Limestone analytics

High School Transit Pass Program: An Investment Case

Final Report

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200 Princess Street, Kingston ON, K7L 1B2
www.limestone-analytics.com

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Authors & Acknowledgements

Limestone Analytics

Limestone Analytics is a consulting firm based in the US and Canada, specializing in the evaluation of public policy, social programs, and international development projects. The firm is recognized for combining academic rigour, state-of-the-art methods, and international development experience to provide customized evaluation and economic analysis services and to help their clients incorporate evidence to improve the design, financing, and implementation of their projects. Information about our current and past projects can be found at limestone-analytics.com.

Authors

Majid Hashemi, Ph.D.
Technical Manager, Limestone Analytics
Adjunct Faculty, Queen's University Department of Economics

Bahman Kashi, Ph.D.
Founder and Director at Limestone Analytics
Adjunct Faculty, Queen's University Department of Economics

Eric Thomson, M.A.
Technical Manager, Limestone Analytics

Rachel Bahn, Ph.D.
Technical Director, Limestone Analytics

Tia Howlett, MBA
Senior Associate, Limestone Analytics

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Disclaimer

The views and opinions expressed herein are those of the author(s) and do not necessarily represent those of the Limestone District School Board. This report was prepared independently by Majid Hashemi, Bahman Kashi, Eric Thomson, Rachel Bahn, and Tia Howlett, who had no conflicts of interest.

Executive Summary

The Limestone District School Board (LDSB) has contracted Limestone Analytics (Limestone) to assess the financial and social benefits of Kingston's youth transit program ("Transit Pass Program" or "Program") on students, their families, school boards, public transit, and the environment. This report presents the findings of Limestone's analysis from cost-benefit analysis (CBA), measuring the impact of the Program using the Program's performance data over the period 2012-2019. The findings of this study can be used to evaluate youth transit programs and enhance the capabilities of school boards and communities exploring similar initiatives. This report will serve as a valuable tool for policymakers, helping to ensure that youth transit programs are both practical and sustainable in meeting the needs of all stakeholders.

High-School Transit Pass Program

The main objectives of the Transit Pass Program have been to popularize the use of public transit among high-school students and increase the share of students who become future regular paying and committed transit passengers. To achieve these objectives, the Program was designed to expose students to the way public transit works and provide them with free transit passes (see **Figure ES.1**).

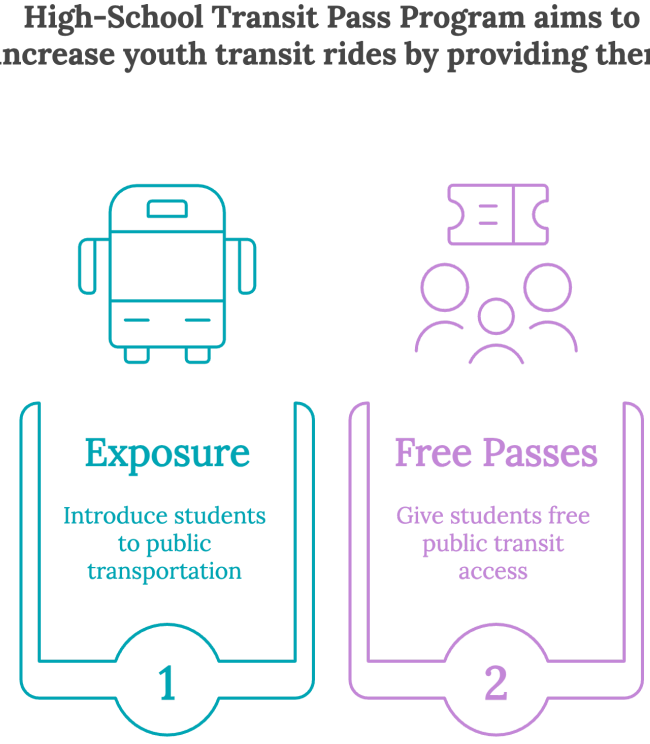


Figure ES.1. High-School transit pass program's approach

Figure ES.2. High-School transit pass program's timeline

The key supporters of this Program have been the LDSB, Algonquin Lakeshore District Catholic School Board (ALCDSB), and the City of Kingston (transit service). **Figure ES.2** shows the Program's milestones. The Program was introduced in 2012 as a pilot program for Grade 9 students, building on a community program called Kingston Gets Active Pass, which launched in 2011 and allowed Grade 9 students free access to municipal facilities. In 2013, students were formally trained on how to use public transit, followed by the Program's extension to Grades 10, 11, and 12 in 2014. In 2022, the Program was officially declared "permanent" by the City of Kingston, and it is no longer subject to annual review for its continuation. Limestone has limited its analysis of the Program to the period 2012-2019 due to the ridership data issues during 2020-2023, due to the impacts of the COVID-19 pandemic.

Program's Impact

Figure ES.3 shows that **196,000** additional student transit rides per year are attributable to the Program, of which **72,000** rides are the replacement of private vehicle trips. Additionally, **83,000** new cultural and social trips are made by students, as well as **16,000** trips to school, resulting in fewer missed school days or delays in getting to school.[1] Reducing private vehicle trips is also associated with broader benefits, including **342,000** kilometers in saved private vehicle trips per year, **10,000** hours of time savings for family members per year, and **70** tonnes reduction in CO_2 emissions per year (equivalent to the impact of carbon sequestration by 1,200 tree seedlings grown for 10 years).[2] The monetized value of benefits to society resulting from the Program reaches nearly **$2 million** annually. When compared to the program's yearly costs of **$0.57 million**, this indicates that for every dollar invested, the program generates a return of more than three times its value, presenting a compelling investment case for the community.

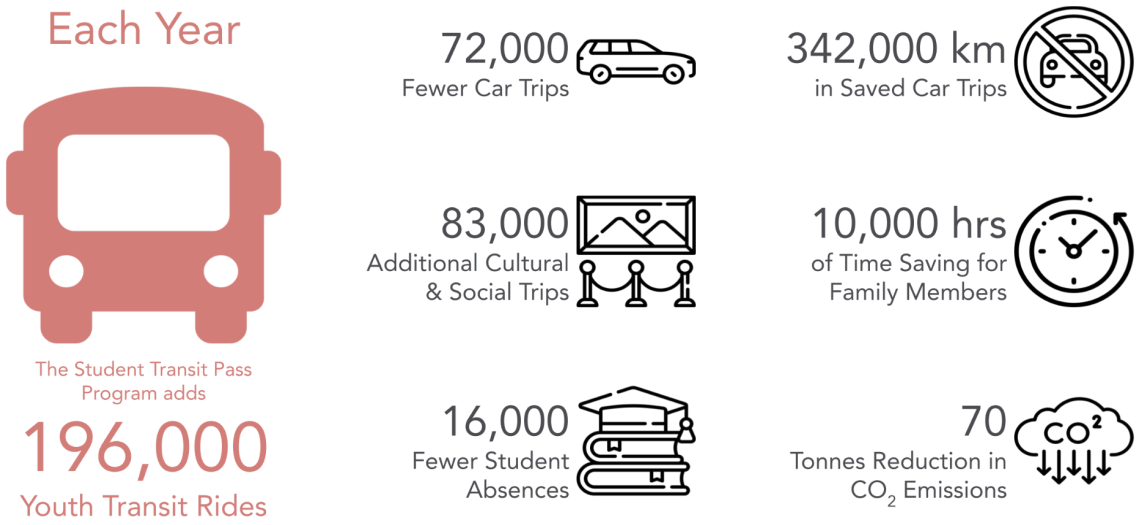


Figure ES.3. Program's impact per year

Methodology

The core objective of this analysis is to determine whether the benefits derived from investing in the Transit Pass Program outweigh the costs incurred. To effectively address this central query, we have divided it into two interconnected questions that can be answered by utilizing the available primary and secondary data (see **Figure ES.4**). The first question delves into the decision-making process of a representative passenger when choosing public transit over other modes of transportation. This involves examining factors such as costs, travel time, convenience, and accessibility. The second question aims to

[1] Cultural and social trips may include many activities, such as field trips, meeting friends, shopping, attending after-school programs, volunteering, or working.
[2] Based on the United States EPA Greenhouse Gas Equivalencies Calculator.

investigate whether providing free transit passes leads to an increase in ridership. This requires analyzing ridership data "without" and "with" the implementation of the Program.

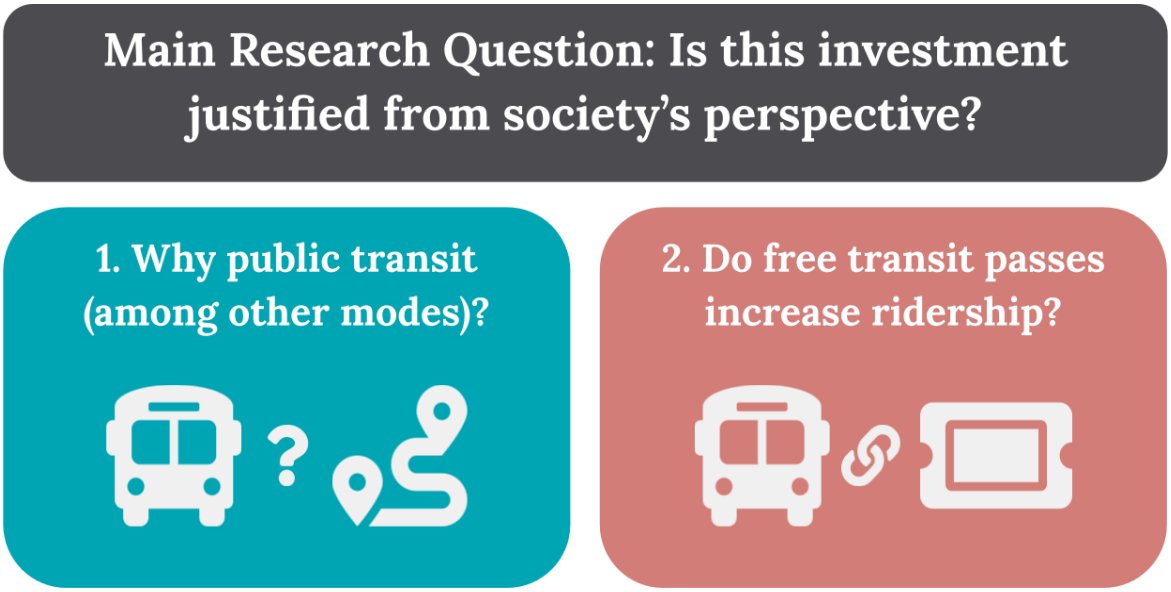


Figure ES.4. Research question

Why public transit (among other modes)?

When a representative passenger is faced with the decision of choosing a mode of transportation for their daily commute or occasional journeys, they take into account a multitude of factors. These factors include the direct out-of-pocket expenses associated with each mode, such as fares for public transit, fuel and maintenance costs for private vehicles or bicycles. They also take into account the total duration of the journey. We group all these costs into "direct costs." In other words, direct costs of transportation include time cost for the traveller, time cost for the driver (e.g., when a caregiver drives a student), and cost of the vehicle (e.g., private cars and bicycles). If we only consider the direct costs of transportation, private cars tend to be a more cost-effective option ($1.24 per kilometre for private cars versus $1.40 for public transit, the values under the Direct Costs column of **Figure ES.5**).

	Direct Costs	Congestion	Emission	Health & Safety	Total Cost to Society
	$1.40	$0.01	$0.02	-$0.09	$1.34
	$1.24	$0.33	$0.06	$0.20	$1.83
	$1.68			-$0.75	$0.93
	$0.56			-$0.01	$0.55

Figure ES.5. Travel cost per kilometer by transportation mode

However, there are other costs beyond the direct costs to travellers. Every time a vehicle gets on the road, it imposes external costs on all other vehicles in the form of congestion. Additionally, combustion-engine vehicles emit greenhouse gases (mainly carbon dioxide or CO_2). Lastly, there are also health benefits associated with physical activities (main reason for "negative" costs under the Health & Safety column of **Figure ES.5**) and safety costs associated with traffic accidents. Therefore, for an average traveller, taking public transit costs less than taking private cars ($1.83 per kilometer for private cars versus $1.34 per kilometer for public transit, the values under Total Cost to Society column of **Figure ES.5**). It is worth noting that the Total Cost to Society per kilometer is lowest for cycling and walking, however, these modes are not always feasible for all travelers and not in all seasons.

Do free transit passes increase ridership?

To tackle the second question, we need to dig deeper than just counting rides. Specifically, we have to tease apart how many of those trips were truly a result of the Program and would not have happened without it. **Figure ES.6** shows a dramatic rise in student transit use—from **28,000** rides in 2012 to nearly **700,000** in 2019, averaging around **392,000** rides per year. While this is an impressive achievement, it would be misleading to attribute every single ride to the provision of free passes. After all, some students might have used transit even without a free pass.

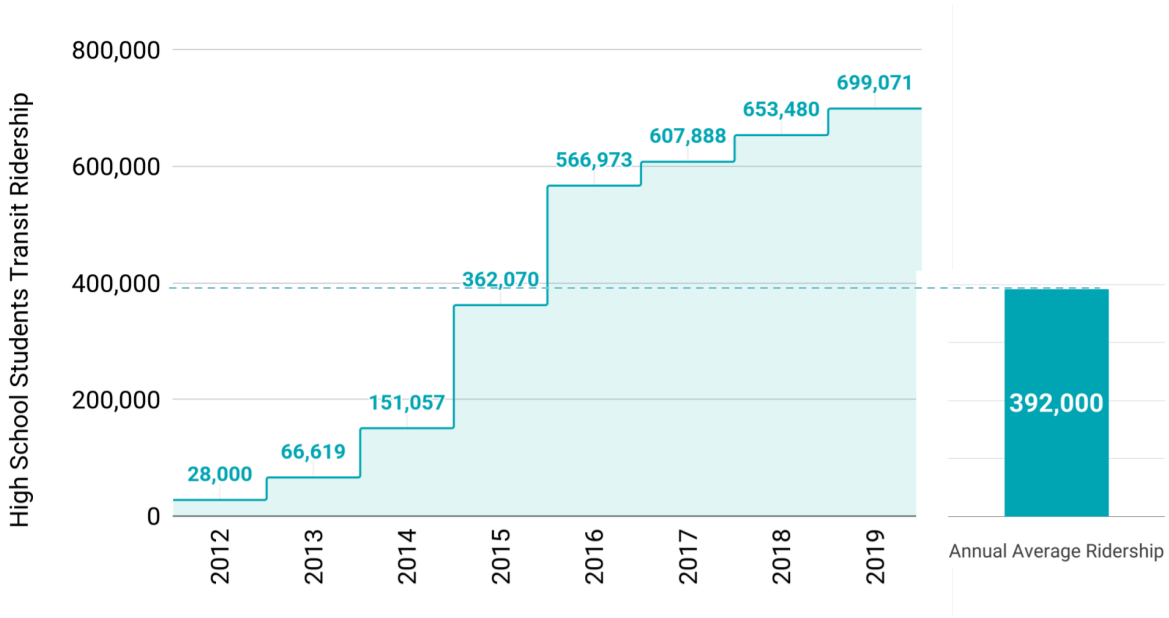


Figure ES.6. High school students' transit ridership with the Program

The challenge lies in estimating this "what if" scenario—the counterfactual. Since we cannot observe what would have happened without the Program, we need to make reasonable assumptions about how much of the ridership increase was truly induced by it. We define three scenarios (see **Figure ES.7**):

1. **Lower-bound (pessimistic) scenario:** This scenario assumes that only **25 percent** of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component of programs such as the Transit Pass Program or the impact of age (youth generally have less ability and access).

2. **Mid-point (baseline) scenario:** This is the baseline scenario in our analysis, and it assumes **50 percent** of the high-school students' rides are new because of the Program.

3. **Upper-bound (optimistic) scenario:** This scenario assumes that **75 percent** of the high-school students' rides are new because of the Program.

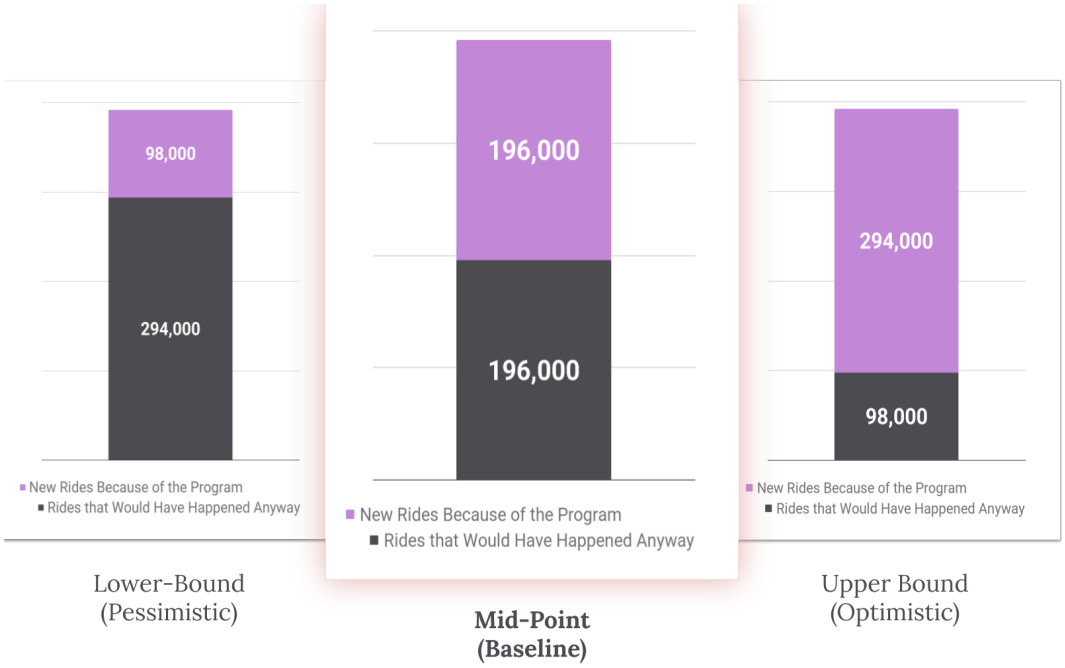


Figure ES.7. Ridership due to the Program: 3 Scenarios

Is this investment justified from society's perspective?

Now, we return to the overarching question: "Is this investment justified from society's perspective?" Society benefits from two pathways: reduction in the cost of existing trips and net benefits of newly empowered trips (see **Figure ES.8**).

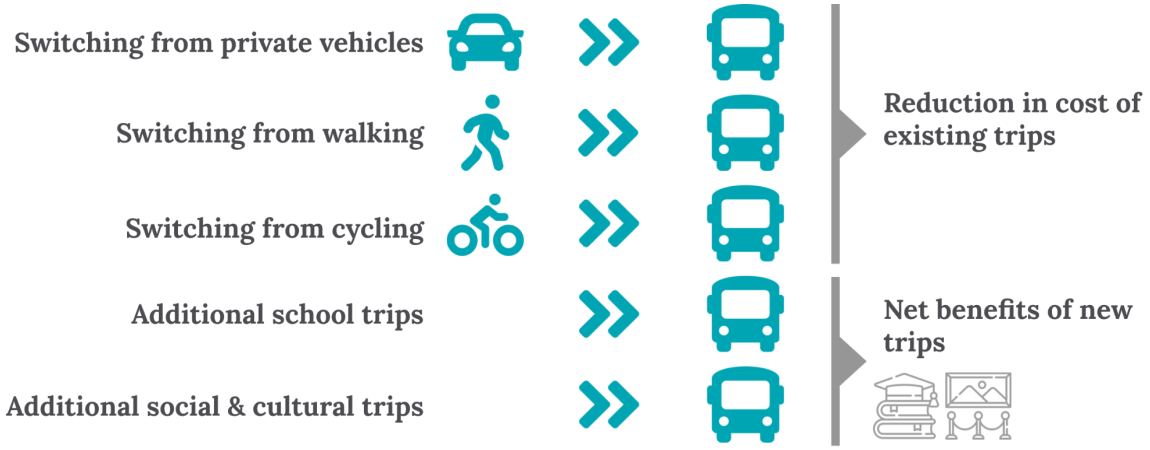


Figure ES.8 Two methods for valuing benefits

Considering the mid-point (baseline) scenario, **Figure ES.9** shows that **196,000** additional student transit rides per year are attributable to the Program, out of which **72,000** rides are the replacement of private vehicle trips, **20,500** rides are the replacement of walking trips, and **4,500** are the replacement of bicycle trips. Additionally, **83,000** new trips are made by

students to cultural and social trips, as well as **16,000** trips to school, resulting in fewer missed school days or delays in getting to school.

