

Financial incentives are among the most common ways to encourage sustainable behaviours. Policies that offer tangible economic benefits, such as lower vehicle insurance rates for eco-driving behaviours, free public transportation, or financial rewards for using public transportation, could help shift behaviour. Additionally, programs that reduce upfront costs for energy-efficient technologies would enable more households to participate in the transition to clean energy. Without these financial supports, many individuals and households are forced to rely on their existing, less sustainable options because they are the most affordable in the short term (Efficiency One Nova Scotia, 2023). Though less effective, the impact of finances can be effective in promoting the long-term economic benefit of the effective use of pro-climate behaviours.

Convenience for Scalability

Scaling successful interventions from pilot projects and experiments to broader applications requires addressing systemic barriers, particularly infrastructure and accessibility. People are more likely to adopt climate-friendly behaviours if they are convenient and reliable. However, the flexibility to choose to adopt these may be a privilege. Consider pro-climate options for transportation, for example. Many rural and suburban communities lack access to efficient public transportation, making it difficult or impossible to shift away from car dependency. This is also evidenced by infrastructure for active transportation, with lower population areas in Canada having fewer bike lanes and even sidewalks (Haina et al., 2015; Winters et al., 2022). In areas where traditional options are not feasible, alternative solutions such as community-driven carpooling or ride-sharing programs could be an option. Infrastructure improvements, along with financial incentives and education, would create a more supportive environment for climate-friendly behaviours.

Overall, effective policy solutions must be practical, accessible, and inclusive; financial incentives, tailored approaches, and improved infrastructure are all necessary to encourage sustainable actions. By prioritizing equitable and thoughtfully developed programs to meet the needs of all communities, policymakers can ensure that climate action efforts are both effective and fair. Investing in these strategies will not only help reduce carbon emissions but also create a more sustainable, low-carbon future for Atlantic Canada.

Conclusions and Future Research Opportunities

The portfolio of research completed by five institutions for Net Zero Atlantic aimed to understand how behavioural science approaches might drive individual-level pro-climate behaviours. Researchers used key theories, such as Self-Determination Theory, the Theory of Planned Behaviour, and the Decision Science approach, to frame people's decisions and actions relating to transportation, energy-efficiency upgrades, and other key areas of carbon emissions. This work reaffirmed how individual behaviour is impacted by multiple factors such as knowledge gaps, community norms, and infrastructure limitations. They also highlighted gaps that exist in turning knowledge into action, such as existing habits, lack of motivation, the rebound effect and moral licensing.

In addition, these projects showcase the role that policies may have in individual-level action. Across studies, researchers learned that policy can be a key driver, particularly when addressing cost, convenience, and infrastructure. The most common barrier, infrastructure limitations, impacts perceived and actual control in making pro-climate decisions, like using public transit or upgrading to solar energy. We learned that psychological and practical considerations, as well as financial incentives, can influence sustainable choices more than environmental concerns alone. Finally, policy can shape awareness by improving formal education and public knowledge. When creating and improving policies, the government and other key parties must be mindful of equity. Considering equity-deserving and underrepresented groups, such as First Nations, rural communities, and lower-income households, is essential as they face unique barriers that must be addressed.

These research pieces will continue as teams expand their understanding. The team at CBU will continue their research by interviewing people from various Mi'kmaq communities in Nova Scotia to understand the challenges they face participating in sustainable housing initiatives. Dal will also continue its work on energy efficiency in housing with a focus on building models predicting adoption, diffusion and adaptations to heat pumps, solar energy and other efficiency applications. UNB's work will expand their understanding by speaking to more citizens about their experiences and city planners about future sustainable cities. MUN fully completed the intended experimental and longitudinal study but will continue to conduct follow-up behavioural analyses on their large dataset to further understand the influence of carbon feedback on behaviour change. UPEI hopes to expand their study by incorporating experimental designs to better understand eco-driving behaviours.

Future researchers could expand our understanding by investigating the impact of interventions on long-term behaviour change, assessing the efficacy of community-driven sustainability initiatives, and developing scalable solutions to support diverse groups who would otherwise be missed.

These findings contribute to global and national goals relating to net zero. Firstly, it expands our knowledge into Atlantic Canada. Pro-climate actions are understudied in Canada as a whole, particularly in this region. In addition, it provides evidence-based strategies for fostering behavioural shifts in key emissions areas through policy, personal understanding, and practical interventions.

References

Ágoston, C., Csaba, B., Nagy, B., Kőváry, Z., Dúll, A., Rácz, J., & Demetrovics, Z. (2022). Identifying Types Of Eco-Anxiety, Eco-Guilt, Eco-Grief, And Eco-Coping In A Climate-Sensitive Population: A Qualitative Study. International Journal Of Environmental Research And Public Health, 19(4), 2461.

