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The Potential for Congestion Pricing Tools in the City of Ottawa

Prepared by:

CPCS

Final Report

March 27, 2017

Solutions for growing economies

The Potential for Congestion Pricing Tools in the City of Ottawa

Acknowledgements

CPCS thanks Councillors Leiper, Chernushenko, McKenney and Nussbaum for funding this research and posing the research questions.

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Acronyms/Abbreviations

BRT	Bus Rapid Transit
CAGR	Compound Annual Growth Rate
CAGR	Compound Annual Growth Rate
CBO	Congressional Budget Office
CMA	Census Metropolitan Area
CVS	Canadian Vehicle Survey
FIR	Financial Information Returns (Ministry of Municipal Affairs database)
GHG	Greenhouse Gas
HOT	High Occupancy Vehicle or Toll
HOV	High Occupancy Vehicle
HTF	Highway Trust Fund
LDV	Light Duty Vehicle
LRT	Light Rail Transit
MBUF	Mileage Based User Fee
MTO	Ontario Ministry of Transportation
NCC	National Capital Commission
NCR	National Capital Region
NFC	Near Field Communications
NHS	National Household Survey
OD	Origin-Destination
ODOT	Oregon Department of Transportation
PKT	Passenger Kilometres Travelled
PWGSC	Public Works and Government Services Canada
STO	Société de transport de l'Outaouais
TBS	Treasury Board Secretariat
TIC	Transportation Investment Corporation
TMP	Transportation Master Plan
VKT	Vehicle Kilometres Travelled
VTTS	Value of Travel Time Savings

Executive Summary

Key Messages

- ***The key objective of this report is to identify specific road pricing tools that would help reduce traffic congestion and increase transit/LRT ridership in Ottawa.***
- ***Four scenarios with congestion pricing or broader road pricing tools were modelled for their impacts on peak hour travel demand: a toll on Highways 417 and 174, a cordon charge to enter the central part of Ottawa, a parking levy and an increase in the gas tax.***
- ***We find that the cordon charge would likely be most effective in encouraging mode shift to transit (13% increase in transit ridership), followed by the parking levy (8.5% increase) and then the toll (7% increase).***
- ***The cordon charge would also likely be most effective in reducing peak hour auto VKT, but would be costly to implement. A parking levy would achieve some of the outcomes expected from a cordon charge, but would be much less costly to implement. Therefore, a parking tax or levy is likely to be the most appropriate congestion pricing tool for Ottawa when giving primary consideration to reducing auto VKT and encouraging mode shift from auto to transit.***

Introduction and Background

Road congestion is a prominent and growing concern in Canadian cities. The City of Ottawa is no exception. Growing congestion in Ottawa and capacity constraints on its Bus Rapid Transit (BRT) network have prompted the construction of a new Light Rail Transit (LRT) system, the first stage of which is slated for completion in 2018.

The key objective of this report is to identify specific road, mobility, or congestion pricing tools suitable to the Ottawa context that would help reduce traffic congestion and increase transit/LRT ridership.

The Transportation Funding Challenge

The main objective of this report is to identify tools that would help reduce congestion and increase transit ridership, rather than identify mechanisms to generate revenue. A congestion pricing tool can help to reduce congestion without generating new revenue, for example if a general tax were reduced so total government revenues decline in the same proportion. However, we do note that like other Canadian cities Ottawa faces a

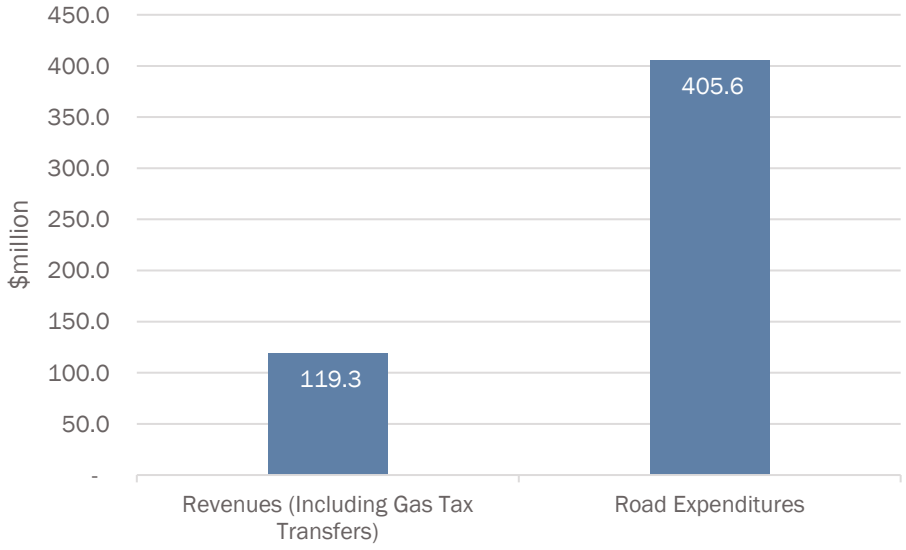
transportation funding challenge. This challenge can be partially addressed through the revenues generated by congestion pricing tools if they were not implemented in a revenue-neutral way.

The funding challenge exists in part due to the fact that different levels of government incur transportation costs and generate related revenues in different proportions. Most notable is the fact that the federal government generates significant sums of revenue through road fuel taxes (the most significant source of revenue from motorists), while local governments in Ontario do not directly collect any revenue through this mechanism.

Although gas tax transfers address this fiscal imbalance issue to some extent, they do not necessarily address the issue to the full extent because those transfers are not made on the basis of where the revenue is generated. In other words, it is not a given that the same proportion of gas tax revenues paid by motorists in one urban area are returned to that same urban area.

As a result, the City's road-related revenues (including transfers) still fall far short of road expenditures (see Figure ES-1).

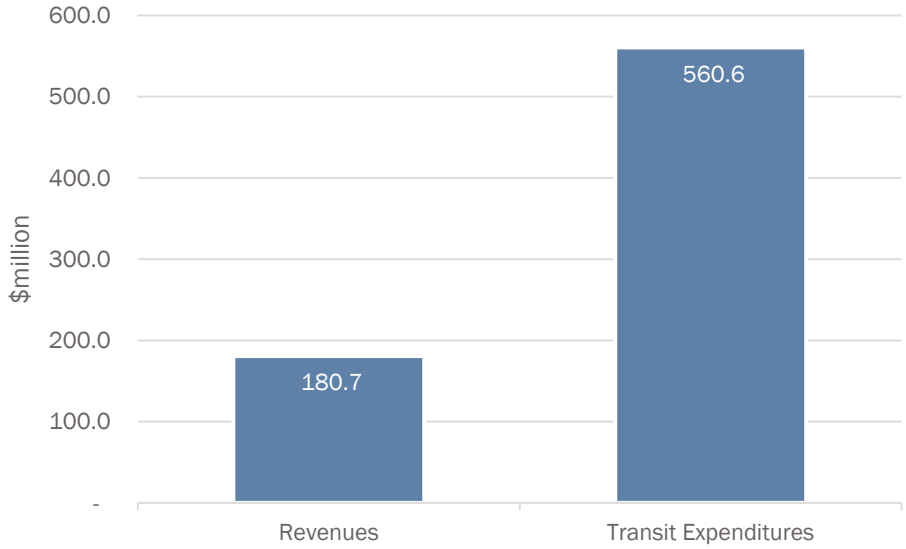
Figure ES-1: City of Ottawa Road Revenues (Including Transfers) and Expenditures, 2015 (millions of dollars)



Source: CPCS Analysis of Data from Ministry of Municipal Affairs
Note: Revenues include gas tax transfers from federal and provincial government

The City of Ottawa also faces funding challenges with respect to public transit. In this case though, the City generates more revenue directly from users through transit fares (see Figure ES-2).

Figure ES-2: City of Ottawa Transit Revenues and Expenditures, 2015 (millions of dollars)

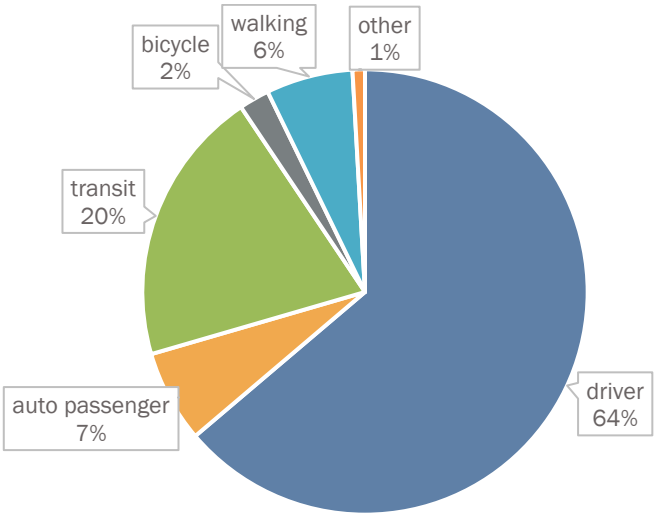


Source: CPCS Analysis of Data from Ministry of Municipal Affairs

Commute Flows and Mode Shares in Ottawa

Although the vast majority of commuters in Ottawa use their cars to get to work, public transit plays a significant role for commuter traffic. According to the last National Household Survey (NHS), 20.1% of workers in the Ottawa Census Metropolitan Area (CMA) relied on transit to get to work (see Figure ES-3).

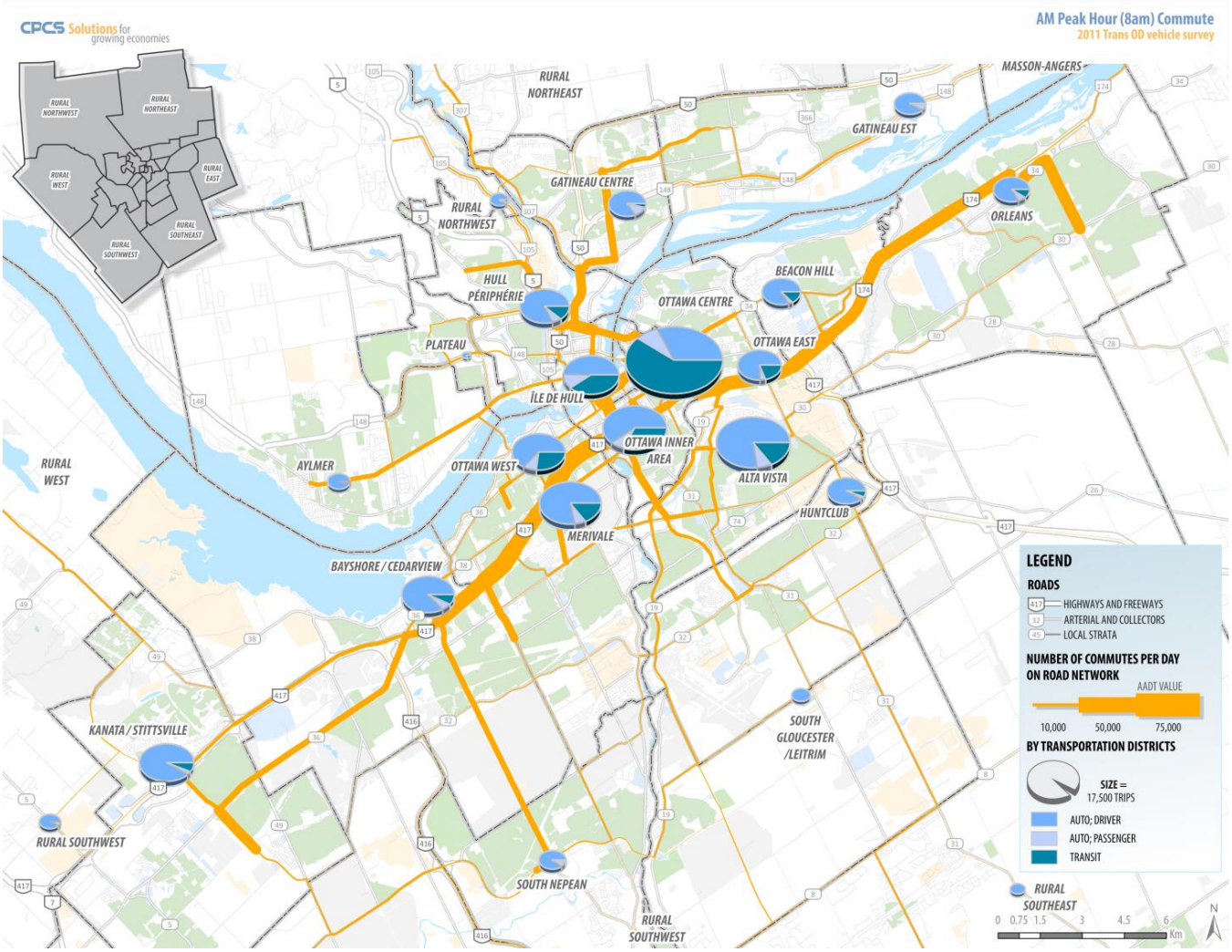
Figure ES-3: Commute Mode Shares in the Ottawa CMA



Source: CPCS Analysis of 2011 National Household Survey Data

Transit mode share is particularly strong for commute trips destined for Ottawa Centre, where about two-thirds of commuters use transit to get to work. But the transit mode share is also strong for other destinations around Ottawa Centre (see Figure ES-4).

Figure ES-4: Mode Shares for Top AM Work Trips Destinations



Source: CPCS Analysis of TRANS Survey data

Potential Congestion Pricing Tools for Ottawa

Given Ottawa's characteristics, among the options for congestion pricing tools are tolls on major highways, cordon charges (a fee to drive into a specified area within a city, typically the downtown area), parking taxes or fees, or some combinations thereof.

Tolling Highway 417, in particular, may help to shift a greater portion of commuters to the Confederation Line LRT, which will largely run parallel to the 417. However, without additional measures, some of the current Highway 417 traffic would likely leak onto parallel arterial roads. Further, a toll on the 417 would not address north-south traffic.

A cordon charge would likely be more costly to implement. However, the natural and artificial barriers presented by rivers and a rail corridor help to make a cordon around the Ottawa Inner Area somewhat feasible. A cordon charge would address both east-west and north-south traffic. However, there would be some potential for some through traffic to spill on to arterial roads just outside of the cordon zone.

A parking tax, while not strictly a congestion pricing tool, can have a similar impact as a cordon charge, but at a lower cost.

Finally, a parking tax, while not strictly a congestion pricing toll, can have a similar impact as a cordon charge, but at a lower cost. The City of Ottawa also has a greater degree of control over parking costs. The City already levies a property tax rate specific to parking lots, which it can increase to influence the rates charged for parking. Further, the City itself provides approximately 14% of off-street parking and directly controls the pricing of that parking. Parking taxes, however, are blunter instruments relative to a cordon charge or toll. Further, parking taxes would not affect through traffic, which may or may not be desirable.

Potential Impacts of Congestion Pricing in Ottawa

The impacts of congestion pricing tools depend on a number of factors, including factors that affect overall travel demand, the availability of alternative modes of transportation and the extent to which the timing of commuters' trips are flexible, among others. While a comprehensive estimation of travel demand and mode shift using a travel demand model is beyond the scope of this report, we used the key principles behind mode choice estimations from travel demand models generally to determine the extent to which the congestion or road pricing tool or tools could potentially contribute to shifts to transit in Ottawa. Note that by focussing on this response (mode shift) and peak hour traffic only, we did not estimate the extent to which pricing tools could shift some traffic to other times during the day, either in addition to or instead of shifting traffic to other modes.

Specifically, four scenarios were modelled for their impacts on peak hour travel demand:

1) A toll on the 417/174 highways equivalent to $0.15/km.

2) A cordon charge in the central part of Ottawa equal to $5 per peak period entry. It is assumed the charge is also assessed to pass-through trips using the 417.

3) A parking levy equal to $2 per parking spot. It is assumed this levy is passed on to all drivers in those zones that already predominately have paid parking. Where parking is currently free, it is assumed the levy is absorbed by the landowner and not passed on to motorists.

4) An increase in the gas tax of $0.30 per litre.