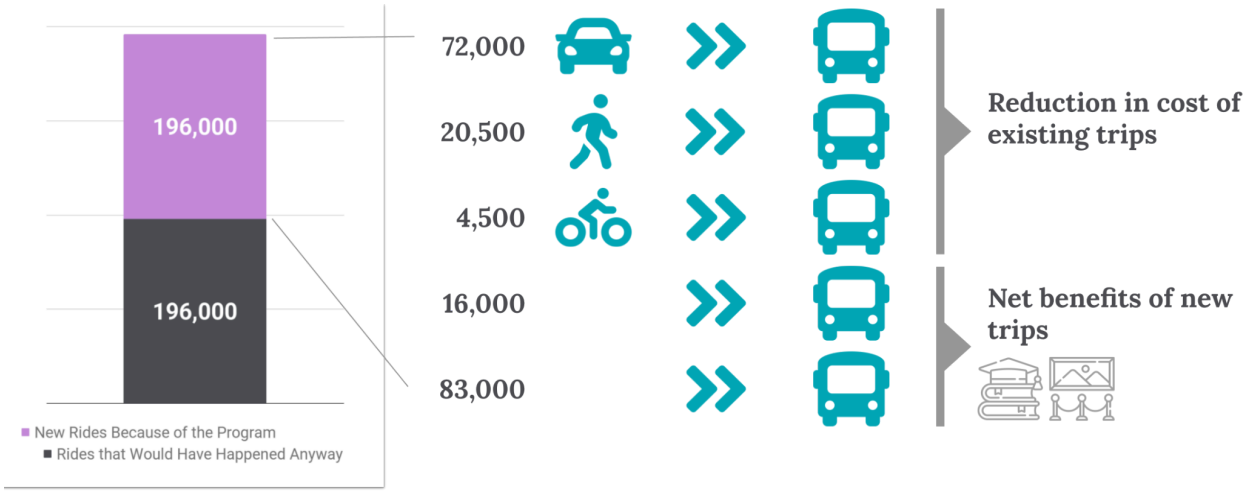


Figure ES.9. New rides by type per year

The monetized value of benefits to society resulting from the Program reaches **$2 million** annually compared to the program's yearly costs of **$0.57 million**, resulting in a net annual impact of **$1.49 million** (see **Figure ES.10**). Education benefits are the most significant with a value of **$1.55 million**, followed by the cost savings from switching transport modes (**$0.51 million**). The annual cost of new transit rides due to the Program adds up to **$0.55 million,** and administrative costs are **$0.03 million** per year.

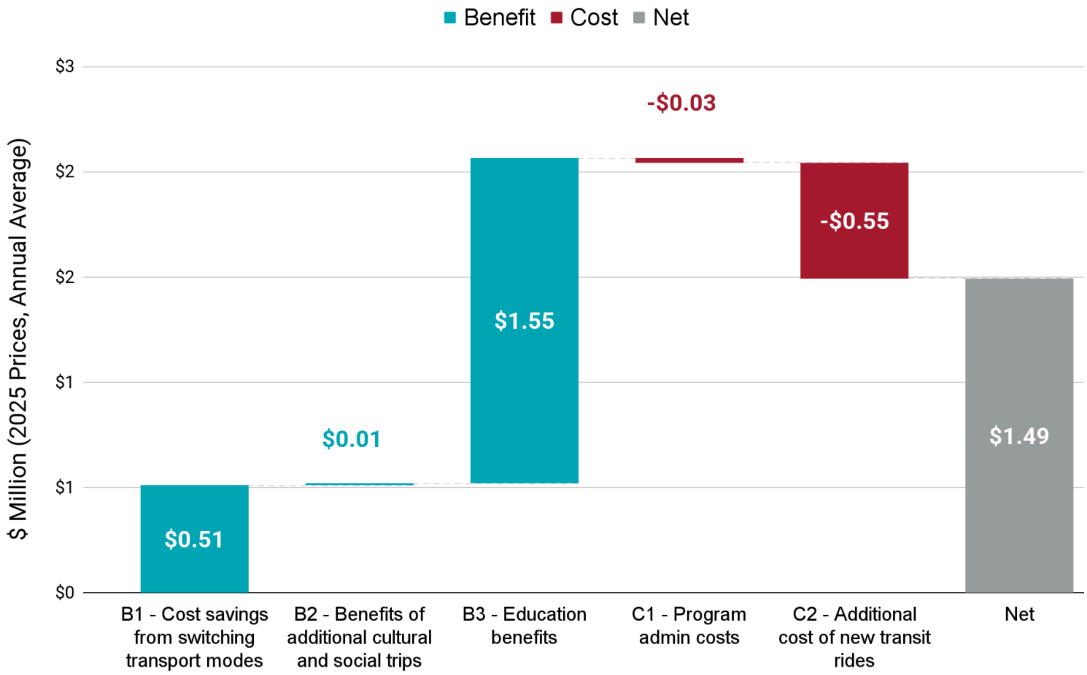


Figure ES.10. Cost and benefits of new rides per year (baseline scenario)

Figure ES.11 shows the distribution of the Program's benefits and costs per year across perspectives for the baseline scenario. The impact on the high-school students is a net benefit of **$1.38 million**. Students' family members also benefit from the Program in the form of reduced trips by private vehicles. As students switch from private vehicles to bus trips, the cost savings to other family members amount to an average annual value of **$0.54 million**. The increased ridership generates societal benefits beyond the private benefits, with Kingston (and, more broadly, Canada) reaping a net gain of **$0.11 million**. These benefits come from reductions in congestion and emissions. Kingston Transit, School Boards, and the Government of Ontario experience annual losses of **$0.45 million**, **$0.04 million**, and **$0.05 million**, respectively.

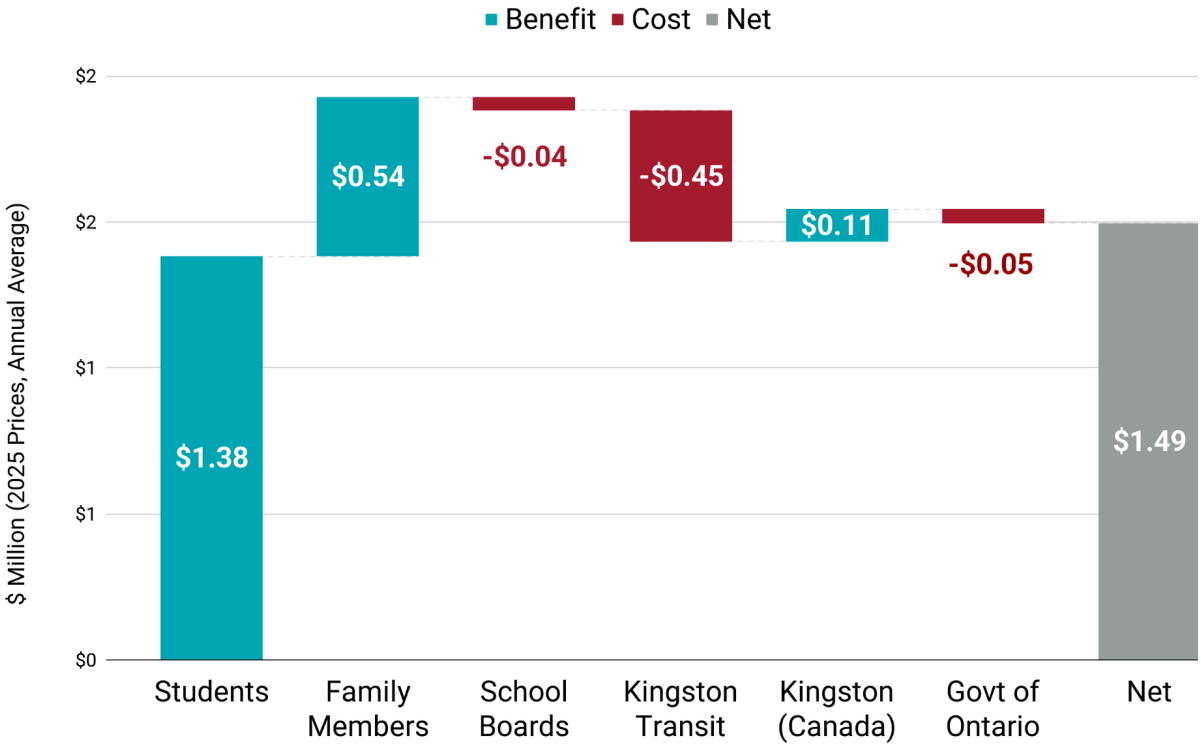


Figure ES.11. Benefits and costs of the Program by perspective per year (baseline scenario)

Analysis of the baseline scenario indicates that the benefit-cost ratio (BCR) of the Transit Pass Program is approximately 3.6. Further analysis in **Figure ES.12** using pessimistic and optimistic scenarios reveals **BCRs of 1.1 and 80.7**, respectively. The pessimistic scenario still suggests that the program generates a positive return on investment, though more modest. Conversely, the optimistic scenario illustrates the potential for the Program to deliver exceptionally high returns, significantly multiplying the value of each dollar invested. These findings underscore the Program's potential to yield substantial benefits to society, far exceeding its costs, and highlight its value as a worthwhile community investment.

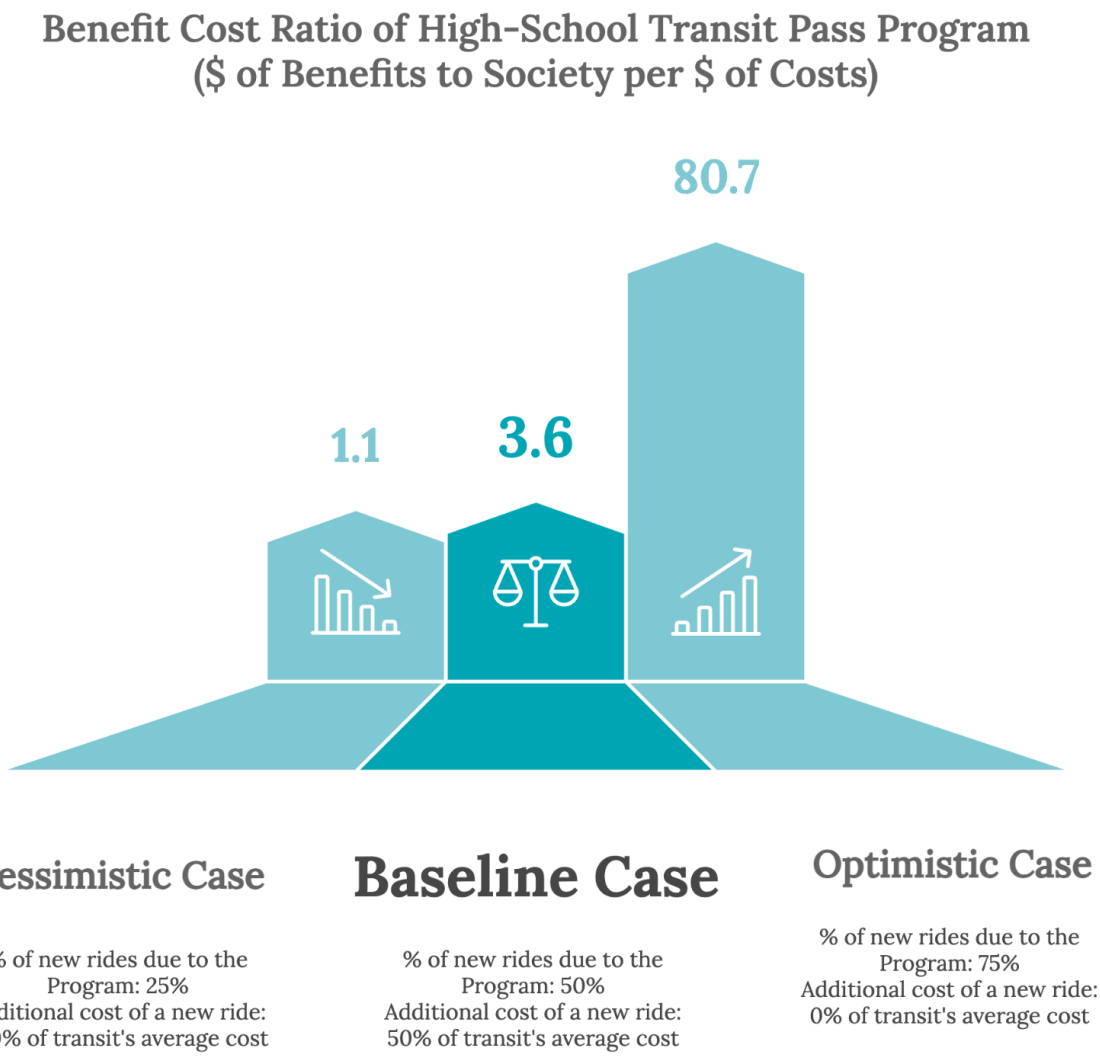


Figure ES.12. Benefit-cost ratio by scenario

It is critical to examine the financial implications of the Program on the City of Kingston's budget, as the distribution of costs and benefits is uneven. While society broadly benefits from this initiative, the primary beneficiaries are students, their parents, and other travellers. The City incurs new costs due to increased transit ridership, even though it generates additional Provincial Gas Tax revenue transfers. Moreover, the City faces a loss of fare revenue from transit trips that would have taken place irrespective of the Program. This financial impact was evident in 2016 when the City of Kingston reported an estimated annual loss of $250,000 due to forgone revenue directly tied to the High-School Transit Pass Program. While the Program boosts ridership and brings in additional revenue, it also leads to new operational costs and a significant loss in fare revenue. This trade-off highlights the importance of exploring alternative funding mechanisms or revenue streams

to offset the forgone fare revenue and ensure the Program's long-term viability without straining the City's finances.

Figure ES.13 shows our estimates of the impacts on the City's budget under the baseline scenario. Assuming that additional rides add operational costs equal to 50 percent of average costs, the increased operational expenses add up to an annual average of **$380,000**. We also estimate an annual loss of income due to free bus passes of **$245,000** (reflecting the City's estimate of foregone revenues). To help offset these costs, the LDSB and ALCDSB have committed to annual contributions averaging **$43,000** per year, supplemented by approximately **$50,000** in gas tax transfers from the Government of Ontario—funds tied to public transit usage. The net fiscal impact is an estimated annual deficit of about **$701,100** from the City's perspective.

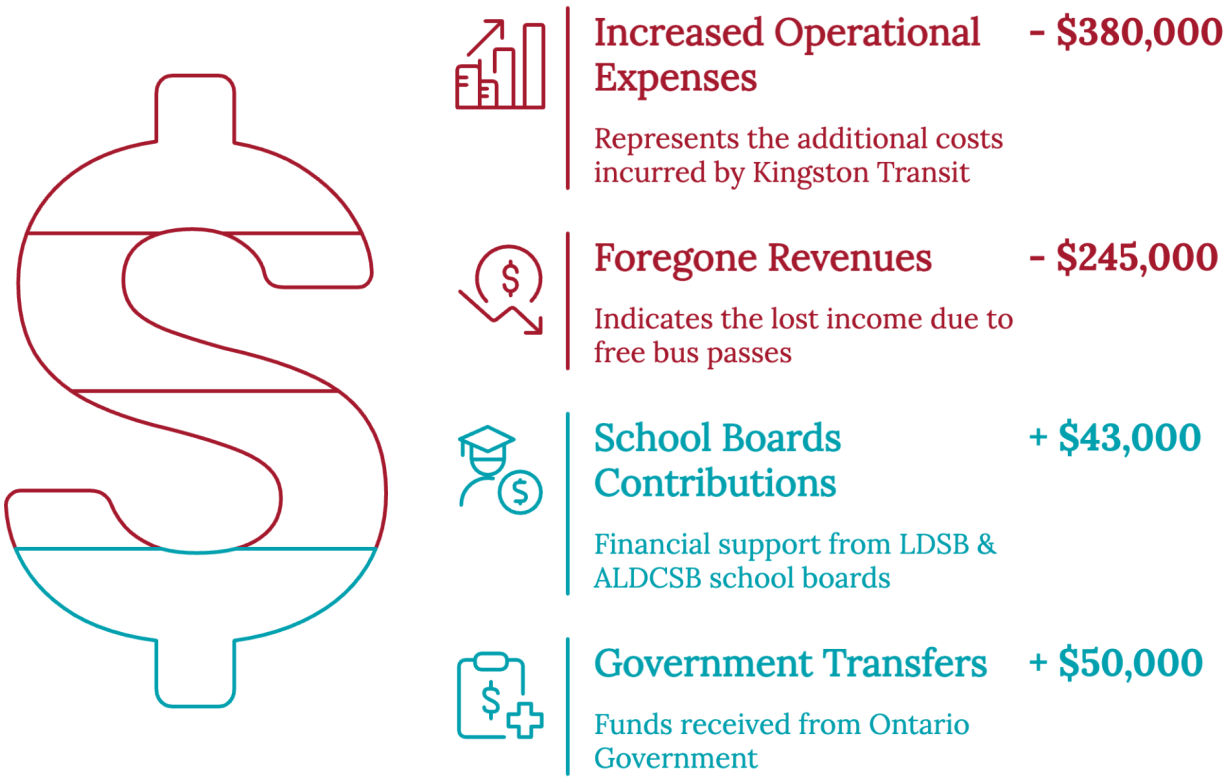


Figure ES.13. Annual impact on the City's budget (baseline scenario)

Figure ES.14 reports the Program's benefit-cost ratio, its net annual impact from the society's perspective, and its net annual impact from the City's perspective across all the scenarios. This sensitivity analysis points out that even under the most pessimistic scenario, the Program's benefits outweigh its costs with a slightly greater than one-to-one ratio (i.e., **BCR = 1.1**). Moreover, under the optimistic scenario, the net impact from the society's perspective significantly exceeds the costs, with a BCR of more than **80**. The net annual impact on the City's budget ranges from as low as **$23,000** under the optimistic scenario to as high as **$890,000** under the pessimistic scenario.

	Pessimistic Case % of new rides due to the Program: 25% Additional cost of a new ride: 100% (% of transit's average cost)	Baseline Case % of new rides due to the Program: 50% Additional cost of a new ride: 50% (% of transit's average cost)	Optimistic Case % of new rides due to the Program: 75% Additional cost of a new ride: 0% (% of transit's average cost)
Benefit-Cost Ratio (society's perspective)	1.1	3.6	80.7
Net Annual Impact (society's perspective)	~$61,000	~$1,505,000	~$2,335,000
Net Annual Impact (City's perspective)	~$890,00	~$701,100	~$23,000

Figures in RED are a net cost while figures in TEAL are a net benefit.
~ and ~ imply that the numbers are rounded for presentation purposes.

Figure ES.14. The Program's impacts by scenario

Lessons Learned and Avenues for Future Research

Overall, even under conservative assumptions, the High-School Transit Pass Program creates a net gain from society's perspective. The major benefits are educational benefits from averted missed school days and student absences, as well as cost savings for households and other travellers from reductions in the use of private vehicles.

