

Climate Action Coast to Coast to Coast - Jurisdictional Approaches to Transportation Planning as a Climate Change Mitigation Tool

ABSTRACT

This paper presents how transportation planning concepts are utilized in municipal climate action plans across Canada. There is currently a gap in the understanding of how different jurisdictions are addressing climate adaptations, and the findings of this study contribute to the understanding of climate change mitigation for practitioners, policy makers, and academics. It is critically important to develop this knowledge given the well-supported evidence that climate change is becoming exponentially more severe due to human activities and Canada's commitment to address climate change through the Paris Agreement. The goals of this study are achieved by identifying relevant climate action plans through an environmental scan of municipal jurisdictions: Halifax, Montreal, Toronto, Winnipeg, Saskatoon, Calgary, Vancouver, Yellowknife, and Whitehorse. A thematic analysis is conducted on the plans to show the prevalence of the themes: (i) Active Transportation, (ii) Public Transportation, (iii) Vehicle Emissions, (iv) Shared Mobility, and (v) Transportation Infrastructure. The results identified by the thematic analysis include the average rate that a theme occurs in each climate action plan and a comparison between municipal and provincial jurisdictions. When compared to literature on climate change policy creation, the results provide insight into how the geopolitical landscape of Canada influences each jurisdiction's approach to transportation planning as an intervention to climate change.

BACKGROUND

Climate change has been a major focus of planning research due to its consequences to human health, the environment, and economic opportunities (Shonkoff, et al. 2011), and due to the role of human activity in producing of greenhouse gases (GHG) (IPCC, 2014; Isman, et al. 2018). The Intergovernmental Panel on Climate Change's 5th Assessment Report clearly shows that climate change is a global issue that affects the biological, physical, and anthropogenic systems in every region (IPCC, 2014). Reporting from the IPCC indicate the governments need to reduce GHG emissions to mitigate GHG emissions to prevent climate change and adapt to the climate hazards that are the by-product of climate change.

Urban areas are disproportionately impacted by climate hazards and other impacts of climate change, such as the heat island effect, poor air quality, and stormwater runoff, due to the concentration of infrastructure and activity (Pinto, 2014). Research from the Urban Climate Change Research Network (UCCRN) found that 153 cities around the world are projected to see a mean annual temperature increase of 1.4 to 3.1°C by the 2050s and a mean annual precipitation increase of -9 to +14% by the 2050s (Bader, et al., 2018). A report on climate change in Canada, published by Natural Resources Canada, shows that Canada is warming faster than other nations, as projections show that Canada's annual average temperature are projected to increase between 1.8 to 6.3°C (Bush & Lemmen, 2018).

Urban areas are also the highest contributors to GHG emissions (Bader, et al., 2018), and therefore they have the highest ability to mitigate emissions through modifying urban factors like density, social and economic resources, city governance, infrastructure, healthcare systems, and land use planning (Rosenzweig, et al., 2011). To address the aspects of urban areas that intersect with climate change, governments can create climate action plans, policies and programs that target GHG emission heavy activities within their region (Sahu & Saizen, 2018).

Transportation is one of the most necessary sector to target for addressing climate change in Canada. As an IPCC reporting sector, 'Transportation' contributed to 30% of Canada's GHG emissions in 2018 (Environment and Climate Change Canada, 2019). The transportation sector's total GHG emissions have increased by 14% from 2005 to 2018, and it is the only sector in Canada to have any increase in GHG emissions in that time (Environment and Climate Change Canada, 2019).

Transportation planning can help reduce GHG emissions by influencing land use patterns, and therefore minimize the movement of people and goods (Mehrotra, et al., 2011; Mashayekh, et al., 2012). In addition to land use changes, cities around the world reduced transportation related GHG emission through implementing fuel and vehicles standards and implementing policies that alter travel behaviour to reduce travel demand (Mashayekh, et al., 2012). Canadian cities can utilize similar strategies to reduce emissions from its most problematic sector and uphold international climate change commitments.

Canada has been a part of various international and intercontinental agreements to reduce GHG emission, including the Vancouver Declaration (2016), and the Paris Agreement (2015). These agreements set goals that countries can all align their policies towards, which is important for countries with close relationship like Canada, the United States of America (USA) and Mexico. Production and trade between Canada, the USA, and Mexico is closely tied and therefore it has been argued by experts that any policy that aims to reduce trade related GHG emissions should be harmonized between the countries (Schott, 2013). Alignment can be difficult at an international scale because there is not an authoritative body to delegate GHG emission gaps, however agreements help regulate some goals.