In the future, as consideration is given to expanding Highway 417 capacity through the addition of new lanes, the feasibility of implementing a network of High Occupancy Vehicle or Toll (HOT) lanes may grow. This is because it is typically more acceptable to the general public to implement High Occupancy Vehicle (HOV) or HOT lanes when new capacity is added (as opposed to repurposing existing unmanaged lanes). Although we do not explicitly model the impacts of the implementation of HOT lanes, we note that the implementation of such lanes would likely generate some portion of the impact of a broader road toll

We find that the cordon charge would likely be most effective in encouraging mode shift to transit, followed by the parking levy and then the toll (see Figure ES-5). The cordon charge would also likely be most effective in reducing peak hour auto VKT (followed by the toll, then parking levy).

Figure ES-5: Expected Impacts of Congestion Pricing Tools, 2031

Scenario	*New AM Peak Transit Trips per Weekday*	*Reduction in Average Workday AM Peak Auto VKT*	*Gross Annual Revenue Generated from Peak Users (2016 $ M)*
Scenario 1: $0.15/km on 417/174 Highway	*10,577*	*192,962*	*$ 58.91*
Scenario 2: $5 per entry peak cordon charge	*19,238*	*252,971*	*$ 59.72*
Scenario 3: $2 parking levy	*12,498*	*136,283*	*$ 65.62*
Scenario 4: $0.30 per litre increase in gas tax	*3,360*	*48,646*	*$ 68.00*

Source: CPCS Analysis

However, because the cordon charge would be more costly to implement (likely in excess of $40 million per year) than a parking levy, it would not likely be effective for the purpose of generating new revenue, at least until the related technology costs declined substantially.

The bulk of the shift in mode share to transit estimated for each of these scenarios are expected to boost LRT ridership. To put these figures into context, the most recent LRT forecasts (including Stage 2) estimated that system-wide OC Transpo ridership would increase to approximately 147,000 riders daily in the AM peak. At the high end, the additional 19,000 AM peak riders that would be gained through a cordon charge represents a 13% increase in ridership, while the parking levy and toll scenario increases are equal to approximately 8.5% or 7% ridership increases, respectively.

Conclusion

Based on our analysis, a parking tax or levy is likely to be the most appropriate congestion pricing tool for Ottawa when giving primary consideration to reducing auto VKT and encouraging mode shift from auto to transit. While this tool may not be as effective as a cordon charge for this purpose, it is technically easier and less costly to implement.

While our analysis presents plausible estimates of the mode shift and transit share ridership impacts of various potential congestion tools, we note the following considerations and limitations that can alter the expected outcomes, including, but not necessarily exclusive to: residential and employment location responses; fuel economy impacts on gas tax revenues; declining technology costs; potential changes in trip timing and route choices; and factoring in other social and political priorities.

We also note that there are other tools and strategies that can be effective in reducing road congestion and improving mobility more generally through increasing the efficiency of use of the current transportation infrastructure. Of particular note is the fact that Ottawa's auto passenger mode share, while respectable by Canadian standards, illustrates that there is a great deal of transportation capacity that continues to go unused. This unused capacity is the result of the fact that although there is often little or no room to accommodate additional vehicles on our roads during peak hours, there is capacity to accommodate more passengers as most vehicles have three or four empty seats during these hours. Strategies and policies designed to take advantage of this capacity have the potential to generate significant bang for the buck.

Chapter 1

Introduction

Key Messages

Road congestion is a prominent and growing concern in Canadian cities. The City of Ottawa is no exception. Growing congestion in Ottawa and capacity constraints on its Bus Rapid Transit (BRT) network have prompted the construction of a new Light Rail Transit (LRT) system, the first stage of which is slated for completion in 2018.

The key objective of this report is to identify specific road, mobility or congestion pricing tools suitable to the Ottawa context that would help reduce traffic congestion and increase transit/LRT ridership.

1 Introduction

1.1 Background

The key objective of this report is to identify specific road, mobility or congestion pricing tools suitable to the Ottawa context that would help reduce traffic congestion and increase transit/LRT ridership.

Road congestion is a prominent and growing concern in Canadian cities. The City of Ottawa is no exception. Growing congestion in Ottawa and capacity constraints on its Bus Rapid Transit (BRT) network have prompted the construction of a new Light Rail Transit (LRT) system, the first stage of which is slated for completion in 2018.

While the completion of the LRT is expected to have appreciable effects on commute mode shares and by extension, road congestion, the construction of new transportation capacity is just one available tool designed to alleviate road congestion. Utilizing multiple tools in conjunction with one another can maximize the efficiency of existing and new transportation capacity. Among other tools that are potentially available for use are congestion or road pricing tools, such as road tolls, cordon charges and parking fees, among others.

In late 2015, Canada's EcoFiscal Commission published a study that made the case that congestion pricing is the missing piece of the urban mobility puzzle. While it explored the merits of congestion pricing more generally, the report also reviewed potential options for congestion pricing in Metro Vancouver, Calgary, the Greater Toronto & Hamilton Area and Greater Montreal. The report found that due to unique geographies, travel patterns, governance structures and other factors, different congestion pricing tools were more suitable for each of the urban areas. For the same reasons, certain congestion pricing tools may be more appropriate than others for Ottawa.

1.2 Objectives and Key Study Questions

The key objective of this report is to identify specific road, mobility or congestion pricing tools suitable to the Ottawa context that would help reduce traffic congestion and increase transit/LRT ridership. To guide the research and realize this objective, we structured the research around the following key questions:

For background and context, what are the approximate public and private costs and revenues associated with the auto and transit modes of transportation in Ottawa?

What existing infrastructure, travel patterns and other factors unique to Ottawa have potential implications for the appropriateness of certain congestion pricing tools?

Given these unique factors, which congestion pricing tools are likely to be most appropriate for Ottawa?

After implementing these tools, what outcome can be expected in terms of mode shift from the auto mode, particularly mode shift to transit and the new LRT line?

1.3 Scope and Methodolgy

We conducted a review of recent literature and analyzed a variety of public data sources including municipal financial statements, transportation survey data and vehicle traffic counts, all of which are documented throughout the report in order to arrive at the report conclusions.

Although we estimate the potential impacts of congestion pricing tools in Ottawa, conducting a comprehensive travel demand forecast and mode shift analysis was beyond the scope of this report. Rather, we relied upon the general principles of travel demand with consideration for Ottawa's local characteristics to develop a reasonable approximation of the likely impacts that congestion pricing tools would have on travel demand in Ottawa. More details on this methodology are included in chapter 4.

The primary geographic scope of this report is the City of Ottawa. However, in many cases we do refer to the larger Ottawa Census Metropolitan Area (CMA), or the slightly smaller National Capital Region (NCR), which include neighbouring municipalities (notably Gatineau).

1.4 Report Organization

The rest of this report is organized in four chapters:

- Chapter 2 reviews transportation costs and revenues in Ottawa, addressing question one above
- Chapter 3 reviews existing factors specific to Ottawa and explores the most appropriate congestion pricing tools for Ottawa, given these factors (addressing questions two and three)
- Chapter 4 estimates the impact of the congestion pricing tools identified in the previous chapters (addressing question four)
- Chapter 5 presents the conclusions of the report

Chapter 2

Auto and Transit Mode Costs and Revenues

Key Messages

This chapter provides an overview of public costs and revenues associated with providing service for automobiles and public transit in the City of Ottawa. The main purpose of this overview is to show the magnitude of government revenues that are generated from motorists relative to the costs that governments incur in order to maintain and operate the road network. This comparison is contrasted against a brief overview of public transit costs and revenues in the City.

Because the federal and provincial governments are also involved in the provision of road and transit services, either directly or indirectly, some considerations of federal and provincial costs and revenues is given. However, the primary emphasis of this chapter is to demonstrate the impact of private automobile and public transit activity on the City of Ottawa's finances.

2 Transportation Costs and Revenues

2.1 Congestion Pricing and Revenue Generation

The main objective of this report is to identify tools that would help reduce congestion and increase transit ridership, rather than identify mechanisms to generate revenue. A congestion pricing tool can help to reduce congestion without generating new revenue, for example if a general tax were reduced so total government revenues decline in the same proportion.

However, we do note that like other Canadian cities Ottawa faces a transportation funding challenge. This challenge can be partially addressed through the revenues generated by congestion pricing tools if they were not implemented in a revenue-neutral way. This chapter provides an overview of public costs and revenues associated with providing service for automobiles and public transit in the City of Ottawa.

The federal government generates significant sums of revenue through road fuel taxes (the most significant source of revenue from motorists), while local governments in Ontario do not collect any direct revenue through this mechanism.

2.2 Government Transportation Costs and Revenues

Governments incur costs associated with providing services to motorists through road construction, maintenance, snow clearing and traffic enforcement, among others. In Ontario, local governments are typically responsible for providing these services on local and arterial roads, while the provincial government is generally responsible for highways.

Meanwhile, governments generate revenue from motorists through a variety of taxes and fees that are exclusive to motorists. The most significant of these taxes and fees are road fuel taxes, which are levied by the federal and provincial governments in Ontario. The provincial government also generates revenue from licensing and motor vehicle registration fees. Local governments in Ontario generate revenue from motorists through direct and indirect means. The most visible fees levied by local governments are parking fees and fines. Local governments raise revenue through development charges as well, a portion of which are used to fund and finance growth related infrastructure costs, including road costs.

Governments also incur costs related to providing public transit services. In this case, local governments usually maintain and operate transit systems with financial support from provincial and federal governments. The major source of user revenues from public transit services is the fare box.

Because road and transit services compete to some extent, governments are interested in maintaining a level playing field with respect to fees from users. Without a level playing field, governments (especially local governments) may be increasing their net costs, causing strain on their budgets and putting those services in

competition with the variety of other services that local governments fund through their general revenues.

2.3 The Fiscal Imbalance

One challenge in accounting for government costs and revenues related to private automobile use is that different levels of government incur costs and generate revenue in different proportions. Most notable is the fact that the federal government generates significant sums of revenue through road fuel taxes (the most significant source of revenue from motorists), while local governments in Ontario do not collect any direct revenue through this mechanism. Meanwhile, local governments are responsible for building and maintaining the majority of the road network in Ontario, while the federal government has little direct involvement in the provision of the road network. However, the federal government does transfer some revenue (including some revenue that is loosely tied to the road fuel tax) to local governments.

Fully addressing this "fiscal imbalance" issue is beyond the scope of this report. To address the fiscal imbalance issue and the extent to which it has or has not been rectified through federal (as well as provincial) transfer payments, one would have to review government finances, taxation authority and constitutional responsibility across all areas of social policy. That said, because this issue and how it is (or is not) accounted for has a significant impact on the portion of government costs and revenues related to private automobile use, we make note of where and how the fiscal imbalance issue likely influences the interpretation of the results that we present.

To summarize, it is necessary to be explicit about how this issue is or is not being addressed in order to provide clarity on which of the two following related but different questions are being answered through the analysis:

- From the users' perspective: how much revenue do all governments generate through fees and taxes on motorists, relative to the costs associated with providing services to those motorists?
- From the City of Ottawa's perspective: how much revenue does the City collect from motorists compared with the costs that the City incurs to provide services to those motorists?

2.4 Negative Externalities

Transportation activity causes some negative externalities, or costs that are borne by non-users. These externalities include, for example, greenhouse gas emissions, local air pollution, noise and, to some extent, safety costs. Safety costs can include loss of life, injuries and property damage from collisions.[1] Transportation activity also causes

[1] Safety costs, however, are to some extent internalized by users through insurance premiums and their own risk tolerances.

some positivity externalities, such as productivity benefits and benefits related to increased domestic and international trade that are not captured directly by users.

Calculating the costs and benefits associated with these negative and positive externalities is beyond the scope of this report. However, we note that in general, public transit generates fewer negative externalities than private automobile use, particularly with respect to GHG and local emissions.

Transit generates fewer of these externalities because of its much lower energy use per passenger or passenger-kilometre travelled (PKT). For example, OC Transpo buses consume approximately 41 million litres of fuel per year.[2]

Per PKT this is approximately 4.3 L/100 PKT, which is considerably more fuel efficient than most single-occupant light-duty vehicles (LDV). As the electric-powered LRT is put into service, both local and GHG emissions will be reduced further, as electric vehicles are able to use their power more efficiently than combustion engine vehicles.

2.5 Transportation Costs and Revenues in Ottawa

2.5.1 Financial Returns-Based Estimates

The Ministry of Municipal Affairs collects financial information from local governments in Ontario. This information is made available through the Ministry's Financial Information Return (FIR) database.[3] From these data, we collected the City of Ottawa's 2015 expenditures on the following items:

- Paved roads
- Unpaved roads
- Bridges and culverts
- Traffic operations & roadside
- Winter control[4]
- Parking

For each of these items, operating & maintenance (including employee salaries and contracted services) as well as interest on long term debt and amortization were included. In 2015, total expenditures were equal to $406 million.

[2] OC Transpo. Annual Performance Report 2014, "Active Fleet.".

[3] Ministry of Municipal Affairs. Financial Information Return.

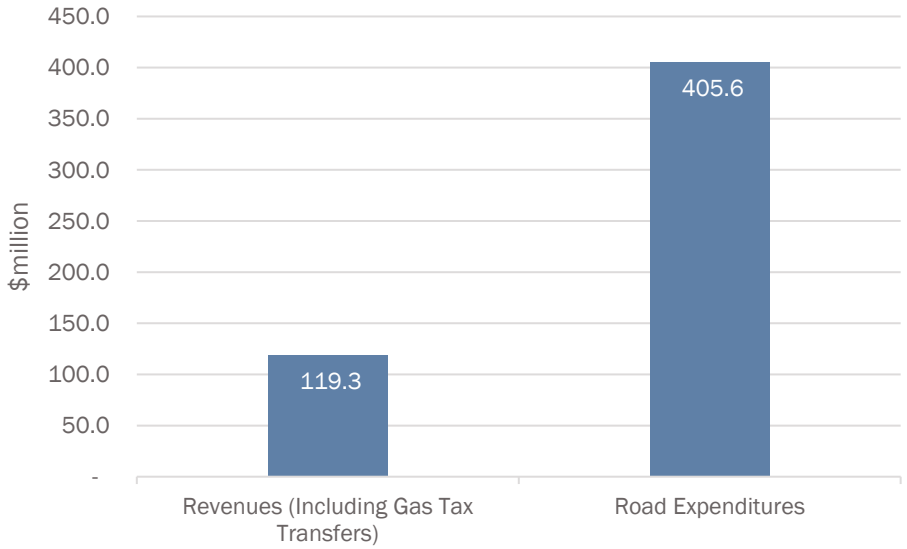
[4] Winter control for parking and sidewalks is combined into one category. We allocated 50% of this category to road vehicles.

For the revenue side of the equation, all user fees and charges associated with the above items were included. By far, the most significant of these fees and charges (which totaled approximately $21 million) are parking fees (approximately $16 million).

Further, we included gas tax transfers that the City of Ottawa receives from provincial and federal governments. Although these transfers are not dedicated to road expenditures, because they are raised from motorists we include them as road revenues. In other words, if people drive less, government revenues decline. In total, the City received over $98 million in gas tax transfers in 2015.

Figure 2-1 shows total revenues and expenditures in 2015.

Figure 2-1: City of Ottawa Road Revenues (Including Transfers) and Expenditures, 2015 (millions of dollars)



Source: CPCS Analysis of Data from Ministry of Municipal Affairs
Note: Revenues include gas tax transfers from federal and provincial government

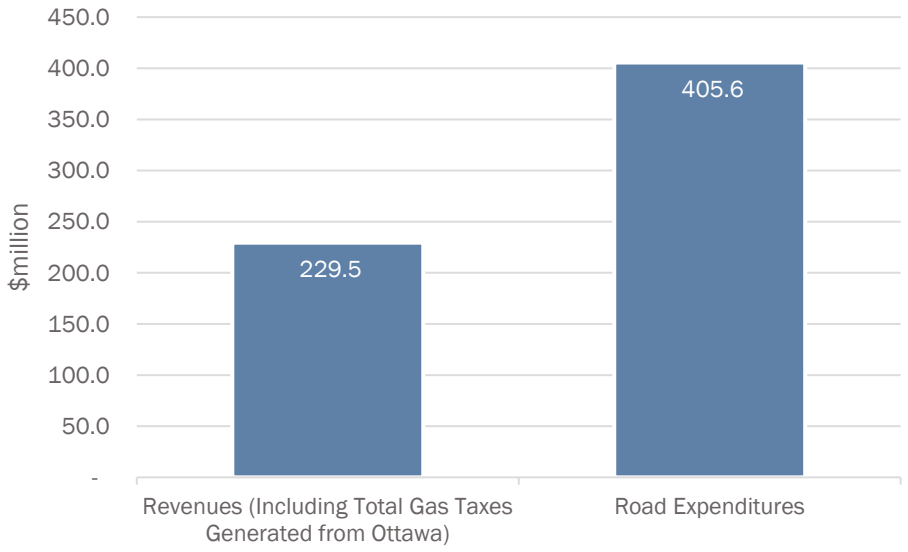
The total shortfall (expenditure minus revenues) was $286 million in 2015, or about 71% of total expenditures.