An important lesson learned from this analysis is that while the financial outlay for training represents a relatively minor portion of the overall program expenditure, its significance cannot be understated, as it plays a pivotal role in ensuring the overall success of the initiative. Analysis of transit pass usage suggests that training high-school students on the use of public transportation can have a more substantial impact than simply offering free transit passes. While this study did not have access to more up-to-date transit pass usage data, such data can facilitate more advanced analysis to increase the accuracy of the results.

Another key lesson for other cities is the importance of assessing whether similar high-school transit pass programs would generate comparable benefits in different contexts. This line of inquiry would help assess the Program's scalability and transferability, providing valuable insights to guide broader provincial or national strategies for

cost-effective transit investments aimed at improving youth mobility and access to education, as well as CO_2 (and other greenhouse gas) emission reduction and time savings for parents and caregivers.

In all scenarios (Baseline, Optimistic, and Pessimistic) for Kingston, there was a net annual impact on the city's budget. Therefore, other communities considering a similar program might need to ensure financial sustainability by identifying and implementing robust funding mechanisms. This could include exploring avenues for securing additional funding by leveraging the long-term benefits, particularly those that align with broader educational or transport policy objectives. For instance, if a program has the potential to enhance educational access and encourage the use of public transit, it might be eligible for provincial or federal grants that support such initiatives. These grants could serve as a crucial source of funding, helping to offset the program's operational costs and ensuring its continued viability. Additionally, partnerships with local businesses, community organizations, or philanthropic foundations could also be explored as potential sources of funding.

Finally, more frequent and granular transit pass usage data would significantly enhance the ability to evaluate program performance over time. Investing in improved data collection and sharing mechanisms would open new avenues for research and policy learning, including better modeling of behavioral changes, estimating long-term mode shifts, and evaluating other co-benefits such as reduced congestion.

Acronyms

ALCDSB	Algonquin Lakeshore Catholic District School Board
BCR	Benefit-Cost Ratio
CAD	Canadian Dollar
CBA	Cost-Benefit Analysis
CO_2	Carbon Dioxide
DC&S	Decision Criteria and Sensitivity
FCM	Federation of Canadian Municipalities
GHG	Greenhouse Gas Emissions
KII	Key Informant Interview
km	Kilometre
LDSB	Limestone District School Board
Q&V	Quantities and Values
TTC	Toronto Transit Commission
UCBA	Unified Cost-Benefit Analysis
UQAM	*Université du Québec à Montréal* (University of Quebec in Montréal)
US	United States

1. Introduction

The Limestone District School Board (LDSB) has contracted Limestone Analytics to develop an investment case for Kingston's High School Transit Pass Program ("Transit Pass Program" or "Program"). Limestone Analytics based this investment case on a cost-benefit analysis (CBA) of historical program performance. This final report summarizes Limestone Analytics' literature review, methodology, results, and discussion of the investment case for the City of Kingston's High-School Transit Pass Program.

1.1 Purpose of the investment case

Across Canada, efforts have been underway to strengthen student transportation partnerships—not only between school boards and transit authorities, but also with provincial and territorial ministries of education and community development, which guide key policies and funding decisions. Municipalities—and in some cases, provinces—are directly involved in operating transit systems, while the federal government provides occasional support for capital investments and targeted programs depending on policy priorities. When students have access to effective transportation, they can enjoy more educational and social experiences, leading to better well-being, educational outcomes, and, in the long run, incomes. Schools and communities may benefit as well from reduced pollution, traffic congestion, and better health. Multiple school boards and municipalities have passed resolutions to investigate the feasibility of free or discount youth transit programs from a school board perspective in Canada. Kingston's High School Transit Pass Program was one of the first of its kind in Canada, making it an ideal program to study.

Limestone Analytics has adopted an approach that fully explores the benefits and costs of the Transit Pass Program on local school boards and communities, including the financial impacts on school boards and Kingston Transit. The investment case focused on the Transit Pass Program's historical implementation over 2012-2019, based on data from the City of Kingston and secondary evidence from Kingston and similar programs in other cities.

The investment case of the Transit Pass Program delivers an analysis that:

- helps school boards and municipalities with decision parameters around when, if, how, and for whom the use of public transit should be promoted,
- quantifies the benefits (and costs) to students, households, school boards, transit authorities, society, and the environment, and
- provides transit and school stakeholders across Ontario and Canada with the scientific basis for advocating for (or against) student transport policies.

1.2 Cost-benefit analysis

This investment case uses a CBA approach. A CBA provides a comprehensive framework for evaluating the overall financial and social impacts of programs, investments, or decisions. For governments and their partners, including school boards, a CBA can help ensure financial sustainability and that public resources are allocated efficiently to the best interest of society. Box 1.1 describes the steps involved in a CBA.

Box 1.1 The Cost-Benefit Analysis Process

1. Define the Policy and Objectives: Identify the policy, its changes over time, and its initial objectives.
2. Identify Perspectives: Identify groups affected by the policy.
3. Identify Costs and Benefits: Conduct primary and secondary research to identify the policy's costs and benefits and to whom they apply.
4. Quantify Costs and Benefits: Quantify the costs and benefits over time against a baseline scenario in which the policy or program did not exist.
5. Monetize Costs and Benefits: Where possible, costs and benefits are monetized to be weighed against each other. If quantification and monetization are not possible, the costs and benefits of the policy or program are described qualitatively.
6. Discount Future Costs and Benefits: Discount costs and benefits that happen in the future.
6. Compare Costs and Benefits: Compare the costs and benefits of the program.
7. Sensitivity Analysis: Perform a sensitivity analysis on the parameters of the CBA to identify the sensitivity of conclusions to critical assumptions.

2. Literature Review

This literature review is organized into seven sections. Section 2.1 provides a summary of the literature review. Section 2.2 describes the history of Kingston's High School Transit Pass Program as per Kingston's documents, data, and research. Section 2.3 reviews the anticipated or measured costs and benefits of similar programs in other cities in Canada and the United States. Section 2.4 reviews how free transit programs have changed transportation mode choices. Section 2.5 reviews a recent analysis from HEC Montréal of the total societal costs of private vehicles, public transit, and active transportation, including the private, government, and hidden costs. Section 2.6 reviews studies on the equity impacts of free transit programs. Section 2.7 concludes with a table summarizing the anticipated costs and benefits of Kingston's High School Transit Pass Program based on the literature review and review limitations.

2.1 Summary of the literature review

Kingston's High School Transit Pass Program was one of North America's first free transit programs for high school students. Kingston's high school students have taken many more public transit trips since the Program launched in 2012. The Transit Pass Program has reportedly delivered multiple benefits. Students who use the Program have reported that the Transit Pass gives them a feeling of independence and the opportunity to reach more after-school and social activities than they could without it (Sullivan, 2012). The Transit Pass Program may have a sustained effect on the use of public transit, as participating students have also stated that they will continue to use public transit in the future.[3] Secondary research also finds that free transit passes for high school students reduce absenteeism (Wexler et al., 2021; McDonald et al., 2004).

Kingston Transit lost fare revenues due to the Transit Pass Program. However, it simultaneously gained from the payments received from school boards, whether those were direct to Kingston Transit or made through the Government of Ontario Gas Tax Fund (City of Kingston, 2016b, 2019). Kingston Transit may also have benefited from higher revenues.[4] Recent high school students may continue to use transit after graduation because of their experience with the Transit Pass Program, leading to higher fare revenues (Kingston Transit, 2022).

Other transit authorities in Canada have also reported that free public transit passes for high school students result in more equitable access to transit, reduce congestion, and improve overall health and well-being. On the costs side, Canadian municipalities have

[3] Anecdotal evidence suggests that youth pass purchasing has gone up 140 percent during the 2017-2023 period.
[4] According to our interview with Jeremy DaCosta (Director of Transit Services City of Kingston during the study period (2012-2019), the guidelines for accessing the Ontario Gas Tax required the rides to have a fare attached. The contributions from the school board for the High School Program were considered a "fare". In other words, school board payments unlocked more revenues from the Provincial Gas Tax.

estimated widely varying foregone revenues, even among similarly sized cities (see Table 2.3 below).

Our review found that free transit passes for high school students should reduce the number of trips taken by other modes of transportation, particularly private vehicles, and increase the number of trips taken overall (Boyd et al., 2003; Bueno et al., 2017; Lachapelle, 2022). Replacing a private vehicle with a public transit trip should reduce societal costs because private vehicles have higher hidden costs from congestion, pollution, and health and safety than public transit. New public transit trips have costs from operating public transit, bus congestion, pollution, and other societal costs (Beaudin et al., 2024).

The Transit Pass Program, in many ways, likely benefitted lower-income families more than other income groups. Lower-income families use public transit more than higher-income families and are likelier to have only one family vehicle (Sullivan, 2017). Similarly, they may be more likely to change transportation modes and choose public transit instead of driving a private vehicle when the option is available (Barri et al., 2021). However, the value of the benefit may accrue more to middle- and high-income families who may have more significant savings from reduced vehicle use (Arranz et al., 2019).

2.2 Kingston's High School Transit Pass Program

Kingston's High School Transit Pass Program is an initiative in Kingston, Ontario, aimed at providing free public transit access to students enrolled in local educational institutions, including public school boards, French school boards, Catholic school boards, private schools, and homeschool students. This program was designed to encourage the use of public transportation among students, promote sustainability, and reduce the financial burden of transit on families, school boards, non-profits and other groups that routinely buy passes for high school students. Under this program, qualifying students receive a transit pass that allows them to use Kingston Transit services at no cost (LDSB, n.d.).

The Transit Pass Program started in the 2012-2013 school year with only Grade 9 students (City of Kingston, 2013). Its original intention was to support Grade 9 students using their ActivPass[5] and to encourage more positive views of public transit before students can drive. Over the next three years, the Transit Pass Program expanded to include the next grade above until it covered all high school students (Grades 9-12) in the 2015-16 school year. Alongside the Transit Pass Program, Kingston Transit made significant investments in its routes for all riders as part of successive Transportation Master Plans, going from 158,000 to 236,000 service hours annually (City of Kingston, 2011; 2016a) (**Figure 2.1**).

[5] The Kingston ActivPass is a card-based program which grants access to recreation facilities at designated times for students in Grade 5 and 9. Link.

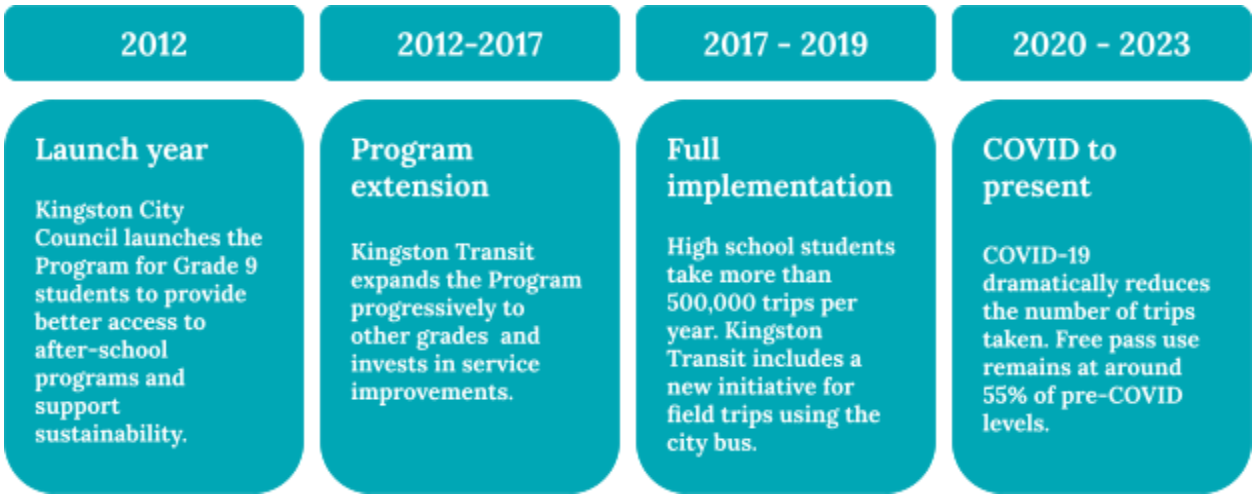


Figure 2.1. Evolution of Kingston's High School Transit Pass Program, 2012 to 2023.
Source: City of Kingston Council Reports, 2013, 2016, 2019

The Transit Pass Program has received recognition for its positive impact on the community and for promoting sustainable transportation. It was the 2018 co-winner of the Transportation category for the Federation of Canadian Municipalities (FCM) Sustainable Communities Awards. This award highlighted the Program's effectiveness in enhancing student mobility, reducing barriers to public transit, and encouraging environmentally friendly commuting options in Kingston (FCM, 2019). In addition to the Transit Pass Program, Kingston Transit (in partnership with both boards) launched a field trip program in 2017 that provided teachers and guardians with free transit for student field trips.[6] The original plan required only one tap per class, making it easier and faster for all students and chaperones to board.

In Council Reports, the City of Kingston also noted that 85 percent of trips taken under the Transit Pass Program were initially to school at the Program's start in 2012 (City of Kingston, 2013). Once the Program was available for all grades, an estimated 50 percent of weekday trips during the school year were school-related (City of Kingston, 2016b). The Council Reports also described the impact of the Transit Pass Program on municipal finances. Initially, the Program did not collect any revenues from school boards, but as the program expanded, the school boards paid Kingston Transit $60,000 per year. Kingston Transit estimated that during the 2015-16 school year, the Program resulted in about $250,000 in foregone fare revenues (about $0.50 per ride). However, higher gas tax funding from the Province of Ontario[7] offset about $125,000 of this difference, resulting in a net decrease of $65,000 to $90,000 in revenues for city coffers (City of Kingston, 2019; 2016a) (see **Table 2.1**).

[6] School boards paid for adult supervisors.
[7] Gas tax funding is weighted 30 percent from city population and 70 percent for public transit ridership. The size of the pool of funds for all Ontario municipalities is updated every year. In 2023-24, the Ontario government distributed $390 million to 107 municipalities.

Table 2.1. Key findings from City of Kingston Council Reports relevant to the investment case

Area	Finding	Document
Overall Transit Network	Between 2011 and 2016, revenue service hours increased from 158,000 to 236,000 annually. Overall ridership in 2015 reached a record of 4.6 million passenger trips. Kingston Transit carried 1.1 million more passengers in 2015 than in 2011, an increase of 31% over those five years.	City of Kingston (2016b)
Financial Transfers	The City of Kingston received a total combined financial contribution of $60,000 each year from the Limestone District School Board and Algonquin and Lakeshore Catholic District School Board in support of the program.	City of Kingston (2019)
Lost Transit Revenues	The Transit Pass Program reduced Kingston Transit fare revenue by approximately $250,000 annually. This loss was offset by the provincial gas tax funding the City received. The estimated total difference in revenues ranged from $65,000 to $90,000 annually.	City of Kingston (2019)
Youth Transit Use - Purpose	Ridership (Grade 9 students) was concentrated around school days' start and end times. Approximately 85% of all trips occurred on weekdays between 7 am and 9 am and 2 pm and 4 pm.	City of Kingston (2013)
	Based on the day and time of travel during the September–March period, it was estimated that 50% of the trips were related to travelling to/from school at arrival/dismissal times. The remaining 50% of trips were non-school-related. Approximately 15% of all trips occurred on weekends (Saturday—Sunday).	City of Kingston (2016)
Field Trips	In 2017-18, Kingston high schools and elementary schools took 300 field trips with the field trip pass program.	Kingston Transit (2019)

The Transit Pass Program has dramatically impacted public transit use by high school students. Grade 9 students took about 28,000 rides in the Program's first year. When all grades could get a free pass in the 2015-16 school year, students took more than 500,000 trips, or 700,000 rides, including transfers. Free bus pass use declined slightly in 2018 and 2019, although this may be from students not tapping their passes as often, especially at large group stops, where transit operators (drivers) could assume all passengers boarding were high school students in an effort to reduce boarding time and keep buses on schedule (personal communication, Dan Hendry and Jeremy DaCosta, November 5, 2024). Free bus pass use dropped sharply during the COVID-19 pandemic. In the first four months of the 2020-21 school year, transit use declined by just over 60 percent among free pass holders compared to 2019-20 (Kingston Transit, 2021) (see **Figure 2.2**).

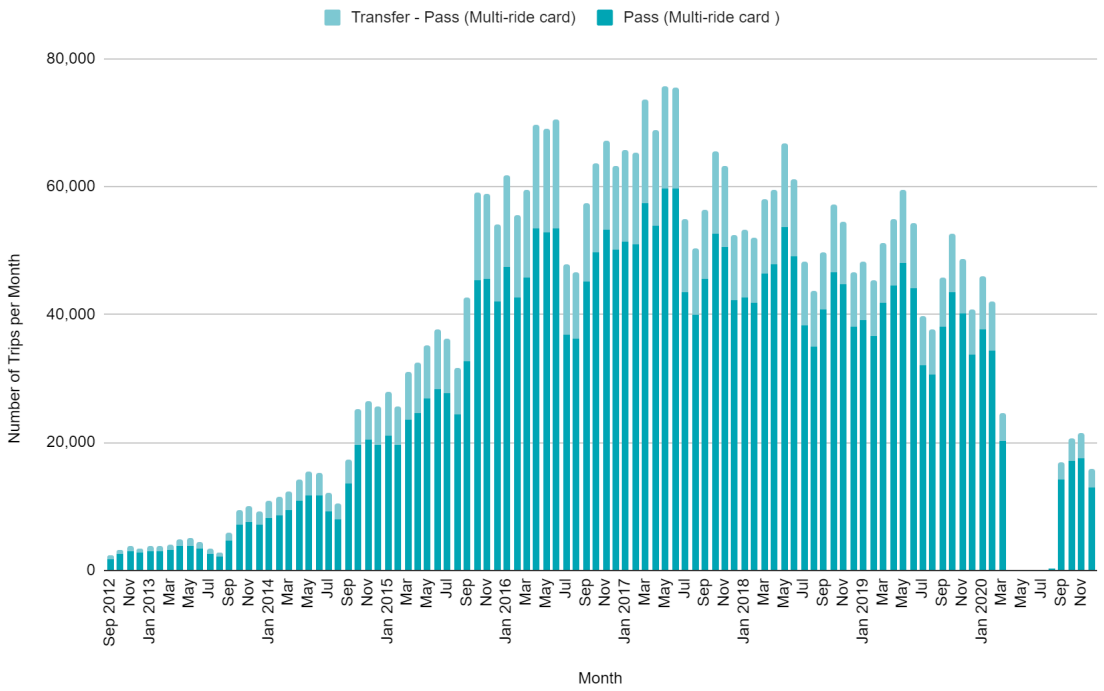


Figure 2.2. Kingston free transit pass use by year, 2012 to 2020
Source: Kingston Transit, 2021

In 2017, Veronica Sullivan (2017) completed a detailed analysis of the Transit Pass Program from the Program's inception to the school year 2016-17. The study looked at free transit pass use patterns and Kingston parents' and caregivers' attitudes about the Program and different modes of transportation. The study found that older teenagers (those in Grades 11 and 12) were especially enthusiastic users of the free pass, particularly for discretionary trips. High school students said 75 percent of trips would be negatively affected without the free transit pass, including 86 percent of social trips and 65 percent of school trips. Based on the parents' survey, the study also reported that parents were most comfortable with their teenager taking the bus, compared to other options such as walking alone or driving themselves (Sullivan, 2017).

Sullivan (2017) and others also reported on the personal experiences of parents and students who used the Transit Pass Program. Parents and students have stated that the free transit pass allowed for greater independence and reduced the need for parents to chauffeur their children. Students also noted that the included training on using the bus helped them feel more confident (**Table 2.2**).

