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Fare Pricing

Exploring how road pricing on the DVP and Gardiner would impact income groups in the GTHA

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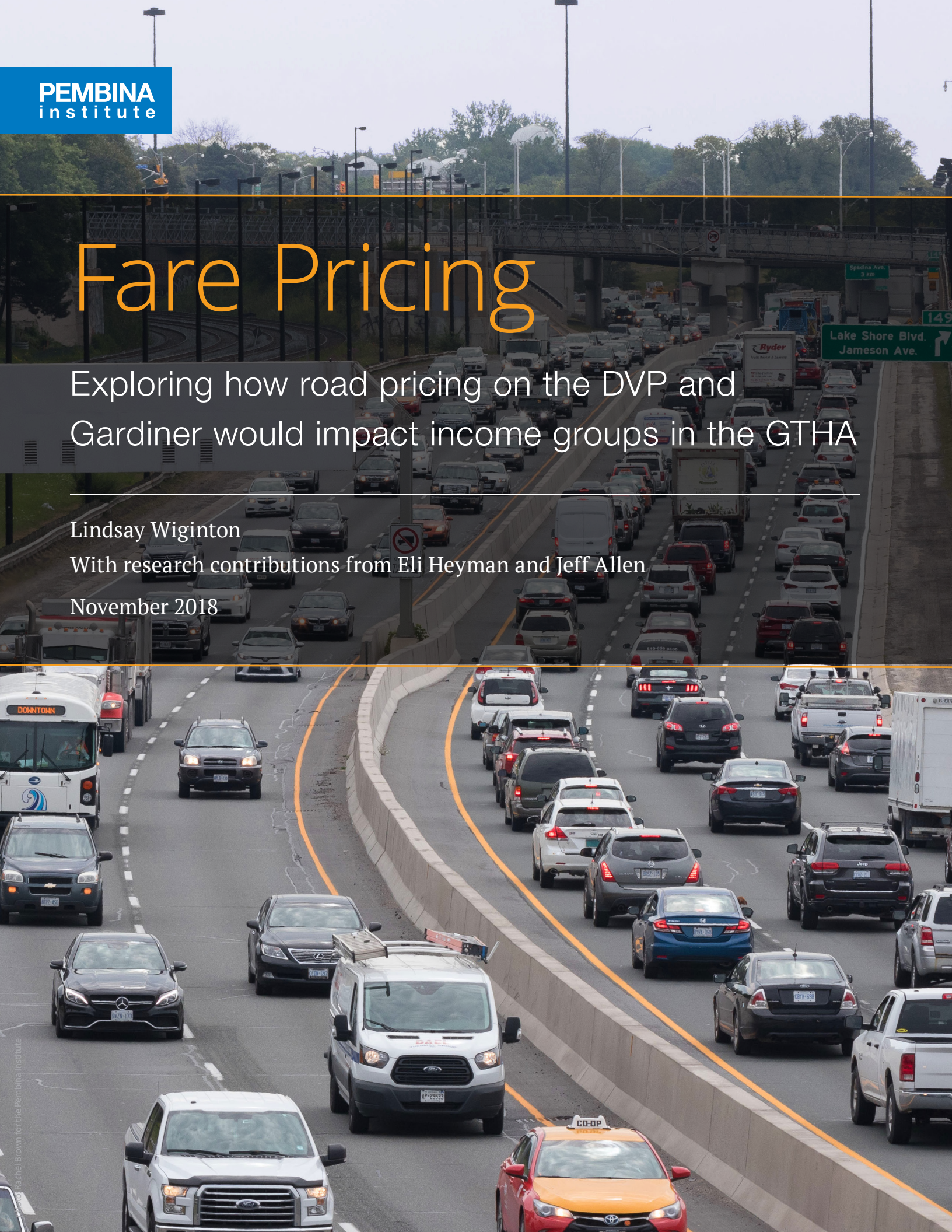

Photo: Rachel Brown for the Pembina Institute

About the Pembina Institute

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Executive summary

Like other global metropolises, the Greater Toronto and Hamilton Area (GTHA) is experiencing rapid population and economic growth, which is putting increased demands on roads and public transit systems. Indeed, residents of Toronto have the longest commute times in Canada, with about one in six people spending more than an hour to get to work.[1] When asked to name the top issues facing the Greater Toronto Area (GTA), 52% of respondents to a 2018 poll listed transportation, traffic and transit issues among their top concerns.[2]

Road pricing is a way of pricing mobility more fairly. It reduces congestion by providing incentives that spread out the use of the roads and encourage the use of alternative modes like transit. This shift helps to reduce air pollution and greenhouse gas (GHG) emissions and raise revenue for public investments in infrastructure, such as transit. Discussions have emerged in Canadian cities and regions — including the City of Toronto and Metro Vancouver — about how well-designed road pricing can improve the transportation system for citizens, following successful programs in other jurisdictions.

Equitable access to transportation is a backbone of strong, sustainable communities. One important concern about road pricing that has been raised by stakeholders is its potential to add to the financial burden of low-income residents. Research on the potential impact of road pricing on low-income communities is scarce, leaving policymakers without essential insights needed to design good policy.

This study examined which income groups would be impacted by the City of Toronto's 2016 proposal[3] to apply a flat highway toll of $2 on the Don Valley Parkway (DVP) and Gardiner Expressway (Gardiner). We find that a majority of GTHA commuters who would be impacted have household incomes above Toronto's median. However, we also find that without mitigation measures, the toll would represent a higher financial burden on those lower-income households that would be impacted.

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[1] Leslie Young, "Toronto has the longest commutes in Canada. How does your commute compare?" (Global News, November 29, 2017). https://globalnews.ca/news/3887057/toronto-commute-long-canada/

[2] Angus Reid Institute, "GTA Housing: Most see affordability worsening, say it will continue 'no matter what' government does" (2018). http://angusreid.org/greater-toronto-housing-prices-policy/

[3] In 2016, Toronto City Council voted in favour of implementing a highway toll on the DVP and Gardiner. In January 2017 however, the provincial government decided not to grant the necessary approval for the City of Toronto to implement highway tolls.

Income characteristics of impacted population

We estimate that approximately 172,000 workers in the GTHA (approximately 5.9% of all workers) are likely to be impacted by a toll on the DVP and Gardiner based on their current commute behaviour.

We find that a much greater proportion of the impacted workers are from higher-income groups in the GTHA. Approximately 69.0% of all impacted workers have household incomes above $60,000 (i.e. roughly above Toronto's median household income) and more than half of these (34.0% of total) have household incomes above $125,000 (roughly double Toronto's median). Approximately 6.8% of all impacted workers have household incomes below $40,000 and 10.2% have household incomes between $40,000 and $60,000.

The likelihood of being impacted by the proposed highway tolls increases as one's household income increases. While workers with household incomes below $40,000 represent 8.8% of the working population as a whole, they represent only 6.8% of impacted workers. Conversely, while 34.0% of impacted workers have household incomes above $125,000, this group makes up only 26.2% of the population of workers. These findings align with experiences and studies in other jurisdictions.

Despite the prediction that a greater share of the higher income population would be impacted by the proposed toll on the DVP and Gardiner, lower-income households spend a significantly higher share of their income on basic necessities like housing and transportation. We found that for households in the lowest before-tax household income quartile, the annual cost of the toll would amount to approximately 23.2% of annual transportation expenditure, whereas the cost would amount to only 4.6% of annual transportation expenditure for households in the highest income quartile (based on Ontario average expenditures). This means that the toll would represent more of a financial burden for lower-income households than for higher-income ones under the scenario where no cost mitigation measures are included.