Although gas tax transfers address the fiscal imbalance issue to some extent, they do not necessarily address the issue to the full extent because those transfers are not made on the basis of where the revenue is generated. In other words, it is not a given that the same proportion of gas tax revenues paid by motorists in one urban area are returned to that same urban area.

To account for this fact, we developed an alternate estimate of revenues from motorists by first estimating the total volume of light-duty vehicle activity in Ottawa and estimating the total amount of federal and provincial gas tax revenues generated from this activity

(regardless of where that revenue ultimately lands). Figure 2-2 shows road revenues and expenditures using this method of accounting for gas taxes.

Figure 2-2: City of Ottawa Road Revenues (Including Gas Taxes Generated in Ottawa) and Expenditures, 2015 (millions of dollars)



Source: CPCS Analysis of Data from Ministry of Municipal Affairs

Using this method of accounting for gas taxes, the shortfall declines but is still a substantial $176 million (43% of expenditures). Further, it should be noted that although this method provides a better indication of how revenues align with costs from the users' perspective, from the City of Ottawa's perspective the shortfall shown in Figure 2-1 is more reflective of the practical problem that it faces with respect to funding its road operations and maintenance.

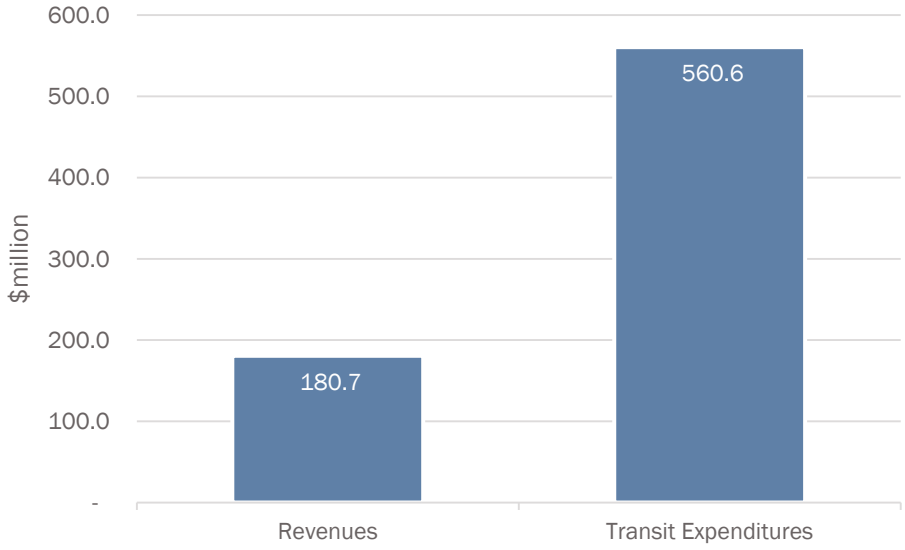
To be more comprehensive, the figures in Figure 2-2 could be adjusted to account for the Province of Ontario's costs of providing service to motorists in Ottawa (the provision and maintenance of Highway 417, for example). However, that would also require an allocation of other provincial revenues collected from motorists (most notably, vehicle registration fees which generate nearly $1.3 billion for the province each year).[5] Although they are not comprehensive, by focusing on the most significant of the fees and taxes, the figures above provide a general indication of the level of road vehicle subsidy.

The City of Ottawa also faces funding challenges with respect to public transit. In this case though, the City generates more revenue directly from users (through transit fares). Through the FIR database we identified all transit expenditures (including

[5] Transport Canada. Transportation in Canada 2014, Addendum Table G4.

interest on long term debt and amortization), as well as user fee revenues. Figure 2-3 provides the results.

Figure 2-3: City of Ottawa Transit Revenues and Expenditures, 2015 (millions of dollars)



Source: CPCS Analysis of Data from Ministry of Municipal Affairs

The City's shortfall was $380 million in 2015. Although this is larger than the road expenditure shortfall, as a share of total expenditures (68%) it is slightly smaller than the road shortfall (71%) as a share of expenditures (from the City's perspective).

2.5.2 Shortfalls Relative to Passenger Volumes

Estimating shortfalls in total show the cumulative impacts of each mode on the City's budget. However, in order to gain an understanding of what financial impacts are likely to be with marginal shifts in activity (shifts from one mode to another, for example), the shortfalls should be placed into context of total passenger volumes for each mode of transportation.

2.5.2.1 Private Automobile Activity

According to the City of Ottawa Transportation Master Plan (TMP), Ottawa residents drove 18.6 km per day in 2011, for a total of 17.1 million vehicle-kilometres travelled (VKT).[6] As this is a modelling-based estimate we contrast this against other estimates of VKT below.

[6] City of Ottawa. (2013), Transportation Master Plan, p. 28.

Estimate of PKT Based on the Canadian Vehicle Survey

For example, up until 2009 (when it was discontinued), the Canadian Vehicle Survey (CVS) provided an estimate of VKT (among other things) by province and type of vehicle (light-duty, medium and heavy). According to the CVS, total light-duty vehicle VKT in Ontario was 116,077 in 2009.[7]

Meanwhile, according to data analyzed from the Ontario Road Safety Annual Report, we estimate that approximately 6% of motor vehicles in Ontario are registered in Ottawa (which is slightly less than the City's share of the provincial population).[8] If we allocate VKT to the City of Ottawa, based on the City's share of motor vehicle registrations (a method that assumes the average use per vehicle is similar across the province), we arrive at an estimate of approximately 7 million auto VKT in the City of Ottawa in 2009.

Estimate of PKT Based on Fuel Sales

Another method of estimating total LDV activity at the provincial level is through an analysis of gasoline sales in the province. In 2015, gasoline sales in Ontario totalled 16.26 million litres.[9] By analyzing data from the Natural Resources Canada Comprehensive Energy Use Database, we estimate that approximately 81% of gasoline sold for road use in the province is consumed by passenger vehicles (which includes vehicles other than personal automobiles).[10] Although other fuels are used to power passenger vehicles as well (diesel, for example), we can assume that the bulk of diesel fuel used for passenger vehicles is used to power buses. By taking a rough estimate of 9 L/100 km as the average fuel efficiency of automobiles in the province, we arrive at an estimate of approximately 155 million VKT in 2015.

By allocating VKT to the City based on its share of motor vehicle registrations as above, we arrive at an estimate of 9.4 million VKT for the City of Ottawa.

2.5.2.2 Calculation of Shortfall per PKT

Both the CVS and fuel sales based estimates of VKT appear to be considerably lower than the official estimate from the City's TMP. One possible explanation is that residents in Ottawa use their cars at a considerably higher rate than the average resident in the province. Another possible explanation is that the CVS underestimated vehicle activity and our estimate of average fuel economy is too high.

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[7] Statistics Canada. Canadian Vehicle Survey 2009, Table 4-1.

[8] Ontario Ministry of Transportation. Ontario Road Safety Annual Report 2013, Table 4.1.

[9] Statistics Canada. CANSIM Table 405-0002.

[10] Natural Resources Canada. Comprehensive Energy Use Database, Transportation Sector (Ontario) Tables 2 and 3.

Using the conservative estimate based on the fuel sales approach and assuming an average load factor of 1.1 passengers per vehicle (including the driver), the City's shortfall per automobile PKT is 2.8 cents. The corresponding figure for transit is 40 cents per PKT, which further illustrates the City's challenge with respect to transit funding as the system and ridership are expected to continue to grow.

2.6 Transportation Costs and Revenues – Other Considerations

2.6.1 Other User Revenues

As already noted, although fuel taxes are most significant there are a variety of other taxes and fees that are applied to motorists. However, these fees and taxes are for the most part collected by the provincial government. Local governments do, however, generate revenues from development charges. For example, in 2013 local governments in Ontario collection a total of $1.3 billion. Of this total, 67% were for hard infrastructure services, which includes roads.[11] To the extent that these fees are ultimately paid by home owners (passed through from the developer), a portion of them could be considered as road user fees.

2.6.2 Private Automobile Costs

There are also a variety of costs associated with private automobile use that are met by motorists out of their own pockets: vehicle ownership costs, maintenance, insurance, fuel, etc. On a VKT or PKT basis these costs are much more significant than the public costs related to the provision of the road infrastructure. For example, the CAA estimates that these costs average 52 cents per VKT for a mid-size car in Ontario.[12] The City of Ottawa's total road expenditures per VKT, meanwhile, is approximately 4 cents per VKT. This illustrates the fact that there are substantial potential cost savings for users themselves by reducing their dependence on automobile use.

2.6.3 Other Road Users

Motorists are not the only road users. Other users include buses, freight vehicles, cyclists and emergency service vehicles. Accounting for the extent that these users generate revenues for governments relative to the costs that they impose on the road infrastructure requires a number of inputs including: total volume by vehicle class, vehicle weights and axle-loads, the timing of activity and the place of activity, among others.

These inputs are required because different road classes of road costs are generated by different factors. For example, a portion of pavement resurfacing costs depend on

[11] Ministry of Municipal Affairs (2013). Development Charges in Ontario: Consultation Document, p. 2.
[12] CAA. Car Costs.

both the volume of vehicles travelling over a given surface and the axle-weights (as opposed to gross weights) of those vehicles. Other pavement resurfacing costs are due strictly to climactic wear. Bridge structure costs are a function of gross vehicle weights. Other costs, such as snow clearing and street cleaning, have less-obvious cost drivers. For the purpose of cost allocation exercises these costs are often allocated on a VKT basis.

While a comprehensive cost allocation exercise is beyond the scope of this report, we can confidently say that although there are other users of the road network in Ottawa (and elsewhere), motorists are the primary users of the system and therefore should be allocated the bulk of the costs associated with the road network. A comprehensive cost allocation exercise could change the results with respect to the subsidy per VKT or PKT, but likely only to a marginal degree.

2.7 Summary of Transportation Costs and Revenues

Generating enough revenues to cover public transportation infrastructure and maintenance costs is a constant struggle for governments. This is especially true for local governments. Identifying appropriate user fees and charges can help to address this challenge.

However, revenue generation is not the sole purpose of user fees and charges. If structured properly, certain fees and charges can help to increase efficiency of the use of the transportation system. With respect to road infrastructure, efficient charges can aid in reducing traffic congestion, which itself imposes a significant cost on users of the transportation system. The next chapter identifies fees and charges that are, or can be used to reduce traffic congestion in the Ottawa context.

Chapter 3

Exploring the Most Appropriate Congestion Pricing Tools for Ottawa

This chapter briefly defines congestion pricing and distinguishes between different congestion pricing tools. It describes some of the factors specific to Ottawa that have implications for the most appropriate tools that could be effective for reducing congestion in Ottawa. Based on these factors, it depicts which tools are likely most appropriate for the City. Although we note where certain infrastructure (highways and bridges, for example) fall within federal or provincial jurisdiction, therefore limiting the City's legislative authority to apply certain congestion pricing tools, for the most part we ignore political constraints and instead base our analysis on travel patterns and infrastructure characteristics.

Given Ottawa's characteristics, among the options for congestion pricing tools are tolls on major highways, cordon charges, parking taxes or fees, or some combinations thereof.

Tolling Highway 417, in particular, may help to shift a greater portion of commuters to the Confederation Line LRT, which will largely run parallel to the 417. However, without additional measures, some of the current Highway 417 traffic would likely leak onto parallel arterial roads. Further, a toll on the 417 would not address north-south traffic.

A cordon charge would likely be more costly to implement. However, the natural and artificial barriers presented by rivers and a rail corridor help to make a cordon around the Ottawa Inner Area somewhat feasible. A cordon charge would address both east-west and north-south traffic. However, there would be some potential for some through traffic to spill on to arterial roads just outside of the cordon zone.

Finally, a parking tax can have a similar impact as a cordon charge, but at a lower cost. The City of Ottawa also has a greater degree of control over parking costs. The City already levies a property tax rate specific to parking lots, which it can increase to influence the rates charged for parking. Further, the City itself provides approximately 14% of off-street parking and directly controls the pricing of that parking. Parking taxes, however, are blunter instruments relative to a cordon charge or toll. Further, parking taxes would not affect through traffic, which may or may not be desirable.

3 Congestion Pricing Tools for Ottawa

3.1 What is Congestion Pricing?

Congestion pricing includes fees or charges that are designed to reduce traffic congestion. By levying fees or charges to road users during peak hours of the day, it is expected that some road users respond by shifting to other modes of transportation, shifting the timing of their trip or eliminating their trip altogether.

There does not need to be a large response from road users for congestion pricing to work. Even small shifts in the mode, changes to the timing or trip reductions can have large, positive impacts on traffic speeds.

The combination of these three responses helps to reduce traffic congestion. For congested roads, there does not need to be a large response from road users in order to significantly impact traffic speeds. Even small shifts in the mode, changes to the timing or trip reductions can have large, positive impacts on traffic speeds.

3.1.1 The Objective of Congestion Pricing

Congestion pricing is related to road pricing, or direct charges for road use, more broadly. The specific purpose of congestion pricing is to manage traffic congestion. Road pricing includes congestion pricing, but could also include other direct charges for road use that are designed to generate revenues to pay for the underlying road infrastructure. For example, a toll may be applied to a bridge to pay for its construction and maintenance. Road pricing more broadly may have other objectives as well, such as reducing emissions and raising revenue for broader purposes.

The two main objectives – managing congestion and paying for infrastructure – are not necessarily mutually exclusive. Indeed, researchers such as Newbery have theorized that, at least in some circumstances, the revenues generated from optimal congestion charges would equal the ongoing maintenance and capital costs of the road network over time.[13] That said, we note the distinction because such fees or charges are often proposed to address one objective or the other. To facilitate such debates, it is useful to be explicit about which objective is meant to be addressed (if not both) because the objective may have implications for the type of fee or charge that is ultimately proposed.

The primary objective of this report is to focus on fees or charges that are likely to have an impact on managing traffic congestion and encouraging mode shift to transit. That said, we recognize the potential for such charges to contribute to the funding of the road or transportation infrastructure more broadly. Further, although we do focus on managing congestion, we do not necessarily dismiss broader road pricing tools that may not vary by time (for example, gas taxes or static road tolls). Although these pricing tools would apply to all users of a facility regardless of prevailing traffic conditions, they

[13] Newbery (1994). The Case for a Public Road Authority.

may also have an impact on traffic congestion by inducing modal shift or eliminating trips altogether.

3.1.2 Examples of Congestion and Road Pricing Tools

A couple of specific congestion and road pricing tools were noted above. It is not the purpose of this report to comprehensively examine and summarize all forms of congestion and road pricing tools. For convenience, we refer to a recent report[14] published by Canada's EcoFiscal Commission that categorized these tools into five broad categories:

- **Single-entity pricing**, such as tolls for specific roads or bridges.
- **High-occupancy toll (HOT) lanes**, which allow single-occupant vehicles to enter for a fee, while allowing high-occupant vehicles to enter free of charge.
- **Zone-based pricing** (or cordon pricing) which includes fees for roads within a given geographic area, or roads that provide access to a given geographic area. These fees are usually charged at specific times of the day (e.g. during the morning peak or throughout the workday).
- **Distance-travelled pricing**, which include fees that are levied on a per-kilometre basis on all roads in a given area.
- **Parking pricing**, which includes typical parking metering but also city or region-wide parking taxes and dynamic parking prices that varies with real-time demand.