Table 2.2. Select quotations about Kingston's High School Transit Pass Program

Quote	Source
"My other daughter is looking forward to getting to high school to get a bus pass and have more independence."	Parent's Survey (Sullivan, 2017)
"The student transit pass is very helpful for our family. All of the kids use their transit pass to get around Kingston with their friends."	
"It's opened the opportunity for my children to be more independent without having to rely on us or our vehicles. It's a learning opportunity for them, and it means they have to be more responsible and attentive to the world around them."	
"Our family schedule is difficult at times with 6 busy people, 2 vehicles and 4 jobs. We use public transit regularly."	
"I have no other way to get to places quickly."	Grade 9 and 12 Survey (Sullivan, 2017)
"My parents are not always free to drive me and I really enjoy public transit."	
"I have no other way to get to places quickly."	
"The free bus pass allowed me to develop independence since I was no longer reliant on my parents for rides, and improved my social life dramatically since I could travel across town reliably without charge."	Get on the Bus, 2024
"It's such a simple concept, but I met so many people during and after high school who didn't have this [public transit training] and who told me how nervous they were at age 17 getting on the city bus for the first time."	Ross, 2023
"As the Mayor of Kingston, I see firsthand the benefits of the high school transit programming initiative in our community. This program provides valuable life skills and resources for youth to navigate public transportation, which is essential for their education, social engagement, and overall well-being."	Mayor Bryan Paterson, City of Kingston[8]
"Over the past 10 years that the Kingston Transit High School Bus Pass Program has been in place I've seen a number of positive changes in the way that students and staff are able to access our two Kumon centres in Kingston. I see young students who are not bound by the availability of their parents to drive them to the centre after school and high school staff who have this sense of pride as they commute to their part-time job on their own."	Kelvin Tang, Co-Owner - Kumon of Kingston

2.3 Community costs and benefits of free or discount youth transit passes in Canada and the United States

2.3.1 Canada

Kingston's High School Transit Pass Program has inspired several cities to pilot or conduct feasibility studies for free transit programs.[9] Canadian cities implement free transit programs to increase access to public transit for youth, seniors, and low-income families. **Table 2.3** summarizes Canadian initiatives and expected or reported impacts from pilot studies. The most commonly noted benefits are better access to activities for high school

[8] Daniel Hendry provided quotations from former mayor Bryan Paterson and Kelvin Tang in a personal communication on December 5, 2024.
[9] This section describes cities with available assessments of free transit pass programs. A total of 16 cities in Canada have implemented or explored free trans passes for youth: Barrie, ON; Belleville, ON; Burlington, ON; Grande Prairie, AB; Halifax, NS; Kitimat, BC; London, ON; Mont Tremblant, QC; Oakville, ON; Orangeville, ON; Orillia, ON; Penticton, BC; St. Albert, AB; Sunshine Coast, BC; Toronto, ON; Victoria, BC; Whistler, BC.

students, transport cost savings to families, better teenage health, promoting sustainability, and reduced traffic congestion, especially around schools.

Cities anticipated transit programs' costs based on foregone revenues. Many cities had estimated foregone revenues to be much higher than in Kingston. For example, Oakville and Guelph, two cities in Ontario of comparable size to Kingston, estimated more than $500,000 in foregone revenues for free transit programs for youth, more than double the expected impact on fare revenues in Kingston (City of Guelph, 2024; City of Oakville, 2023b). On the other hand, the Toronto Transit Commission (TTC) estimated that free transit for field trips for more than 140,000 students would cost about the same (TTC, 2024). In Halifax, the total funding of a free transit program for youth from Grades 7 to 12 for public transit, including ferries, was budgeted at $1.8 million for 28,000 students (Government of Nova Scotia, 2024).

Three small Canadian cities have eliminated public transit fares for all groups: Orangeville, Ontario; Canmore, Alberta; and Mont-Tremblant, Quebec. Orangeville recently made public transit free for everyone and estimated that foregone revenues were $150,000, but the public transport authority saved $80,000 in fare enforcement (Dunne, 2024).

Table 2.3. Key findings on free transit for high school students from other Canadian cities

City	Impacts (anticipated or measured)	Identified costs	Reference
Vancouver	• Access to free transit greatly impacted participants' social determinants of health. • Riders averaged 1.5 trips per day.	• Passes were provided to 100 people during the pilot.	SMA, 2023; Singh, S., 2022
Sunshine Coast	• Increased youth ridership • More equitable access to transit • Greater affordability for families • Fewer parent drop-offs at school • Reduced congestion issues at schools	• Foregone revenues of $81,567 • Monitoring and evaluation costs • Program administration costs	Lattani, 2023
Guelph	• 2023: Providing free passes to high school students is not recommended.	• 2023: $650,000 in foregone revenue	City of Guelph, 2023
	• 2025: Implementing a pilot program for evenings and weekends.	• Not Available	City of Guelph, 2025
Oakville	• Enhanced transportation options for the overall well-being of the community.	• $550,000 in foregone revenue over the pilot year	City of Oakville, 2023a; City of Oakville, 2023b
Toronto	• Increase in field trips and increase in youth ridership • More students can use transit.	• $500,000 in foregone revenue	TTC, 2024

City	Impacts (anticipated or measured)	Identified costs	Reference
	• Pilot is straightforward to use and administer.		
Halifax	• Passes are more affordable for families. • Students have greater independence. • Promotes sustainability	• $1.8 million program cost ($1.2 million from the government)	Government of Nova Scotia, 2024

2.3.2 United States

A 2014 prospective evaluation of the costs and benefits of free transit passes in Los Angeles County estimated that a free transit pass program could cost the Municipal Transit Authority (MTA) up to US$71 million in lost revenue in 2013. However, the analysis included the value of new trips. For benefits, the study noted that free transit passes would increase school attendance, reduce contact with the justice system for fare evasion, reduce costs to families, improve health, and lead to more attendance at after-school activities. The study also noted that the program would reduce the need for school buses, which cost Los Angeles County US$273 million in 2011-12 (Gase, 2014).

In the United States (US), a few studies have tried to quantify the benefits to students beyond measuring the number of new trips or the change in mode of transportation. Nevertheless, a handful of studies have examined the impacts of similar free or discount transit pass programs on students' educational outcomes. For example, in Minneapolis, a free transit pass program targeted at low-income households reduced excused absences by 11.5 percent for pass users and 27.5 percent for those eligible for a pass, even if they did not take it (Wexler et al., 2021). In San Francisco, a free transit pass program for low-income youth increased public transit use in northern areas of the city, with better transit access to after-school programs, but it had no effect in southern areas. They found no significant changes in school absenteeism (McDonald et al., 2004).

A primary benefit of free transit passes for high school students is increasing their access to after-school programs and new social opportunities. According to a systematic review of US after-school programs, well-designed programs result in better self-perception, school bonding, test results, and fewer problem behaviours (Durlak & Weissberg, 2007). Teenagers are also less likely to experience mental health issues and substance use in their later school years if they indicate high levels of school connectedness and positive social relationships during their early secondary education (Bond et al., 2017).

2.4 Transportation choice

A primary rationale for free transit passes for high school students and other groups is to promote sustainability by reducing private vehicle use. This section reviews trends in the choice of mode of transportation in Kingston and the effects of similar free transit

programs on transportation choice. How students and families change their transportation choices is essential to the investment case, as Limestone Analytics must estimate the number of new bus trips, the number of trips replacing other modes of transportation, and the number of trips high school students would have taken even without the Transit Pass Program. In the investment case, we will apply price elasticities[10] from general public transportation research as well as the implied elasticities based on similar programs.

Todd Litman has summarized research on price elasticity of demand and cross-price elasticities for public transit fares (Litman, 2024). In cities under one million people, bus fares have a price elasticity of -0.43 compared to -0.36 in larger cities (Pham & Linsalata, 1991). Bus fare elasticities are also higher in the long run, particularly in non-urban areas (Dargay & Hanly, 1999). Local public transportation service level is associated with a short-run elasticity of 0.43 and 0.75 in the long run (Fearnley & Bekken 2005). In Newcastle, Australia, car use has a cross-price elasticity of 0.116 with respect to the cost of a single transit fare. In a meta-analysis on cross-price elasticities, a 25 percent reduction in transit fares is associated with a 1.5 percent reduction in car trips (Brechan, 2017).

Elsewhere, studies have found that free or discounted transit passes reduce car use for non-discretionary trips to university or work if public transportation is not a common commute method. In Minneapolis, Fan and Das (2015) estimated that the local Student Pass program for high school students reduced vehicle miles by 158,400 for yellow school buses and 2,038,784 for personal vehicles. At UCLA, the BruinGo pass increased public transit use by more than 50 percent over ridership in 2000 (the year before BruinGo), while more than 1,000 fewer automobile trips were taken to the UCLA campus daily (Boyd et al., 2003). Researchers in New Jersey and New York found that workers who received incentives to take public transit (e.g., free transit passes) were more than twice as likely to use public transit to get to work (Bueno et al., 2017).

In Montréal, access to discount passes was not a strong predictor of university students' choice of transportation to campus - implying a low elasticity. Using a discontinuity design to compare students at the University of Quebec in Montréal (UQAM) aged 25 with access to a discount pass and students aged 26 without access to a discount, the authors found little difference when controlling for other factors affecting transportation choice, such as distance to school. Public transit use, in general, was already relatively high among students (more than 80 percent) because the campuses of UQAM are located near subway stations.

Kingston has a high rate of students using public transportation to get to school, although it is still the third most popular option. **Figure 2.3** shows that 19 percent of high school students aged 15 to 19 used Kingston Transit to get to school in 2019. The main method of

[10] A negative price elasticity indicates that demand falls when the price increases. A price elasticity less than one means that each one percent change in price has less than a one percent effect on the quantity demanded.

transportation to school was a school bus (36 percent), followed by a private vehicle as a driver or passenger (29 percent) (Open Data Kingston, 2021).

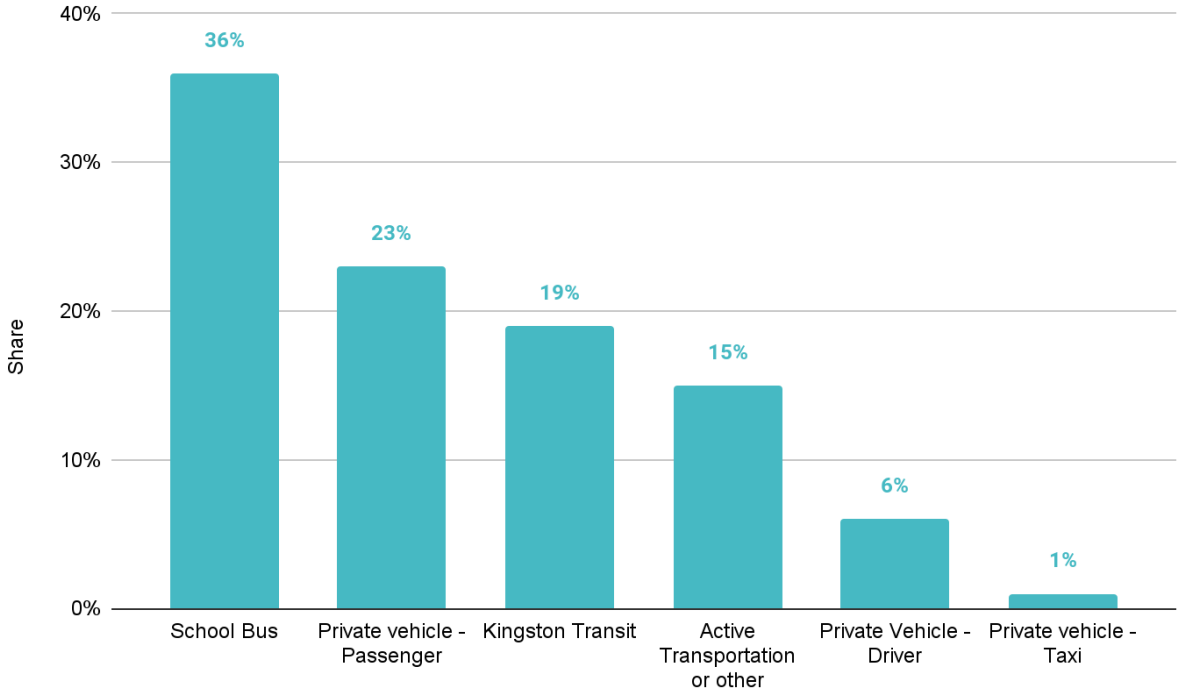


Figure 2.3. Mode of transportation used by students ages 15 to 19 to travel to/from school in Kingston, 2019
Source: Open Data Kingston, 2021

Data on student transportation mode before the Transit Pass Program has yet to be made available to Limestone Analytics. However, even without the Transit Pass Program, high school students may have increased their bus use compared to other modes of transportation: Overall, Kingston commuters of all ages increased their transit use by 33 percent between 2011 and 2016, likely due to significant investments that Kingston Transit made in service hours (Statistics Canada, 2022; John, 2016).

Evidence from Kingston also shows that recent high school graduates continue to use public transit at least immediately after high school. **Figure 2.4** shows that youth monthly and multiride pass[11] use increased significantly from 2017 to 2020, the first years that recent high school graduates would have recent experience with the Transit Pass Program.

[11] The youth monthly pass and youth multiride pass are available to those ages 15 to 24 who are out of school (Kingston Trasnit, n.d.).

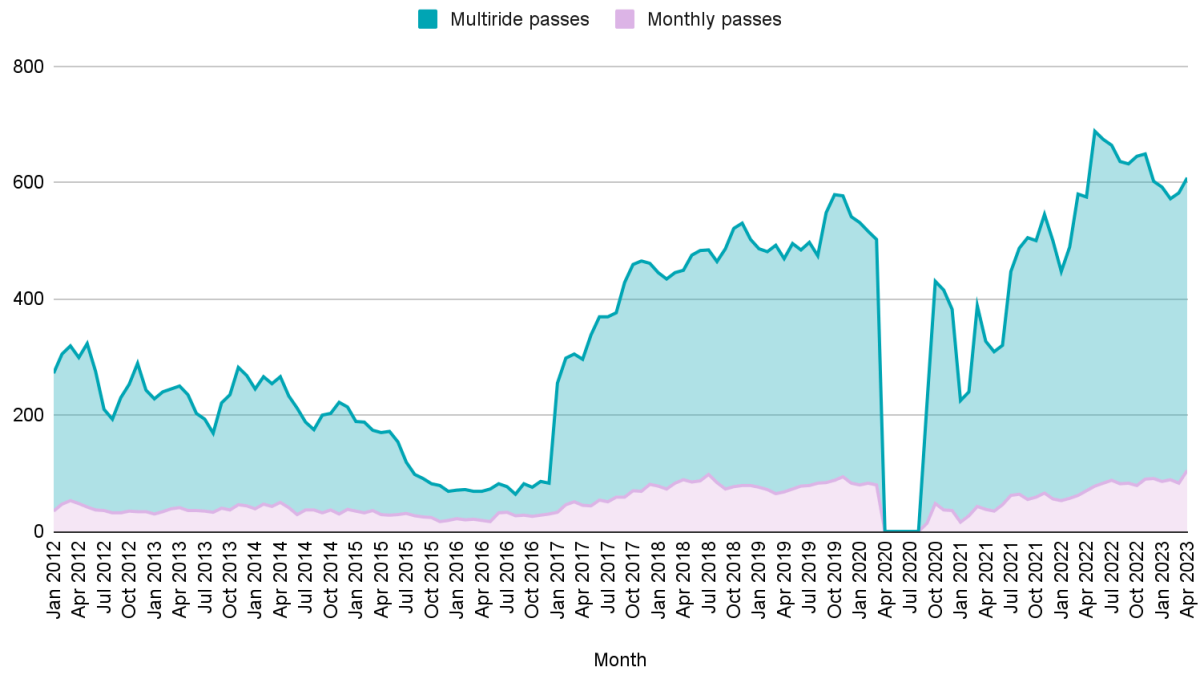


Figure 2.4. Sales of youth monthly passes and youth multiride passes by month, 2012-2023
Source: Kingston Transit, 2023

Although students in Kingston have shown a desire to keep using transit (Sullivan, 2017), research on temporary programs for free or reduced public transit use shows that users often return to previous modes. A meta-analysis of interventions to reduce car use examined several free or reduced transit fare schemes (Graham-Rowe et al., 2011). The authors noted that Bamberg (2006) found that offering free transit tickets to encourage a change in transit use after relocation resulted in a 17 percent decrease in car use, compared to a 5 percent decrease for the control group in Stuttgart, Germany. On the other hand, Fujii and Kitimara (2003) found no statistically significant change in car use when students in Kyoto received a free one-month bus pass. In Chile, two weeks of free transit passes for workers led to 23 percent more trips but no differences in car trips. The increase was concentrated mainly among transit users living near subway stations. However, the authors noted that transportation elasticities are more significant in the long run, so the two-week period may have been insufficient to identify all behavioural shifts (Bull et al., 2021). Thøgersen and Møller (2008) similarly reported that although drivers in Denmark who received a free one-month transit pass increased their public transit use temporarily, the effect disappeared after four months.

2.5 Societal costs by mode of transportation

The literature contains extensive research on the private, government, and social costs of different modes of transportation (e.g., Litman, 2022). This section describes a recent

analysis of societal costs by mode in Montréal and surrounding regions that can be adjusted to fit Kingston's context (Beaudin et al., 2024a, 2024b).

In Montréal, private and government costs for private vehicles were slightly lower than public transit over the same distance. However, private vehicles are associated with much higher hidden costs from environmental harm, congestion, risks to other road users, and the use of physical space. Each private vehicle kilometre (km) travelled imposed $2.54 in total societal costs compared to just $1.55 for public transit. Active transportation — cycling and walking — cost $0.93 and $3.66 per km, respectively (Beaudin et al., 2024b). **Figure 2.5** summarizes the private, government, and hidden costs by mode of transportation per km.

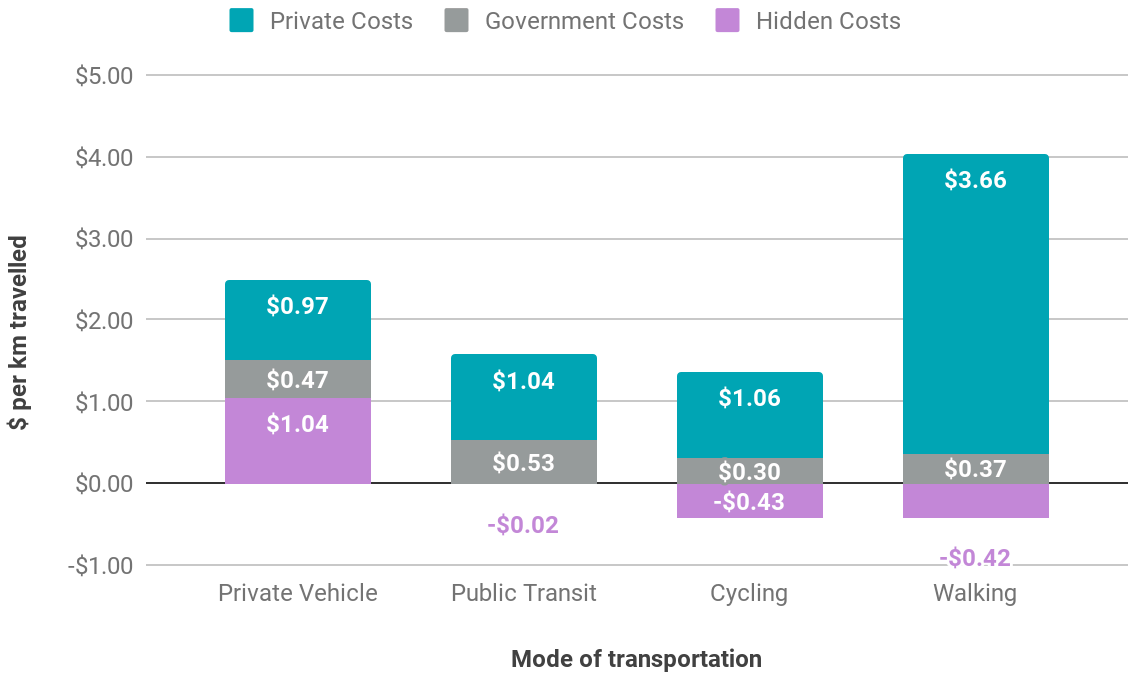


Figure 2.5. Private, government, and hidden costs per km by mode, Montréal, 2024
Source: Beaudin et al., 2024b

Private transportation costs include direct travel costs, such as vehicle ownership, maintenance, buying a transit ticket, personal health risks from accidents, and the value of time cost. Public transit and active modes of transportation take longer than driving for the same distance, which balances the cost of vehicle operation, based on the calculator from Beaudin et al. (2024b). In Montréal, the private driving and public transit costs were similar per km, at $0.97 and $1.04 per km, respectively. Walking was the most expensive at $3.66 per km, followed by cycling at $1.06 per km because of the slower travel speed (Beaudin et al., 2024b).