Spatial distribution

Based on our modelling, the City of Toronto is home to the greatest share (116,000 people or approximately 67.8%) of impacted workers across the region. About 12.0% of impacted workers are from Peel Region, 8.3% are from York Region, and 6.7% are from Durham Region. The City of Toronto is home to the vast majority of impacted low-income workers: about 81.7%.

Within the City of Toronto itself, the greatest absolute number of impacted workers (approximately 40,160) are from downtown. East York and North York are home to the greatest numbers of impacted low-income workers, with approximately 28.2% and 25.0% of Toronto's impacted low-income workers respectively. These results give direction for where cost mitigation efforts, including transit investment, should be focused.

Cost mitigation options

We review direct and indirect approaches to mitigating the financial impact of road pricing on lower-income populations. We find that while there is precedent in other jurisdictions for providing direct discounts and exemptions to certain target groups that include vulnerable populations such as people with disabilities, we did not find precedents of providing such discounts and exemptions to low-income users specifically. We recommend that it would be appropriate to provide a discount based on a combination of household income, household size, and use of the priced roadway. This could be done in place of capping the annual amount that any user would pay per year (one option that City of Toronto staff were asked to study). Different approaches would require varying levels of administrative burden, which should be studied further.

We also recommend that the net revenue generation from a road pricing plan be legally tied to investments in public transit. Based on the spatial distribution of commuters that are likely to be impacted, we highlight planned or proposed transit projects that can be accelerated to provide viable alternatives to travelling by car on the DVP and Gardiner. Finally, based on our results, we also recommend that time-of-day, dynamic, and distance-based pricing designs be further studied especially because of their potential to make a road pricing plan more equitable.

The Pembina Institute believes that mobility pricing, and road pricing specifically, must be part of a multi-pronged approach to addressing the GTHA's current transportation challenges and preparing for future trends. This study contributes new knowledge about the income impacts of a specific City of Toronto road pricing proposal, with the intention to contribute to the ongoing region-wide conversation now and in the future.

1. Introduction

1.1 The importance of road pricing to address mobility trends

Road pricing[4] is one tool in the broader category of mobility pricing (Figure 1), and is a proven means to reduce and manage congestion while pricing mobility more fairly. If well designed, road pricing can help cities reduce gridlock by providing incentives that spread out the use of the roads and make transit a more attractive option. Road pricing can also encourage the deep mode shift needed to reduce transportation-related air pollution and GHG emissions and raise dedicated revenue for public transit.

For example, a 2015 Pembina Institute report found that distance-based road pricing on the DVP and the Gardiner in the City of Toronto could result in peak period traffic congestion relief of 13 and 16% respectively, while mitigating 173 and 238 tonnes of carbon dioxide daily, respectively, at peak periods.[5] Benefits have been realized in practice: Oregon rush hour drivers reduced their peak-period mileage by 22% and also drove 14% less during off-peak periods, suggesting that trips were reduced or shifted to other modes, in response to distance-based road pricing.[6] Despite widespread use in other jurisdictions, few forms of road pricing are present in Canada. However, several Canadian jurisdictions are studying the concept, including TransLink (the regional transportation authority in Vancouver) through the Mobility Pricing Independent Commission, the City of Toronto subsequent to a 2016 decision by city council, and the Province of Ontario as part of the High-Occupancy Toll (HOT) pilot.

[4] Sometimes referred to as "congestion pricing" or "decongestion pricing."

[5] Lorie Srivastava and Cherise Burda, *Fare Driving: Exploring the benefits of traffic pricing in Toronto and the GTA* (Pembina Institute, 2015). http://www.pembina.org/pub/fare-driving

[6] Oregon Department of Transportation, 2007, documented in Canada's Ecofiscal Commission, *We Can't Get There from Here: Why pricing traffic congestion is critical to beating it* (2015), 14. https://ecofiscal.ca/wp-content/uploads/2015/10/Ecofiscal-Commission-Pricing-Traffic-Congestion-Report-November-2015.pdf

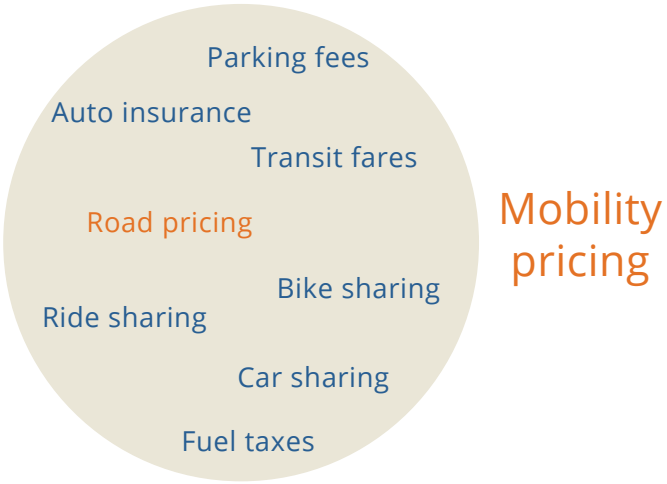

Figure 1. Mobility pricing options

Source: Adapted from Vancouver Mobility Pricing Independent Commission Report

Beyond addressing current congestion concerns, road pricing is also a tool to "future proof" urban transportation systems. Congestion will continue to grow due to population growth and potentially due to disruptive trends like automated vehicles and ridehailing. At the same time, governments will experience declining revenues from traditional forms of revenue generation for public transit (e.g. fuel taxes), as personal vehicles become more fuel efficient. New, fair revenue tools are needed to ensure urban regions have the funds they need to build and maintain modern, efficient and fair transportation systems.

1.2 Road pricing in the GTHA

Like other global metropolises, the GTHA is experiencing rapid population and economic growth, which is putting increased demands on roads and public transit systems. Road congestion in the GTHA is estimated to cost the region at least $6 billion annually in lost productivity.[7] At the same time, municipal and provincial governments are struggling to — or choosing not to — raise the capital needed to make the required investments in transit and other transportation infrastructure that can help to address the problem.

[7] Toronto Region Board of Trade, "Why we all need to fund regional transportation," (2013). https://www.bot.com/Advocacy/Campaigns/LetsBreakTheGridlock.aspx

Indeed, residents of Toronto have the longest commute times in Canada, with about one in six people spending more than an hour to get to work.[8] When asked to name the top issues facing the GTA, 52% of respondents to a 2018 poll listed transportation, traffic and transit issues among their top concerns.[9]

In 2016, as part of the City of Toronto's long-term financial planning process, Toronto city council voted in favour of implementing a highway toll on the DVP and Gardiner (both city-owned highways) in order to raise capital funds for transportation.[10] In January 2017, however, the provincial government decided not to grant the necessary approval for the City of Toronto to implement highway tolls[11] and announced instead that a greater share of the gas tax would be allocated to municipalities across Ontario for transit.[12]

The regional conversation about road pricing continues, however. For example, the Province of Ontario recently launched a 2- to 4-year high-occupancy toll (HOT) pilot on the QEW, following a successful pilot during the Pan-Am games. Municipal leaders in Toronto's neighbouring communities, such as York Region, are indicating their interest in having tolling powers to raise local revenue for transportation.[13] There is also some precedent for tolling in the region: Highway 407, which runs east to west through the region, was built as a toll highway in 1997. Highway 407 is operated privately, and tolling revenue is not reinvested in public infrastructure.