There are further variations within each broad category, such as with respect to the extent that prices vary with demand. For example, tolls, zone-based pricing and distance-based pricing may or may not vary by time of day or in response to real-time traffic levels.

There are also other fees and charges that are more crude forms of congestion or road pricing, including traditional user taxes and fees such as gas taxes and vehicle registration fees. While these taxes and fees are blunt instruments for addressing congestion (because they do not vary by time and place, or in the case of registration fees, usage), they may impact traffic levels due to the fact that they increase the total cost of driving. Furthermore, they are relatively low cost and easy to implement (logistically, not necessarily politically), which are the reasons why they are so prevalent to begin with. For these reasons, we do not immediately dismiss these taxes and fees as potential tools to reduce congestion.

[14] Canada's EcoFiscal Commission (2015). We Can't Get There From Here: Why Pricing Traffic Congestion is Critical to Beating It., p. 10.

3.2 What Factors Unique to Ottawa Have Implications for the Appropriateness of Certain Congestion Pricing Tools

The geography, transportation infrastructure, residential and employment population distribution, and commuter travel patterns in Ottawa have implications for what congestion pricing tools are most suitable for the City. We review those features here for the purpose of informing our assessment of appropriate congestion pricing tools.

We are aware of policy constraints but acknowledge them only as a secondary consideration, as we are primarily interested in an assessment of congestion pricing tools that logically flow from the factors noted above. For example, as described later in section 3.2.2.1, the bridges that connect Gatineau and Ottawa are owned by the federal government. Meanwhile, the key highways in Ottawa, including Highway 417, are owned by the provincial government. The City of Ottawa therefore has limited ability to price these facilities, if it was interested in doing so. In fact, previous calls from the City of Ottawa to toll Highway 174 were dismissed by the provincial government despite the fact that it is owned by the City.[15]

That said, we do acknowledge key governance issues that would affect the likelihood of one tool or another. Further, we acknowledge certain tools that would likely be relatively easy to implement both from a cost and a political or legislative perspective.

3.2.1 Key Highways in Ottawa

The key highways in Ottawa include Highway 417, which connects Kanata and Stittsville west outside of the Greenbelt, the areas inside the Greenbelt including downtown Ottawa (though the highway runs just south of downtown), and the areas south and east of downtown inside the Greenbelt. Highway 416 connects other areas outside of the Greenbelt to the west via Highway 417. Meanwhile, Highway 174 connects areas inside the Greenbelt to the east, as well as Orléans outside of the Greenbelt to downtown and other areas via Highway 417. Finally, as noted in section 3.2.2.1, there are five key bridges that connect Gatineau and Ottawa.

The 400-series highways are owned and maintained by the Province of Ontario, while Highway 174 is owned and maintained by the City of Ottawa. The City of Ottawa owns and maintains the bulk of the local and arterial network in Ottawa, including key north/south connectors such as Bronson Ave./Airport Parkway and Riverside Dr., among others.

According to the most recently available traffic count data from MTO, the busiest stretches of Highway 417 (just south of downtown) see more than 170,000 vehicles per day. All sections of the 417 from the 416 in the west and Highway 174 in the east

[15] Willing (2013). City Stuck with 174, but no Tolls.

see more than 130,000 vehicles per day. Volumes on Highway 416 are significantly lower (with the busiest sections seeing up to 40,000 vehicles per day). MTO does not keep traffic counts for Highway 174 since it is owned by the City. However, judging by the increase in traffic on Highway 417 after the point at which Highway 174 connects to it, we can infer that at the western terminus of Highway 174 total vehicle volumes approach 50,000 per day.

3.2.1.1 Existing HOV Lanes

There are already several existing HOV lanes on the provincial highway network in Ontario, including in Ottawa on a stretch of Highway 417 that runs through Kanata. HOV lanes in Ontario can be used by vehicles with at least two occupants (including the driver). Further, HOV lanes are being considered on Highway 174 / County Road 17.[16]

Notable, the Ontario Ministry of Transportation (MTO) has planned to convert portions of the HOV network to HOT lanes. MTO has already initiated a HOT pilot project in the Greater Toronto and Hamilton Area (GTHA), which will last for two to four years. During the pilot, a 16.5 kilometre section (in both directions) of the QEW through Oakville and Burlington (west of Toronto) has been converted from HOV to HOT lanes. A limited number of HOT permits will be sold to motorists every three months for the duration of the pilot. Permits cost $60 per month.[17]

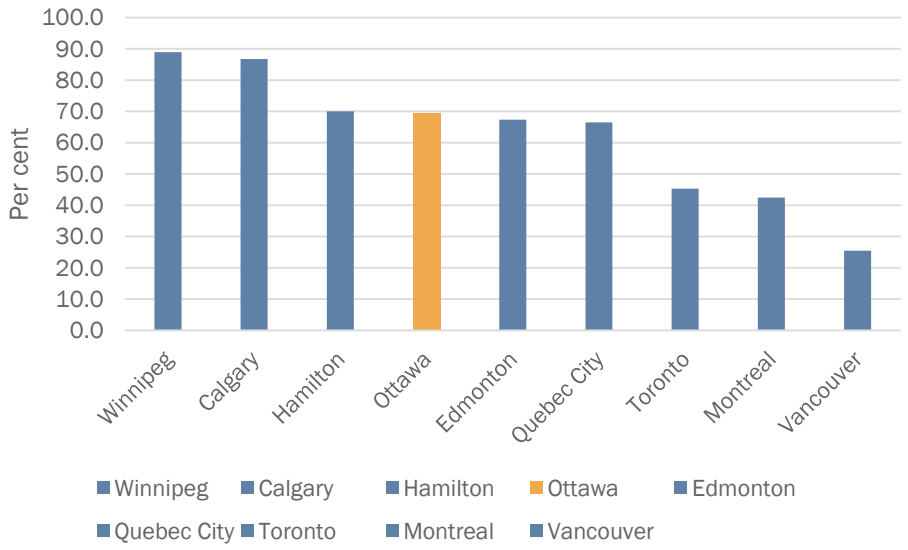
3.2.2 Political Boundaries and Transportation Governance Structure

Although we did note that, for the most part, we are not concerned with policy constraints, we do acknowledge the potential impact of political boundaries on the feasibility of congestion pricing tools. Urban areas that are more politically fragmented will naturally face more administrative obstacles to implementing certain tools. For example, distance-travelled pricing is best implemented throughout an entire contiguous area. Or a city that wishes to manage automobile demand through blunt instruments such as a city-wide gas tax will likely see significant leakage to retail gas stations outside of city limits, if a significant portion of the CMA population resides outside of the central city.

As far as Canadian urban areas are concerned, the NCR is reasonably amalgamated, with the significant exception of Gatineau. Figure 3-1 shows the city-to-CMA population ratios for the nine largest urban areas in Canada.

[16] City of Ottawa (2015). Open Houses - April 20, 21 and 23, 2015.
[17] Ontario Ministry of Transportation. High-Occupancy Toll Lanes.

Figure 3-1: City to Census Metropolitan Area Population Ratios



Source: CPCS Analysis of Census Data

Only the cities of Winnipeg and Calgary have significantly higher shares of their total CMA population. Hamilton is slightly ahead of Ottawa in this regard, but this statistic ignores the fact that the Hamilton CMA is itself part of the larger contiguous region of the GTHA.

Canada's largest cities of Toronto, Montreal and Vancouver notable have much lower shares of their respective CMA populations. However, those regions have regional transportation agencies that have varying degrees of powers and responsibilities over the regional transportation systems. Notably, TransLink is responsible for both the transit and (major) road network in Metro Vancouver[18] (whereas their regional equivalents in Toronto and Montreal have significantly less direct responsibility for their respective regions' road networks).

3.2.2.1 Bridge Infrastructure

A factor that is somewhat unique to Ottawa is that the five key bridges that connect Ottawa and Gatineau are federal bridges that are owned and maintained by the Government of Canada. Public Works and Government Services Canada (PWGSC) maintains the Chaudière Crossing just west of downtown Ottawa and the Alexandra and Macdonald-Cartier Bridges northeast of downtown.[19] Meanwhile, the National Capital Commission (NCC) maintains the Champlain and Portage Bridges.

[18] TransLink. About Us.
[19] Public Works and Government Services Canada, Ottawa-Gatineau Area Federal Bridges.

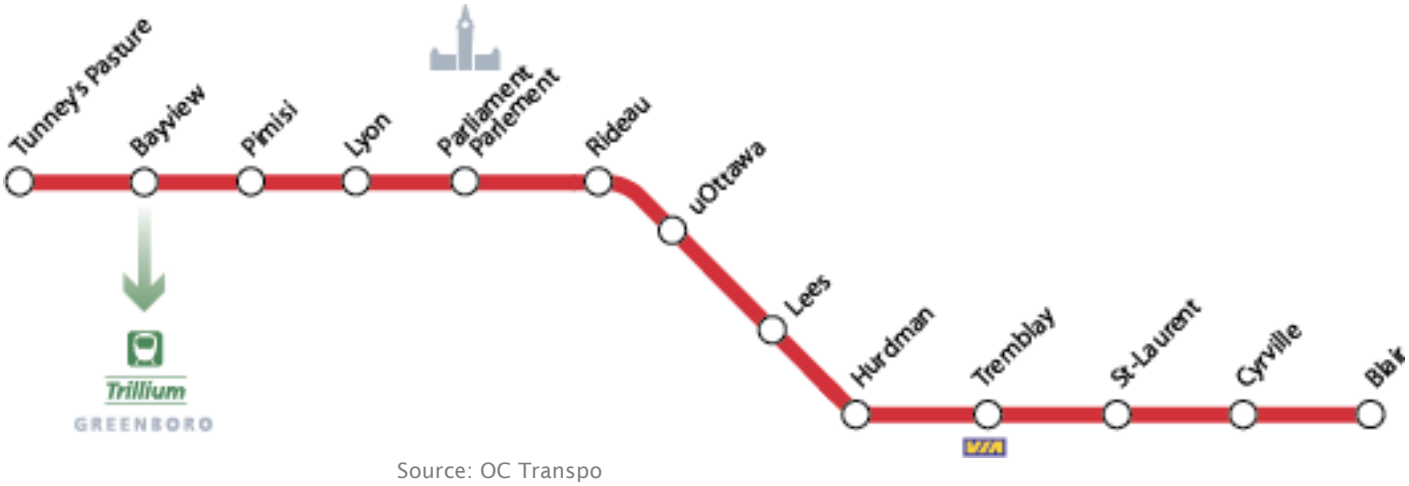
These bridges are important because they enable the movement of commuters and people more generally from Gatineau into the City of Ottawa and vice versa. According to an analysis of 2011 origin-destination (OD) data, 6.6% of all trips (all purposes or modes) within the Ottawa-Gatineau area crossed one of these bridges (assuming that all traffic between Ottawa and Gatineau make use of one of these bridges). If we narrowed this down to AM commuter traffic only, we find that 14.3% of trips cross one of these bridges.

The bridges are important for enabling the flow of people in both directions. The raw number of commuters travelling from Gatineau to Ottawa (approximately 32,500 per day) in the morning is much higher than in the other direction (13,700 per day). However, as a portion of the total commuter flow to each city, the commuter traffic from Ottawa to Gatineau is higher than the commuter traffic from Gatineau to Ottawa: 21.5% of people who work in Gatineau commute from Ottawa, whereas 12.6% of people who work in Ottawa commute from Gatineau.

3.2.3 LRT Alignment

Stage 1 of the Confederation Line LRT is under construction and is anticipated to be in service in 2018. It will replace a portion of the existing east-west BRT system in Ottawa. The north-south Trillium Line and Confederation Line will intersect at one station (Bayview), though the tracks will be completely separated.

Figure 3-2: Ottawa Confederation Line LRT Stage 1

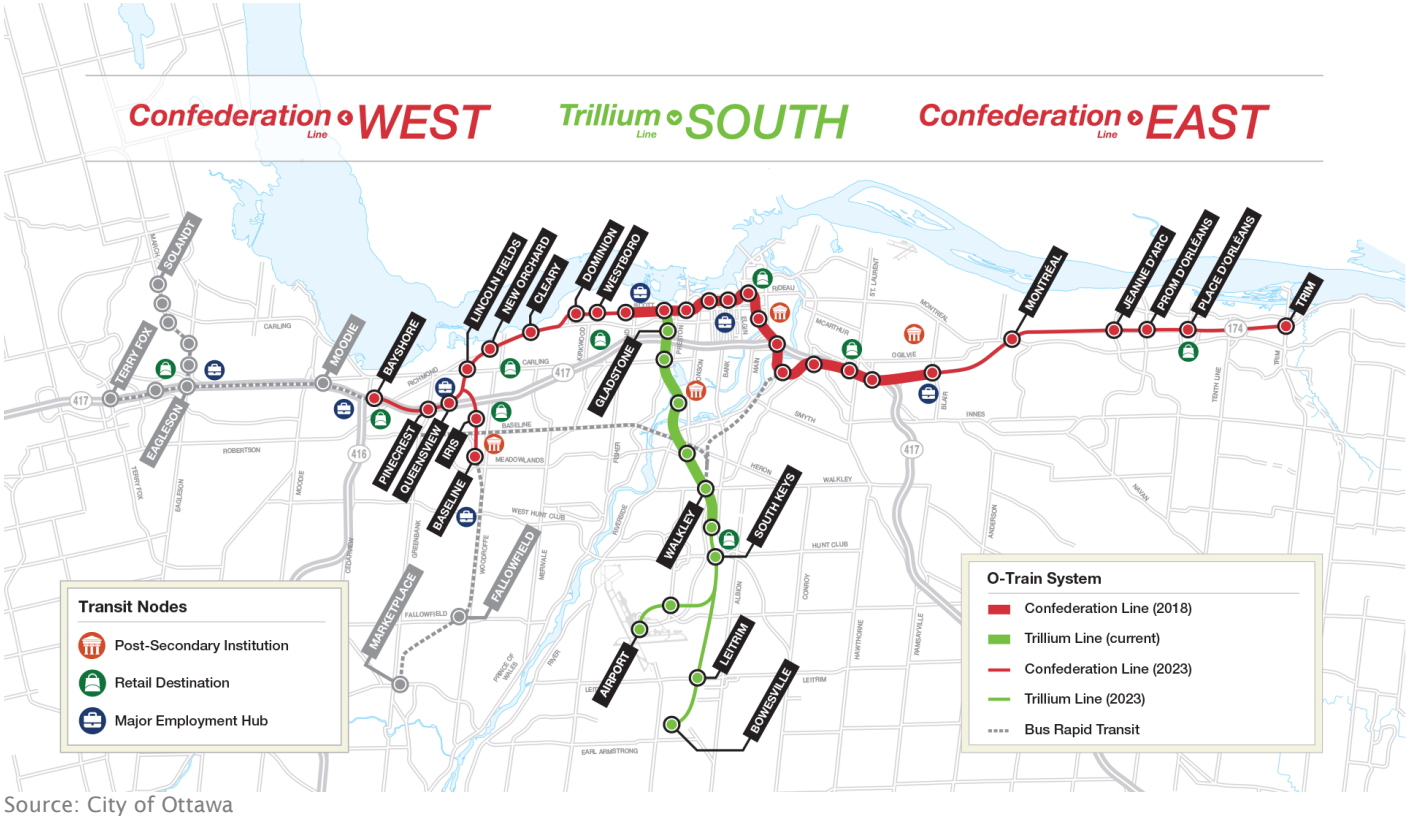


Source: OC Transpo

Stage 1 of the Confederation Line will extend 12.5 kilometres over 13 stations. Annual ridership is expected to reach 76 million by 2031. Stage 2 plans to further extend the LRT system both east-west and the existing Trillium line south with 22 additional

stations and 36 kilometres of track (see Figure 3-3). Stage 2 is expected to commence construction in 2018 and be in service by 2023.[20]

Figure 3-3: Ottawa Stage 2 LRT Alignment



Source: City of Ottawa

Importantly, the LRT will connect population centres in the west, east and south to employment hubs both within and outside of the downtown core, including the Ottawa Inner Area, Alta Vista and Merivale.