In Canada, the federal and provincial governments have a complicated relationship in terms of climate change policy, but Canada's policy framework for carbon pricing provides an example of a clear jurisdictional relationship that informs policy creation. Carbon pricing is a legal tax that falls within section 91(1) of the Constitution Act 1897 (Schwartz, 2018). The federal government allows the provinces to create their own carbon pricing policies that better fit their regions; however, all policies must satisfy the federal target at a minimum (Schwartz, 2018). In cases where provinces fail to create a carbon pricing policy that satisfies the federal target, the federal government has enacted backstop policies that collect carbon tax and return the revenue to the respective province (Snoddon, 2018). This level of accountability that the federal government holds provincial governments to is not observed in every aspect of climate change adaptation and mitigation policies. Approaches to climate change adaptation and mitigation, like altering travel behaviour, reducing waste, or promoting sustainable food systems, lack clearly defined relationships to the federal government.

Within Canada, municipal governments with strong urban centres have the highest capacity to address climate change through policy because of the agglomeration of activity that produces GHG emissions (Sahu & Saizen, 2018). Unlike the federal government, municipalities have the benefit of addressing climate mitigation and adaptation action on a smaller scale, which allows them to create more diverse policies to suit their local politics, technology and finances, and industry (Foss & Howard, 2015; Xiao et al, 2011; Sina et al, 2016; Sah & Saizen, 2018). Literature has shown that cities can best address climate change through transportation since a large portion of GHG emission from cities can be attributed to these sectors (Environment and Climate Change Canada, 2019; Isman, 2017). However, most municipal plans are created based on available funding and industry opportunity, rather than the most effective sectors (Sharp et al, 2011; Tozer, 2018). It was found that many local governments only create climate-oriented plans when there are fiscal incentives from the federal government, and many plans include carbon intensive practices have been rebranded to appear ‘sustainable’ (Tozer, 2018). The influence that the federal government must promote climate change adaptation and mitigation, shows reason to develop research to better understand what priorities are reflected in municipal plans.

METHODS

Approach

This study builds off other qualitative analyses applied to municipal climate policy research by reviewing transportation related themes in climate action plans from a selection of municipalities. Nine jurisdictions were selected, and a thematic analysis was conducted to identify transportation related climate change mitigation and adaptation initiatives within their climate action plans. These initiatives were identified and then analysed to provide insight into the landscape of climate change planning across Canada.

Thematic analysis is a form of qualitative research that allows the user to develop a deeper understanding of the relationship between actions and build a complex understanding of an emerging issue (Nowell, et al., 2017; Castleberry & Nolen, 2018). It is used to interpret data through classifying patterns of similar and different attributes (Nowell, et al., 2017; Alhojailan, 2012). A researcher can use thematic analyses to understand the frequency that a theme appears and gain an understanding of an issue from a wider perspective (Alhojailan, 2012).

A study on climate adaptation and mitigation plans within Europe (Reckien et al., 2014) and a study analysing climate change policy in Canada (Abhishek, et al., 2019) used a thematic analysis to provide answer to similar questions asked in this study. The high level of freedom and flexibility that thematic analyses facilitate will allow for a diverse range of themes to be identified diverse range of transportation themes to emerge (Nowell, et al., 2017). This freedom and flexibility that a thematic analysis facilitates is ideal for this study since there is little concrete information about the relationship between transportation planning and climate change action in Canada.

To ensure that trustworthiness is maintained in this study, the steps outlined in the article, *Thematic Analysis: Striving to Meet the Trustworthiness Criteria* by Nowell (et al., 2017), were followed when conducting the thematic analysis. These steps include: (1) Familiarizing yourself with your data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5)

defining and naming themes, (6) producing the report (Nowell, et al., 2017). The software NVIVO was used to store, organize the data source, and to develop and analyse the themes through coding. Using a software improved the rigour of analysis by leaving a traceable and auditable history (Nowell, et al., 2017). Traceability and auditability were important components in each step of the analysis to maintain credibility, as was reflexivity and peer critique (Nowell, et al., 2017). Self-critical accounts and peer critiques were recorded in a physical journal to ensure that the researcher's own biases and experiences did not influence decisions.