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[8] Leslie Young, "Toronto has the longest commutes in Canada. How does your commute compare?" (Global News, November 29, 2017). https://globalnews.ca/news/3887057/toronto-commute-long-canada/

[9] Angus Reid Institute, "GTA Housing: Most see affordability worsening, say it will continue 'no matter what' government does" (2018). http://angusreid.org/greater-toronto-housing-prices-policy/

[10] City of Toronto staff were asked to further study toll implementation, including the impacts of the highway tolling proposal on traffic diversion, road safety for all users, travel patterns of residents of specific wards, and pricing and discount options. City of Toronto Council, *The City of Toronto's Immediate and Longer-term Revenue Strategy,* Decision EX20.2, December 13, 2016. http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.EX20.2

[11] Although Ontario municipalities have the potential to toll their own highways as set out in the Municipal Act, the Province of Ontario must pass enabling regulations for such a proposal to move forward.

[12] The Enhanced Gas Tax Program committed to gradually increasing the municipal share of gas tax funds from two cents per litre up to a total of four cents per litre in 2021-22. See Province of Ontario (2017), "Enhanced Gas Tax Program." https://news.ontario.ca/mto/en/2017/01/enhanced-gas-tax-program.html

[13] Regional Municipality of York, *Transportation Master Plan*, Chapter 8, Policy P54 (2016). http://www.york.ca/wps/wcm/connect/yorkpublic/d7ec2651-8dc5-492e-b2a0-f76605edc122/16296_TmpFinalBigBook_NovWEB-FIX.pdf?MOD=AJPERES

1.3 Transportation equity in the GTHA

Equitable access to transportation is a backbone of strong, sustainable communities. Everyone needs access to work and education opportunities, commerce, services and leisure, and a functional transportation system is critical to ensuring that access.

As income inequality in Toronto and the GTHA grows, so does the divide between those who have access to opportunities and those who do not.[14] In recent decades there has been a dramatic shift in the distribution of the City of Toronto's population along socioeconomic lines. In the 1970s, most of the city's low-income neighbourhoods were in the inner city, whereas now they are concentrated in the northeastern and northwestern inner suburbs,[15] further from the existing higher-order transit system (Figure 1).

The barriers to mobility and accessibility are multiple and they vary across groups and geographies in the region.[16] A report prepared for Metrolinx examined the extent to which socially disadvantaged census tracts in Toronto (measured using variables for median household income, unemployment rate, proportion of recent immigrants, and housing affordability) have transit accessibility to work. It found that the most socially disadvantaged areas (lowest decile) have above-average transit access to jobs. Yet, it also found that "lower-middle income" census tracts (the second- and third-lowest deciles) have lower transit access to jobs, and these neighbourhoods are more regionally dispersed.[17]

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[14] Toronto Foundation, *Toronto's Vital Signs Report 2017/18* (2018), 7. https://torontofoundation.ca/wp-content/uploads/2018/01/TF-VS-web-FINAL-4MB.pdf

[15] David J. Hulchanski, *The Three Cities Within Toronto: Income Polarization Among Toronto's Neighbourhoods, 1970-2005* (University of Toronto, 2007). http://www.urbancentre.utoronto.ca/pdfs/curp/tnrn/Three-Cities-Within-Toronto-2010-Final.pdf

[16] Alan Walks, *Assessing and Measuring the Factors Affecting Mobility, Transportation Accessibility, and Social Need: Barriers to Travel among those with Low Income and Other Vulnerable Groups [Factors affecting mobility],* Prepared for Metrolinx (year unknown). http://www.metrolinx.com/en/regionalplanning/rtp/research/Assessing_and_Measuring_the_Factors_Affecting_Mobility_Transportation_Accessibility_and_Social_Need.pdf

[17] Ahmed M. El-Geneidy, Ron Buliung, Ehab Diab, Dea van Lierop, Myriam Langlois and Alexander Legrain, *Non-stop equity: Assessing daily intersections between transit accessibility and social disparity across the Greater Toronto and Hamilton Area (GTHA),* Prepared for Metrolinx (2014). http://www.metrolinx.com/en/regionalplanning/rtp/research/Non-stop_equity_Assessing_daily_intersections_between_transit_accessibility_and_social_disparity_across_the_GTHA.pdf

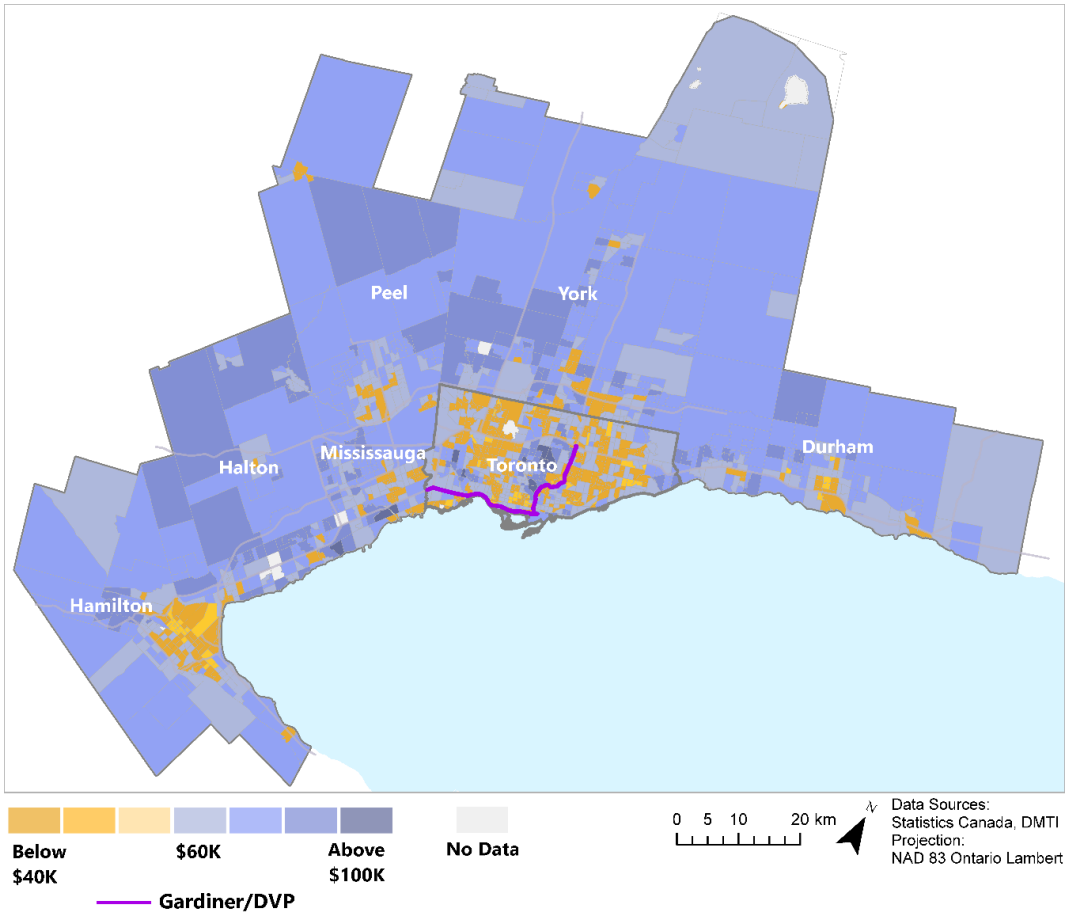

Figure 2. Study area showing 2015 census tract median after-tax household income

Source: Statistics Canada, map by Eli Heyman

Another study conducted at the University of Toronto examined travel behaviour using census place of work data and a survey of residents in key areas. It confirmed that residents with incomes less than the median have a higher transit mode share for trips to work, but that there are areas (especially outside the City of Toronto) where low-income transit ridership is lower, suggesting poor transit access. Further, the majority of low-income commuters still drive for all trips greater than 15 km.[18]

One of the important concerns that has been raised by stakeholders about road pricing is its potential to add to the financial burden of low-income residents. Research on the potential impact of road pricing on low-income populations is scarce, however, leaving policymakers without the essential insights needed to design good policy. This study was designed to provide an initial analysis of the impacts of the City of Toronto road pricing proposal on low-income populations, and to begin charting the path to

[18] *Factors affecting mobility.*

equitable road pricing design in the Greater Toronto and Hamilton Area. Investments or changes in the cost of transportation should contribute to increasing the equity of the transportation system and improving access for the region's most vulnerable populations.