Ajzen, I. (1991). The theory of planned behaviour. Organizational Behaviour and Human Decision Processes, 50(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Al-Tawil, J. (2019, December 5). Homeownership, income, and residential property values. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/46-28-0001/2019001/article/00002-eng.htm
Bergquist, M., Thiel, M., Goldberg, M. H., & van der Linden, S. (2023). Field interventions for climate change mitigation behaviors: A second-order meta-analysis. Proceedings of the National Academy of Sciences, 120(13), e2214851120. https://doi.org/10.1073/pnas.2214851120

Blanken, I., van de Ven, N., & Zeelenberg, M. (2015). A Meta-Analytic Review of Moral Licensing. Personality and Social Psychology Bulletin, 41(4), 540–558. https://doi.org/10.1177/0146167215572134

Canada Energy Regulator. (2024, September 6). Provincial and territorial energy profiles. Government of Canada. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/index.html

Chapman, G. B. (2019). A decision-science approach to health-behavior change. Current Directions in Psychological Science, 28(5), 469-474.

Datta, S., & Mullainathan, S. (2014). Behavioral design: a new approach to development policy. Review of Income and Wealth, 60(1), 7-35.

Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. Psychological inquiry, 11(4), 227-268.

Doucette, M. E. (2023). Two-Eyed Critical Sensemaking: An Integrative approach for studying post-TRC organizational change [Doctor of Philosophy]. Saint Mary's University. 195 pp. (Oct. 27)

Efficiency One Nova Scotia. (2023). Energy Poverty and Equitable Transition. Halifax.

References

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. Annual Review of Environment and Resources, 30, 441–473.

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. American Psychologist, 66(4), 290–302. 10.1037/a0023566

Haarbosch, S. W., Kaufmann, M., & Veenman, S. (2021). A Mismatch in Future Narratives? A Comparative Analysis Between Energy Futures in Policy and Citizens. Frontiers in Sustainable Cities, 3, 654162.

Hajna, S., Ross, N. A., Joseph, L., Harper, S., & Dasgupta, K. (2015). Neighbourhood walkability, daily steps and utilitarian walking in Canadian adults. BMJ Open, 5(11), e008964. https://doi.org/10.1136/bmjopen-2015-008964

Hamamoto, M. (2019). An empirical study on the behavior of hybrid-electric vehicle purchasers. Energy Policy, 125, 286–292. https://doi.org/10.1016/j.enpol.2018.10.042

Helms Mills, J., Thurlow, A., & Mills, A. J. (2010). Making sense of sensemaking: the critical sensemaking approach. Qualitative Research in Organizations and Management: An International Journal, 5(2), 182–195. https://doi.org/10.1108/17465641011068857

Jasanoff, S. (2015). Future imperfect: Science, technology, and the imaginations of modernity. In S. Jasanoff, & S-H. Kim (Eds). Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power (pp. 1-33). University of Chicago Press.

Kokoni, S., & Leach, M. (2021). Policy mechanisms to support heat pump deployment: A UK case study based on techno-economic modelling. Renewable and Sustainable Energy Transition, 1, 100009.

Liang, J., Qiu, Y. (Lucy), & Xing, B. (2022). Impacts of electric-driven heat pumps on residential electricity consumption: An empirical analysis from Arizona, USA. Cleaner and Responsible Consumption, 4, 100045. https://doi.org/10.1016/j.clrc.2021.100045

Lois, D., Moriano, J. A., & Rondinella, G. (2015). Cycle commuting intention: A model based on the theory of planned behaviour and social identity. Transportation research part F: traffic psychology and behaviour, 32, 101-113.

References

Marsden, G., Anable, J., Chatterton, T., Docherty, I., Faulconbridge, J., Murray, L., ... & Shires, J. (2020). Studying disruptive events: Innovations in behaviour, opportunities for lower carbon transport policy?. Transport Policy, 94, 89-101.

McCarthy, B., & Liu, H. (2022). Power to regional households: consumer attitudes towards electricity-saving, the solar rebound and the determinants of rooftop solar adoption. Australasian Journal of Environmental Management, 29(4), 405-424.

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Science, 6(42), 1–12. https://doi.org/10.1186/1748-5908-6-42

Native Women's Association of Canada. (2022). Native Women's Association of Canada Research Toolkit. NWAC. https://www.nwac.ca/

Natural Resources Canada. (2011, September 1). Energy Use in Canada: Trends Publications. Government of Canada. https://oee.nrcan.gc.ca/publications/statistics/trends/2019/residential.cfm

Nguyen, L. T., Ratnasiri, S., Wagner, L., Nguyen, D. T., & Rohde, N. (2024). Solar rebound effects: Short and long-term dynamics. Renewable Energy, 223, 120051.