Data Collection: Identifying Climate Action Plan

The first step of conducting the analysis was to become familiar with the data. To identify documents for the thematic analysis, an environmental scan of plans, policies and acts related to climate change was conducted for nine jurisdictions, including four jurisdictions that were not included in the final analysis. The four jurisdictions were not included in the analysis because they were provincial and federal, and they were only used to better understand the influences of municipal climate action plans. While many documents and policies were investigated in this stage, Climate Action Plans were chosen as the only document to code since they provide the most comprehensive overview of a municipality's climate change goals and actions, including both adaptation and mitigation.

The federal government does not require municipalities to develop Climate Action Plans, although the Federation of Canadian Municipalities (FCM), which is a group that advocates for municipalities at the federal level, have created resources and incentives for municipalities to develop climate action plans. They provide education and resources to municipalities through the Green Municipal Fund, the Municipalities for Climate Action Innovation Program, and the Municipal Climate Action Hub. The FCM also highlights guides for help municipalities develop Climate Action Plans, which includes the *Provincial Government of Nova Scotia's Municipal Climate Change Action Plan Guidebook* (Province of Nova Scotia, 2011), and the *Small and Rural Communities Climate Action Guidebook* (Federation of Canadian Municipalities, n.d.).

These guidebooks, along with information from the United Nation's Habitat explain that Climate Action Plans should include both mitigation and adaptation actions. It they also state that plans should touch on the areas of transportation, buildings, land use, waste, and development of the agriculture, resources and tourism sector (Federation of Canadian Municipalities, n.d.). Beyond these sectors, the UN Habitat (2004) noted that all actions should be ambitious, inclusive, fair, comprehensive and integrated, relevant, actionable, evidence-based, and transparent and verifiable. All the guiding sources discussed how climate action should be framed in relation to the costs savings it will provide to municipalities.

Selecting Municipalities

A key component of thematic analysis is to obtain a diverse set of data sources (Alhojailan, 2012); therefore, cities from provinces across Canada were considered for the analysis. However, after determining that Climate Action Plans were going to be the source of data, only municipalities with a Climate Action Plan in place could be selected for the analysis.

To represent the diverse risks and opportunities that cities in Canada face with climate change, this study looks at the following nine cities: Halifax, Montreal, Toronto, Winnipeg, Saskatoon, Calgary, Vancouver, Yellowknife, and Whitehorse. Municipalities from Newfoundland, Prince Edward Island, and New Brunswick were considered for this study, but they could not be included due to their climate action plan. The municipalities chosen for this study and the Climate Action Plan's name can be seen in Figure 1.



Figure 1 – Map of selected municipalities.

Municipality	Climate Action Plan Name
Halifax	HalifACT 2050
Montreal	Climate Plan 2020-2030
Toronto	TransformTO
Winnipeg	Winnipeg's Climate Action Plan
Saskatoon	Climate Action Plan
Calgary	Climate Resilience Strategy
Vancouver	Climate Emergency Action Plan
Yellowknife	Corporate and Community Energy Action Plan
Whitehorse	Sustainability Plan 2015-2050

Table 1 – Name of Climate Action Plan per

Transportation Themes

Codes were initially generated for any theme that emerged in Climate Action Plans, even when they fell outside the general topic of transportation. Nowell (et al., 2017) noted that this step

allows the researcher to gain a general understanding of the data and focus on specific characteristics.

After consulting with peers and reflexive journaling, the initial codes were grouped into themes, and solidified through completing steps three, four and five the thematic analysis. After a general understanding of the components of the plans was determined, the relevant codes were organized into groups that related to the research questions (Nowell, et al., 2017). In step 4, the themes were reviewed and refined to ensure that they were reflected in the issues present in the Climate Action Plans and to ensure that there is a distinct and meaningful relationship between the themes (Nowell, et al., 2017). The stories behind each theme were captured through the name that they were assigned (Nowell, et al., 2017). The themes in this study were named to relate directly to general concepts in transportation planning, so that they could be recognized by a wide audience and align with other research in the field.

Five themes were identified from the analysis. The themes and their description can be seen in *Table 2*.