2. Study approach

2.1 Purpose and scope

Despite widespread agreement that equity is a crucial consideration in road pricing design, there is currently a lack of understanding of how road pricing would affect low and lower-middle income populations in the GTHA and in other Canadian cities. This study is scoped specifically to the City of Toronto's proposal to apply a highway toll on the DVP and Gardiner. We answer the following research questions:

1. Based on existing origin–destination data on trips in the region, what is the household income profile of the individuals who likely use the DVP and Gardiner for regular trips to work by car?
    a. What is the share of low-income individuals among the impacted population?
    b. What is the spatial distribution of the impacted population?
2. What solutions are used in other jurisdictions to mitigate impacts on low-income individuals/households?

2.2 Methodology

To investigate the income profile of populations likely to be impacted by road pricing on the DVP and Gardiner, we conducted the following analysis:

- We modelled trips on the road network between all census tract pairs in the GTHA.[19] Using a shortest-path analysis, we selected origin–destination pairs representing journeys that would use a segment of the DVP and/or Gardiner greater than 900 m if taken by car assuming they choose the fastest route.[20] Factors for travel time under free-flow conditions were applied to road segments in the modelling.[21]

[19] Slightly different limits for the GTHA were used than those that are officially recognized. Small sections of the municipalities of Dufferin and Simcoe were included at the northern boundary of the study area, and the rural townships of Scugog (pop. 21,617) and Brock (pop. 11,642) were excluded. These minimal boundary differences were necessary because of the layout of the census tracts.

[20] The 900 m cutoff was chosen to approximate the average distance between interchanges.

[21] Future analysis could use congested travel time factors.

- We linked the "impacted" census tract origin–destination pairs to trip-level survey data from the 2016 Transportation Tomorrow Survey (TTS) using census dissemination areas to match the trips. To focus on regular commuters, we selected trips made for work purposes (only those with a regular place of work and who commute from home). We selected only trips made by private vehicle (car as driver, car as passenger, or motorcycle).
- We analyzed the before-tax household incomes of the individuals making these "impacted" trips. (For the first time, the 2016 TTS collected information on before-tax household income according to six brackets).
- We analyzed whether there was a difference in the income distribution of the impacted population according to modelled distance travelled on the tolled highways and the time of day of the trip.
- We compared the volumes of commuter movement on the Gardiner and DVP resulting from the modelling exercise against Cordon Count data for those highways to validate the findings.

We also conducted analysis following a method similar to that described above, but with personal income data obtained from the Statistics Canada commuting flows data. Those results are available but are not presented here because household income is a more relevant means to examine policy equity. Results for personal income were, however, very similar to those produced for household income.

2.3 Methodology limitations

We did not model how workers' behaviour might change in a road pricing scenario: the "impacted" population is defined as those likely to be using the targeted highway based on current commuting behaviour. Further, we did not include non-work, commercial or tourist trips.

The figures presented as "number of workers" and "number of impacted workers" should be interpreted as estimates only. Data for this analysis is drawn from the 2016 Transportation Tomorrow Survey which represents 5% of households in the Greater Golden Horseshoe (GGH) region and uses a set of expansion weights which allow extrapolating the sample up to population level estimates. The margin of error for smaller subsets of the data is greater, and in an effort to understand spatial and socio-economic impacts in this study, we have at times used categories with relatively few

travellers. The TTS is also thought to under-represent the lowest and highest-income households in the region.[22]

The income categories presented in the study results were designed according to the categories and geographical scope of the income categories in the source data. Since we use both the TTS and Statistics Canada census data, income categories are in some instances not directly comparable. We have made an effort to clarify these differences where applicable. Before-tax household income is used throughout, but adjustments are not made to account for household size.

In this study, we do not examine the City of Toronto's tolling proposal as it relates to congestion benefits, revenue generation potential or air quality benefits. For such modelling, please see the 2015 Pembina Institute report *Fare Driving* (referenced in Section 1.1).

As a continuation of the above-mentioned report, this study does not investigate road pricing options on corridors other than the DVP and Gardiner, despite the fact that a regional approach to road pricing could be preferable in terms of geographical fairness, revenue and congestion benefits across the region. The methodology developed for this study can be applied in future studies.

The use of the word "impacted" in this study refers strictly to financial impact, i.e., being required to pay the toll. We do not examine other impacts such as traffic diversion on neighbourhoods or travel time costs/benefits to users.

[22] Malatest, *Transportation Tomorrow Survey Data Expansion and Validation* (2018), 4. http://dmg.utoronto.ca/pdf/tts/2016/2016TTS_DataExpansion.pdf

3. Findings

3.1 Income characteristics of the impacted population

According to our analysis, approximately 172,000 workers in the GTHA (approximately 5.9% of all workers) would be impacted by a toll on the DVP and Gardiner according to current commute patterns.

Table 1. Impacted workers in the GTHA according to household income bracket

	All workers in GTHA		Impacted workers in GTHA		
Annual before-tax household income	Number of workers	Percent of all workers	Number of impacted workers	Percent of all impacted workers	Percent of all workers in income bracket
1 - $0 to $14,999	41,909	1.4%	1,822	1.1%	4.3%
2 - $15,000 to $39,999	213,473	7.4%	9,919	5.8%	4.6%
3 - $40,000 to $59,999	352,168	12.1%	17,545	10.2%	5.0%
4 - $60,000 to $99,999	684,337	23.6%	36,588	21.3%	5.3%
5 - $100,000 to $124,999	391,265	13.5%	23,556	13.7%	6.0%
6 - $125,000 and above	759,317	26.2%	58,275	34.0%	7.7%
7 - Decline / don't know	460,855	15.9%	23,906	13.9%	5.2%
Total	**2,903,324**	**100.0%**	**171,611**	**100.0%**	**5.9%**

Source: In-house analysis using Transportation Tomorrow Survey 2016 with only home-based trips conducted by private vehicle, for work purposes, with a regular place of work (i.e. regular commuters)

To examine the household income characteristics of the impacted population, we are limited to the before-tax household income brackets provided by the TTS (see column 1 in Table 1).

In 2015, the median total household income (across all household sizes) in Toronto was $65,829; this is the lowest of all regions in the GTHA.[23] Therefore, income brackets 1, 2, and 3 in Table 1 roughly correspond to below-median household incomes in Toronto.

The low-income measure is a threshold set by Statistics Canada at 50% of the national adjusted median household income, which is adjusted for household size.[24] In 2015, the before-tax low-income measure in Canada was $25,516 for a one-person household, $36,084 for a two-person household, and $44,194 for a three-person household.[25] Since this measure is established nationally, it does not consider differences in the cost of living from one community to the next. Income brackets 1 and 2 in Table 1 roughly correspond to households below or near the national low-income measure.

As shown in Table 1, workers with above-median household incomes are significantly more impacted by the proposed tolls. Approximately 69.0% of all impacted workers have household incomes above $60,000 (putting them roughly at or above Toronto's median household income) and more than half of these (34.0% of total) have household incomes above $125,000 (roughly double the median). Approximately 6.8% of all impacted workers (11,741 workers) have household incomes below $40,000 and 10.2% (17,545 workers) have household incomes between $40,000 and $60,000.