The LRT business case estimated that the capacity of the current BRT system would be exhausted by 2018. Without the investment in the LRT, transit would not be able to maintain, let alone grow its mode share as population and employment grow. As such, when we estimate the mode share impacts of congestion pricing options in chapter 4, we do not factor in any mode share increase that transit will have taken as a result of the LRT in the future.

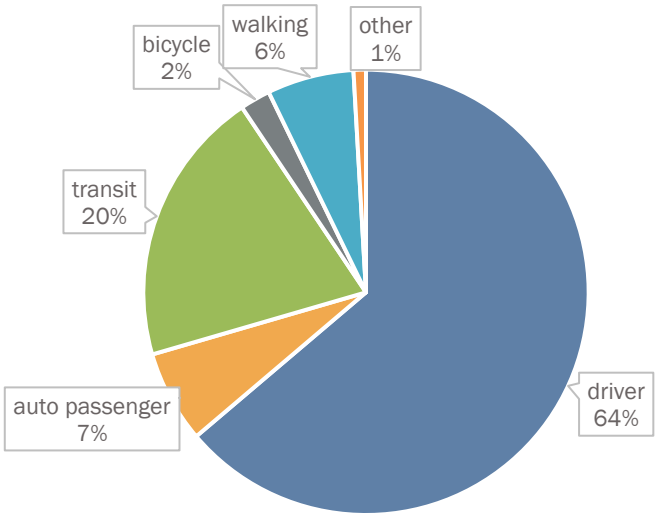
[20] MMM Group (2015). Stage 2 Ottawa LRT Business Case.

3.2.4 Commuting Patterns and Trends in Ottawa

Importantly, the LRT will connect population centres in the west, east and south to employment hubs both within and outside of the downtown core, including the Ottawa Inner Area, Alta Vista and Merivale.

Although the vast majority of commuters in Ottawa use their cars to get to work, public transit plays a significant role for commuter traffic. According to the last National Household Survey (NHS), 20.1% of workers in the Ottawa CMA relied on transit to get to work (see Figure 3-4).

Figure 3-4: Commute Mode Shares in the Ottawa CMA



Source: CPCS Analysis of 2011 National Household Survey Data

Further, transit mode share has been growing over time. Over the period from 2001 to 2011, transit mode share among commuters in the Ottawa CMA has grown from 18.5% to 20.1% (see Figure 3-5). That growth appears to have come from a mix of auto drivers (0.8% decline) and auto passengers (0.7% decline). Walking mode share was also down (by 0.5%) but the combined active transport mode (walking combined with cycling) was only down marginally (0.2%).

Figure 3-5: Trends in Commute Mode Share in the Ottawa CMA

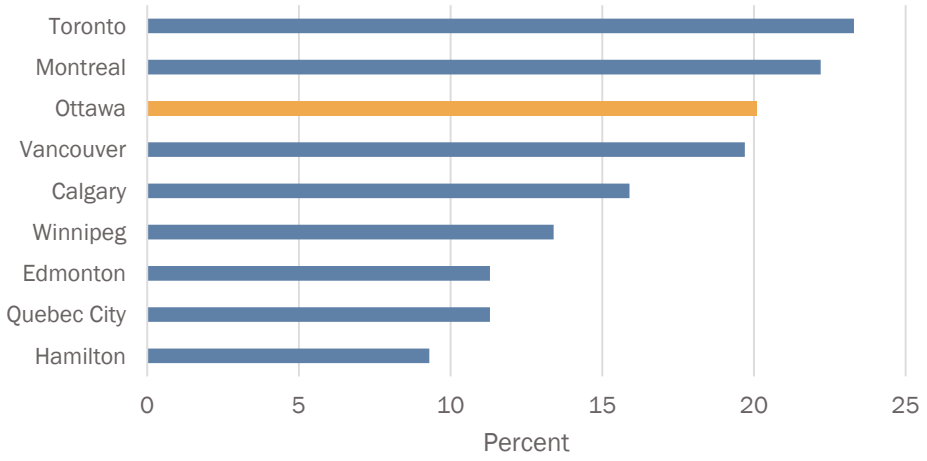
	2001	*2006*	*2011*
Driver	64.6	62.8	63.8
Passenger	7.4	8	6.7
Transit	18.5	19.4	20.1
Bicycle	1.9	2.1	2.2
Walking	6.8	6.8	6.3
Other	0.8	0.9	0.9

Source: CPCS Analysis of Data from the National Household Survey and Census

One challenge that remains is that it is difficult for transit to compete with the auto mode in terms of total commute time. For auto drivers the average commute time is 23 minutes, while transit users take 38.6 minutes to get to work on average in Ottawa.

The transit mode share of 20.1% puts Ottawa near the top among urban areas in Canada. Only Toronto and Montreal have transit mode shares that are higher (see Figure 3-6).

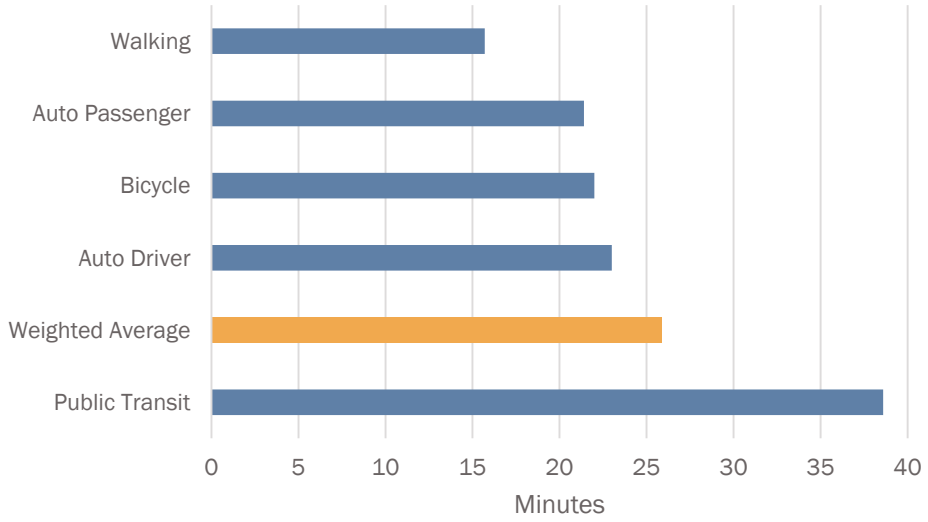
Figure 3-6: Public Transit Commute Mode Shares in Large CMAs, 2011



Source: CPCS Analysis of Data from the 2011 National Household Survey

Despite the growth in the importance of public transit, one challenge that remains (in Ottawa and other urban areas) is that it is difficult for transit to compete with the auto mode in terms of total time to commute to work. The average commute time (one way) in Ottawa is approximately 25.9 minutes. For auto drivers, the average commute time is 23 minutes, while transit users take 38.6 minutes to get to work on average (Figure 3-7). Although these commute times are not adjusted for distance (which is the reason why walkers experience the shortest commute time), it is not likely that transit users travel longer distances to work than auto drivers or passengers.

Figure 3-7: Commute Times by Mode of Transportation in the Ottawa CMA



Source: CPCS Analysis of 2011 National Household Survey Data

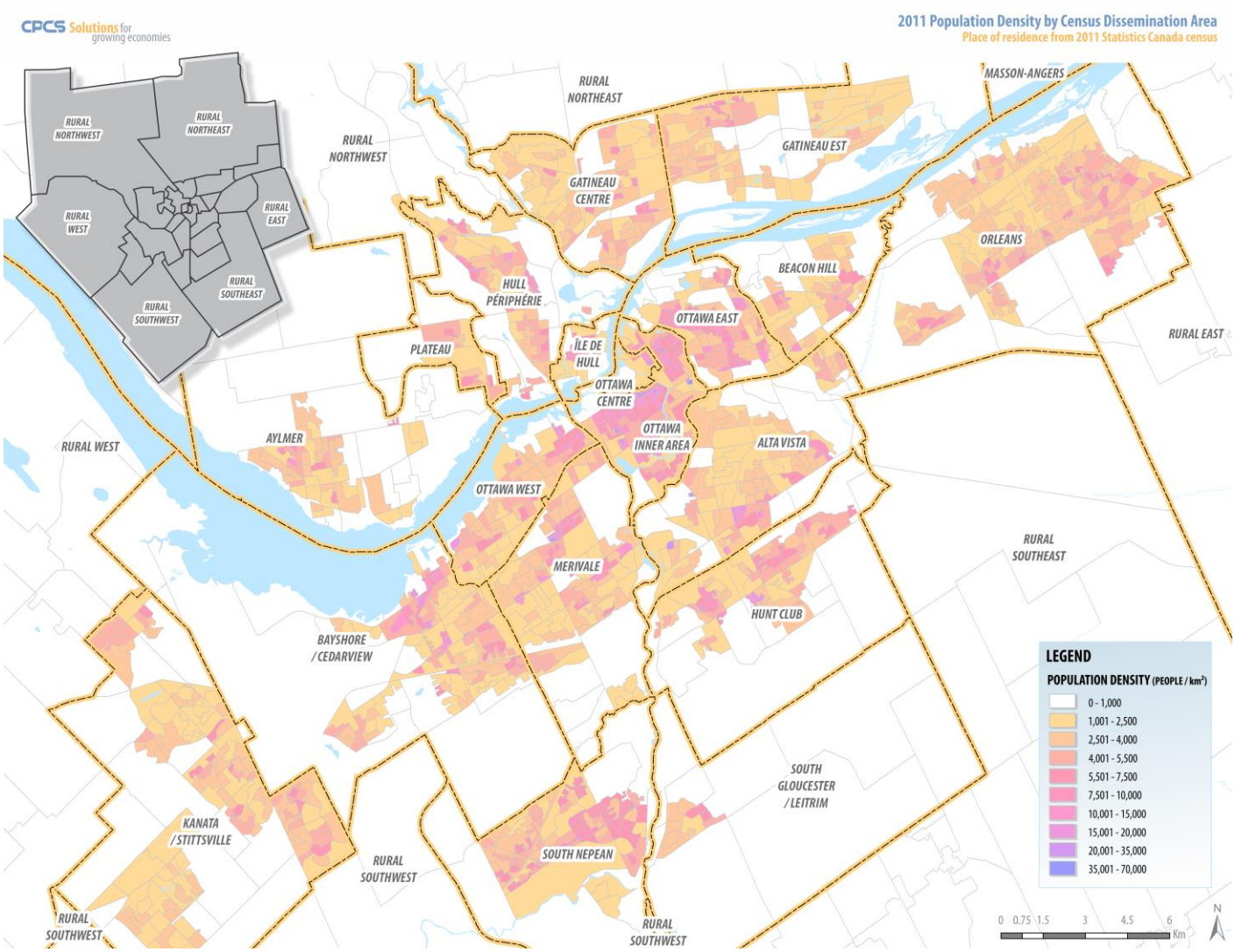
3.2.4.1 Residential and Employment Nodes

Like many Canadian cities, residential population density is generally highest in, or near, the downtown core, and lower in suburban areas. However, there are pockets of higher density areas scattered throughout the city as shown in Figure 3-8.

It is no surprise that downtown Ottawa ("Ottawa Centre" according to the TRANS Committee[21] District definition – see Figure 3-9) is the most common AM commute destination, at 64,000 commuter destinations per day in the AM peak. But several other areas were important destinations for commuters, particularly Alta Vista (33,700 in the AM peak), Ottawa Inner Area (28,700 in the AM peak) and Merivale (24,400 in the AM peak). Among all commuters in the AM peak, 20% are destined for downtown Ottawa and 47% are destined for these four areas combined.

[21] The TRANS Committee is a joint committee comprised of the National Capital Commission, the Ministère des Transports du Québec, the Ministry of Transportation of Ontario, Ville de Gatineau, the City of Ottawa and the Société de transport de l'Outaouais.

Figure 3-8: Ottawa CMA Population Density by Census Dissemenation Area, 2011



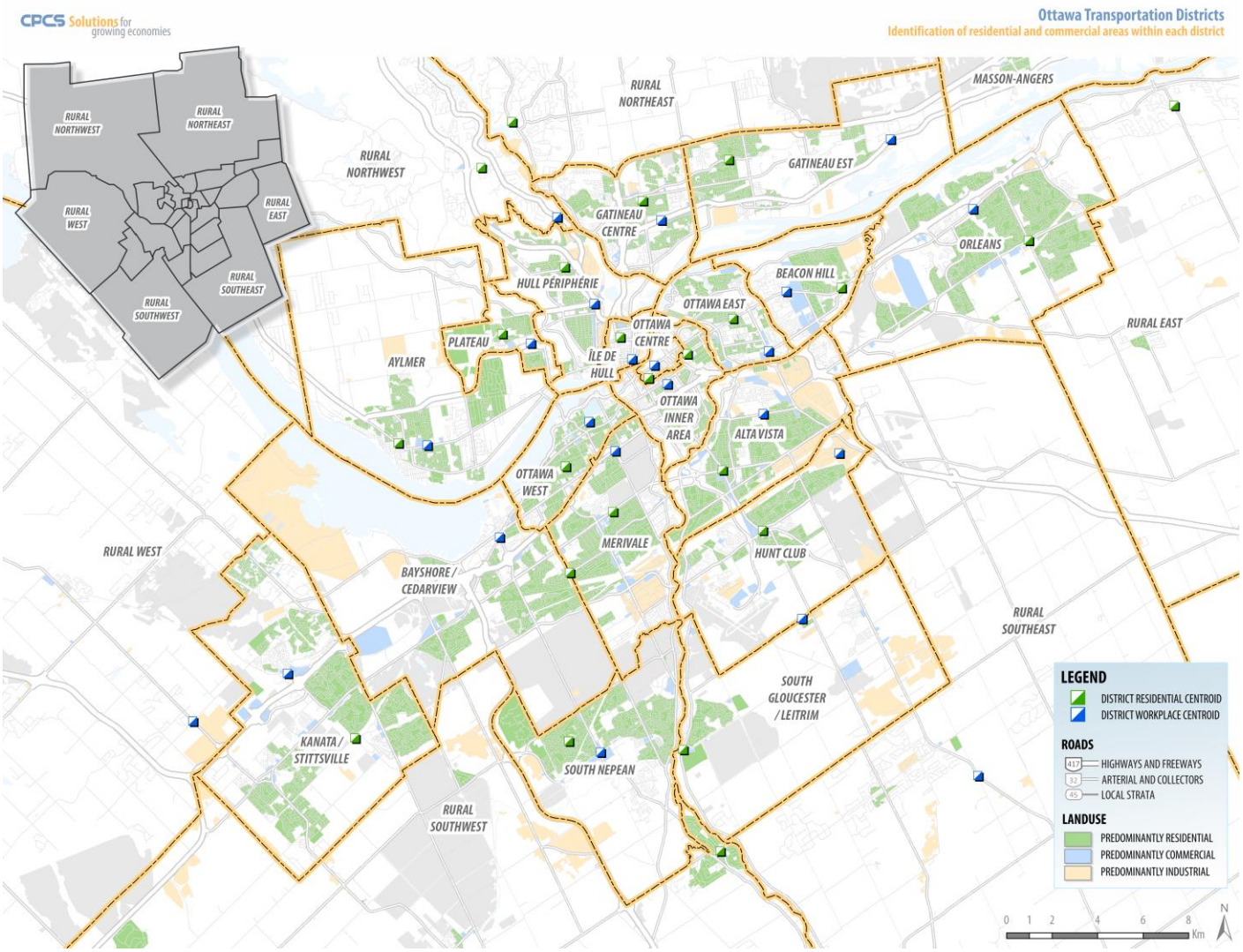
Source: CPCS Analysis of Census Data

As noted in section 3.2.3, the LRT will increase access to and from these areas, among others. Specifically, in addition to enhancing access to downtown, access to Alta Vista will be enhanced through the extension to the Trillium Line, the Ottawa Inner Area will see improved access through that extension as well as the extension to the Confederation Line East, and access to Merivale will be improved through the Confederation Line West.