Theme	Description
<i>Active Transportation</i>	Includes walking, biking, or other non-motorized modes of transportation.
<i>Public Transportation</i>	Includes modes of transportation like buses, trains, and subways, which are operated by public agencies that aims to move the public through a transportation network.
<i>Vehicles Emissions</i>	The reduction of GHG emissions through vehicle technology and upgrades. This also includes the promotion of vehicles that use electric motors, rather than combustion engines.
<i>Shared Mobility</i>	Includes any reference to vehicles that are shared by multiple individuals, such as carpooling,
<i>Transportation Infrastructure</i>	Includes both hard (roads and rails) and soft (transportation demand management and other policies) infrastructure that facilitates the movement of people from one location to the other.

Table 2 – Transportation themes and descriptions.

RESULTS

The relationship between themes and the stories behind them are explored in this section through a descriptive review of the thematic analysis’ results and by situating the results within background policy, legislation, and political information. *Table 3* displays data from the thematic analysis; aspects of this data will be explored in two subsections. *Chart 1* displays themes by the overall frequency that they were referenced in each municipal climate action plans.

The frequency data in *Chart 1*, shows that Winnipeg’s Climate Action Plan had the highest number of references to transportation themes, with a total of 96. The lowest number of references to transportation themes occurred in both Halifax and Yellowknife’s plans, with a total of 12 references each. Altogether there is large range in with a mean frequency of 37

references. Vehicle Emission was the most referenced theme with a total of 90, and Shared Mobility was the least referenced with a total of 24.

The following subsections will explore each theme’s overall popularity across municipalities through comparing the average percentage of each theme’s reference. Data will provide insight into how transportation themes may be more popular in certain municipalities through provincial and federal influence through comparing themes when the data is normalized to account for discrepancies in the size of each plan.

	<i>Active Transportation</i>	<i>Public Transportation</i>	<i>Vehicles Emissions</i>	<i>Shared Mobility</i>	<i>Transportation Infrastructure</i>	Total References in Plans
Halifax	2	2	5	0	3	12
Montreal	4	4	9	4	3	24
Toronto	6	6	14	4	6	36
Winnipeg	23	29	18	6	20	96
Saskatoon	4	4	8	3	7	26
Calgary	4	6	11	3	6	30
Vancouver	15	8	17	0	24	64
Yellowknife	3	2	6	1	0	12
Whitehorse	10	7	2	3	9	31
Total Frequency of Theme Reference	71	68	90	24	78	331

Table 3 – Frequency that each theme was referenced by plan.

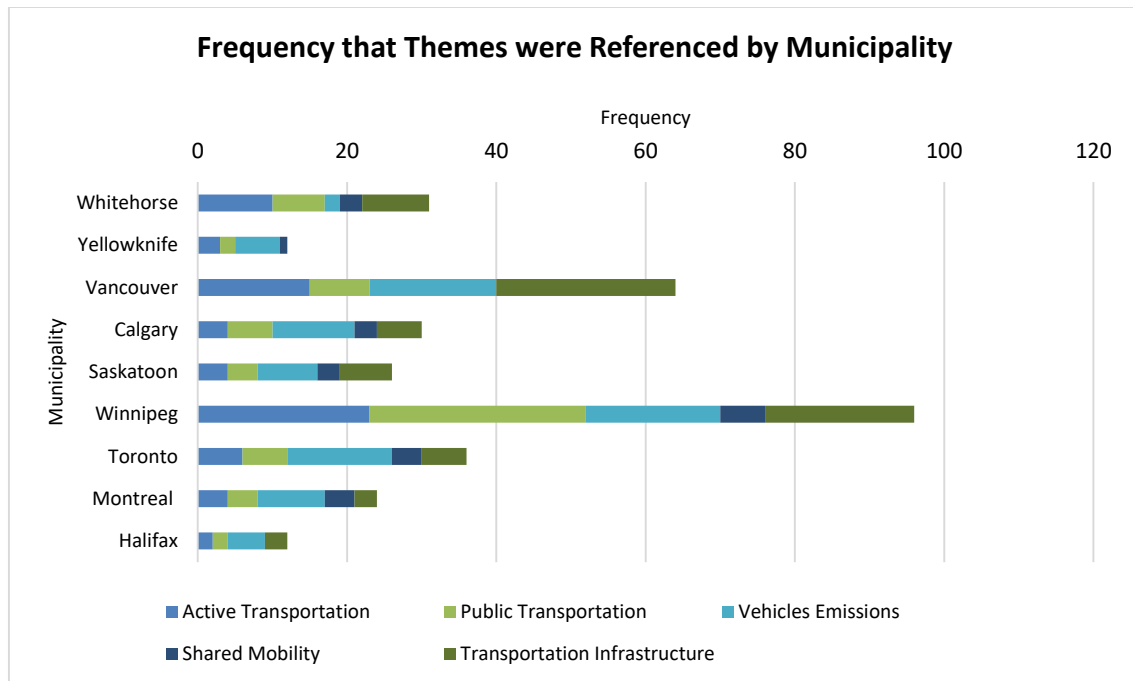


Chart 1 – Frequency that themes were referenced in each municipality’s climate action plan