Further, as shown in the last column of Table 1, the likelihood of being impacted by the proposed highway tolls increases as one's household income increases. Similarly, as shown in Figure 3, while workers with household incomes below $40,000 represent 8.8% of the working population as a whole, they represent only 6.8% of impacted workers. Conversely, while 34.0% of impacted workers have household incomes above $125,000, this group makes up only 26.2% of the population of workers.

These findings align with experiences in other jurisdictions: in Stockholm and Metro Vancouver, pre-implementation studies for road pricing scenarios predicted that highest income groups would be most impacted by road pricing scenarios.[26]

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[23] City of Toronto, "2016 Census: Income – Backgrounder" (2017). https://www.toronto.ca/wp-content/uploads/2017/10/8f41-2016-Census-Backgrounder-Income.pdf

[24] Statistics Canada, "Low income measures" (2015). https://www150.statcan.gc.ca/n1/pub/75f0002m/2015002/lim-mfr-eng.htm

[25] Statistics Canada, Dictionary, Census of Population, 2016 - Table 4.2: Low-income measures thresholds (LIM-AT and LIM-BT) for private households of Canada, 2015. http://www12.statcan.gc.ca/census-recensement/2016/ref/dict/tab/t4_2-eng.cfm

[26] J. Eliasson and A. Transek, Cost-benefit analysis of the Stockholm congestion charging system, 18. http://siteresources.worldbank.org/INTTRANSPORT/Resources/StockholmcongestionCBAEliassonn.pdf; Mobility Pricing Independent Commission, *Metro Vancouver Mobility Pricing Study* (2018). https://www.itstimemv.ca/uploads/1/0/6/9/106921821/mpic_full_report_-_final.pdf

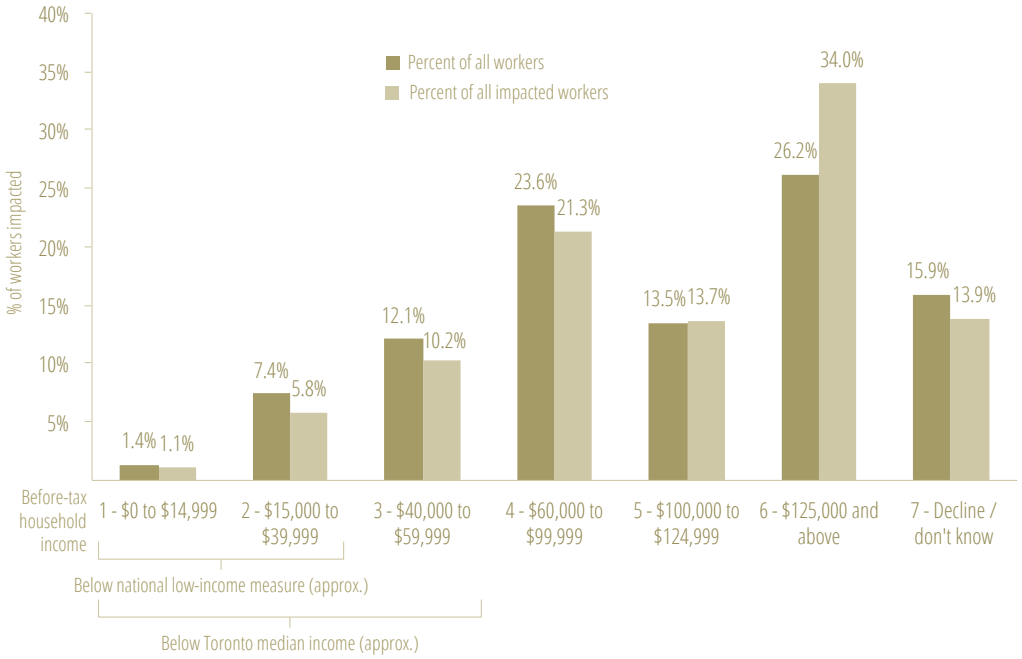

Figure 3. Impact of highway tolls on DVP and Gardiner, by income group

3.2 Financial burden on households

Despite the prediction that a greater share of the higher income population would be impacted by the proposed toll on the DVP and Gardiner, it is important to consider the relative financial burden of the toll cost on different household profiles.

The proposal initially put forth by the City of Toronto was a flat $2 toll regardless of distance travelled or time of day. The annual cost of paying a $2 toll twice per day for 242 yearly work days is $968.

Lower-income households spend a significantly higher share of their income on basic necessities like housing and transportation. Table 2 shows household expenditure by income quartile for Ontario[27] and compares the burden of the proposed toll cost across households. As shown, the annual cost of the proposed toll would represent a significantly higher share of annual transportation expenditure for lower-income households. For households in the lowest before-tax household income quartile, the annual cost of the toll would amount to approximately 23.2% of annual transportation expenditure, whereas the cost would amount to only 4.6% of annual transportation

[27] The household expenditure data is not provided publicly at a smaller level of resolution than the province.

expenditure for households in the highest income quartile (again, based on Ontario average expenditures). This means, not surprisingly, that the toll would represent more of a financial burden for lower-income households than for higher-income ones under the scenario where no mitigation measures are included.

Table 2. Proposed toll as a share of annual household expenditure

Average expenditure per household (Ontario)[28]	Before-tax household income quintile (Ontario)					
	All quintiles	Lowest quintile	Second quintile	Third quintile	Fourth quintile	Highest quintile
Total expenditure	$88,953	$35,628	$56,374	$76,026	$101,056	$175,436
Transportation	$12,347	$4,164	$8,427	$12,265	$15,907	$20,944
Private	$10,926	$3,401	$7,272	$10,998	$14,358	$18,577
Public	$1,421	$763	$1,155	$1,267	$1,549	$2,367
Annual cost of $2 toll	$968	$968	$968	$968	$968	$968
Annual toll cost as % of total expenditure	1.1%	2.7%	1.7%	1.3%	1.0%	0.6%
Annual toll cost as % of transportation expenditure	**7.8%**	**23.2%**	**11.5%**	**7.9%**	**6.1%**	**4.6%**

3.3 Spatial distribution of the financially impacted population

The City of Toronto is home to the greatest share of impacted workers across the region: approximately 67.8% of impacted workers, or about 116,354 workers, are from Toronto. As shown in Table 3, about 12.0% of impacted workers are from Peel Region, 8.3% are from York Region, and 6.7% are from Durham Region.

Similarly, the likelihood of being impacted by the road pricing plan is higher for residents of the City of Toronto: approximately 10.1% of City of Toronto workers are likely to be impacted, while the likelihood is well below 5% in all other regions. The City

[28] Statistics Canada Table: 11-10-0223-01 Household spending by household income quintile, Canada, regions and provinces. Data collected via the 2016 Survey of Household Spending.

of Toronto is also home to the vast majority of impacted low-income workers: about 81.7% of impacted low-income workers region wide are from Toronto.

Table 3. Regional distribution of impacted workers

Region/ city	All workers	Impacted workers in region/city			Low-income impacted workers (income < $40,000) in region/city		
	Number	Number	Percent from among all workers in region/city	Percent from among all impacted workers in GTHA	Number	Percent from among all impacted workers in region/city	Percent from among all low-income impacted workers in GTHA
Toronto	1,154,737	116,354	10.1%	67.8%	9,594	8.2%	81.7%
Peel	573,522	20,605	3.6%	12.0%	716	3.5%	6.1%
York	471,177	14,267	3.0%	8.3%	696	4.9%	5.9%
Durham	256,540	11,436	4.5%	6.7%	351	3.1%	3.0%
Halton	228,948	7,225	3.2%	4.2%	205	2.8%	1.7%
Hamilton	221,189	1,483	0.7%	0.9%	100	6.7%	0.8%
Other regions	41,101	243	0.6%	0.1%	81	33.2%	0.7%
Total	2,947,215	171,613		**100.0%**	**11,742**		**100.0%**

Source: In-house analysis using Transportation Tomorrow Survey 2016 with only home-based trips conducted by private vehicle, for work purposes, with a regular place of work (i.e. regular commuters). These results should be interpreted carefully because the division of TTS results into small categories increases the margin of error.