Nikolić-Ristić, D. (2022). The influence of subjective norms on the use of heat pumps in achieving sustainable development. The Annals of the Faculty of Economics in Subotica, 59(50), 37-50. https://orcid.org/0000-0003-0066-8644

Ogunbode, C. A., Doran, R., Hanss, D., Ojala, M., Salmela-Aro, K., Van Den Broek, K. L., ... & Karasu, M. (2022). Climate anxiety, wellbeing and pro-environmental action: Correlates of negative emotional responses to climate change in 32 countries.. Journal Of Environmental Psychology, 84, 101887.

Orlove, B., Shwom, R., Markowitz, E., & Cheong, S. M. (2020). Climate decision-making. Annual Review Of Environment And Resources, 45, 271-303.

Parkins, J. R., Rollins, C., Anders, S., & Comeau, L. (2018). Predicting intention to adopt solar technology in Canada: The role of knowledge, public engagement, and visibility. Energy Policy, 114, 114-122.

References

Raynaud, M., Osso, D., Bourges, B., Duplessis, B., & Adnot, J. (2016). Evidence of an indirect rebound effect with reversible heat pumps: Having air conditioning but not using it? Energy Efficiency, 9(4), 847–860. Scopus. https://doi.org/10.1007/s12053-015-9419-2

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68\u201378. https://doi.org/10.1037/0003-066X.55.1.68

Sanguinetti, A., Queen, E., Yee, C., & Akanesuvan, K. (2020). Average impact and important features of onboard eco-driving feedback: A meta-analysis. Transportation Research Part F: Traffic Psychology and Behaviour, 70, 1–14. https://doi.org/10.1016/j.trf.2020.02.010

Seebauer, S. (2018). The psychology of rebound effects: Explaining energy efficiency rebound behaviours with electric vehicles and building insulation in Austria. Energy Research & Social Science, 46, 311–320. https://doi.org/10.1016/j.erss.2018.08.006

Simbrunner, P., & Schlegelmilch, B. B. (2017). Moral licensing: a culture-moderated meta-analysis. Management Review Quarterly, 67(4), 201–225. https://doi.org/10.1007/S11301-017-0128-0

Sovacool, B. K., & Griffiths, S. (2023). Predicting the adoption of electric vehicles: An application of the Theory of Planned Behaviour. Energy Policy, 156, 112351.

Statistics Canada (2022a, February 9). Population growth in Canada's rural areas, 2016 to 2021. Government of Canada. https://www12.statcan.gc.ca/census-recensement/2021/as-sa/98-200-x/2021002/98-200-x2021002-eng.cfm

Statistics Canada (2022b, March 30). Indigenous Peoples Reference Guide, Census of Population, 2021 (Catalogue No. 98-500-X2021009). https://www12.statcan.gc.ca/census-recensement/2021/ref/98-500/009/98-500-x2021009-eng.cfm

Statistics Canada. (2024, August 13). The Daily — Households and the Environment Survey: Electric and hybrid vehicles, 2021. Government of Canada. https://www150.statcan.gc.ca/n1/daily-quotidien/240813/dq240813a-eng.htm

References

Tongco, D. (2007). Sampling as a Tool for Informant Selection. Ethnobotany Research & Applications, 5, 147–158. https://doi.org/http://hdl.handle.net/10125/227

Urban, J., Bahník, Š., & Kohlová, M. B. (2019). Green consumption does not make people cheat: Three attempts to replicate the moral licensing effect due to pro-environmental behavior ☆. Journal of Environmental Psychology, 63, 139–147. https://doi.org/10.1016/j.jenvp.2019.01.011

Vélez-Henao, J. A., García-Mazo, C. M., Freire-González, J., & Vivanco, D. F. (2020). Environmental rebound effect of energy efficiency improvements in Colombian households. Energy Policy, 145. https://doi.org/10.1016/j.enpol.2020.111697

Verplanken, B., & Whitmarsh, L. (2021). Habit and climate change. Current Opinion in Behavioral Sciences, 42, 42–46. https://doi.org/10.1016/j.cobeha.2021.02.020

Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. Journal of Environmental Psychology, 28(2), 121–127. https://doi.org/10.1016/j.jenvp.2007.10.005

Weick, K. E. (1995). Sensemaking in organizations. Sage Publications.

Winters, M., Beairsto, J., Ferster, C., Laberee, K., Manaugh, K., & Nelson, T. (2022). The Canadian Bikeway Comfort and Safety metrics (Can-BICS): National measures of the bicycling environment for use in research and policy. Health Reports, 33(10), 3–12. https://doi.org/10.25318/82-003-x202201000001-eng

Wynes, S., Zhao, J., & Donner, S. D. (2020). How well do people understand the climate impact of individual actions?. Climatic Change, 162, 1521-1534. https://doi.org/10.1007/s10584-020-02811-5