Popularity of Themes Across Canada

This section will examine the popularity of each theme across Climate Action Plans. While the table and figure above looked at the difference in themes across municipalities, this section will look at the overall popularity in comparison to each other. As seen in *Chart 1* and *Table 2*, some plan – like the City of Winnipeg’s Climate Action Plan – have a disproportionately higher number of references, and this would impact the presence of certain themes across plans. To account for the disparate sizes of each municipality’s climate action plan, the frequency and percentage that themes were referenced was normalized based on the overall number of references within the plan.

This average percentage is displayed in *Chart 2*, and details of the average percentage that plans were present in each municipality is shown in *Chart’s 4-7*. Examining this data allows for a better understanding of the presence of themes across Canada and allows for the political framework that fostered these themes to be examined.

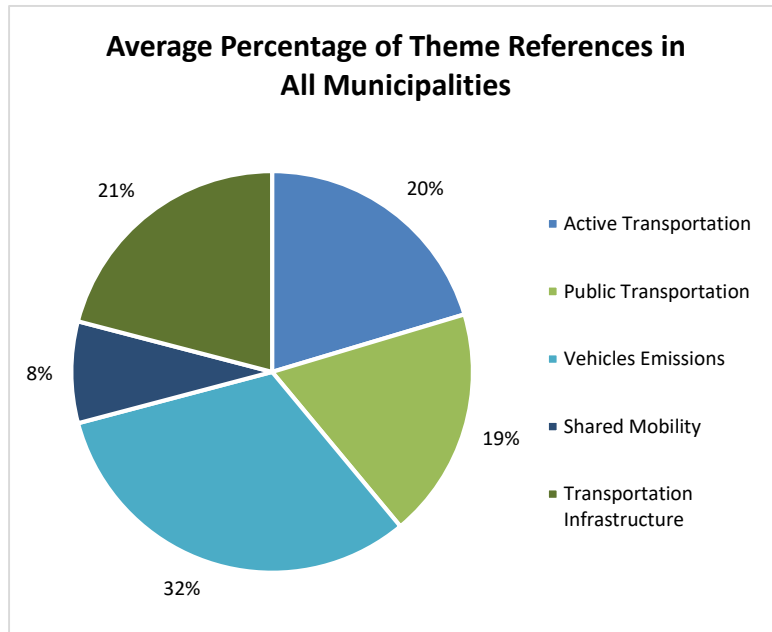


Chart 2 – The average percentage that themes were referenced in all climate action plans.

Of the chosen municipalities, *Chart 2* shows that:

- ‘Vehicle Emissions’ is the most popular theme at 32%,
- The themes ‘Active Transportation’, ‘Public Transportation’, and ‘Transportation Infrastructure’ have a similar presence in climate action plan at 19% to 21%,
- And Shared Mobility is the least popular theme at 8%.

While guidelines on municipal climate action plans show that both adaptation and mitigation need to be incorporated in climate action plans, within the sample of Climate Action Plans, transportation was only referenced for its ability to mitigate greenhouse gas emissions. This could be due to some municipalities having specialised plans for their climate change adaptation like Vancouver’s Climate Change Adaption Strategy, or the municipalities may not target adaptation through transportation in favour of other adaptation measures. In the first step of the thematic analysis, which involved becoming familiar with the Climate Action Plans, it was observed that adaptation was mostly addressed through green infrastructure like parks and vegetation, and through hazard specific infrastructure like infrastructure to protect from flooding in homes. As highlighted in the background section, it is important to address climate adaptation through these measures and it is important to reduce GHG emissions in the transportation sector; however, this research highlights a gap in municipalities planning for transportation to adapt to climate change. Climate Action Planning should recognize that transportation plays a key role during extreme weather events, and the transportation system may need to adapt to changing environmental conditions.