Within the City of Toronto itself, there are impacted workers across each of the former municipalities (Table 4). The greatest absolute number (approximately 40,160) are from downtown, representing about 34.5% of impacted Toronto workers. The share of impacted workers relative to the number of workers, however, is highest in the former municipalities of East York (22.2%) and Etobicoke (15.7%). East York and North York are home to the greatest share of impacted low-income workers, approximately 28.2% and 25.0% respectively.

As discussed in the next section, these results give direction for where mitigation efforts, including transit investment, should be focused.

Table 4. Distribution of impacted workers within City of Toronto

Former Municipality	All workers	Impacted workers in former municipality			Low-income impacted workers (income < $40,000) in former municipality		
	Number	Number	Percent from among all workers in former municipality	Percent from among all impacted workers in Toronto	Number	Percent from among all impacted workers in former municipality	Percent from among all low-income impacted workers in Toronto
Toronto	388,476	40,160	10.3%	34.5%	1,194	3.0%	12.4%
Etobicoke	152,171	23,830	15.7%	20.5%	1,348	5.7%	14.0%
Scarborough	238,012	21,498	9.0%	18.5%	1,877	8.7%	19.6%
North York	266,555	18,935	7.1%	16.3%	2,399	12.7%	25.0%
East York	47,763	10,588	22.2%	9.1%	2,708	25.6%	28.2%
York	61,760	1,343	2.2%	1.2%	68	5.1%	0.7%
Total	**1,154,737**	**116,354**			**9,594**		

Source: In-house analysis using Transportation Tomorrow Survey 2016 with only home-based trips conducted by private vehicle, for work purposes, with a regular place of work (i.e. regular commuters). These results should be interpreted carefully because the division of TTS results into small categories increases the margin of error.

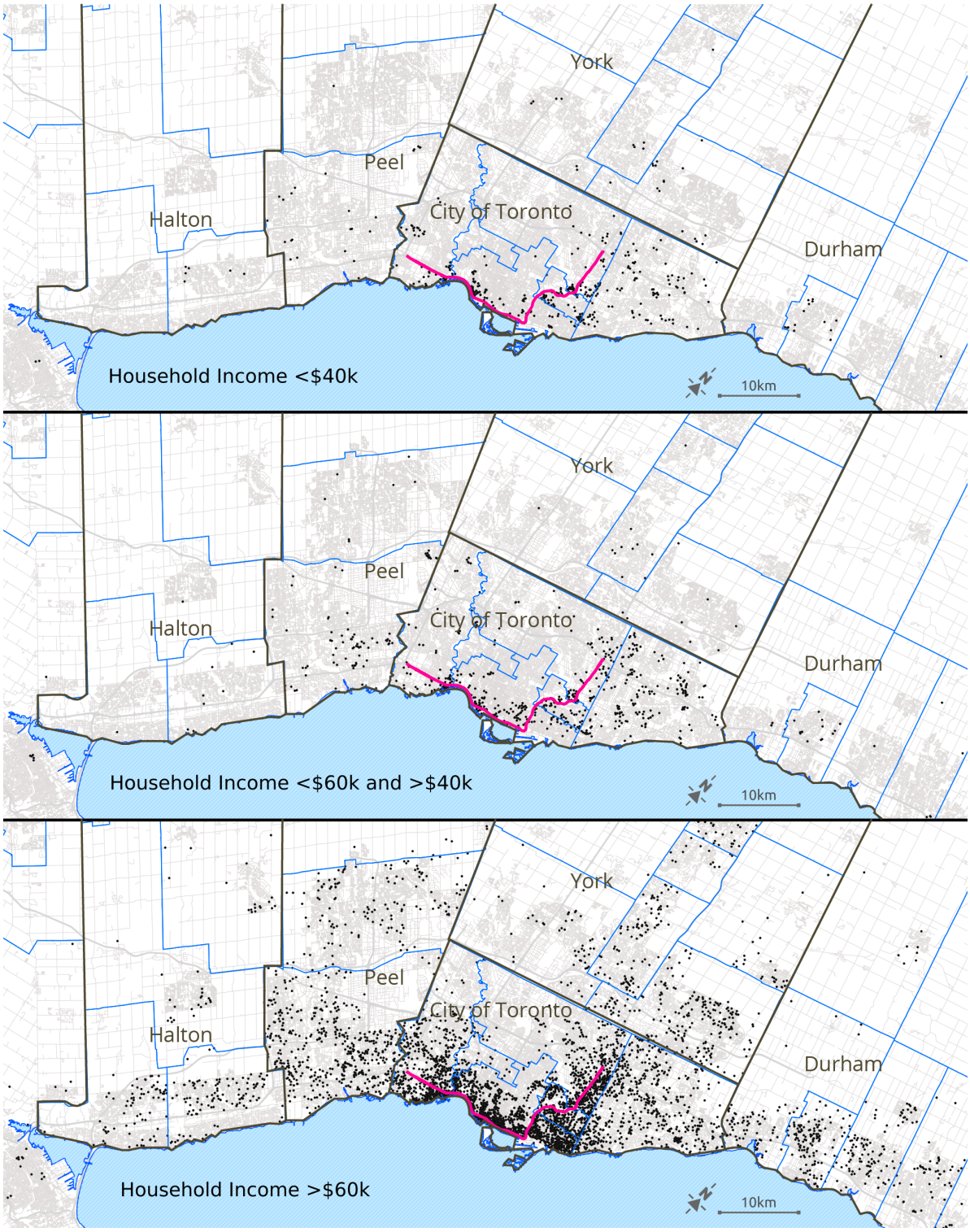

Figure 4. Location of impacted workers by income group

Note: each dot represents 20 workers

Source: 2016 Transportation Tomorrow Survey and in-house analysis, map by Jeff Allen. These results should be interpreted carefully because the division of TTS results into small categories increases the margin of error.

3.4 Variation in impact with time of day and distance travelled

Time of day

Time-of-day and dynamic pricing — charging a different price throughout the day according to average or real-time levels of congestion — is widely understood to be a preferable design for a road pricing system because it allows for better management of congestion by rewarding off-peak trips. Interestingly, dynamic pricing is also typically characterized as a desirable approach from an equity perspective because in many jurisdictions, low-income populations tend to travel more during off-peak hours.[29]

To understand whether this is the case in the GTHA, Figure 5 shows the hour of travel of the impacted population from the TTS data according to income bracket, for work trips only. The results demonstrate that lower-income populations do make more work trips during off-peak hours than their higher-income counterparts. The inverse is also true: higher-income groups commute more at peak hours. This confirms that dynamic pricing would be a more progressive approach from an income perspective, although it would not eliminate the impact on lower-income households.