Trends in Employment Distribution

Although employment in the City is relatively concentrated in a few geographic areas, according to data from the City of Ottawa's employment survey (which excludes areas

Figure 3-9: TRANS Districts with Residential and Workplace Centroids



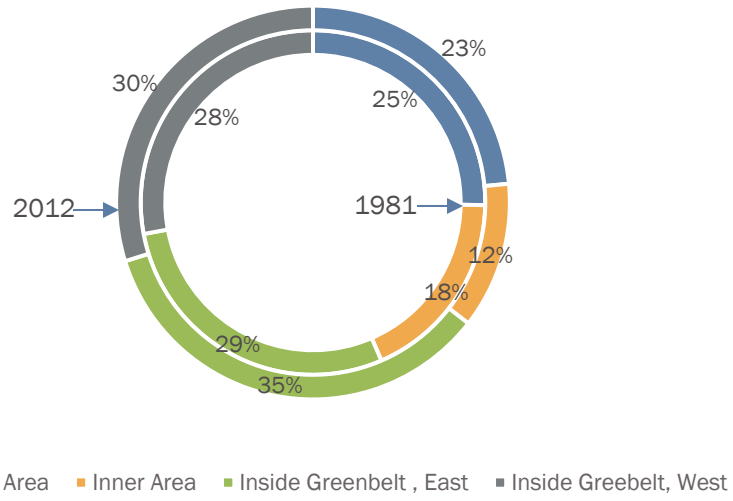
Source: CPCS Analysis of TRANS Committee boundaries and Census data

outside of the City of Ottawa limits such as Gatineau), employment has been becoming more decentralized in recent years. This decentralization has occurred in two distinct ways.

One way that employment population has dispersed has been within the Greenbelt. There, employment has become less concentrated within the Central Area (downtown Ottawa) and particularly away from the Inner Area (the area outside of downtown roughly bound by the Rideau River to the east and the south, and the Trillium Line to the west) in favour of the outer areas of the City inside of the Greenbelt.

As shown in Figure 3-10, the central and inner areas accounted for 43% of total employment within the Greenbelt in 1981. This share declined to 35% in 2012.

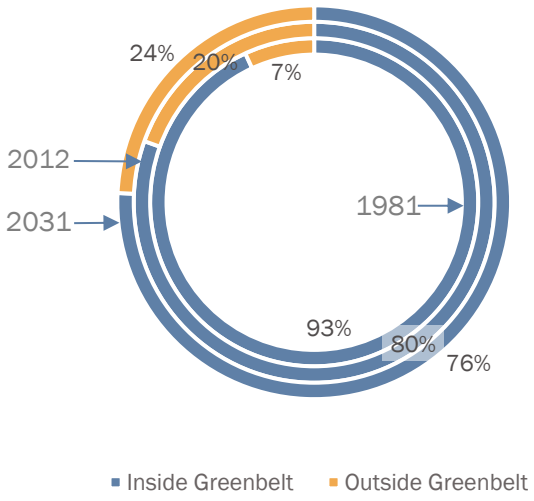
Figure 3-10: Distribution of Employment Inside the Greenbelt in Ottawa



Source: CPCS Analysis of Data from City of Ottawa Employment Surveys

The second way that employment has become more decentralized has been through a shift of employment from inside the Greenbelt to outside of the Greenbelt. As shown in Figure 3-11, only 7% of all employment in Ottawa was outside of the Greenbelt in 1981. By 2012, 20% of all employment was outside of the Greenbelt. This trend is expected to continue into the future, as according to the City's employment forecasts, 24% of all employment will be outside of the Greenbelt by 2031.

Figure 3-11: Distribution of Employment Inside and Outside Greenbelt



Source: CPCS Analysis of City of Ottawa Employment Surveys and LRT Stage 2 Business Case

3.2.4.2 Commute Patterns and Mode Shares to Key Employment Hubs

Figure 3-12 shows the top destinations for AM work trips according to the TRANS survey[22] data. Not surprisingly, Ottawa Centre is the most common destination for AM work trips. However, other districts are also destinations for large numbers of AM commute trips, including the Ottawa Inner Area, Alta Vista and Merivale.

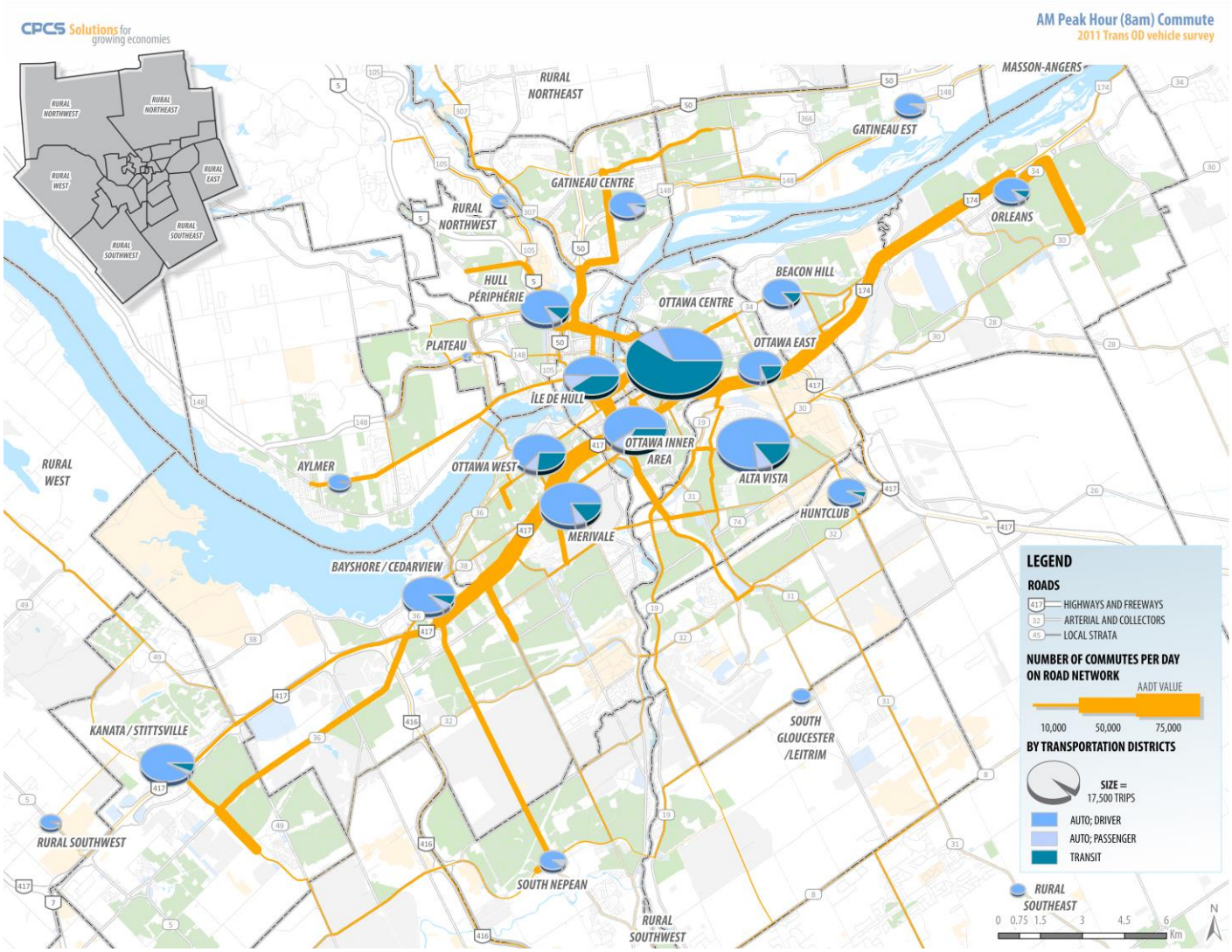
Using the TRANS survey data, we isolated the top OD pairs with respect to commute flows and identified where transit was particularly strong or weak among these pairs. In total, there are 99 OD pairs where the total number of daily AM peak commuters (excluding other trip purposes) are equal to or greater than 1000. These OD pairs along with their auto driver, auto person and transit mode shares are shown in Appendix A.

Unsurprisingly, many of the top OD pairs have Ottawa Centre or the Ottawa Inner Area as the destination. However, there are several key OD pairs that do not include one of those zones as a destination. The second most common OD pair is the intra-Kanata/Stittsville pair, in which the transit mode share (2.7%) is particularly low. Other notable OD pairs that start or end in the City of Ottawa with low transit mode shares include (among others):

- Kanata – Bayshore (5.9%),
- Kanata – Merivale (4.5%),
- South Nepean – Bayshore (4.8%),
- South Nepean – South Nepean (4.8%),
- Ottawa West – Ottawa West (5.3%)
- Hunt Club – Hunt Club (5.6%)
- South Nepean – Kanata (0%)
- Rural West – Kanata (0%)

[22] The TRANS Committee conducts an OD survey in the NCR every five years. The results of these surveys are used to inform travel demand modelling in the Region.

Figure 3-12: Mode Shares for Top AM Work Trips Destinations



Source: CPCS Analysis of TRANS Survey data

Potentially, of the above, Stage 2 of the Confederation Line could help to increase the transit mode share particularly in the OD pairs to Bayshore and Ottawa West (except for those that originate in Kanata as the line will not extend that far). In any case, it is noted that the OD pairs with the lowest transit share are, for the most part, outside of the Ottawa Centre and Ottawa Inner Areas.

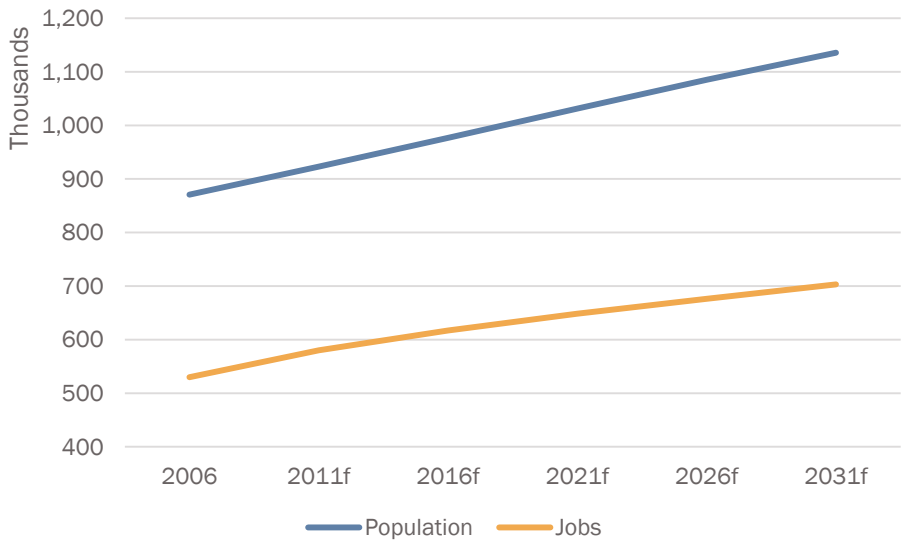
Population and Employment Forecasts

During the research phase of the present study, the City of Ottawa was in the midst up updating its long term population and employment projections. The most recent

projections were completed in 2007[23] and are briefly summarized here to provide some indications of the magnitude of growth that the City is likely to experience in the coming decades.

According to the projections, approximately 871,000 people lived in the City of Ottawa in 2006, while nearly 530,000 worked in the City. Population was projected to grow to 1.14 million by 2031, while employment was expected to grow to just over 700,000 in the same year (Figure 3-13).

Figure 3-13: Population and Employment Growth Projections, City of Ottawa



Source: City of Ottawa, Growth Projections for Ottawa

In percentage terms, this corresponds to approximately 33% more jobs in the City by 2031, for a compound annual growth rate (CAGR) of 1.14%. However, we note that when compared with the more recent employment survey data (2012), the employment projection for 2011 (580,000 jobs) appears to be slightly behind the actual figure for 2012 (566,000). Nonetheless, when we scale the potential impacts of a congestion pricing tool for Ottawa to 2031 in chapter 4, we factor in the combined residential and employment population CAGR to account for likely growth in commuting traffic over the long term.[24]

[23] City of Ottawa (2007). Growth Projections for Ottawa 2006 - 2031.

[24] The projections showed a combined residential and population employment growth CAGR of 1.17% for the Greater Ottawa-Gatineau Area as a whole. This growth factor is used in chapter 4.

3.2.5 Cordon Considerations

A cordon charge is a fee to drive into a specified area within a city, typically the downtown area. An important consideration for cordon charges is whether the area under consideration is naturally or artificially bound by relatively few access points. In a most extreme example, a cordon charge would be easy to implement around an island that is accessible by only one bridge, as a toll on that bridge would effectively act as a cordon charge.

On the other end of the extreme is an area without any natural or artificial boundaries and many access points. In order to implement a cordon charge in such an area, a more sophisticated and costly system would be required. Such was the case, for example, with the London congestion charge zone. Although successful in helping to reduce congestion, the costs associated with building and administrating the system were, at least initially, nearly equal to the revenue that was generated from the charge.[25]

Downtown Ottawa has some notable natural and artificial barriers. There are the five bridges connecting Gatineau and Ottawa. The Rideau Canal and the Rideau River form part of an eastern and southern boundary. The area west of downtown is exposed to the most access points, though this is limited to some extent by the presence of the rail corridor.

3.2.5.1 Natural and Artificial Barriers to Downtown Ottawa

Downtown Ottawa and the surrounding area have some notable natural and artificial barriers. Specifically, there are the five bridges connecting Gatineau and Ottawa. Further, the Rideau Canal and the Rideau River form part of an eastern and southern boundary. The area west of downtown is exposed to the most access points, though this is limited to some extent by the presence of the rail corridor that is used by the Trillium Line. Collectively there are:

- Nine access points over the rail corridor between the Ottawa River and the Rideau Canal (including one for Highway 417)
- Seven access points along the Rideau Canal between the rail corridor and the Ottawa River, or 12 access points along the Rideau River between the area just south of the rail corridor and the Ottawa River (including one for Highway 417)
- Three bridges over the Ottawa River within the smaller area bound by the rail corridor and the Rideau Canal, or four bridges within the larger area bound by the rail corridor and the Rideau River

In total, the area bound by the Ottawa River, the rail corridor and the Rideau Canal has a total of 19 access point. The larger area would be bound instead by the Rideau River (rather than the Rideau Canal), which has 25 access points. Included in both figures are two access points (one in the east and one in the west) for Highway 417. An alternative to these two Highway 417 access points is to include each of the eight off-ramps within the area as an access point. This would have the effect of allowing

[25] Prud'homme and Bocarejo (2005). The London Congestion Charge: A Tentative Economic Appraisal.

through traffic on Highway 417 to avoid the cordon charge, but would also increase the cost of administering the cordon.

3.2.5.2 Commute Flows to the Hypothetical Cordon Area

According to the TRANS data, an average of 143,000 people commute to work within this area (this figure is slightly smaller than the estimate from the employer survey). Of these people, approximately 60,000 commute by car (either driver or passenger). However, this figure declines to 38,000 when isolating the AM peak. By contrast, approximately 40,000 already commute by transit during the AM peak, indicating that transit already has a strong commute mode share to this area.

Allowing through traffic to avoid the cordon charge relieves the concern that some motorists will detour around the cordon, adding to congestion on nearby arterials such as Baseline Rd. and Riverside Dr. However, it can be argued that since through traffic does contribute to congestion on Highway 417 that it too should be subject to the cordon charge as well.

3.2.6 Parking

The availability of parking and parking pricing has a significant influence on commuter mode choice. Particularly important is whether parking is priced at all, as commuters are far more likely to drive over other modes of transport if parking is provided free of charge. For example, one study found that a daily parking charge of $6 in the Portland central business district would result in 21 fewer auto commuters per 100 commuters.[26]

A parking tax or increase in parking fees in a specific area can help to achieve some of the same objectives as a cordon charge, with some key differences. Like cordon charges, parking taxes could be used to target specific areas. But, because cities do not usually control the supply of all parking, it is more difficult to adjust parking fees and taxes by time of day. That said, private parking providers naturally tend to vary prices by time already (at least where supply is constrained), so a general parking tax may exacerbate the differences between peak and off peak prices that already exist. Unlike cordon charges, parking taxes that do target a specific area do not affect through traffic.