These results indicate that the municipalities put a larger emphasis on technology-based solutions like hybrid, fuel efficient, and electric vehicles rather than activity-based solutions like carpooling and multi-modal transportation. ‘Vehicle Emissions’ may be the most popular theme due to the federal carbon tax and funding opportunities from the Federation of Canadian Municipalities that incentivise reducing vehicle emissions. Whereas municipal government often must develop their own funding opportunities to incentives shared mobility. The following sub-sections will examine the themes popularity across the municipalities.

Active Transportation

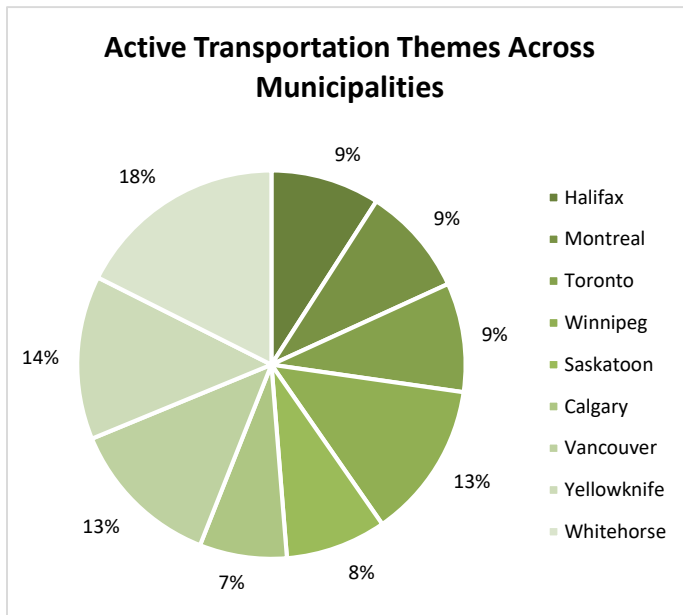


Chart 3 – The average percentage that the ‘Active Transportation’ theme were referenced in all climate action plans.

Chart 2 shows that ‘Active Transportation’ accounted for 20% of all references when they were normalized for the size of the plan. Chart 3 shows which municipal plans contribute to that overall percentage. ‘Active Transportation’ was referenced in plans ranging between 7% and 18%. Whitehorse referenced ‘Active Transportation’ the most when normalized for the number the references to transportation themes in their plan, and Calgary referenced it the least.

Public Transportation

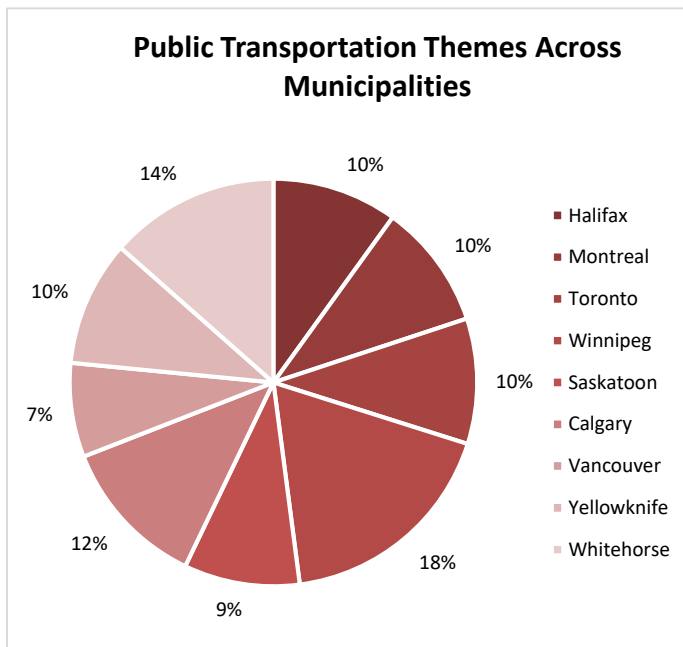


Chart 4 – The average percentage that the ‘Public Transportation’ theme were referenced in all climate action plans.

Chart 2 shows that ‘Public Transportation’ accounted for 19% of all references when they were normalized for the size of the plan. Chart 4 shows which municipal plans contribute to that overall percentage. ‘Public Transportation’ was referenced in plans ranging between 7% and 18%. Winnipeg referenced ‘Public Transportation’ the most when normalized for the number the references to transportation themes in their plan, and Vancouver referenced it the least.