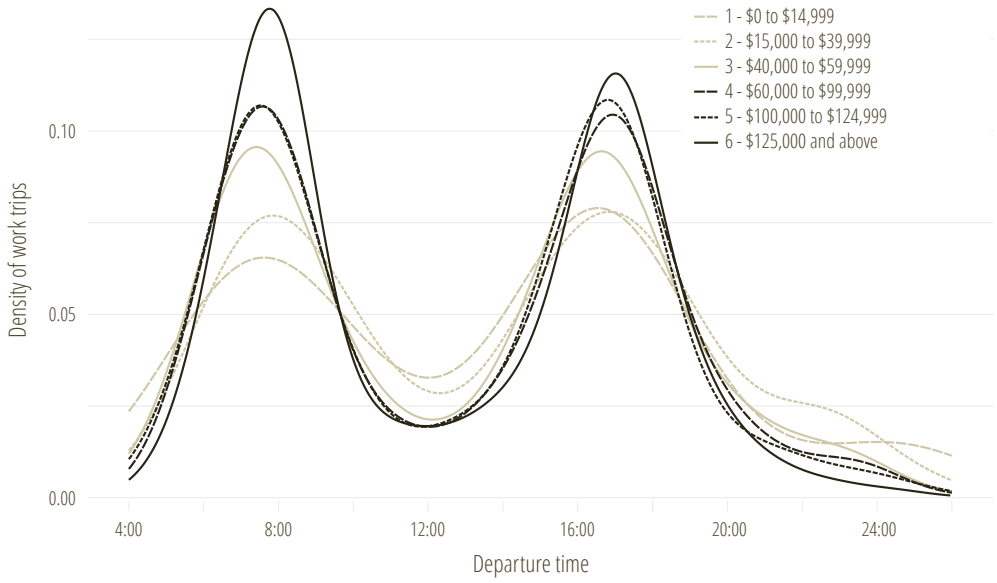

Figure 5. Distribution of work trips by departure time for impacted residents

Data source: 2016 Transportation Tomorrow Survey

[29] *Metro Vancouver Mobility Pricing Study, 29.*

Distance

We also conducted analysis to explore whether distance-based pricing — charging a higher price for longer trips — would change the impact from an income perspective. Figure 6 shows the average distance travelled on the priced highways, according to our modelling, by income group. In general, longer distances are travelled by higher-income (before-tax household income above $60,000) groups, with the exception of those with household incomes below $15,000. These initial findings suggest that a distance-based toll could also be more progressive from an income standpoint, but more work is required to determine the significance and policy design implications of these findings.

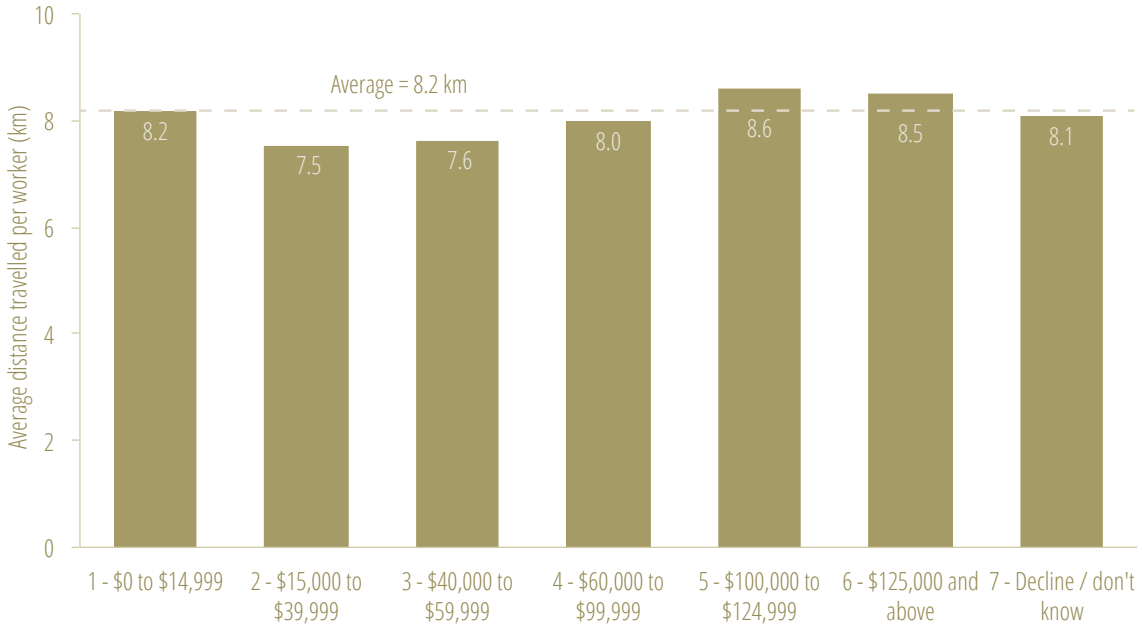

Figure 6. Average distance travelled for work trips on priced highways by income bracket

4. Options for mitigating financial impact on low-income populations

4.1 Approaches in other jurisdictions

There are precedents in other jurisdictions of actions to mitigate the financial impact of road pricing on certain vulnerable groups (see Table 5). We have grouped mitigation approaches into two categories: indirect (using revenue and/or policy design to create a system that provides viable alternatives for target impacted populations) and direct (reducing the amount that target populations pay relative to others).

Indirect mitigation

Any viable road pricing plan should guarantee that frequent, reliable and affordable transit options for making the same trip by transit are available. Providing transit options is more than a mitigation mechanism: it is key to achieving the desired result of shifting car trips to other modes. Transit investment is a core component of successful cordon charges in Stockholm, Sweden and London, England. In London, there is a legal requirement to reinvest collected revenue in the public transit system.[30] In the consultations held by the Metro Vancouver Mobility Pricing Independent Commission, some stakeholders suggested reducing the price of public transit in exchange for implementing a decongestion charge.

Another approach to indirect mitigation is to provide the option to drivers of both priced (and therefore less congested) and non-priced lanes on a highway. Interestingly, under the right conditions this approach can improve the overall throughput of a roadway, improving travel times even for those who do not choose to use the priced lanes. This is the approach of high-occupancy toll (HOT) schemes in Ontario, Minnesota and San Diego. This approach may be a good starting point for existing highways in jurisdictions that are not ready to implement a cordon-style charge; however, fewer congestion and revenue benefits are possible.

[30] R. Evans, *Central London Congestion Charging Scheme: ex-post evaluation of the quantified impacts of the original scheme* (Transport for London, 2007), 29. http://content.tfl.gov.uk/ex-post-evaluation-of-quantified-impacts-of-original-scheme.pdf

Direct mitigation

There is also precedent in jurisdictions with road pricing for providing discounts or exemptions to target groups (see Table 5). Examples include discounts or exemptions for individuals living in the cordon zone (Stockholm, London, Milan) and for disabled persons (London). The discount or exemption is applied either upon registration of the vehicle to the pricing system, or through the autopay system.

None of the jurisdictions reviewed in this study have implemented discounts or exemptions targeted at low-income individuals or households specifically, although it has been contemplated. The Metro Vancouver Mobility Pricing Independent Commission has recommended exploring options for returning excess revenues to households through direct rebates or a cap, or by offsetting other costs and taxes.[31] Researchers in Stockholm modelled the impact of direct road pricing revenue redistribution to the impacted population and found the greatest net social benefit to low-income groups under this scenario; however, this approach was not implemented.[32]

Table 5. Road pricing financial impact mitigation mechanisms in Europe and North America

City	Type of road pricing	Road pricing revenue investment (indirect mitigation)	Groups receiving discounts or exemptions (direct mitigation)
London, UK[33]	Cordon	• Fund public transit services	• Disabled persons • Residents in zone • Alternative fuel vehicles • Health service workers • Taxis • Motorcycles • Public service and emergency vehicles

[31] *Metro Vancouver Mobility Pricing Study.*

[32] J. P. Franklin, J. Eliasson and A. Karlström, "Traveller Responses to the Stockholm Congestion Pricing Trial: Who Changed, Where Did They Go, and What Did It Cost Them?" in *Travel Demand Management and Road User Pricing: Success, Failure and Feasibility* (Ashgate Publishing, Ltd. 2009).