Governments subsidize all forms of travel in Canada. With limited exceptions, the costs of roads, sidewalks, and parking are funded through taxes rather than directly by private vehicle drivers. For public transit, fare revenues are only about one-third of operational costs, with federal, provincial, and municipal government subsidies making up for shortfalls (CUTA, 2024). The HEC Montréal study estimated that government costs were slightly higher for public transportation at $0.53 per km, compared to $0.47 per km for private vehicles. Public costs for cycling and walking are lower at $0.30 and $0.37 per km because they do not require as much infrastructure as private vehicles or public transit (Beaudin et al., 2024a).

The hidden costs of transportation include environmental costs, congestion costs, safety risks to other road users, health benefits, and the use of public space. Public transportation, cycling, and walking have net hidden benefits because their health benefits outweigh other hidden costs. Walking and cycling have no external environmental costs, require minimal space, and have a limited impact on the safety of others. They both provide significant health benefits from exercise, with a hidden net benefit of more than $0.40 per km (Beaudin et al., 2024b).

Private vehicles have high environmental costs per km, causing an estimated $0.11 in damage per km compared to just $0.02 for public transit. Private vehicles are also associated with a congestion cost of $0.33 per km compared to just $0.01 for public transportation. Private vehicles are significantly less safe than public transportation and are associated with an external safety cost of $0.27 per km compared to less than one cent for public transit. Physical space used for parking is also a significant externality, with a cost of $0.33 per km for private vehicles and only $0.06 per km for public transit.

2.6 Equity

As part of the investment case, Limestone Analytics has examined equity issues related to bus passes by considering the distribution of impacts across income groups and other disadvantaged groups as much as possible. While limited, the recent research summarized below has found that transit programs targeting low-income groups expand access to transport, that low-income groups benefit more from free transit pass programs, and that they are more likely to change their mode of transportation when offered a free bus pass.

A free bus pass is more likely to expand the transportation possibilities for low-income students. Higher-income parents are more likely to chaperone their children to activities. Sullivan (2017) noted that chauffeuring high school students is limited to households with a vehicle and that high-income parents are generally more attentive. Free transit programs expand access to transit and mobility for low-income populations. For example, in Tallinn, Estonia, free transit passes for low-income households led to a 14 percent increase in trips taken and improved mobility (Cats et al., 2017). Ofosu-Kwabe et al. (2024) found that free

transit passes for low-income households increased transit use by 28 percent in small and 34 percent in medium urban zones in the United States.

The effects of free transit programs may work through mobility to improve socialization. For example, one study for the City of Guelph reported that people with low incomes and access to free or discounted transit passes also found it easier to pay their monthly bills because of the savings from a free transit pass, and free passes increased mobility, socialization, and access to services (Ellery & Peters, 2010). A pilot study on free transit passes for low-income families in Vancouver showed that the passes allowed greater access to activities and students from low-income families to feel more included (Single Mothers' Alliance, 2023). Free transit passes for low-income youth in San Francisco resulted in more after-school activities and better school attendance, but the effect was uneven across study areas (Wexler et al., 2021).

There is mixed evidence on the extent to which low-income groups benefit compared to other income groups from free transit pass programs. Sullivan (2017) noted that, in Kingston, teenagers in low-income households were more likely to use public transit than children from high-income households who had the financial means to chauffeur their children. This effect may be by design, as in many cases, free or discounted public transit programs target students from low-income families to help them access work or recreational activities they otherwise could not access and to reduce the financial burden of travel. Elsewhere, a free youth transit program in Spain had the most significant benefit for middle-income households, who saved the most from reduced transport costs (Arranz et al., 2019).

Limited evidence indicates that low-income groups are more likely than other income groups to change their mode of transportation due to free transit programs. In Canada, low-income households were more likely to switch to public transit from driving when transit was more accessible in Toronto and Hamilton (Barri et al., 2021).

2.7 Expected impacts by perspective

Based on the above literature review, **Table 2.4** summarises the expected main costs and benefits by the stakeholder group of Kingston's High School Transit Pass Program.

Table 2.4. Summary of the costs, benefits, and transfers of Kingston's High School Transit Pass Program by perspective

Perspective	Costs	Benefits	Source
High School Students	• Increased travel time when a private vehicle trip is replaced by public transit	• Increased discretionary trips for socializing, after-school programs, and expanded access to services • Improved physical and mental health • Greater independence • Reduced school absences • Reduced absences from after-school programs.	• Kingston Transit, 2021 • Sullivan, 2017 • Wexler et al., 2021 • Ellery & Peters, 2010
Other Family Members		• Reduced private costs for trips to school and discretionary activities • Reduced collision risks • Reduced transit fares	• Kingston Transit, 2021 • Sullivan, 2017 • Beaudin et al., 2024
Kingston School Boards and School Bus Transit	• Payment to Kingston Transit	• Reduced school bus capital and operational costs • Reduced pollution and congestion around schools	• Kingston Transit, 2021 • City of Kingston Council Reports
Kingston Transit	• Lost fare revenues • Higher operating and capital costs	• Payment from school boards • Payment from the Province of Ontario gas tax fund • Higher fare revenues from improved network and public transit use post-high school	• City of Kingston Council Reports • Kingston Transit Financial Reports • Sullivan, 2017
Other Road Users	• Increased congestion from public transit • Increased collision risks from public transit	• Reduced congestion from private vehicles, particularly around schools • Reduced collision risks from private vehicles	• Beaudin et al., 2024
Canada	• Increased pollution from more public transit	• Reduced pollution from private vehicles • Reduced pollution from school buses	• Beaudin et al., 2024

Perspective	Costs	Benefits	Source
Other Government	• Payment to Kingston Transit from the Provincial Gas Tax Fund • Increased direct and indirect transfers from all levels of government to support public transit • Increased road maintenance costs from public transit	• Reduced road maintenance costs from private vehicles • Other reduced transfers	• City of Kingston Council Reports • Beaudin et al., 2024

2.7.1 Review limitations

Like any review, this one is subject to limitations. Limestone Analytics restricted the secondary literature review to documents provided directly by LDSB counterparts and to documents published or discoverable through online database searches, such as Google Scholar, written in English and published between 2000 and 2024.

Caution should be applied when transferring evidence of impacts across programs, regions, and different populations. Many of the studies from secondary literature apply to university students or adults, which may limit their applicability to free transit programs directed to high school students.

The HEC Montréal study reviewed in Section 2.5 provides a good base case for estimating the societal costs of different modes of transportation. However, as part of the investment case, we must make essential adjustments to the figures to account for the differences between the transportation costs in Montréal and Kingston.

3. Methodology

This section describes the methodology of the investment case for Kingston's Transit Pass Program by identifying the benefits, costs, and perspectives of stakeholders affected by the Transit Pass Program. Annex 1 of this report presents a series of quantity and value (Q&V) instruments, including formulas and data sources, used to calculate the benefits and costs per Limestone's unified cost-benefit analysis (UCBA) framework. This report follows the principles of UCBA and applies the relevant specification instruments prescribed by Limestone Analytics (see Kashi & Bahn, 2025).

3.1 Transit rides attributable to the Program

Economic analysis aims to isolate the welfare effects of a specific intervention by comparing the outcomes of interest among those impacted by the intervention with a counterfactual, i.e., the hypothetical outcomes that would have occurred without the intervention. This alternative scenario, the counterfactual, is also called the 'without program' scenario. It allows for attributing changes in an outcome to a specific intervention or comparing the effects of different types of interventions.

We start by looking at the rides that occurred using free transit passes and compare them with the total transit ridership in Kingston. **Figure 3.1** illustrates that despite the continuous growth of total Kingston ridership over the period, the number of rides with student transit passes experienced a decline.

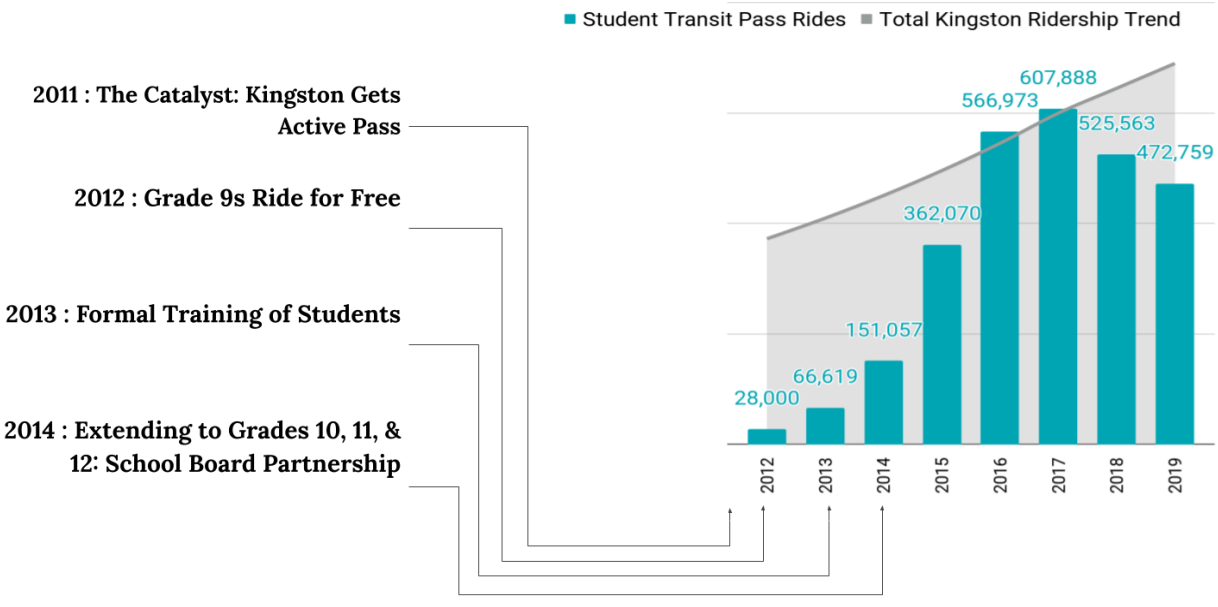


Figure 3.1 Transit ridership trends

Anecdotal evidence suggests that this drop is due to students not tapping their passes as often, especially at large group stops, where transit operators (drivers) could assume all passengers boarding were high school students in an effort to reduce boarding time and keep buses on schedule.[12]

Therefore, we have matched the same trend for 2018 and 2019. **Figure 3.2** shows the observed and adjusted values over the study period.

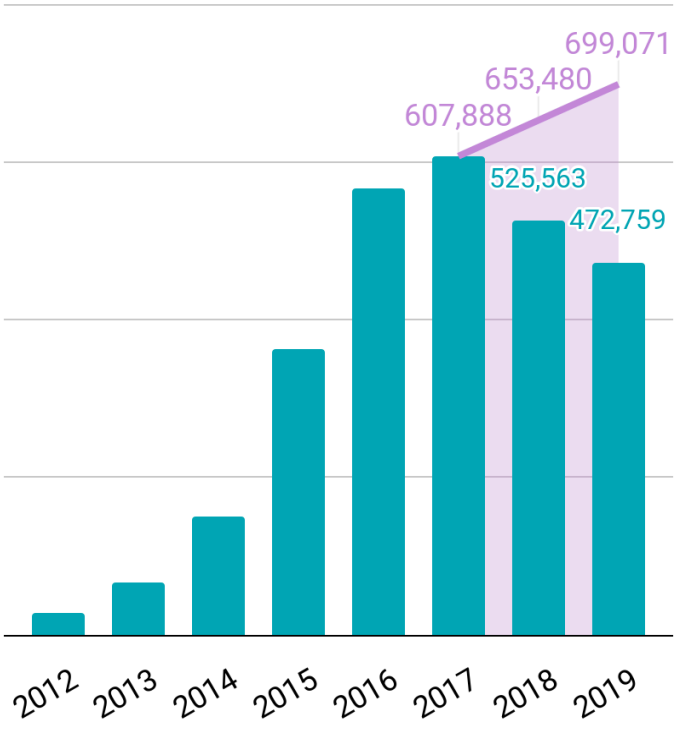


Figure 3.2. Adjusted ridership trends

To estimate how many rides are attributable to the Program, we need to dig deeper than just counting rides that occurred with free transit passes. **Figure 3.3** shows the high school transit pass rides per year. There has been a considerable increase in student transit use, from 28,000 rides in 2012 to nearly 700,000 in 2019, with an average of approximately 392,000 rides per year. It is important to distinguish the number of rides directly attributable to the Program. It would be inaccurate to attribute every ride to the availability of free passes, as some students may have utilized transit regardless of the Program.

[12] Interview with Jeremy DaCosta (Director of Transit Services City of Kingston during the study time, 2012-2019).

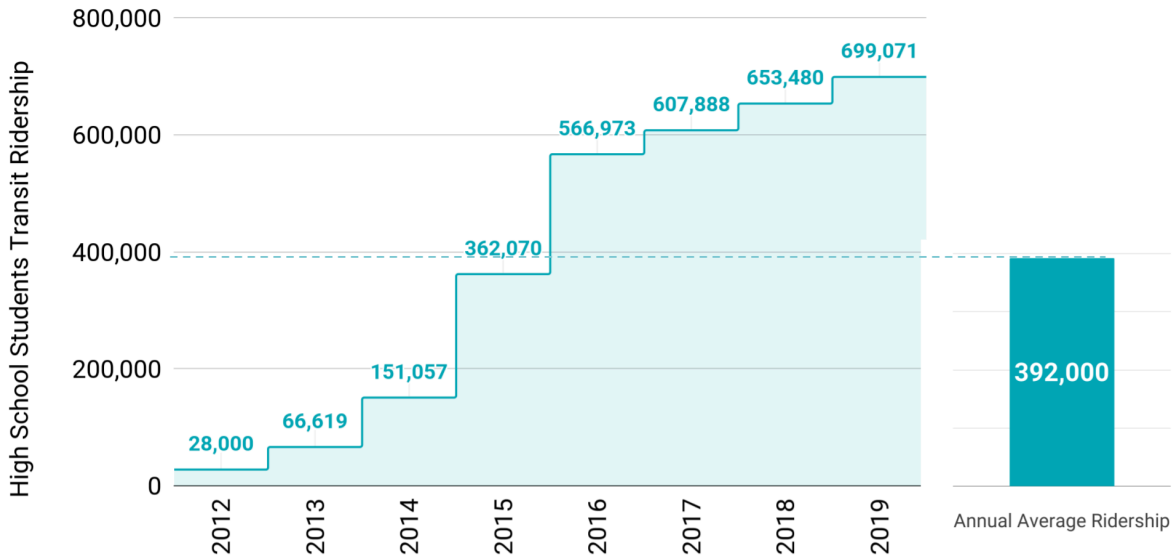
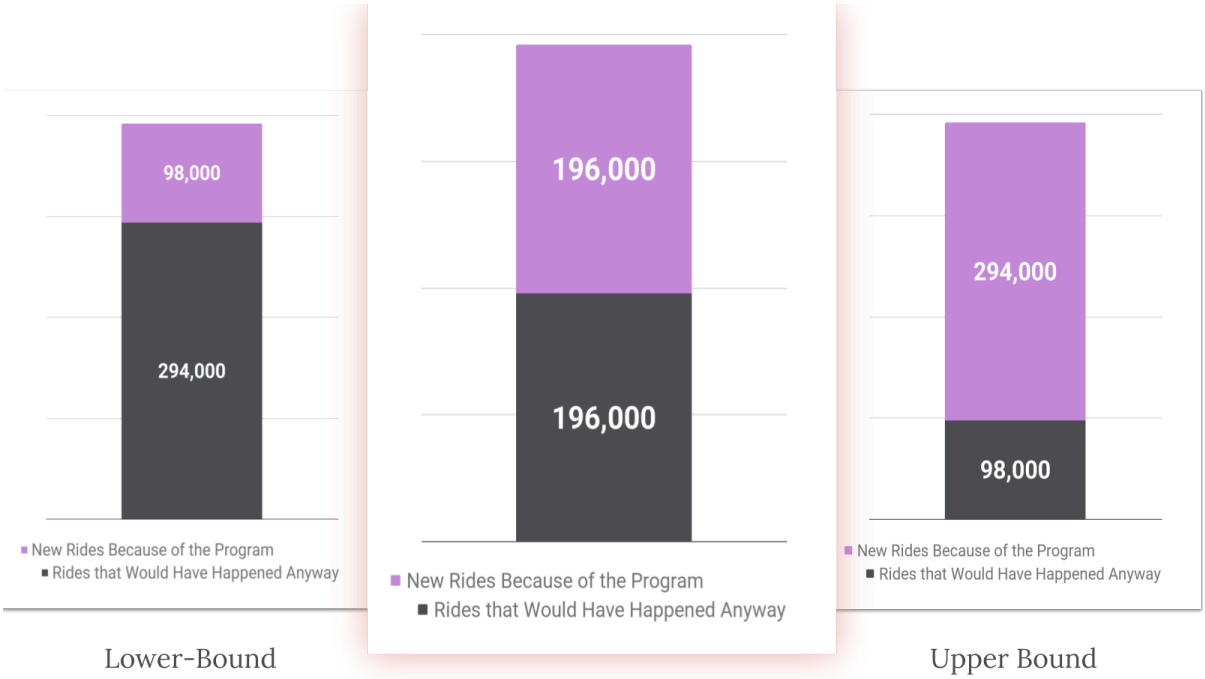


Figure 3.3 High school students' transit ridership with the Program

Therefore, the challenge lies in estimating this "what if" scenario—the counterfactual. Since we cannot observe what would have happened without the Program, we need to make reasonable assumptions about how much of the ridership increase was truly induced by it. We define three scenarios (see **Figure 3.4**):

- **Lower-bound (pessimistic) scenario:** This scenario assumes that only **25 percent** of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component of programs such as the Transit Pass Program or the impact of age (youth generally have less ability and access).
- **Mid-point (baseline) scenario:** This scenario is the baseline scenario in our analysis, and it assumes 50 percent of the high-school students' rides are new because of the Program.
- **Upper-bound (optimistic) scenario:** This scenario assumes that 75 percent of the high-school students' rides are new because of the Program.



Lower-Bound (Pessimistic)

Mid-Point (Baseline)

Upper Bound (Optimistic)

Figure 3.4. Ridership due to the Program: 3 Scenarios

3.2 Benefits, costs, & perspectives

Table 3.1 lists the intervention's benefits, costs, transfers, and perspectives. The sign of transfers implies whether the transfer is an inflow (+) or outflow (-) from the listed perspective.

Table 3.1. Benefits, Costs, & Perspectives[13]

Benefit, Costs, or Transfer	Students	Students' family members	School boards	Kingston Transit	Kingston (Canada)	Govt of Ontario
B1 - Cost savings from switching transport modes	✓	✓	✓	✓	✓	
B2 - Benefits of additional cultural and social trips[14]	✓					
B3 - Education benefits	✓					
C1 - Program administration costs			✓	✓		
C2 - Marginal costs of new rides	✓			✓	✓	
T1 - Payment for free bus passes from school boards to Kingston Transit			✓-	✓+		
T2 - Public transit transfers from the Government of Ontario to Kingston Transit				✓+		✓-
T3 - Changes in transit revenues	✓+	✓+		✓-		

The benefits, costs, and perspectives table (**Table 3.1**) includes only the socioeconomic benefits and costs that can be effectively quantified within the CBA model. However, Limestone Analytics has identified other potential benefits and costs of the Transit Pass Program that the CBA model cannot include either because they cannot be quantified due to the lack of data and robust estimation approaches or are captured indirectly through other quantified benefits and costs. The following paragraphs list these potential benefits and costs, briefly explaining why we have excluded them from the CBA model.