Electronic Vehicles

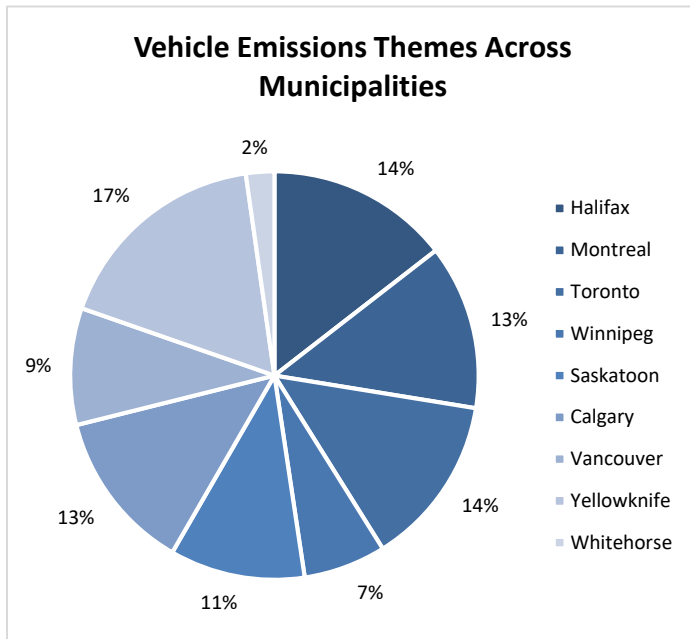


Chart 5 – The average percentage that the ‘Electric Vehicle’ theme were referenced in all climate action plans.

Chart 2 shows that ‘Vehicle Emissions’ accounted for 32% of all references when they were normalized for the size of the plan. Chart 5 shows which municipal plans contribute to that overall percentage. ‘Vehicle Emissions’ was referenced in plans ranging between 2% and 17%. Yellowknife referenced ‘Public Transportation’ the most when normalized for the number the references to transportation themes in their plan, and Whitehorse referenced it the least.

Shared Mobility

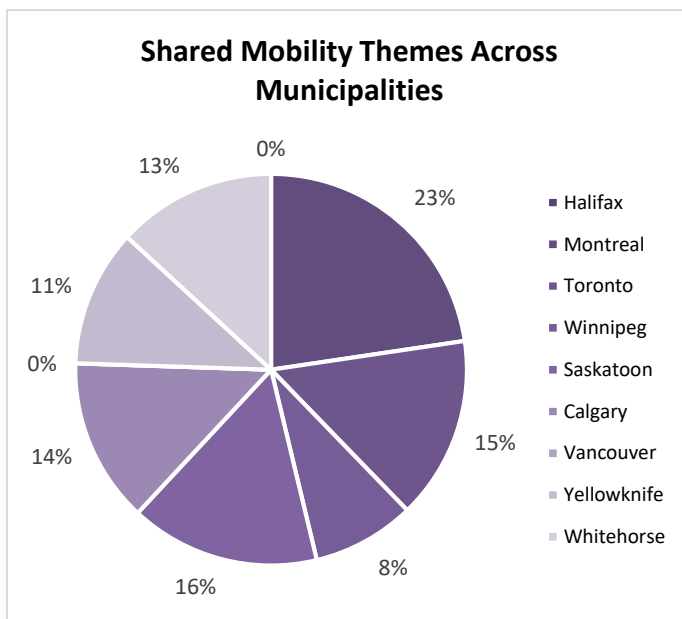


Chart 6 – The average percentage that the ‘Shared Mobility’ theme were referenced in all climate action plans.

Chart 2 shows that ‘Shared Mobility’ accounted for 8% of all references when they were normalized for the size of the plan. Chart 6 shows which municipal plans contribute to that overall percentage. ‘Shared Mobility’ was referenced in plans ranging between 0% and 23%. Montreal referenced ‘Shared Mobility’ the most when normalized for the number the references to transportation themes in their plan, and Halifax and Vancouver referenced it the least.

