City of Peterborough

To:	**Members of the Peterborough Transit Liaison Committee**
From:	**Michael Papadacos, Asset Management and Capital Planning Director**
Meeting Date:	**June 8, 2023**
Subject:	**Climate Implications of Public Transit, Report PTLC23-004**

Purpose

A climate lens analysis report, to share with the Peterborough Transit Liaison Committee, on the climate implications of single occupancy vehicle trips and the utilization of public transit as a climate action.

Background

The global climate is a dynamic system that involves complex interactions that regulate temperature, precipitation patterns, and ocean characteristics. Global temperature is maintained through positive and negative feedback loops to buffer any imbalance in the climate system, with changes occurring very gradually. Greenhouse gases (GHG) are integral to maintaining stable atmospheric temperatures because of its unique heat-trapping property that fuels the global climate system. Several natural sources of GHGs exist, such as carbon dioxide (CO_2) emitted from forest fires, methane (CH_4) created by wetlands, and nitrous oxide (N_2O) released from soils. Over time, GHGs are slowly reabsorbed back into the biosphere, land, and ocean systems, resulting in a steady concentration of atmospheric GHGs, leading to a stable global climate system.

Climate change is caused by the rapid increase in GHG concentrations which produces more heat, resulting in excess atmospheric heating that modifies the global climate system. Natural sources of GHG emissions are significantly outpaced by human sources of emissions, which include the combustion of fossil fuels, industrial processes and by-products like refrigerants, agricultural fertilizers, and livestock digestion. Moreover, the planet cannot quickly absorb the additional GHGs due to impaired natural environments such as deforestation to offset the increase in GHGs. In 2021, annual global GHG emissions reached 37 billion metric tons of CO_2 equivalent (tCO_2e),

increasing global surface temperature by 1.3ºC from the baseline. Changes to the global climate system from rising GHG concentrations are manifested in alterations to regional weather patterns that increase the frequency, intensity, and duration of weather events that exceed normal conditions, such as:

- higher mean temperatures,
- more intense heat waves,
- extreme rainfall events; and
- longer droughts

Specifically, transportation is one of the leading human sources of GHG emissions due to the combustion of fossil fuels to propel vehicles, ships, and aircraft. In 2021, global transportation emissions accounted for 7.7 billion tCO_2e, with on-road vehicles comprising 75 percent of the total. Vehicle ownership is expected to expand globally, increasing GHG emissions unless internal combustion engines (ICE) are displaced by low-carbon vehicles like electric engine vehicles (EV). In Ontario, recharging EVs still produce GHG emissions, albeit significantly less than ICE, due to electricity grids using fossil fuels to generate electricity. Overall, the total lifecycle GHG emissions for ICE vehicles contribute far more per vehicle than EVs (Table 1).

Table 1. Lifecycle GHG Emissions for ICE vs. EV

	Internal Combustion Engine (tCO_2e)	Electric Engine (tCO_2e)
Fuel Emissions	36	12
Manufacturing Emissions	6	5
Battery-related Emissions	-	2
Total Lifecycle Emissions	**42**	**19**

Single occupancy vehicle trips are the largest overall source of vehicle emissions. Reducing these single occupant trips is key to reducing total transportation fuel GHG emissions. A primary objective of the City's Transportation Master Plan is a significant mode shift away from single-occupant trips to transit vehicles, such as buses. Public transit buses can effectively remove at least 50 single-occupant vehicles, ICE or EVs, off the road per bus through ridership due to mode shifting. Attracting new riders to public transit, that previously drove, would result in immediate community transportation emission reduction. In addition, congestion-related GHG emissions would subside with fewer vehicles on the road. Public transit networks that provide access to frequent, rapid, and direct public transit routes to destinations can effectively support mode shifting away from private vehicles. Shifting to transit can limit road infrastructure expansion and maintenance needed to accommodate more vehicles on the road, which otherwise could be used for walking and cycling infrastructure, greenspace, and denser communities.

A. Peterborough Context

In 2016, the City of Peterborough adopted a Climate Change Action Plan (CCAP) that established a GHG emissions reduction target of 30 percent from 2011 levels by 2031. The CCAP introduced 19 strategies to lower community emissions which included climate actions for transportation. In particular, Strategy M3: *Make public transportation more appealing to increase its usage,* identified several actions to increase ridership which included the following:

- Implement a trip planning program/service for public transit,
- Implement technology for real-time bus tracking system and make it available on the web and smartphone apps,
- Explore opportunities to increase the number of students using public transportation to get to school; and
- Explore transitioning from a transit hub model to a grid model of public transit during the next Public Transit Operations Review

On September 23, 2019, City Council passed the motion to ratify a Climate Emergency Declaration (CED) for the purpose of "naming, framing and deepening our commitment to protecting our community, its economy, and its ecosystems from climate change." The CED increased the community reduction target from 30 percent to 45 percent to be achieved by 2030 from the 2011 baseline. In addition, the CED directed City staff to develop a climate lens to support municipal decision-making to ensure climate change is considered in plans and projects. Applying a climate lens provides meaningful early insight into the projected impact of GHG emissions produced from a plan or project that encourages adding mitigation features.