As in other cities, parking rates vary by location in Ottawa. Further, the City provides some of the supply of parking in the city and controls the associated parking prices. Currently, the City owns approximately 14% of the total supply of off-street parking in Ottawa.[27] Monthly parking rates at downtown municipal lots are as high as $195,

[26] Hess (2001). The Effect of Free Parking on Commuter Mode Choice.
[27] City of Ottawa. Parking Services.

whereas rates in municipal lots near, but outside, the downtown core are roughly $100 or lower.[28]

The City can influence private parking prices through property taxes, as the City distinguishes between parking lots and other types of properties (residential, commercial, etc.) for the purpose of setting property tax rates.

3.2.6.1 Property Taxes

The City can also influence private parking prices through property taxes. Currently, the City distinguishes between parking lots and other types of properties (residential, commercial, etc.) for the purpose of setting property tax rates. The current city-wide (excluding policy, fire, transit zone and other property taxes) property tax on parking lots is 0.686258% of the assessed value, while the equivalent rate is 0.562050% for residential properties and 1.047372% for commercial properties.[29]

The level of property tax for parking lots will have implications for the supply of parking, at least over the long term. Higher relative property taxes on parking lots will decrease the property owner's return to the extent that the owner cannot pass through the full value of that property to customers (without an associated decrease in demand). In the short term, the implications for automobile traffic is somewhat ambiguous though, as again that depends on the extent to which higher taxes would result in higher parking prices.

3.2.6.2 Parking Management Strategy

The City has a parking management strategy, in which it has laid out the following objectives:

1. Provide and maintain an appropriate supply of affordable, secure, accessible, convenient and appealing public parking

2. Provide and promote affordable short-term parking services, and fair and consistent enforcement services, that support local businesses, institutions and tourism

3. Promote, establish and maintain programs and facilities that encourage the use of alternative modes of transportation including public transit, car/van pooling, taxis, auto sharing, cycling and walking

4. Support residential intensification and resolve parking problems within residential areas caused by significant traffic generators or conflicting uses of the roadway, including implementing on-street permit parking programs to

[28] City of Ottawa. Short Term and Monthly Rates.
[29] Calculated from City of Ottawa's Property Tax Calculator.

relieve area residents and visitors from parking regulations directed at the non-resident

5. Ensure the revenues generated by the Municipal Parking Program are sufficient to wholly recover all related operating and life-cycle maintenance expenditures; contribute to a reserve fund to finance future parking system development, operation and promotion; and then assist in the funding of related initiatives to encourage the use of alternative modes of transportation.[30]

It can be argued that parts of objectives 1 and 2 are somewhat at conflict with objective 3, as including the objective of "affordable" parking is at odds with discouraging the use of the automobile in favour of other modes of transportation. That said, it is not clear how, if at all, the City has applied its affordability criteria. If this criteria is applied through parking charges at municipal lots that are lower than those charged by private lots, the City can revisit this practice as a first step towards managing auto demand through higher parking charges.

3.2.7 Gas Taxes

Gas taxes are levied by the federal government, provincial governments and, in some cases, local governments in Canada. The federal tax on gasoline is 10 cents/litre. The Ontario provincial gas tax is 14.7 cents/litre, while the Quebec provincial gas tax is 20.2 cents/litre. However, to address the fact that gas stations in and around Gatineau compete with gas stations in Ottawa, the Government of Quebec lowered its gas tax by 8 cents/litre for gas stations within five kilometres of the border, 6 cents/litre for stations within 5-10 kilometres, 4 cents/litre for those within 10-15 kilometres and by 2 cents/litre for stations within 15-20 kilometres.[31]

Some regions in Canada and elsewhere levy their own gas taxes primarily as a revenue raising measure but also to manage automobile demand and/or reduce GHG emissions. The most significant example in Canada is found in Metro Vancouver, where TransLink levies a tax of 17 cents per litre in order to fund transportation infrastructure.[32] The Montreal region applies a similar (albeit much smaller at 3 cents) tax to gasoline.

If the City of Ottawa and surroundings municipalities were to apply a gas tax of their own, presumably the Government of Québec would respond by eliminating the reductions to the gas tax in the Gatineau area, which are only in place to address the disparity in the rates applied on each side of the border. This means that the City of

[30] City of Ottawa. Municipal Parking Management Strategy.
[31] Publications Québec (2016). Regulation Respecting the Application of the Fuel Tax Act, section 2R1.
[32] BC Ministry of Finance (2016). Tax Bulletin: Tax Rates on Fuels, p. 5.

Ottawa and surrounding municipalities could likely apply a gas tax of 8 cents per litre without fear of significant leakage of tax revenues across the border.

However, this does not consider the potential impact of the Province of Ontario's new climate change plan, which includes a cap-and-trade system designed to reduce GHG emissions. After the implementation of this plan gasoline prices are expected to increase approximately 4.3 cents a litre.[33] If this were to happen, this would limit the amount that could be added to the gas tax locally without a corresponding increase to the gas tax in Gatineau.

3.3 Most Appropriate Tools for Ottawa

Given Ottawa's local peculiarities, we have identified four potential congestion pricing tools that could help to manage peak automobile demand. These options are discussed further below.

3.3.1 Cordon Charges

As noted in section 3.2.5, the area bound by the Ottawa River, Rideau River and the Trillium Line rail corridor has 25 points of access. This area would encompass the entire Ottawa Centre and Ottawa Inner Area TRANS Districts, or similarly named areas according to the Ottawa Employment Survey. According to the employment survey, nearly 28% (162,000 jobs) of all employment in Ottawa falls within this larger area.

We reiterate that several of these access points are owned and maintained by the federal or provincial government and would thus require the cooperation of those governments to implement a related cordon charge.

One option to implementing a cordon charge would be for the City to use electronic tolling technology, including video cameras for license plate recognition and radio frequency identification (RFID) at each of these access points. Motorists would be given the option of purchasing or leasing transponders or windshield decals that are automatically recognized by RFID devices, or recognized through video cameras. Similar systems are in place elsewhere in Canada, notably Highway 407 in the Toronto area and on the Port Mann Bridge that crosses the Fraser River in the Vancouver area.

3.3.1.1 Operating Costs

The costs of such a system would vary according to local circumstances. To provide a rough order of magnitude of these costs, Transport Investment Corporation (TIC), the Crown Corporation that operates the Port Mann Bridge and its electronic tolling system, reports tolling and customer engagement costs of approximately $19 million per year.

[33] Benzie (2016). Curbing Climate Change in Ontario Will Cost You $13 a Month.

We estimate the cost of a cordon system in Ottawa to be very roughly in the range of $30 - $40 million annually.

Meanwhile, its total revenues are approximately $136 million,[34] meaning that tolling costs are in the order of 14% of total revenues. Average weekday daily traffic on the bridge is approximately 110,000 vehicles (similar to the traffic level on sections of the 417 through Ottawa).

Such a system would likely be more expensive to run for the purposes of a cordon in Ottawa due to the larger number of access points. The gross book value of TIC's tolling and traffic system assets is in excess of $100 million,[35] meaning Ottawa's investment for the purpose of a cordon charge would likely be higher (these assets include not only cameras and readers, but also the backend equipment and systems). On the other hand, a cordon charge could possibly raise considerably more revenue than the Port Mann Bridge, as current bridge tolls are fairly low ($3.15 per crossing for light-duty vehicles) and total traffic within the cordon would likely remain considerably higher than the Port Mann Bridge's traffic (as current traffic levels on the 417 alone exceed the bridge's traffic levels).

In section 3.3.3.1 we roughly estimate the operating costs of an electronic toll highway. Using the costs per interchange as guidance for the cost of the cordon system (assuming that the cost per access point is similar to the cost per interchange), we estimate the cost of the cordon system to be very roughly in the range of $30 - $40 million annually.

3.3.1.2 Current Auto and Transit Mode Share

As noted above, approximately 162,000 jobs are located within the larger cordon. However, many of these commuters already use public transit to get to work, as discussed in section 3.2.4.2, while others enter the area to work outside of peak hours. According to the TRANS data, approximately 34,000 commuters make trips destined to this area by automobile (including drivers and passengers) each day during the AM peak. This figure excludes commuters who begin their trips from within the same area.

Commuters are not the only people who enter the area during the AM peak. An additional 12,000 people from outside of this area make trips to the area by automobile (for a total of 46,000) for non-work purposes during the AM peak. Because these people are not travelling for commuting purposes, the timing of their trips may be more flexible and as such, they may be more willing to shift the timing of their trips in response to a cordon charge. However, a portion of these people are travelling for school purposes, meaning that the timing of their trips may not be as flexible.

[34] Transportation Infrastructure Corporation (2016). 2015-16 Annual Service Plan Report, p. 23.
[35] Ibid, p. 33.

3.3.2 Parking Fees and Taxes

As noted in section 3.2.6, parking costs are a significant determinant of whether commuters choose to drive to work, or use some other mode of transportation. However, even in cases where parking costs are high, if commuters are subsidized for their parking costs by their employer, they will be less likely to factor these costs in when choosing their mode of transportation.

Notably, the federal government has largely phased out its subsidies for parking in Ottawa. More recently, the Treasury Board Secretariat (TBS) has completely eliminated parking benefits for management category employees in several bargaining unit groups.[36] Although other employers in the City may provide subsidized parking (particularly those employers who are well outside of the downtown core), the fact that the federal government is by far the largest employer in the City (accounting for over 120,000 and 20% of all jobs in the City) suggests that this practice (providing subsidized parking) is less typical in Ottawa than it is in other cities.

Because employees are more likely to cover their own parking costs in Ottawa, fees and taxes that increase parking costs could be an effective tool for the purpose of relieving congestion. Note that when we model the impacts of a parking fee or levy in chapter 4, we assume that the fee will apply to all auto commuters to the central districts. To the extent that the fee does not get passed on to those commuters (because they do not cover their existing parking costs to begin with, for example) the impacts from the parking fee will be smaller than what we have modelled.

3.3.2.1 Operating Costs

Depending on how a parking fee or tax was implemented, the associated operating costs could be negligible. As mentioned in section 3.2.6, the City already has a property tax specific to parking lots. Therefore, the City can increase this rate at no cost, other than administrative time.

Other methods of implementing a parking tax would be more costly, as well as possibly requiring a change to provincial regulations. In Metro Vancouver, a parking tax is levied on the sale of a parking right.[37] In the City of Toronto, where parking taxes are allowed to be implemented through the City of Toronto Act, 2006,[38] a $1-a-day tax on commercial parking spots had been proposed as an option for revenue generation.[39] The expected cost of implementing such a tax was estimated to be moderately low,

[36] Public Works and Government Services Canada (2012). Subject: Elimination of the Parking Benefit for Certain Management Category Employees.

[37] TransLink, About the Parking Tax.

[38] City of Toronto (2016). 2016 Operating Budget Briefing Note: Revenue Tools under the City of Toronto Act, 2006, p. 3.

[39] AECOM (2013). Big Move Implementation Economics: Revenue Tool Profiles, p. 170.

with the main costs stemming from the need to develop an inventory of all commercial parking spots and administrative costs for collection.

3.3.2.2 Other Factors

Depending on the specific parking fee or tax that is implemented, it may be difficult to control the variation of the fee or tax by time of day. For example, if a fee or tax is imposed on the parking lot owner, the owner has control over how he or she passes this fee or tax on to customers. However, because demand for parking is obviously subject to variations in demand throughout the day and because pricing already changes in different time periods, it is expected that any fee or tax on the owner would be passed through disproportionately to peak period customers.

3.3.3 Single-Entity Pricing

Highway 417 is the main artery that is used by commuters to get to and from downtown Ottawa and the surrounding area. However, many commuters, notably those coming from Gatineau, enter the area via the bridges over the Ottawa River. A toll on Highway 417 would, for the most part, not impact these commuters. To address this concern, in conjunction with highway tolls, tolls could be implemented on these five bridges.

A toll on Highway 417 would likely divert some traffic to adjacent arterials roads as some commuters look to avoid the toll. While this would reduce congestion on Highway 417, it would add to congestion on those arterial roads.

At the same time, a toll on Highway 417 (and potentially Highway 174) would have the advantage of addressing congestion in a broader area. As noted in section 3.2.4, employment population in Ottawa has become more dispersed over time, a trend that could continue in the future. Further, traffic speeds slow during peak periods on sections of 417 that are well outside of the Ottawa Inner Area. A cordon charge would indirectly affect these sections as many motorists on these sections are making trips to the downtown and surrounding areas, but a toll would affect these motorists more directly.

Tolls could be levied on Highway 417 using a technology similar to the technology used by 407 ETR in the Greater Toronto Area. This highway uses electronic sensors located on overhead gantries at on/off ramps to detect transponders located in motorists' vehicles. Motorists who do not lease a transponder from 407 ETR are detected through cameras that read vehicle license plates.

3.3.3.1 Operating Costs

407 ETR's financial statements provide some indication of the cost of such a system. In 2015, the company incurred $92 million in expenses related to systems and

customer operations expenses, related to maintaining the tolling system, operating the customer call centre, transponder distribution, etc.[40]

In addition, the company incurs capital costs associated with toll equipment, transponders, and operations centre. The depreciation expense for these items was $27 million.[41]

The combined operating and depreciation costs are in the range of $120 million per year.[42] In total, 407 ETR has 198 on/off rams and gantries, 41 interchanges and stretches 108 kilometres. By comparison, the stretch of Highway 417 plus Highway 174 from March Rd. in Kanata to Trim Rd. in Orléans is approximately 38 kilometres with approximately 28 interchanges.[43]

If we assumed that the costs of operating a tolling system would be similar on a per kilometre basis, such a system would cost approximately $42 million annually. If based on the number of interchanges the cost rises to $81 million annually. Neither figure takes into account 407 ETR customer volumes (which total 440,000 trips per workday[44]) relative to Highway 417. 407 ETR's higher volumes likely contribute to higher customer operations expenses.[45] This may suggest that tolling operating costs for Highway 417 would be towards the lower end of the range noted above.

3.3.3.2 HOT Lanes

Although HOT lanes are categorized as a pricing tool that is distinct from single-entity pricing, we discuss them as a subset of other single-entity pricing such as a toll on Highway 417 because they exhibit some of the same benefits and costs, though usually to a smaller degree.

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[40] 407 International Inc. (2016). Consolidated Financial Statements December 31, 2015, p. F-23.

[41] Ibid, p. F-12.

[42] Note that there would be some additional capital financing costs on top of the depreciation expenses reported.

[43] Estimated from MTO AADT data and Google Maps.

[44] 407 International Inc. Usage Statistics.

[45] 407 ETR's trip volumes are not strictly comparable to AADT counts on Highway 417, as the former counts all vehicles on any part of the highway while the latter counts vehicles on specific segments. From 407 ETR's public usage statistics (which include gross VKT) we estimate the average trip length to be 22 kilometres. Given that the length of the highway is 108 kilometres, we can deduce that the typical customer covers approximately 1/5th of the highway on each trip. By dividing the average number of workday trips by five to account for this, we estimate that the average AADT on 407 ETR segments is approximately 90,000. While this is lower than the highest AADT on specific segments of Highway 417, it is higher than 417's weighted average. Furthermore, AADT should be multiplied by the highways total length to get an indication of the relative number of "customers" on each highway. As 407 ETR is much longer, it stands to reason that even if traffic volumes were similar on any given segment, there are overall many more 407 ETR customers than there are Highway 417 customers.

To the extent that HOV lanes already exist in Ottawa and are free of congestion, converting those lanes to HOT lanes will likely be more acceptable to the public due to the fact that their implementation will be making use of available space as opposed to redistributing existing, congested space. Furthermore, the conversion of a HOV to HOT lane means that some motorists who remain in the unmanaged lanes may benefit as new HOT lane users free up space on the unmanaged lanes.

As noted in section 3.2.1.1, HOV lanes already exist on Highway 417 through Kanata. Although the conversion of these lanes to HOT lanes may help to reduce congestion marginally, they would certainly not address congestion on a city-wide scale.