Transportation Infrastructure

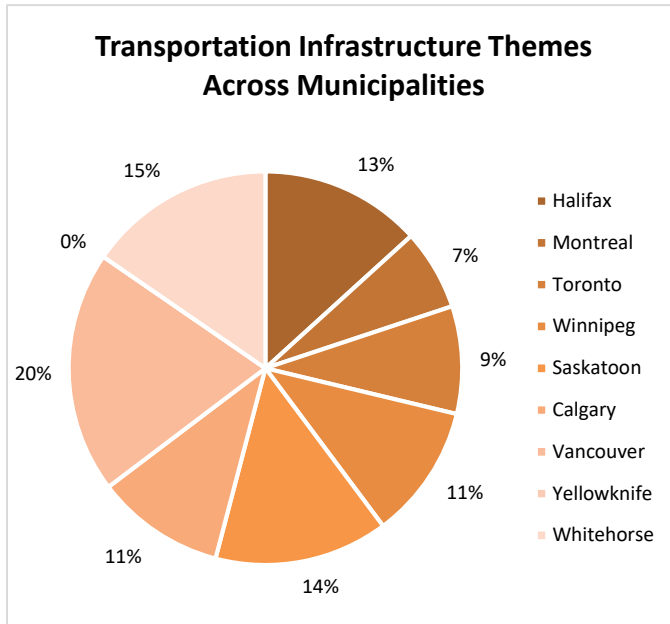


Chart 7 – The average percentage that the ‘Transportation Infrastructure’ theme were referenced in all climate action plans.

Chart 2 shows that ‘Transportation Infrastructure’ accounted for 21% of all references when they were normalized for the size of the plan. Chart 7 shows which municipal plans contribute to that overall percentage. ‘Transportation Infrastructure’ was referenced in plans ranging between 0% and 20%. Vancouver referenced ‘Transportation Infrastructure’ the most when normalized for the number the references to transportation themes in their plan, and Yellowknife referenced it the least.

DISCUSSION

Through conducting a thematic analysis of nine Canadian municipality’s Climate Action Plans, the current state of Canada’s climate actions related to transportation can be understood. Background research shows that there is significant overlap between the challenges and opportunities that cities face when creating climate change mitigation plans, and that the transportation sector needs to be a focus of municipal action. The thematic analysis showed that the frequency which municipalities referenced transportation to reduce GHG emissions varies significantly between municipalities, and the type of climate action that jurisdictions commit to varies based on municipal, federal, and provincial legislation, and funding incentives. The findings highlighted that there needs to be legislation and incentives for municipalities to address the gaps using transportation as a climate adaptation measure and to address the travel-activity aspect of transportation.

Thematic analyses are naturally limited by the researcher’s bias, knowledge, and perspective, which will have impacted the results of this study. It should also be acknowledged that this research could not capture the full scope of a municipality’s activities. A municipality could be implementing a program that relates to one of the transportation themes, like bikeshare, but if it is not explicitly acknowledged in their Climate Action Plan than it could not be included this research. In addition to the research methodology, the scope of this analysis was limited to just identifying the themes. This meant that the findings could not determine the effectiveness of plans in achieving GHG emissions targets. Understanding this would require a more quantitative study that compared plan goals and outcomes. Instead, this study provides insight into how transportation is conceptualized as a method of reducing GHG emissions, based on a sample of jurisdictions across Canada. It is also limited in the number of municipalities that were available

to be analysed, since some municipalities could not be included due to them not having a designated Climate Action Plan or their plan being in development.

The findings here can help planners, policy makers, and other practitioners create plans that are more thematically balanced and synergistic with related jurisdictions. This research provides a foundational understanding of transportation in climate change mitigation and adaptation planning in Canada, but future work should be done to expand the impact of prioritizing each theme. Further research could also include expanding the scope of analysis to a larger sample of jurisdictions to determine if the findings change based on a larger sample size, comparing the findings to themes in public discourse, or comparing the successes of each jurisdiction in meeting GHG emissions goals. There are opportunities to expand the understanding of climate action in each theme identified in this study to build a better understanding of Canada's climate action.

CONCLUSIONS

This study aimed to contribute to the field of planning by describing the current landscape of climate mitigation and adaptation planning in Canada. Background information shows that Canada needs to reduce the impact that climate change will have on its most vulnerable area (adaptation) and that that Canada needs to reduce its GHG emissions (mitigation). Both adaptation and mitigation can be effectively targeted through transportation planning in urban municipalities. Reviewing a sample of nine municipalities Climate Action Plans and conducting a thematic analysis on these plans identified five transportation themes. Investigating the relationship between these themes and their frequency across the sample of jurisdictions provided insight into areas that practitioners could investigate further to improve climate action in Canada.

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