[13] It should be noted that all the benefits and costs (not the transfers) would be counted as economic benefits and costs to the whole Canadian economy. However, this table only shows the allocation of benefits and costs by perspectives.
[14] Non-school trips may include many activities, such as field trips, meeting friends, shopping, attending after school programs, volunteering, or working.

Other long-term education and mental health benefits of cultural and social trips: The CBA model includes the benefit from additional trips for after-school programs, socialization, and field trips (B3), but the value per trip in our model conservatively assumes that the free bus pass does not reduce barriers to accessing cultural and social trips. We use this conservative value for this benefit because we found no studies that estimated the long-term value of the benefits resulting from more opportunities for after-school programs, socialization, and field trips.

Independence: Our literature review and key informan interviews (KIIs) indicated that high school students and parents believe that a free bus pass gives students greater independence. Fostering independence during the teenage years sets the foundation for a successful and fulfilling adult life. However, we found no studies that would allow us to quantify or value the potential benefit of greater teenage independence.

School congestion: We applied a standard cost per kilometre by mode for the cost of congestion imposed on roads from Beaudin et al. (2024a). However, this congestion cost only accounts for road traffic, but not traffic immediately around schools (e.g., increased time spent waiting to drop off a student, pollution around schools). We found no studies of the effect of a free bus pass on school congestion.

School choice: Students may use the free transit pass to attend a different school or a school outside of their catchment area. Increased options for matching students with schools with specialized programs may improve education outcomes. However, we did not quantify or value this benefit due to a lack of studies that estimated the long-term value of improved school choice.

Long-term induced transportation changes: Induced transportation changes refer to the phenomenon where incentives or expansions in transportation infrastructure lead to changes in travel behaviour, land use, and overall transportation demand that were not initially anticipated. Our model did not capture the induced trips that may occur. For example, a parent who no longer needs to drive their child to an after-school activity may use it for a new trip to go shopping. Families that know about access to the free bus pass may be more likely to move near a bus stop. We found no studies that estimated the effect of a free bus pass for high school students on long-term induced transportation changes.

Certain personal non-market costs and benefits by mode: Our analysis of the private costs of transportation was limited to the time people spend travelling and the private costs of transportation, such as fares and vehicle ownership, and a health benefit, when the mode involves physical activity. We did not include other non-market values that individuals may place on different modes of transportation. For example, our model does not include the personal value of greater flexibility of a private vehicle trip or the better sense of well-being that a walking trip provides.

4. Key Informant Interviews

4.1 Background

To inform the investment case, in January 2025, Limestone Analytics conducted key informant interviews (KIIs) with selected experts who had relevant experience with the Kingston Transit Pass Program and/or specialized knowledge of the societal costs of transportation. The three key informants were:

- Logan Jackson, Researcher, KCHC Pathways to Education
- Todd Litman, Founder and Executive Director, Victoria Transport Policy Institute
- Anne Marie McDonald, Principal at Bayridge Secondary School in Kingston, Ontario

The following section summarizes the key findings from our interviews, organized into key themes.

4.2 Key themes

4.2.1 Impact on student behaviour

School Attendance & Engagement:

- While the bus pass did not completely eliminate absenteeism, it helped reduce chronic lateness. There is also anecdotal evidence of increased graduation rates.
- The free bus pass provided a second option for students who missed their school bus, leading to improved attendance, particularly when students lived far from school but were not eligible for a school bus.

Expanded Work, Volunteering & Learning Opportunities:

- The pass increased students' ability to pursue co-op placements, volunteer opportunities, and jobs that were previously inaccessible due to transportation and financial barriers.
- Schools look for co-op opportunities on bus routes that are more accessible to students.
- Free bus passes have made it easier for teachers in Kingston to take school field trips that are accessible by city bus and reduced the need to rent a school bus.

4.2.2 Personal development and peer relationships

Holistic Student Development:

- A free bus pass gives students greater independence and confidence in navigating the city.
- Students have more opportunities to socialize with friends and build social networks outside of school.
- Better healthcare access, as students no longer needed to be chauffeured to healthcare services, and also gave them greater independence in access.

Challenges & Safety Concerns:

- Conflict and peer dynamics sometimes extended onto buses, leading to verbal confrontations and, in some cases, safety concerns at bus stops and on the bus (bus drivers not trained/comfortable approaching these situations).
- Incidents of violence at transfer stations and bus stops became an emerging issue, with students avoiding certain locations due to safety concerns.

4.2.3 Program implementation

Initial Hesitation & Uptake:

- Early skepticism from students, especially those with anxiety or trauma histories, made initial adoption slow.
- Training on bus etiquette and familiarity-building exercises were necessary for a smoother transition.
- Over time, bus use became normalized and integrated into student routines.

Early Orientation is Key:

- Implement bus training sessions for Grade 9 students as part of school orientation.
- Familiarize students with bus etiquette, stop requests, and bike transport on buses.

Improve Administrative Processes:

- Streamline bus pass distribution and renewal, reducing bureaucratic delays at City Hall.
- Make it easier for students to replace lost passes without requiring an in-person visit.

Enhance Transit Safety Measures:

- Address security and safety concerns at bus stops and transfer stations.
- Work with Kingston Transit to train bus drivers on youth-specific safety issues.

4.2.4 Societal costs of public transit

- Public transit is generally more cost-effective than driving, not only due to lower congestion, safety risks, and pollution but also due to the high costs associated with car ownership and parking infrastructure.
- Congestion costs are not significant in rural areas.
- Beyond vehicle expenses, chauffeuring can be disruptive, requiring parents to leave work or other commitments. In some cases, chauffeuring offers quality time, but in others, it is a significant inconvenience.

4.2.5 Impact of free transit on ridership and mode substitution

- Most new transit trips would come from people who would have otherwise walked or biked rather than from drivers shifting to public transit.
- For programs aimed at reducing car usage, investing in transit service improvements (e.g., frequency, coverage, safety) is more effective than fare-free transit alone.
- Research suggests that youths who regularly use public transit are more likely to continue using it into adulthood.
- To maximize effectiveness, transit systems should be well-integrated with safe and accessible walking and cycling routes.

4.2.6 Funding a free bus pass

- A trade-off exists between fare-free transit and service quality—funding could instead be used for:
    - Improved frequency and coverage
    - Enhanced rider amenities (e.g., Wi-Fi, real-time tracking)
    - Increased safety and accessibility
- Induced demand could exacerbate congestion in systems that are already near capacity.

4.2.7 Equity

- Students from low-income backgrounds particularly benefited from the Transit Pass Program, as they now had reliable access to healthcare, job opportunities, and social services.
- Free transit programs often function as an economic transfer, benefiting low-income individuals who now take transit instead of walking long distances.
- Free transit programs reduce financial burdens on non-governmental organizations that provide support to high school students.

5. Results

This section reports the CBA results from the baseline scenario and presents a sensitivity analysis that evaluates how the benefits and costs would change under different scenarios.

5.1 Baseline results

5.1.1 Is this investment justified from the society's perspective?

The analysis started by focusing on two questions: why should an average traveller choose public transit? And, do free passes increase ridership? This section reports the findings regarding these two questions and summarizes the CBA results from the baseline scenario. Lastly, it presents a sensitivity analysis that evaluates how the benefits and costs would change under different scenarios.

When choosing a mode of transportation, passengers consider many factors, including direct out-of-pocket expenses (fares, fuel, and maintenance) and total travel time. These are grouped as "direct costs," which include the time cost for both the traveler and driver (if applicable), as well as vehicle costs. When only considering direct costs, private cars are often more cost-effective ($1.24 per kilometer) than public transit ($1.40 per kilometer), as shown in **Figure 5.1**.

	Direct Costs	Congestion	Emission	Health & Safety	Total Cost to Society
	$1.40	$0.01	$0.02	-$0.09	$1.34
	$1.24	$0.33	$0.06	$0.20	$1.83
	$1.68			-$0.75	$0.93
	$0.56			-$0.01	$0.55

Figure 5.1 Travel cost per kilometer by transportation mode

Beyond the direct costs to travelers, there are additional costs associated with vehicle use. Every vehicle on the road contributes to congestion, imposing external costs on other vehicles. Combustion engine vehicles also emit greenhouse gases, primarily carbon dioxide (CO_2). However, there are also health benefits linked to physical activity and safety concerns associated with traffic accidents. These factors are reflected in **Figure 5.1**. For an

average traveler, public transit is more cost-effective than private cars ($1.34 per kilometer versus $1.83 per kilometer, as shown in the Total Cost to Society column of **Figure 5.1**). While cycling and walking have the lowest Total Cost to Society per kilometer, they are not always feasible for all travelers and in all seasons.

To tackle the second question—"Do free transit passes actually boost ridership?"—we need to dig deeper than just counting rides. Specifically, we have to tease apart how many of those trips were truly a result of the Transit Pass Program, and would not have happened without it. **Figure 5.2** shows a dramatic rise in student transit use—from **28,000** rides in 2012 to nearly **700,000** in 2019, averaging around **392,000** rides per year. While this is an impressive achievement, it would be misleading to attribute every single ride to the provision of free passes. After all, some students might have used transit even without a free pass.

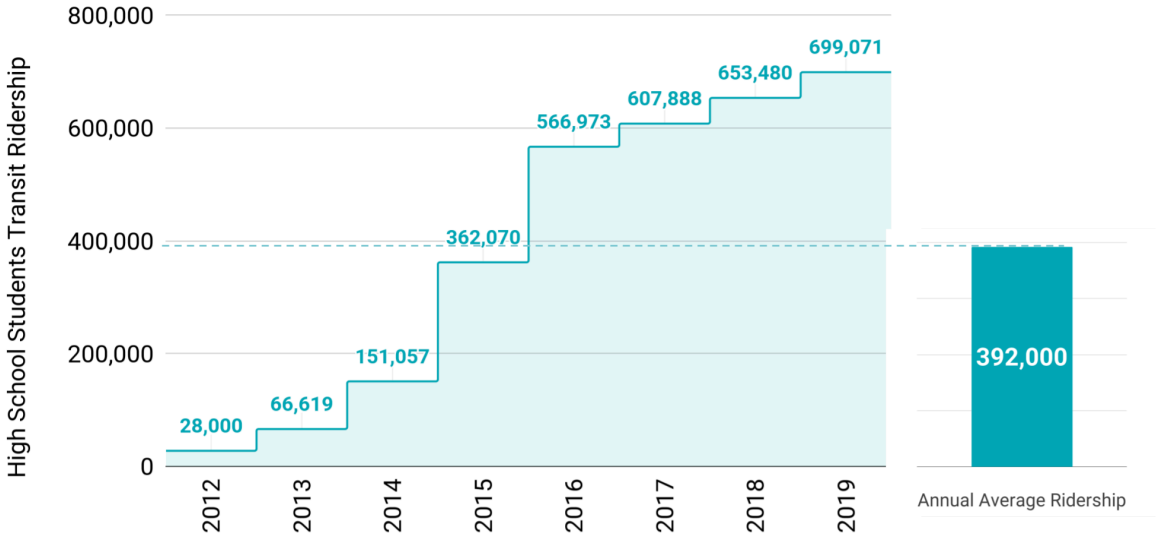


Figure 5.2. High school students' transit ridership with the Program

5.1.2 CBA results

Table 5.1 summarizes the main findings of the CBA. The benefits of the Transit Pass Program amount to an average of **$2 million** per year. The benefits outweigh the Program's costs of **$0.57 million**, resulting in a net of **$1.49 million**. This positive net value suggests that society gains more value than what is spent on the program, making it a beneficial and worthwhile investment in the long term. The ratio of the Program's benefits to its costs (known as the benefit-cost ratio, BCR) is **3.60.**

Table 5.1. Summary of the CBA findings (million $)

Annual Benefits	Annual Costs	Annual Net Impact	Benefit-Cost Ratio
$ 2.07	$ 0.57	$ 1.49	3.60

Figure 5.3 shows the breakdown of this program's benefits and costs. The most significant benefit category is the education benefit (B3), which results from additional school trips and has an annual average value of **$1.55 million**. The cost savings from switching transport modes (B1) is the second most significant benefit, amounting to **$0.51 million** per year. On the cost side, the most significant category is the marginal societal cost due to the increase in bus rides, which adds up to an annual average of **$0.55 million**. Lastly, the program administration cost, while it is relatively insignificant compared to the other costs, adds another **$0.03 million** per year.

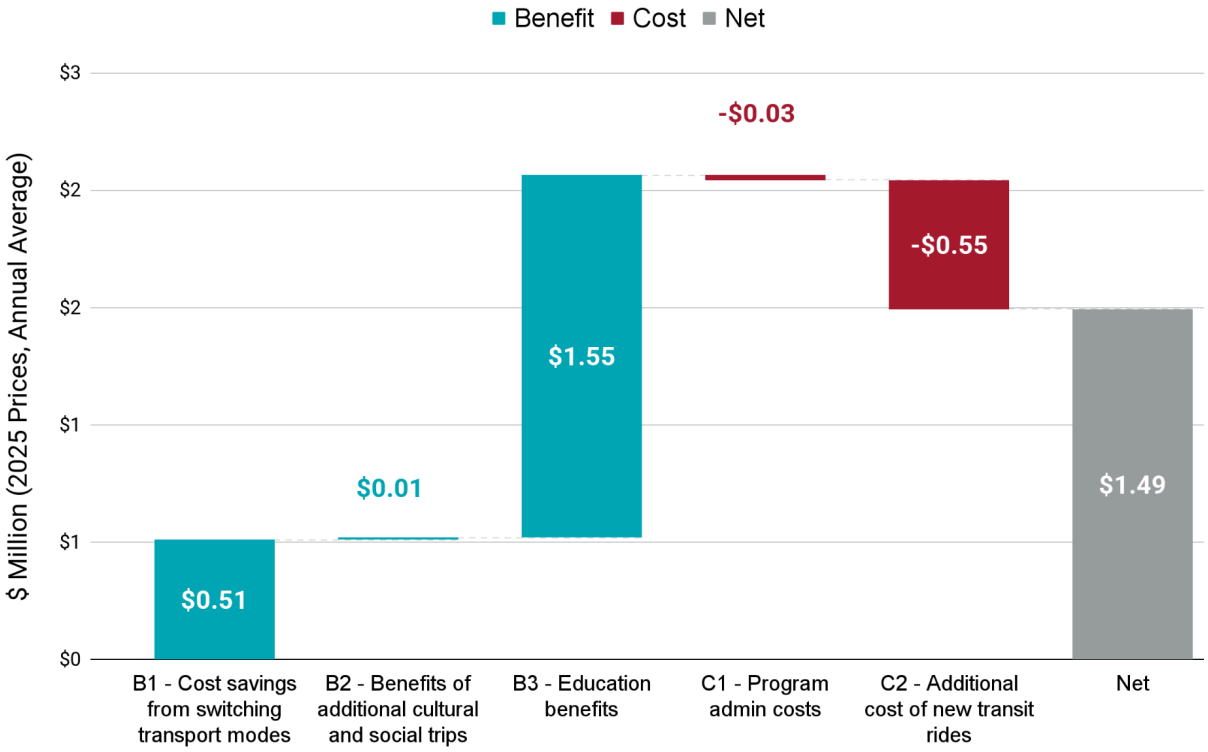


Figure 5.3. Breakdown of benefits and costs with the Program (baseline scenario)

The Program's benefits and costs per year for the baseline scenario are shown in **Figure 5.4**. High school students benefit the most, with a net benefit of **$1.38 million**. Family members of students also benefit, saving **$0.54 million** annually due to reduced private vehicle trips. Society benefits significantly as well, with Kingston (and Canada) seeing a net gain of **$0.11 million** due to reduced congestion and emissions. On the other hand, Kingston Transit, School Boards, and the Government of Ontario experience annual costs of **$0.45 million**, **$0.04 million**, and **$0.05 million**, respectively.

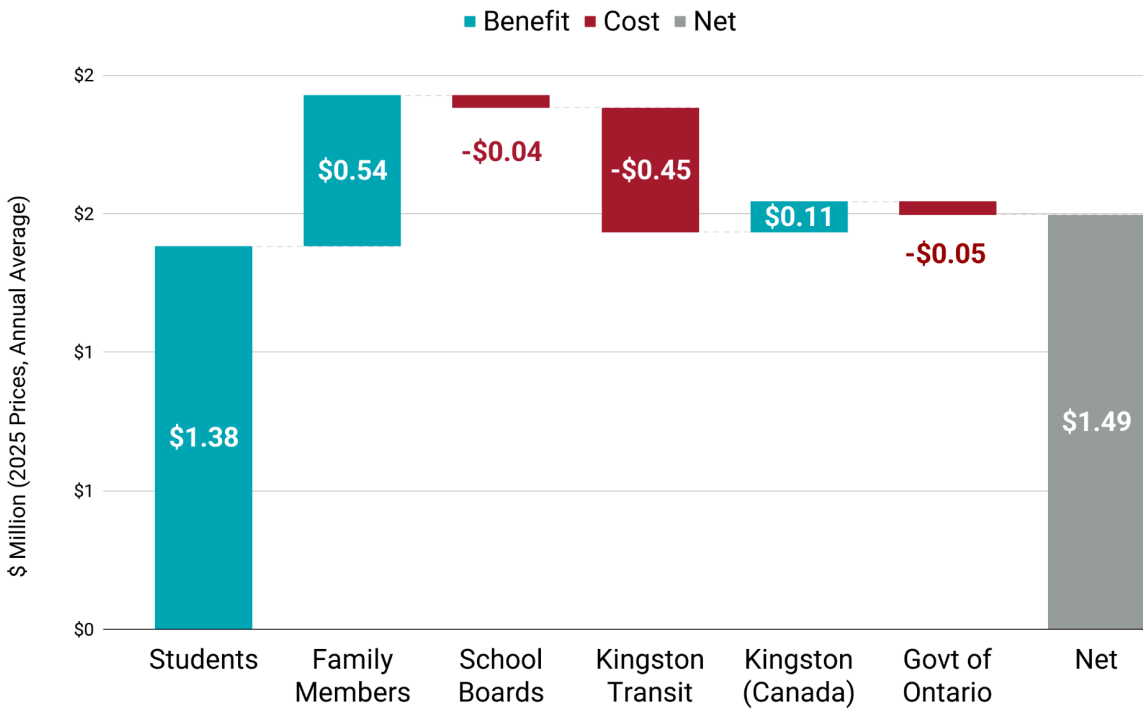


Figure 5.4. Benefits and costs of the Program by perspective (baseline scenario)

5.2 Sensitivity analysis

Figure 5.5 illustrates the sensitivity analysis conducted for the High School Transit Pass Program. It presents the benefit-cost ratio (BCR), the net annual impact from a societal perspective, and the net annual impact from the City's perspective across various scenarios.

	Pessimistic Case % of new rides due to the Program: 25% Additional cost of a new ride: 100% (% of transit's average cost)	Base Case % of new rides due to the Program: 50% Additional cost of a new ride: 50% (% of transit's average cost)	Optimistic Case % of new rides due to the Program: 75% Additional cost of a new ride: 0% (% of transit's average cost)
Benefit-Cost Ratio (society's perspective)	1.1	3.6	80.7
Net Annual Impact (society's perspective)	~$61,000	~$1,505,000	~$2,335,000
Net Annual Impact (City's perspective)	~$890,00	~$701,100	~$23,000

Figures in RED are a net cost while figures in TEAL are a net benefit.
~ and ~ imply that the numbers are rounded for presentation purposes.