[33] Michele Dix, "Central London Congestion Charging Scheme," presented at *Urban Access & Road Pricing in European Metropolitan Cities,* IMPACTS 9th Annual Conference, Amsterdam, March 17, 2005. http://www.impacts.org/documents/Amsterdam2005/Dix.pdf

Stockholm, Sweden[34]	Cordon	• Fund public transit services (incl. subway extension) • Build new infrastructure	• Disabled persons • Motorcycles • Public service and emergency vehicles
Milan, Italy[35]	Cordon	• Public transit investments • Active transit investments • Goods distribution	• Residents in zone • Commercial vehicles • Public service and emergency vehicles
Ontario, Canada[36]	HOT Lanes pilot (permit approach)	• Revenue neutral	• Multi-person vehicles • Motorcycles • Vans or light trucks • Commercial trucks less than 6.5 meters long with a gross weight of 4,500 kg or less • Buses of all types • Licensed taxis and airport limousines • Emergency vehicles • Electric vehicles with green licence plates
Minnesota, USA[37]	HOT Lanes	• Road maintenance • Improved bus service	• Multi-person vehicles • Public service vehicles • Motorcycles
San Diego, USA[38]	HOT Lanes	• Road maintenance • Carpool facilities • Improved transit service	• Multi-person vehicles • Public service vehicles

[34] M. Börjesson, J. Eliasson, M.B. Hugosson and K. Brundell-Freij, "The Stockholm congestion charges—5 years on. Effects, acceptability and lessons learnt.," *Transport Policy*, 20 (2012). https://doi.org/10.1016/j.tranpol.2011.11.001; J. Eliasson, L. Hultkrantz, L. Nerhagen and L.S. Rosqvist, "The Stockholm congestion–charging trial 2006: Overview of effects," *Transportation Research Part A: Policy and Practice,* 43 (2009). https://doi.org/10.1016/j.tra.2008.09.007

[35] Comune di Milano, "Congestion Charge - Area C." https://www.comune.milano.it/wps/portal/ist/en/area_c

[36] Government of Ontario, "High-Occupancy Toll (HOT Lanes)." https://www.ontario.ca/page/high-occupancy-toll-hot-lanes

[37] Minnesota Department of Transportation, "MnPASS Express Lanes." https://www.dot.state.mn.us/mnpass/mnpassexpresslanes.html

[38] U.S. Department of Transportation. "Congestion Pricing: Examples Around the U.S." https://ops.fhwa.dot.gov/congestionpricing/resources/examples_us.htm

4.2 Considerations for Toronto and the GTHA

Indirect mitigation

Reinvesting net revenue in public transit would be a key component of a viable road pricing plan. Following the successful cordon pricing scheme in London, a plan for road pricing in the City of Toronto or the GTHA should include a legal guarantee that net revenue be reinvested in public transit services. Prior to, or in tandem with, the implementation of the pricing system, the City of Toronto and the Province of Ontario should collaborate to provide frequent, reliable and affordable transit options for making the same trip by transit so that impacted users (particularly in lower-income groups) have a viable alternative option. In the near term, bus services should be prioritized because they can be implemented quickly.

Based on our analysis of the City of Toronto's proposal for pricing on the DVP and Gardiner, service improvements or new investments should focus as a priority on serving East York, North York and Etobicoke. Several future planned or proposed investments would serve the impacted areas:

- Metrolinx's Regional Transportation Plan proposes a Frequent Regional Express Bus service using an expanded managed lanes network on 400-series and other major highways.[39]
- City of Toronto plans new express bus services and measures to relieve peak and off-peak crowding.[40]
- The Waterfront West LRT, the Relief Line subway, and Eglinton East LRTs, and the Sheppard East LRT would all serve impacted areas.
- 15-minute two-way GO RER service improvements on the Stouffville, Richmond Hill, and Lakeshore West Lines would serve impacted areas.

While the revenue generated from the proposed tolls would likely not be sufficient on its own to fund these projects, these projects should be accelerated in tandem with a road pricing plan. Further research should examine these proposals against the impacted population's travel behaviour and needs to determine potential benefits to accessibility and travel time.

[39] Metrolinx, *2041 Regional Transportation Plan* (2017), 65. http://www.metrolinx.com/en/regionalplanning/rtp/

[40] TTC, *Capacity Improvements on Bus and Subway Services* (2018). https://www.ttc.ca/About_the_TTC/Commission_reports_and_information/Commission_meetings/2018/May_8/Reports/7_Capacity_Improvements_on_Bus_and_Subway_Services.pdf

As previously discussed, a time-of-day or dynamic (higher rates during peak hours) and/or a distance-based (pay per distance) tolling structure may reduce the financial impact on lower-income populations. We therefore recommend that these design elements be studied further, not only because of their congestion management benefits, but because they could support more equitable outcomes.

Direct mitigation

Despite the lack of precedent for road pricing discounts or exemptions for low-income groups specifically, the results of this study suggest it would be appropriate for a road pricing plan in the City of Toronto or the GTHA to incorporate this approach. The Metro Vancouver Mobility Pricing Independent Commission also recommended further study on income-based discounts. It would be appropriate to provide a discount based on combination of household income, household size, and use of the priced roadway.

Income-based rebates or exemptions would require income verification by the implementing agency (e.g. the City of Toronto in the case of the current proposal) or another government partner. While the City of Toronto does not directly collect income information, it does screen individuals for income for programs such as the Fair Pass Discount Program, which provides discounted transit passes for individuals receiving support from the Ontario Disability Support Program or Ontario Works.

Depending on the system design, a road pricing system may require regular users to register their vehicle. Proof of income could be provided at the time of registration on an annual basis. Discounts could be applied at the time of use, via an autopay system, and could be phased out over time as the choice and availability of transportation alternatives improve. Different approaches would require varying levels of administrative burden and accuracy, which should be studied further.

The City of Toronto council directed staff in late 2016 to study the possibility of capping the amount of toll that a Toronto resident would pay per year; however, this recommendation was not geared toward lower-income groups specifically. Given that approximately 69.0% of impacted commuters have above-median household incomes, it would be a better use of revenue to direct mitigation efforts at lower-income groups.

5. Discussion and conclusions

Mobility pricing, and road pricing specifically, must be part of a multi-pronged approach to address the GTHA's current transportation challenges, make the transportation system fairer, and prepare for future disruptive trends. This study contributes new knowledge about the income impacts of a specific City of Toronto road pricing proposal (flat toll on the DVP and Gardiner) as a contribution to the ongoing region-wide conversation about mobility pricing.

We find that a much greater proportion of the impacted workers are from higher-income groups in the GTHA. Approximately 69.0% of all impacted workers have household incomes above $60,000 (i.e. roughly above Toronto's median household income). The likelihood of being impacted by the proposed highway tolls increases as one's household income increases. However, the toll would represent more of a financial burden for lower-income households than for higher-income ones under the scenario where no cost mitigation measures are included.

Looking to trends in cities around the world, it is clear that fair mobility pricing must be part of the policy landscape in the GTHA if we are to manage worsening congestion and keep the region moving. It must be part of a package that includes strong and sustained investment in transit, including in those geographical areas highlighted in this report. In the near term, actors in the GTHA can connect with the discussions happening via the Metro Vancouver Mobility Pricing Independent Commission and could consider taking such an approach to facilitating discussion and study in this region.

As income inequality in Toronto and the GTHA grows, so does the divide between those who have access to opportunities and those who do not. Mobility pricing is not a primary tool for addressing income inequality, but investments or changes in the cost of transportation should contribute to increasing the equity of the transportation system and improving access for the region's most vulnerable populations.

Future research should continue to apply an equity lens to mobility pricing design. Future studies should explore the potential of region-wide road pricing plans and explore intermediary steps, like region-wide deployment of toll lanes. Further research should also explore travel time benefits and costs across income groups of both road pricing scenarios and complementary transit investments.