In 2023, the City completed a community GHG emission inventory report that assessed community sources of emissions from 2018 to 2021 compared to the 2011 base year. The evaluation revealed that 258,487 tCO_2e was produced by on-road transportation, which comprised 53 percent of Peterborough's GHG total in 2021. The report identified public transit being an enabling action to achieve transportation emission reduction by supporting drivers shifting to taking public transit through the following enabling measures:

- Launch of a transit trip planner to enhance customer trip planning,
- Piloting The Link rural bus route servicing Lakefield, Curve Lake First Nation, Bridgenorth, and Ennismore communities with connections to Peterborough Transit,
- Youth under 12 ride for free to foster lifelong transit ridership behaviours in residents; and
- Installation of five bus bike racks to support multi-modal commuting

A community projection was also developed which forecasted a decline of 14 percent in GHG emissions from Peterborough by 2030 from 2011 base year levels. A primary

factor for the limited reduction is the slow adoption of EVs and transit uptake over the next 7 years. As a result, the 45 percent CED target will not be achieved by 2030.

In February, City staff presented to the Peterborough Environmental Advisory Committee (PEAC) about the climate implications of public transit routing. In Report PEAC23-001, a climate lens assessment was undertaken that reviewed the Transportation Master Plan and Transit Route Review to determine the climate outcomes of each document. The following is a summary of that report.

B. Climate Implications of Transit Route Network Options

In 2018, a Transit Route Review (TRR) was completed to determine if redesigning the radial (hub and spoke) bus network would benefit the municipality. The TRR assessed the merits of the radial, grid, and multi-hub systems to ascertain which network provided better transit outcomes. Results identified that the grid network ranked highest in multiple evaluation categories compared to the radial and multi-hub networks. The grid network was determined to be able to provide 74 percent more direct routes to major destinations and 73 percent faster overall trips than the radial network. Specifically, the grid network contributes the following features:

- Reduces reliance on the constrained Downtown Transit Terminal,
- Provides better service to key locations outside the downtown,
- Increases service coverage to post-secondary institutions and provides increased frequency to improve overall travel times for non-student riders,
- Allows most trips to be completed with one transfer,
- Provides faster and more direct trips to major destinations,
- Balances service coverage and travel times,
- Minimizes duplication of routes; and
- Improves service performance

Concurrent with the TRR, the City embarked upon the development of the Transportation Master Plan (TMP). The recommended TMP strategy identified investing in new transit services by increasing service hours, adding new routes, incorporating transit supporting feature on key routes and improving peak period frequency of service on key corridors. This servicing strategy is projected to stimulate a community transit mode share of up to 12 percent by 2051. City staff recommended in Report IPSTR21-018 that achieving the recommended TMP strategy would be dependent on attracting new ridership through:

- enhanced service hours of bus routes,
- improved frequency of buses,
- improved travel time to key destinations,
- reduced number of transfers/more direct routes,
- adding more routes,
- optimally serve land use and growth area; and
- establish new Transit Fare policies for children and low-income residents

The grid network enables achieving the TMP objectives through increased frequency of buses, decreased travel time to key destinations, more direct routes and fewer transfers. Enhanced frequency and direct bus routes were already motivating factors that attracted non-student mode shifts for residents along the Trent and Fleming express bus routes within the original radial network. Both routes recorded the highest ridership of non-student passengers representing 21 percent of commuters on each route as opposed to 6 percent of passengers on other non-express routes. This observation demonstrates that non-student residents will take transit if it is frequent and more direct. It is reasonable to conclude that more non-student residents will choose public transit if that same level of service is offered community-wide. Additionally, the grid network supports added capacity to post-secondary institutions that will result in more student ridership than the radial network presently affords. Within this context, the grid network is the only transit network that will support attaining the TMP mode shift goal if fully realized across Peterborough.

Climate Implications of Public Transit

The benefit of public transit as a climate action far outweighs the GHG emissions of buses when the magnitude of emissions avoided is considered. Moreover, the completion of the Transit Alternative Fuels Study will guide the infrastructure and pathway needed to decarbonize the City's bus fleet. The TMP projected that community-wide GHG emissions would decline by 14,000 tCO_2e in 2051 if more non-student residents took the bus to commute. However, if the transition to public transit is not achieved, community transportation emissions are expected to rise by 44 percent in 2051 from 2018 levels due to more single-occupancy vehicle trips.

The grid network is a better climate abatement measure than the radial or multi-hub networks because it will likely deliver a sustained shift in resident behaviour patterns to favour public transit. Adopting the grid network is supported by the CCAP which recommends a grid network to attract more ridership. Through its effective bus routing and scheduling, the grid network will decrease travel time without sacrificing service area penetration, enticing more residents to take public transit. Without adopting the grid network permanently, fostering non-student mode shift will not be possible and will hinder achieving the near and long-term GHG reduction goals.

Summary

Transportation-associated GHG emissions continue to rise globally and in Peterborough. Utilizing public transit as a climate action measure can avoid vehicle trips and encourage mode shift to mitigate community transportation emissions. The Transit Route Review recommended fully implementing the grid network because it provides better transit outcomes than the radial and multi-hub network. The grid network also supports the objective of the Transportation Master Plan in shifting resident behaviours to greater transit mode share. Lastly, the grid network enables improved climate

outcomes through a faster and more efficient transit service that will appeal to more residents, avoiding GHG emissions from single-vehicle trips to destinations in Peterborough.

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