Figure 5.5. The Program's impacts by scenario

The results of this sensitivity analysis show that the Program's benefits exceed its costs across all scenarios. Even under the most pessimistic scenario, the BCR is **1.1**, indicating that for every dollar invested in the program, $1.10 worth of benefits are generated.

Furthermore, the analysis reveals that the net impact from a societal perspective is substantial, particularly in the optimistic scenario, with a BCR exceeding **80**. This suggests that the benefits to society as a whole significantly outweigh the costs.

The net annual impact on the City of Kingston's budget varies depending on the scenario. In the optimistic scenario, the City could see a positive impact of **$23,000** per year. However, under the pessimistic scenario, the City's budget could be negatively affected by up to **$890,000** annually. Overall, the sensitivity analysis underscores the Program's potential to generate positive outcomes for both society and the City, although the financial impact on the City's budget is sensitive to the specific conditions and assumptions of each scenario.

6. Conclusions and Recommendations

Overall, even under conservative assumptions, the High-School Transit Pass Program generates a net benefit from society's perspective. The primary advantages stem from improved educational outcomes due to reduced student absences and missed school days, along with household and traveler cost savings resulting from decreased reliance on private vehicles. This suggests that the Transit Pass Program is an effective use of funding.

A key lesson from this evaluation is that training high school students to effectively use public transit, although a relatively small component of total program costs, can play a disproportionately important role in driving the Program's success. Usage data indicates that equipping students with the confidence and knowledge to navigate the transit system may yield greater benefits than the provision of free passes alone. Future program iterations should prioritize and monitor this component more closely.

Another important insight is the need to evaluate whether similar initiatives would generate comparable benefits in different geographic or demographic contexts, such as suburban, rural, or smaller urban areas. Scenario modeling, pilot programs, or observational studies could support this exploration. Understanding the program's scalability and transferability would inform broader provincial or national strategies aimed at making transit investments more effective, particularly in advancing youth access to education and independent mobility.

In all scenarios (Baseline, Optimistic, and Pessimistic) for Kingston, there was a net annual impact on the city's budget. Therefore, other communities considering a similar program might need to ensure financial sustainability by identifying and implementing robust funding mechanisms. This could include exploring avenues for securing additional funding by leveraging the long-term benefits, particularly those that align with broader educational or transport policy objectives. For instance, if a program has the potential to enhance educational access and encourage the use of public transit, it might be eligible for provincial or federal grants that support such initiatives. These grants could serve as a crucial source of funding, helping to offset the program's operational costs and ensuring its continued viability. Additionally, partnerships with local businesses, community organizations, or philanthropic foundations could also be explored as potential sources of funding.

Finally, more frequent and granular transit pass usage data would significantly enhance the ability to evaluate program performance over time. Investing in improved data collection and sharing mechanisms would open new avenues for research and policy learning, including better modeling of behavioral changes, estimating long-term mode shifts, and evaluating other co-benefits such as reduced congestion.

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Annex 1. Quantity and Values Tables

The UCBA framework requires a detailed description of the model assumptions, parameters, and the underlying system of equations. These are specified through a series of quantity and value (Q&V) tables to ensure the replicability of the model and analysis. This section includes Q&V tables, which model the Transit Pass Program's socio-economic benefits, costs, and major financial transfers.

B1 - Cost savings from switching transport modes

Narrative

Using their free bus pass, high school students will increase their use of public transit and decrease their use of alternative modes of transportation such as private vehicles, cycling, and walking. Therefore, the Transit Pass Program reduces the societal costs for other modes of transportation when a bus trip replaces a trip by another mode. Societal costs fall into three classifications: private, government (including public transportation), and social (including health and safety, congestion, and Greenhouse Gas, GHG, emissions).[15]

The calculation of cost savings required us to calculate the incremental trips taken by mode. We defined three scenarios:

- Lower-bound (pessimistic) scenario: This scenario assumes that only 25 percent of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component.
- Mid-point (baseline) scenario: This is the baseline scenario in our analysis, and it assumes 50 percent of the high-school students' rides are new because of the Program.
- Upper-bound (optimistic) scenario: this scenario assumes that 75 percent of the high-school students' rides are new because of the Program.

We calculated the reduction in societal costs for private vehicles, walking, and cycling using the societal costs per kilometer by cost category based on adjusted estimates from Beaudin et al. (2024). We included five cost categories: private, health and safety, congestion, and GHG emissions (see Annex 1). We calculated the costs of GHG emissions per km by multiplying the quantity of GHG emissions per km per mode by the social cost of carbon (SCC).[16]

We calculated the reduction in total costs for each mode as the reduction in the number of trips by mode multiplied by the average distance travelled per trip by mode and the sum of societal costs per km per mode across all cost categories.

All prices are in 2025 CAD.

Timeframe(s)

2012 to 2019

Inputs	Dimensions	Unit	Source

[15] GHG emissions refer to the release of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) into the atmosphere, contributing to global warming and climate change. GHG emissions are often represented in carbon-dioxide-equivalent (CO_2-eq) units by converting the global warming potential of CH_4 and N_2O emissions compared to CO_2. This analysis uses GHG emissions in CO_2eq units.
[16] The SCC is an estimate of the damages associated with one tonne of CO_2 (or CO_2-eq) emitted. This analysis employs the Canadian Government's SCC estimates.

SCC_t	*Social cost of carbon per tonne of emission*	*time*	CAD	*Natural Resources Canada, 2023*
GHG_M	*GHG emissions (CO_2-eq) per passenger km*	*Mode*	*kg*	*See Annex 1*
KM_M	*Kilometres per trip*	*Mode*	*km*	
EC_M	*Emissions costs per km*	*Mode*	CAD	
$PC_M^{Current}$	*Marginal private costs per km, current student*	*Mode*	CAD	
CC_M	*Marginal congestion cost per km*	*Mode*	CAD	
HC_M	*Marginal health and safety cost per km*	*Mode*	CAD	
$\Delta\chi_{S,M,t}$	*Change in trips with program, all grades, all purposes*	*Scenario, mode, time*	#	*See Annex 2*
Intermediate Calculations				
$\Delta TC_{S,t}^{Private}$	***Change in private costs to current students and their families:*** $\Delta TC_{S,M,t}^{Private} = \sum_M \Delta\chi_{S,M,t} \times PC_M^{Current} \times KM_M$			
$\Delta TC_{S,t}^{Societal}$	***Change in societal costs:*** $\Delta TC_{S,M,t}^{Societal} = \sum_M \Delta\chi_{S,M,t} \times \left(CC_M + HC_M + EC_M\right) \times KM_M$			
Final Calculations				
Benefit:	$B1_{S,t} = \sum_{M\ (exc.\ Bus)} (\Delta TC_{S,M,t}^{Private} + \Delta TC_{S,M,t}^{Societal})$			

B2 - Benefits of additional cultural and social trips

Narrative

Per our KIIs, the Transit Pass Program led to new student trips for after-school programs, socialization, and field trips. Similarly, students in Kingston reported that many cultural and social trips would be disrupted or cancelled without the Transit Pass Program (Sullivan, 2017). This is consistent with evidence from the literature review that reduced or free fare programs allowed students to access more cultural and social activities, experiences, and services in other cities (Wexler et al., 2021; Single Mothers' Alliance, 2023).

The calculation of this category of benefits required us to calculate the incremental trips taken by mode. We defined three scenarios:

- Lower-bound (pessimistic) scenario: This scenario assumes that only 25 percent of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component.
- Mid-point (baseline) scenario: This is the baseline scenario in our analysis, and it assumes 50 percent of the high-school students' rides are new because of the Program.
- Upper-bound (optimistic) scenario: this scenario assumes that 75 percent of the high-school students' rides are new because of the Program.

The final value of the benefit is the marginal value of the additional trips to current students. According to Boardman et al. (2017), the value of each trip is between the previous price - the average fare without the program - and the new price - free. The value of additional trips for cultural and social activities is the change in trips for cultural and social activities multiplied by the average fare per trip without the program divided by two.

All prices are in 2025 CAD.

Timeframe(s)

2012 to 2019

Inputs		Dimensions	Unit	Value	Source
R	*Average fare revenue per youth transit trip*		CAD	$1.19	*Kingston Transit, 2024*
$\Delta\chi^{NS}_{S,M,t}$	*Change in trips with program, all grades, non-school*	*Scenario, mode, time*	#	*See Annex 2.*	

Final Calculations

Benefit: $B3_{S,t} = \frac{\sum_{M}\Delta\chi^{NS}_{S,M,t}}{2} \times R$

B3 - Education benefits

Narrative

Free transit passes in the U.S. often led to reduced school absences (Wexler et al., 2021; McDonald et al., 2004). In our KIIs, interviewees noted that the free bus pass gave high school students an alternative way to get to school when they missed the school bus or have a long walk. Interviewees noted that the effect of free bus passes on absenteeism is significant for students further away from school or from low-income or less supportive households. High absenteeism rates are associated with lower graduation rates in Ontario, leading to worse economic prospects (Robson et al., 2023). This model therefore estimates the benefit to education from reductions in student absenteeism as a result of the Transit Pass Program.

The calculation of education benefits required us to calculate the incremental trips taken by mode. We defined three scenarios:

- Lower-bound (pessimistic) scenario: This scenario assumes that only 25 percent of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component.
- Mid-point (baseline) scenario: This is the baseline scenario in our analysis, and it assumes 50 percent of the high-school student rides are new and because of the Program.
- Upper-bound (optimistic) scenario: this scenario assumes that 75 percent of the high-school student rides are new and because of the Program.

The change in the number of absences was calculated as the sum of the change in school trips by mode divided by two to account for the return trip. To calculate the benefit, we multiply the change in absences by the present value of the long-term income benefit of an extra school day for each grade (see Annex 3).

All values are in 2025 CAD.

Timeframe(s)

2012 to 2019

Inputs		Dimensions	Unit	Value	Source
PVI_G	*Present value of income benefit per missed day of school*	*Grade*	CAD	*See Annex 3.*	
$\Delta\chi^{School}_{S,G,t}$	*Change in trips with program, school, all modes*	*Scenario, grade, time*	#	*See Annex 2.*	

Final Calculations

Benefit: $$B4_{S,t} = \sum_G PVI_G \times \frac{\Delta\chi^{School}_{S,G,t}}{2}$$

C1 - Program administration costs

Narrative

As part of the Transit Pass Program, Kingston Transit and school boards offer high school students training on using transit and transit etiquette. Interviewees noted that this is essential to reduce student anxiety and increase confidence in students taking the bus. The training is offered to each incoming class of Grade 9 students and newcomers to Kingston.

We estimated program costs based on the number of employees Kingston Transit and the school boards assign to these programs, the number of hours each employee allocates, and the cost of the employees' time, including overhead (i.e., costs incurred beyond the average hourly wage received by the employee). We estimated the parameters for this calculation based on discussions with the Limestone District School Board (LDSB).

All prices are in 2025 CAD.

Timeframe(s)

2012 to 2019

Inputs		Dimensions	Unit	Value	Source
E	*Number of LDSB and Kingston Transit employees engaged in program administration*		#	4	LDSB, 2024
N	*Number of schools*		#	12	
H	*Hours per school per employee*		#	8	
W^{2023}	*Average hourly wage per employee, 2023*		CAD	40	*Statistics Canada, 2024a*
OH	*Overhead cost percentage*		%	60%	*Authors' assumption*

Final Calculations

Cost: $C1_t = E \times W^{2023} \times H \times (1 + OH) \times N$

C2 - Marginal costs of new rides

Narrative

The Transit Pass Program encourages students to take more bus trips, and these incremental bus trips impose costs on students, Kingston Transit, Kingston, and Canada. The change in societal costs depends on the change in bus trips and the societal costs per bus trip by each cost category: private, public transportation, health and safety, congestion, and GHG emissions.

Calculating the marginal costs of new rides due to the Program required us to calculate the incremental trips taken by mode. We defined three scenarios:

- Lower-bound (pessimistic) scenario: This scenario assumes that only 25 percent of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component.
- Mid-point (baseline) scenario: This is the baseline scenario in our analysis, and it assumes 50 percent of the high-school students' rides are new because of the Program.
- Upper-bound (optimistic) scenario: this scenario assumes that 75 percent of the high-school students' rides are new because of the Program.

Bus trip costs are divided into two categories: induced bus trips and trips that replace other modes.

Induced trips are trips by bus that do not replace trips by other modes. The number of induced bus trips is equal to the sum of the change in trips across all modes. We calculated the change in societal costs for induced bus trips as the sum of costs by category per km for bus trips multiplied by the number of induced bus trips and the average distance per bus trip.

We calculated the number of bus trips that replace other modes as the sum of the change in trips by other modes. The distance of these bus trips depends on the distance of the mode it replaces. For example, a bus trip that replaces a walking trip will be shorter than a bus trip that replaces a car trip. However, bus trips will also be less direct because routes are designed to cover more areas. We accounted for this with a route inefficiency penalty. We calculated the change in societal costs for bus trips that replace other modes as the sum of costs by cost category per km for bus trips multiplied by the change in trips by other modes, the average distance per trip by mode, and a route inefficiency penalty.

Prices are in 2025 CAD.

Timeframe(s)

2012 to 2019

Inputs		Dimensions	Unit	Value	Source
RI	*Route inefficiency penalty*		%	10	*Authors' assumption*
PTC^{Bus}	*Marginal operations and amortization costs per bus trip, Kingston Transit*		CAD	$3.36	*See Annex 1.*
SCC	*Social cost of carbon per tonne of GHG emissions*		CAD	$266	*Natural Resources Canada, 2023*
KM_M	*Kilometres per trip by mode*	*Mode*	*km*	*See Annex 2.*	
GHG_M	*GHG emissions (CO2 eq) per passenger km by mode*	*Mode*	*kg*	*See Annex 1.*	
$PC_M^{Current}$	*Marginal private costs per km, current student*	*Mode*	CAD		

HC_M	*Marginal health and safety costs per km*	*Mode*	CAD	
MCC_M	*Marginal congestion costs per km*	*Mode*	CAD	
$\Delta\chi_{S,M,t}$	*Change in trips with program, all purposes, all grades*	*Scenario, mode, time*	#	*See Annex 2.*

Intermediate Calculation

EC_M	***GHG emissions costs per km by mode:*** $EC_M = SCC \times \frac{GHG_M}{1000}$
$\Delta TC_{S,t}^{Students}$	***Change in costs to students and their families:*** $\Delta TC_{S,t}^{Students} = -\sum_M \Delta\chi_{S,M,t} \times PC_t^{Bus} \times KM^{Bus} - \sum_{M\ (exc.\ Bus)} \Delta\chi_{S,M,t} \times PC_t^{Bus} \times \left(KM_M \times (1 + RI)\right)$
$\Delta TC_{S,t}^{Kingston}$	***Change in costs to Kingston:*** $\Delta TC_{S,t}^{Kingston} = -\sum_M \Delta\chi_{S,M,t} \times \left(CC_t^{Bus} + HC_t^{Bus}\right) \times KM^{Bus} - \sum_{M\ (exc.\ Bus)} \Delta\chi_{S,M,t} \times CC_t^{Bus} \times \left(KM_M \times (1 + RI)\right)$
$\Delta TC_{S,t}^{Canada}$	***Change in costs to Canada:*** $\Delta TC_{S,t}^{Canada} = -\sum_M \Delta\chi_{S,M,t} \times EC_t^{Bus} \times KM^{Bus} - \sum_{M\ (exc.\ Bus)} \Delta\chi_{S,M,t} \times EC_t^{Bus} \times \left(KM_M \times (1 + RI)\right)$
$\Delta TC_{S,t}^{KT}$	***Change in costs to Kingston Transit:*** $\Delta TC_{S,t}^{Kingston} = -\sum_M \Delta\chi_{S,M,t} \times PTC^{Bus} \times KM^{Bus} - \sum_{M\ (exc.\ Bus)} \Delta\chi_{S,M,t} \times PTC^{Bus} \times \left(KM_M \times (1 + RI)\right)$
$NBC_{S,t}$	***Costs of induced bus trips:*** $NBC_{S,t} = -\sum_M \Delta\chi_{S,M,t} \times KM^{Bus} \times \left(PC_t^{Bus} + HC_t^{Bus} + CC_t^{Bus} + EC_t^{Bus} + PTC_t^{Bus}\right)$
$BC_{S,t}$	***Costs of bus trips replacing other modes of transportation:*** $BC_{S,t} = \sum_{M\ (exc.\ Bus)} \Delta\chi_{S,M,t} \times \left(PC^{Bus} + HC^{Bus} + CC^{Bus} + EC^{Bus} + PTC^{Bus}\right) \times \left(KM_M \times (1 + RI)\right)$

Final Calculation

Cost:	$C2_{S,t} = NBC_{S,t} + BC_{S,t}$

T1 - Payment for free bus passes from school boards to Kingston Transit

Narrative

This transfer represents the payment made from Kingston area school boards to Kingston Transit to cover part of the foregone revenues from the Transit Pass Program. The transfer from school boards to Kingston Transit is available from the school boards' and Kingston Transit documents from 2012 to 2023. The payment has remained unchanged in nominal terms since 2016. For years after 2023, we assumed Kingston school boards would maintain the current nominal payment through 2031.

The payments are adjusted for inflation to 2025 CAD.

Timeframe(s)

2012-2019

Inputs		Dimensions	Unit	Value	Source
C_t	*Payment made from the school board to Kingston Transit*	*Time*	CAD	*See Time-varying inputs*	*City of Kingston, 2016*
CPI_t	*CPI Index*	*Time*	#	*See Time-varying inputs.*	*Statistics Canada, 2024c*

Final Calculations

Benefit: $T1 = C_t \times \frac{CPI^{2023}}{CPI_t}$

T2 - Public transit transfers from the Government of Ontario to Kingston Transit

Narrative

Kingston Transit reported higher transfers from the provincial government under the Provincial Gas Tax Fund due to the Transit Pass Program (City of Kingston, 2016). Kingston Transit estimated that higher gas tax funding offset between $125,000 and $150,000 of the foregone revenues due to the program in 2015.

The Ontario government allocates the Provincial Gas Tax Fund pool to more than 100 municipalities based on transit ridership and population. In 2019, Kingston Transit received just over $3 million for this transfer when annual bus trips reached just under 7 million trips (Kingston Transit, 2024; Government of Ontario, 2019). We estimated the Provincial Gas Tax Fund transfer received by Kingston Transit per trip as the total transfer to Kingston Transit in 2019 multiplied by the weight of the funding from ridership divided by the number of trips.

The calculation of transfers required us to calculate the incremental trips taken by mode. We defined three scenarios:

- Lower-bound (pessimistic) scenario: This scenario assumes that only 25 percent of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component.
- Mid-point (baseline) scenario: This is the baseline scenario in our analysis, and it assumes 50 percent of the high-school student rides are new and because of the Program.
- Upper-bound (optimistic) scenario: this scenario assumes that 75 percent of the high-school student rides are new and because of the Program.

We calculated the number of trips by mode for past students[17] using travel data from the 2019 Household Travel Survey (Open Data Kingston, 2021) and estimates of the number of past students. The earliest Transit Pass Program users would have graduated from Kingston high schools in 2016.

We calculated the number of affected past students based on a lag of the number of Grade 12 students in previous years, calculated from Government of Ontario enrolment figures (Government of Ontario, 2024). We removed students who stayed an extra year in high school. We have assumed that past students maintain this behavioural change for five (5) years based on Cooper (2006).

We then estimated the number of trips per year by mode for past students in 2019. In 2019, past students had benefited from the Transit Pass Program for several years. We assumed that each past student has the same trips per day and mode share as Kingston's population aged 20 to 24 on weekdays (Open Data Kingston, 2021). To estimate the number of trips that past students take for the whole year, we assumed that past students have 240 regular weekdays per year and that 15% of trips happen on weekends and holidays.

We calculated the change in bus trips based on Cooper's (2006) finding that recent university students who had access to a free pass increased their transit use by 17% after university. We did not include any induced trips past students may have taken due to the Transit Pass Program because they bear the full costs and benefits of those additional trips.

Finally, we estimated the Provincial Gas Tax Fund transfer by multiplying the change in bus trips for current and past students by the estimated Provincial Gas Tax Fund transfer per trip, adjusted for inflation.

Prices are adjusted to 2025 CAD.

Timeframe(s)

[17] We assumed that the effect of the Transit Program Pass applies equally to students who graduate from high school and those who do not complete high school.

2012–2019

Inputs		Dimensions	Unit	Value	Source
GT	Total gas tax transfer, 2019		CAD	$3,170,746	Government of Ontario, 2019
RS^{2019}	Total Kingston Transit ridership, 2019		#	6,929,280	Kingston Transit, 2024
SG	Share of gas tax transfer allocated for ridership		%	70%	Government of Ontario, 2019
F	Percent increase in transit use because of the program		%	17%	Cooper, 2009
WT	Number of trips per weekday, ages 20 - 24		#	3.43	Open Data Kingston, 2021
YG	Years of program effect on transit use		#	5	Cooper, 2009
SW	Share of all trips on weekends and holidays, 2016		%	15%	City of Kingston, 2016
WD	Work days per year		#	240	Authors' assumption
GS	Percent of Grade 12 students who finish high school		%	80%	Government of Ontario, 2024
σ_M^{20-24}	Share of trips taken on weekdays by mode, all users	Mode	#	See Annex 2.	Kingston Household Travel Survey
CPI_t	Consumer price index	Time	#	See Time-Varying Inputs	Statistics Canada, 2024c
$\Delta\chi_{S,t}^{Bus}$	Change in trips with program, all grades, all purposes, bus	Scenario, time	#	See Annex 2.	

Intermediate Calculations

PG	**Provincial gas tax transfer per passenger per trip:** $PG = \frac{GT \times SG}{RS^{2019}} \times \frac{CPI^{2023}}{CPI^{2019}}$
TY	**Trips per past student per year:** $TY = WT \times WD \times (1 + SW)$
TY_M	**Trips per past student per year by mode:** $TY_M = TY \times \sigma_M^{20-24}$
YG_t	**Years of affected past students:** $YG_t = if(t < 2015, 0, if(t > 2015 + YG, YG, t - 2015))$
AG_t	**Number of affected past students:** $AG_t = \sum_{t=t-YG_t}^{0} Pop_t^{Grade\ 12} \times GS$
$\Delta\omega_t^{Bus}$	**Change in trips by mode, past students:** $\Delta\omega_t^{Bus} = AG_t \times TY_M^{Recent\ Grad} \times \frac{F}{1+F} \times CV_t\ when\ M = Bus$

Final Calculation

Transfer:	$T2 = \left(\Delta\chi_{S,t}^{Bus} + \Delta\omega_t^{Bus}\right) \times PG$

T3 - Change in transit revenues

Narrative

Kingston Transit will see lower revenues as high school students immediately benefiting from the Transit Pass Program will no longer need to purchase a transit pass or tickets. On the other hand, if those students continue to use public transit after graduation, this would raise fares over the long term and offset part of the foregone revenue from eliminating fares for high school students. This transfer thus accounts for the change in transit revenues paid by current and past high school students and collected by Kingston Transit. Parents or guardians of current students are more likely to pay for bus fares, so the transfer for the change in revenue to current students accrues to their family members.

The calculation of forgone revenues required us to calculate the incremental trips taken by mode. We defined three scenarios:

- Lower-bound (pessimistic) scenario: This scenario assumes that only 25 percent of new rides are because of the Program, and the remaining 75 percent would have happened anyway. This assumption is consistent with the secondary literature on how the change in the public transit fare would affect ridership. However, this literature does not explore the impact of the "exposure" component.
- Mid-point (baseline) scenario: This is the baseline scenario in our analysis, and it assumes 50 percent of the high-school student rides are new and because of the Program.
- Upper-bound (optimistic) scenario: this scenario assumes that 75 percent of the high-school student rides are new and because of the Program.
-

We calculated the number of trips by mode for past students[18] using travel data from the 2019 Household Travel Survey (Open Data Kingston, 2021) and estimates of the number of past students. The earliest Transit Pass Program users would have graduated from Kingston high schools in 2016.

First, we estimated the number of affected past students based on a lag of the number of Grade 12 students in previous years (Government of Ontario, 2024). We did not count Grade 12 students who stay an extra year in high school. Based on Cooper (2006), we assumed that past students changed their behavior for five (5) years after leaving high school.

We then estimated the number of trips per year by mode past students in the with program scenario. We assumed that each past student has the same trips per day and mode share as Kingston's population aged 20 to 24 on weekdays (Open Data Kingston, 2021). To estimate the number of trips that past students take for the whole year, we assumed that past students have 240 regular weekdays per year and that 15% of trips happen on weekends and holidays (Kingston Transit, 2016).

We calculated the change in bus trips based on Cooper's (2006) finding that recent university students who had access to a free pass increased their transit use by 17% after university. We did not include any induced trips past students may have taken due to the Transit Pass Program because they bear the full costs and benefits of those additional trips. Thus, the change in bus trips for past students equals the sum of the change in trips across other modes. We calculated the change in trips for other modes by multiplying the total change in bus trips by the share of trips by mode with bus trips removed.

We calculated the foregone revenue from current students as the revenue per trip multiplied by the number of bus trips without the program (the number of trips with the program minus the change in the number of trips). We estimated the incremental revenue from past students as the change in bus trips for past students multiplied by the revenue per trip.

Prices are in 2025 CAD.

Timeframe(s)

[18] We assumed that the effect of the Transit Program Pass applies equally to students who graduate from high school and those who do not complete high school.

2012–2019

Inputs		Dimensions	Unit	Value	Source
$B_{S,P}$	*Percent increase in bus trips*	*Scenario, purpose*	%	*See Annex 2.*	*Litman, 2024 and authors' assumptions*
R	*Average fare revenue per youth transit trip*		CAD	$1.19	*Kingston Transit, 2024*
F	*Percent increase in transit use because of the program*		%	17%	*Cooper, 2009*
WT	*Number of trips per weekday, ages 20 - 24*		#	3.43	*Open Data Kingston, 2021*
YG	*Years of program effect on transit use*		#	5	*Cooper, 2009*
SW	*Share of all trips on weekends and holidays, 2016*		%	15%	*City of Kingston, 2016*
WD	*Work days per year*		#	240	*Author's own assumption*
GS	*Percent of Grade 12 students who finish high school*		%	80%	*Government of Ontario, 2024*
σ_M^{20-24}	*All trips on weekdays share by mode, ages 20 - 24*	*Mode*	#	*See Annex 2.*	
$\chi_{S,P,t}^{Bus}$	*Trips with program, all grades, bus*	*Scenario, purpose, time*	#	*See Annex 2.*	
Intermediate Calculations					
TY	**Trips per past student per year:** $TY = WT \times WD \times (1 + SW)$				
TY_M	**Trips per past student per year by mode:** $TY_M = TY \times \sigma_M^{20-24}$				
YG_t	**Years of affected past students:** $YG_t = if(t < 2015, 0, if(t > (2015 + YG), YG, (t - 2015)))$				
AG_t	**Number of affected past students:** $AG_t = \sum_{t=t-YG_t}^{0} Pop_t^{Grade\ 12} \times GS$				
$\Delta\omega_{M,t}$	**Change in trips by mode, past students:** $\Delta\omega_{M,t} = AG_t \times TY_M \times \frac{F}{1+F} \times CV_t \ when\ M = Bus$				
Final Calculation					
Transfer:	$T3_{S,t} = \left(\Delta\omega_t^{Bus} \times R\right) - \left(\sum_P \frac{\chi_{S,P,t}^{Bus}}{1+B_{S,P}} \times R\right)$				

Annex 2. Societal Costs by Transportation Mode

Narrative

This model annex describes how the CBA model calculates the critical inputs to measure the societal costs for each mode of transportation and to estimate the share of costs by stakeholder group. Within societal costs, we included five cost categories for each mode of transportation: private, health and safety, congestion, public transportation, and greenhouse gas (GHG) emissions. These cost categories are defined as follows: private costs, health and safety, congestion, public transportation, and GHG emissions.

We have estimated the marginal societal costs per kilometre (km) for each mode of transportation, using a combination of sources, although our overall strategy and parameters are from Beaudin et al. (2024), which estimated the average cost per km for private vehicles, public transit, walking, and cycling in Montreal. We implicitly assumed that the Beaudin et al. (2024) data were applicable to Kingston. However, where we had data available for Kingston, we updated the estimates from Beaudin et al. (2024).

Private costs include the costs of operating a vehicle and the time value for high school students and parents. We set private vehicle operations costs using the Canadian Revenue Agency mileage allowance. Cycling also has small vehicle operation costs related to buying and maintaining a bicycle. Next, the time value for students is based on the Ontario minimum wage, the average speed by mode, and the opportunity cost as a share of the hourly wage. For parents, the time value is based on the average wage for the Kingston-Pembrooke economic region. We included parents' time when they chauffeur their children (about four in five trips by private vehicle(Open Data Kingston, 2021). Parents' time includes a return trip factor because they must return home or take a longer route when they chauffeur their children. We have also estimated different private costs for past students: We have assumed that they are no longer chauffeured, and so their opportunity cost of time is calculated in the same way as we calculated for parents.

Health and safety impacts include health costs from road collisions and health benefits from increased physical activity (public transit, cycling, and walking only). The health and safety costs are based on the total travel kilometres by all modes for Kingston residents over the age of five (calculated from the 2019 Household Travel Survey), the accidents reported in 2019 by Kingston Police, and the societal costs for each accident by severity. The societal cost per accident by severity comes from Beaudin et al. (2024). Because the data from Kingston Police includes three levels of severity (property, injury, fatal), we use a weighted average of minor and serious collisions from Beaudin et al. (2024) to estimate the cost of an injury collision in the Kingston Police report. In addition, Kingston Police did not publish the number of bus accidents, so we have assumed that 6% of commercial vehicle accidents were bus accidents based on Transport Canada collision statistics (2024). We calculated the health and safety costs per km for each mode as the number of collisions multiplied by the cost per collision divided by the total number of kilometres travelled. Public transit, cycling, and walking each require physical activity that improves health, so we have included the public health benefit per km directly from Beaudin et al. (2024).

Congestion costs are the cost of delays from higher traffic levels, including the emissions and time costs for passengers. To estimate congestion costs, we have assumed that the marginal congestion costs per km by mode are the same for Kingston as the average estimated for Montreal (Beaudin et al., 2024) due to a lack of alternative data sources.

Public transportation costs are the direct costs to Kingston Transit, including operating and amortization costs. Our main data sources were the operating budgets for Kingston Transit, obtained from City of Kingston budget documents (City of Kingston, 2011 to 2024), and Kingston Transit farebox data on the number of trips per year. We calculated the average operating cost per trip as the operating costs divided by the total number of trips. Next, we calculated the average amortization per trip from Kingston Transit fleet size data, the average new cost of a city bus, the depreciation rate for buses, and the number of bus trips in Kingston per year. To do so, we estimated the current fleet value by multiplying the fleet size by the replacement cost of a diesel city bus adjusted for depreciation based on the average bus age. We multiplied

the current fleet value by the depreciation rate and then divided by the number of bus trips to obtain the average amortization costs per bus trip.

We calculated Kingston Transit's marginal cost per trip as the sum of the average operating and amortization cost per trip, multiplied by a marginal cost factor to account for economies of scale (Mattson & Ripplinger, 2011).

GHG emissions are the costs to Canada for additional GHGs emitted from travel. GHG emissions costs are calculated as a multiple of the kilograms of carbon dioxide (CO_2) equivalent emissions per km multiplied by the SCC per tonne. We used the GHG emissions per km from Beaudin et al. (2024) for all modes, except the estimate for public transportation. For public transportation, we used an alternative source of GHG emissions per km for buses (FTA, 2010) because the Montreal public transportation system includes an underground metro with lower emissions.

Inputs		Dimensions	Unit	Value	Source
Y	*Days per year*		#	365	
W^{Adult}	*Average hourly wage, Kingston-Pembrooke, adults, 2023*		CAD	$23.30	*Statistics Canada, 2024a*
$W^{Student}$	*Minimum hourly wage for students, Ontario, 2023*		CAD	$15.50	*Statistics Canada, 2024a*
OC	*Opportunity cost as a share of the hourly wage*		%	50%	*Limestone Analytics*
ϵ	*Share of trips with both driver and passenger*		%	79%	*Open Data Kingston, 2021*
RF	*Return trip factor*		%	50%	*Authors' assumption*
KM_M	*Kilometres per trip*	*Mode*	*km*	*See Annex 2.*	*Open Data Kingston, 2021*
S_M	*Average speed*	*Mode*	*kph*	*See Annex 2.*	*Authors' assumption*
O_M	*Average vehicle ownership and operating costs per km*	*Mode*	CAD	*See Annex 2.*	*Beaudin et al., 2024, Canada Revenue Agency, 2024*
$\sigma_M^{All\ users}$	*Share of trips, all users, weekdays*	*Mode*	%	*See Annex 2.*	*Open Data Kingston, 2021*
Pop	*Kingston population, 2019*		#	135,204	*Statistics Canada,*
Pop^{U5}	*Kingston population under 5, 2019*		#	5,820	*Statistics Canada*
T^W	*Number of trips per weekday, all users*		#	3.02	*Open Data Kingston, 2021*
WD	*Weekdays per year*		#	240	*Authors' assumption*
RWH	*Share of all trips taken on weekends and holidays*		%	15%	*City of Kingston, 2016*
CSC	*Share of commercial vehicle collisions that involve a bus*		%	6%	*Transport Canada, 2022*
$C_{M,Sv}$	*Total number of collisions, 2019*	*Mode, Severity*	#	*See Model Annex 1.*	*Kingston Police, 2019*
J	*Relative tisk of serious compared to minor injuries*	*Mode*	#	*See Model Annex 1.*	*Beaudin et al., 2024*
CC_{Sv}	*Cost of a collision*	*Severity*	CAD	*See Model Annex 1.*	*Beaudin et al., 2024*

HB_M	Marginal health benefit per trip km	Mode	CAD	See Model Annex 1.	Beaudin et al., 2024
MCC_M	Marginal congestion cost per km	Mode	CAD	See Model Annex 1.	Beaudin et al., 2024
OC^{2019}	Kingston Transit operating costs, 2019		CAD	$24,052,692	City of Kingston, 2019
RS^{2019}	Total Kingston Transit ridership, 2019		#	6,929,280	Kingston Transit, 2024
FS	Fleet size, Kingston Transit		#	48	CPTBD Wiki, 2025
BC	Average bus cost, 2023		CAD	$850,000	Bay Today, 2024
BA	Average bus age in years, Kingston Transit		#	7	CPTBD Wiki, 2025
DRB	Depreciation rate of buses		#	14.9%	Statistics Canada, 2007
MC	Marginal costs as a share of average costs for public transportation, 58 system average		#	71%	Mattson & Ripplinger, 2011
GHG_M	GHG emissions per passenger km	Mode	kg	See Annex 1.	Beaudin et al., 2024
CPI_t	Consumer price index	Time	#	See Time-Varying Inputs	Statistics Canada, 2024

Calculations

$VT_M^{Current}$	**Value of time per km by mode, current student:** $VT_M^{Current} = \frac{W^{Student} \times OC}{S_M}$ when $M \neq Private\ Vehicle$; $VT_M^{Current} = \frac{W^{Student} \times OC}{S_M} + \frac{W^{Adult} \times OC}{S_M} \times \epsilon \times (1 + RF)$ when $M = Private\ Vehicle$
VT_M^{Past}	**Value of time by mode per km, past student:** $VT_M^{Past} = \frac{W^{Adult} \times OC}{S_M}$
$PC_M^{Current}$	**Marginal private costs per km by mode, current student:** $PC_M^{Current} = VT_M^{Current} + O_M$
PC_M^{Past}	**Marginal private costs per km by mode, past student:** $PC_M^{Past} = VT_M^{Past} + O_M$
TT_M	**Total trips per year by mode:** $TT_M = T^W \times Y \times \left(Pop - Pop^{U5}\right) \times \sigma_M^{All\ users} \times (1 + RWH)$
TK_M	**Total annual trip kilometres by mode, all users, 2019:** $TK_M = TT_M \times KM_M$
C_{Sv}^{Bus}	**Number of collisions, bus:** $C_{Sv}^{Bus} = C_{Sv}^{Commercial-Vehicle} \times CSC$
CC^{Injury}	**Cost of collision:** $CC^{Injury} = \frac{CC^{Serious}}{J} + \frac{CC^{Minor} \times (J-1)}{J}$
TCC_M	**Total cost of collisions by mode:** $TCC_M = \sum_{Sv} CC_{Sv} \times C_{M,Sv}$
SR_M	**Safety cost to passengers and others per km by mode:** $SR_M = \frac{TCC_M}{TK_M}$
HC_M	**Marginal health and safety cost per km:** $HC_M = vv$
PTC^{Bus}	**Marginal public transportation cost per km:** $PTC^{Bus} = \left(\frac{OC^{2019}}{RS^{2019}} \times \frac{CPI^{2023}}{CPI^{2019}} + \frac{FS \times BC \times DRB}{(1+DRB)^{BA} \times RS^{2019}}\right) \times MC$

Annex 3. Returns to Education

Narrative

We estimated the benefit from reductions in student absenteeism based on the expected long-run return to income for each additional day of schooling. This benefit comes in the form of higher future income for students who attend school. We calculated the income benefit for each day a student attends school as the expected weekly income in Ontario in 2023 multiplied by the number of weeks in a year and the change in lifetime income per additional year of schooling, divided by the school days per year.

Psacharopoulos and Patrinos (2018) estimated that each additional year of school completed yields a 6.6% return for high-income countries like Canada. We assume that this return is linear with the number of days of extra school, so the long-term income benefit of an additional day at school is one divided by the number of days of school, multiplied by the percent change in long-term income.
We forecast the present value of this annual benefit by grade, assuming that the average student enters the workforce at 21, earning the average weekly salary and continues at this wage until they retire at 65. We have adjusted the expected annual salary for the average annual real income growth, labor force participation rate, and unemployment rate from 2013 to 2024.

We have included this benefit in the year when the additional school day occurs, discounting the future value of the income benefit over a student's expected working life.

Inputs		Dimensions	Unit	Value	Source
Dis	*Discount rate*		%	7%	*Limestone Analytics*
SD	*School days per year*		#	195	*Government of Ontario, 2024*
X	*Change in lifetime income per year of schooling*		#	6.6%	*Psacharopoulos &Patrinos, 2018*
WL	*Working life length, Ontario*		#	44	*Authors' assumption*
AE	*Average age at entry into the workforce*		#	21	*Authors' assumption*
W	*Average weekly wages, Ontario, 2023*		CAD	$1,231.95	*Statistics Canada, 2024a*
WY	*Weeks per year*		#	52	
A_G	*Age by grade*	*Grade*	#	See Annex 3.	*Authors' assumption*
ΔG	*Annual real income growth rate, Ontario*		%	0.4%	*Statistics Canada, 2024a*
PR	*Participation rate, 25 to 54, Ontario*		%	88.8%	*Statistics Canada, 2024c*
UR	*Unemployment rate, Ontario*		%	7.3%	*Statistics Canada, 2024c*
Intermediate Calculations					
IB	***Average annual wage increase per day present at school, 2023:*** $IB = \frac{W \times WY \times X}{SD}$				
$I_{G,t}$	***Forecast income benefit:*** $I_{G,t} = if(or(\left(AE - A_G\right) > t, \left(A_G + t + 1\right) > (AE + WL)), 0, IB \times (1 + \Delta G)^t \times PR \times (1 - UR))$				
PVI_G	***Present value of income benefit per student by grade:*** $PVI_G = \sum_1^t \frac{I_{G,t}}{(1+Dis)^t} + I_0$				