Converting existing unmanaged lanes on Highway 417 and other highways to HOT lanes to create a network of HOT lanes would have a more significant effect. However, doing so would come at roughly the same, or even additional, cost relative to implementing tolls on the highways in their entirety, with likely fewer benefits. For this reason we consider broader tolls, rather than HOT lanes, as a potential appropriate tool for Ottawa.

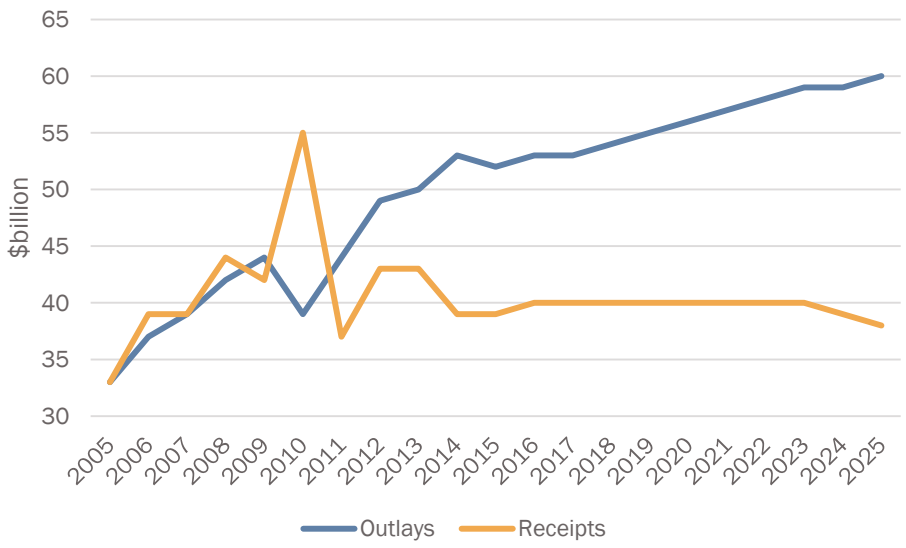
3.3.4 Gas Taxes

As noted in section 3.1.1, although a gas tax is at best a very blunt instrument for managing congestion, it should not necessarily be dismissed entirely due to the fact that gas taxes are already applied and increases to the gas tax are easy to implement (logistically, not necessarily politically). Further, as noted in section 3.2.7, the Province of Québec would likely respond to an increase in the gas tax in Ottawa with the elimination of the exemption zone in Gatineau, thereby easing concerns that a local gas tax would encourage motorists to purchase fuel on the Québec side of the border.

One concern with a local gas tax is that unlike a cordon charge or electronic toll, it cannot vary by time or place. Furthermore, as automobiles continue to become more fuel efficient, the impact of the gas tax is eroding over time. Electric vehicles, a small but growing part of the vehicle fleet, are not impacted at all by gas taxes but contribute to congestion nonetheless.

Vehicle fuel efficiency improvements have posed a challenge for governments who use gas taxes explicitly as an infrastructure funding source. In the United States, the federal government places gas tax revenues in the Highway Trust Fund (HTF), which funds the construction and maintenance of the Interstate Highway System (IHS) as well as local public transit infrastructure. Due to fuel efficiency improvements, the US Congressional Budget Office (CBO) has warned that outlays from the HTF account have and will continue to far exceed the HTF receipts (see Figure 3-14).

Figure 3-14: Highway Trust Fund Outlays and Receipts, Historical and Forecast



Source: CPCS Analysis of Data from the Congressional Budget Office

As a result of declining fuel tax revenues caused by better automobile fuel efficiency, there have been growing calls to replace the gas tax with another form of funding entirely, such as distance-travelled pricing.

As a result of this funding challenge, there have been growing calls to replace the gas tax with another form of funding entirely, such as distance-travelled pricing. Although the problem for the HTF is one of funding, as opposed to congestion management, the two problems are related. Although in the near-term an increase in the gas tax will increase government revenues, in the medium to long-term the gas tax will necessarily need to be replaced. This fact, coupled with the fact that the gas tax is an indirect tool for addressing congestion, at best suggests that other tools will be more useful and sustainable for the purpose of addressing congestion in Ottawa.

3.3.5 Other Potential Congestion Charges

In large part due to declining gas tax revenues, distance-travelled pricing is another form of road pricing that is of growing interest to governments around the world. Implementing distance-travelled pricing using mobile communications has yet to be widespread but is being tested in a number of countries. The technology has obvious potential for this application given that modern smartphones incorporate a number of technologies such as Near Field Communications (NFC) and GPS. Together, these technologies can measure usage by time and place, as well as allow for seamless payment.

One notable example of new technology being put in place for this purpose is the Oregon Department of Transportation's (ODOT) "OReGO" initiative. OReGO is a voluntary initiative where road users pay an MBUF instead of the fuel tax. Mileage is

recorded and reported through an Onboard Diagnostic Port (OBD-II) satellite-positioning device that is plugged into volunteers' vehicles.[46]

While the OReGO initiative is still in development stages, it is becoming increasingly obvious that alternative road use charges will have to become more prominent in the near future. Oregon is far from being the only state that has accepted this reality. California, Washington, Indiana, Wisconsin, Michigan, Illinois, Maine, Delaware and Florida, among other states are studying MBUFs,[47] though the specific technology used for this purpose may differ from OReGO's solution.

Although the application of distance-travelled pricing to light-duty vehicles remains novel and limited to pilot projects, distance-based pricing has in fact been applied for well over a decade to heavy vehicles. Countries such as Switzerland, Austria and Germany have implemented automated systems for heavy vehicle weight-distance charges (charges that take into account both the weight and distance travelled by each vehicle) since the early 2000s. These countries have used GPS, short-range communications devices or automatic license plate-reading technologies to implement these charges.[48]

Despite the growing interest and need to implement distance-travelled pricing in the face of declining gas tax revenues, the idea has yet to gain any significant traction in Canada. Although we do not consider distance-travelled pricing further in this report, it is noted that such pricing will at some point be likely to replace gas taxes and by virtue of the technology, will allow for variation of charges by time and place. In other words, although it will likely be implemented for the purpose of replacing revenues lost from gas taxes, it will at the same time allow for more direct forms of congestion pricing.

3.4 Summary of Congestion Pricing Tools for Ottawa

In the next chapter we consider the potential impacts of cordon charges, parking fees, single-entity pricing (highway and bridge tolls) and gas tax increases in Ottawa.

[46] Oregon Department of Transportation, My OReGo Device.
[47] Oregon Department of Transportation, Frequently Asked Questions.
[48] Oehry, Charging Technology and Cost Effectiveness.

Chapter 4

Potential Impacts of Congestion Pricing Tools in Ottawa

The impacts of congestion pricing tools depend on a number of factors, including factors that affect overall travel demand, the availability of alternative modes of transportation and the extent to which the timing of commuters' trips are flexible, among others. While a comprehensive estimation of travel demand and mode shift using a travel demand model is beyond the scope of this report, we used the key principles behind mode choice estimations from travel demand models generally to determine the extent to which the congestion or road pricing tool or tools could potentially contribute to mode shift to transit in Ottawa.

Specifically, four scenarios were modelled for their potential impact on peak hour travel demand:

1) A toll on the 417/174 highways equivalent to $0.15/km.

2) A cordon charge in the central part of Ottawa equal to $5 per peak period entry. It is assumed the charge is also assessed to pass-through trips using the 417.

3) A parking levy equal to $2/parking spot. It is assumed this levy is passed on to drivers only in those zones that already have paid parking. Where parking is currently free, it is assumed the levy is absorbed by the landowner and not passed on to motorists.

4) An increase in the gas tax of $0.30 per litre.

We find that the cordon charge would likely be most effective in encouraging mode shift to transit, followed by the parking levy and then the toll. The cordon charge would also likely be most effective in reducing peak hour auto VKT (followed by the toll, then parking levy). However, because the cordon charge would be more costly to implement than a parking levy, it would not likely be effective for the purpose of generating new revenue, at least until the related technology costs declined substantially.

4 Potential Impacts of Congestion Pricing Tools

4.1 Estimating the Impacts of Congestion Pricing Tools

The impacts of congestion pricing tools depend on a number of factors, including the availability of alternative modes of transportation and their associated costs and service levels, the extent to which the timing of commuters' trips are flexible and the extent to which the trips themselves are necessary.

There will already be some commuters who are at the margin of shifting to another mode of transportation, shifting their commute time, or eliminating their commute trip entirely. These commuters will be the ones who are most likely to be affected by the implementation of congestion pricing. For others, alternatives to their current commute trips and times are so costly or undesirable for other reasons that congestion pricing will have little or no impact on their behaviour.

Transportation modellers attempt to capture the factors that affect mode choice, in particular, by estimating a "generalized travel cost" function. The generalized travel cost takes into account both out-of-pocket costs of making a trip (gas costs, parking costs, transit fares, etc.) as well as non-monetary costs of making a trip (most notably the travel time). In a generalized travel cost function, the non-monetary costs are assigned monetary values and added to out-of-pocket costs to estimate the total generalized travel cost. Travel times are monetized by estimating the value of travel time savings (VTTS).

Assigning monetary values can be done, for example, by estimating a commuter's willingness-to-pay (WTP) for reductions in travel time. That value is then multiplied by the actual reduction (or increase) in travel time that would be incurred by shifting to another mode. In a case where commuters are assumed to value their time at $20 per hour, the monetary value that would be assigned to a 15 minute reduction in travel time is $5.

4.2 Estimating Generalized Travel Cost

Urban travel demand models typically forecast travel demand in four steps: 1) estimating total trip generation, 2) estimating the distribution of those trips, 3) determining the mode choice of the distributed trips, and 4) assigning the trips by mode of transport to the transportation network.

As noted in chapter 1, a comprehensive estimation of travel demand and mode shift using a travel demand model is beyond the scope of this report. To provide a rough, but reasonable, approximation of modal shift, we focused on a method roughly corresponding with the third step, which is the mode choice step. We applied this

methodology using travel demand data for the top 99 OD pairs that were identified in section 3.2.4.2.

Introducing congestion or road pricing impacts generalized travel costs by increasing the direct costs of driving (and potentially decreasing indirect costs if there is an appreciable effect on traffic flows). To the extent that it increases the total generalized cost of travel for auto users on certain origin-destination pairs, it could encourage a shift from the auto to transit mode (if the generalized cost for driving rises and the generalized cost for transit remains unchanged).

To determine the extent to which the congestion or road pricing tool or tools could potentially contribute to mode shift we:

- Reviewed any relevant estimates of the VTTS as it relates to the generalized travel cost from the LRT business cases
- Calculated generalized travel cost for key origin-destination pairs of interest
- Estimated mode share and total trip volumes for origin-destination pairs from the local travel demand survey data
- Calibrated an excel model that computes the probability of selecting a mode based on the relative generalized costs of each mode, using factors specific for this study
- Estimated the new generalized cost of travel for the auto mode on these pairs after the implementation of congestion or road pricing
- Estimated mode shift from auto to transit as a result of the change in the relative generalized cost of travel for each mode

Additional details about the above steps and key inputs are described further below.

4.2.1 Model Inputs

4.2.1.1 Corridors for Analysis

As noted in section 3.2.4.2, there were 99 OD pairs (using TRANS districts as origins and destinations) with daily AM peak commuter flows of 1000 or more. We focused on these corridors for our travel time and generalized travel cost analysis. Of note, the top 99 ODs were responsible for nearly 70% of the total AM peak work trips. While the transit mode share and general viability of transit in the residual OD pairs is much lower than on average, were we to include all OD pairs the mode shift impacts resulting from the application of congestion pricing would be greater at least to a small degree.

To identify travel times for each mode among these OD pairs, we first identified representative residential and employment locations within each TRANS district. To do this, we identified a specific point within each district that was at the geographic centre of residential or employment populations within those districts, taking into account the densities of residential or employment population. Not only did this allow us to calculate

An individual's average commute time might be 30 minutes. However, that commute might take up to 45 minutes once or twice a month due to variability in traffic. In order to avoid being late for work once or twice a month, that individual might plan for a 45 minute commute every day.

travel times and distances between each district, it also allowed us to calculate times and distances within each district (by using the residential point as the origin and the employment point as the destination).

4.2.1.2 Travel Times by Mode

After identifying specific origin and destination points in each district, we used Google Maps direction function to estimate travel times by mode. For each OD pair we looked up travel directions and times during the AM peak (8am). Travel times were recorded for auto, transit and cycling modes. For auto modes, we recorded the range that is estimated by Google Maps based on the typical traffic conditions within each corridor. This allowed us to calculate generalized travel costs, taking into consideration either the average travel time or the "planning time."

The planning time includes a buffer to account for the variability and unpredictability of traffic conditions. For example, an individual's average commute time might be 30 minutes. However, that commute might take up to 45 minutes once or twice a month due to variability in traffic. In order to avoid being late for work once or twice a month, that individual might plan for a 45 minute commute every day even though the actual commute will be less than 45 minutes most of the time.

Google Maps does not provide a similar range for transit travel times. We assumed that the transit travel times shown are somewhere in between the average travel time and the planning time. An analysis of transit travel times in peak and off peak periods showed that the transit travel time took expected traffic conditions at peak hours into consideration, at least to some degree. Transit times were not available for the Quebec portion of the metropolitan area; in this case we utilized an identical method except using the Société de transport de l'Outaouais (STO) website. Although no exact "planning time" equivalent is available for transit, we found that comparing auto planning times and transit schedule times correlates well with other permutations of auto and transit times we examined.

4.2.1.3 Value of Travel Time Savings

Because there are no direct markets for buying and selling time, indirect methods of calculating the VTTS are used as inputs in travel demand models. These methods can include surveys or analyses of behavioural responses by travellers who are faced with different travel time options. While in reality the VTTS will vary by individual, trip purpose, mode of travel, etc., for the purpose of populating travel demand models, the VTTS is often based off of some fraction or multiple of average wage rates in the area of study. For example, for personal travel time savings the VTTS is sometimes

assumed to be 25% or 50% of the average wage rate.[49] While there is some debate whether the VTTS scales with income at unity, there is general agreement that there is a strong relationship between VTTS and income.[50]

The average hourly wage in Ontario is approximately $26,[51] which implies a VTTS of $13 if it was half of the wage rate. According to the Stage 2 LRT business case, the VTTS used was $14.42 in 2015, escalated by 1.8% annually to 2048. This figure and escalation factor was in turn based on a previous study conducted for Transport Canada.[52] As these two approaches result in a VTTS in the same range, we used a VTTS of $14 for the purpose of our analysis.

4.2.1.4 Parking Costs

Parking costs were estimated through an analysis of parking rates at City of Ottawa municipal parking lots. As noted in section 3.2.6, the City owns approximately 14% of the off-street parking supply. Average monthly rates were calculated for districts in which the City publishes rates (Alta Vista, Ottawa Centre, Ottawa East, Beacon Hill, Ottawa Inner Area and Ottawa West). These rates were divided by 20 to estimate the price per day. Parking was assumed to be free in areas that did not have published rates.

Because the rates were based on prices of municipal lots, parking costs may be underestimated in our modelling. However, the prices at municipal lots do vary considerably by district and likely reflect the variation in prices charged at private lots more generally. For example, the highest parking prices are observed in Ottawa Centre, followed by the Ottawa Inner Area. On the other hand, as noted in chapter 3, to the extent that the parking fee does not get passed on to commuters to these districts (because they do not cover their existing parking costs to begin with, for example) the impacts from the parking fee will be smaller than what we have modelled

4.2.1.5 Fuel Costs and Transit Fares

Fuel costs were estimated by calculating the average automobile distance for each OD pair, assuming an average automobile fuel economy of 10 litres/100 km (assuming slightly less efficient driving during peak hours than on average) and multiplying the computed gasoline consumption by $1.00/litre.

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[49] TRB Transportation Economics Committee, Transportation Benefit-Cost Analysis: Travel Time.
[50] Fosgerau, Unit Income Elasticity of the Value of Travel Time Savings.
[51] Analysis of data from Statistics Canada, Labour Force Survey CANSIM Table 282-0151.
[52] MMM Group (2015). Stage 2 Ottawa LRT Business Case, p. 39.

Transit fares were assumed to be $3 per ride. OC Transpo cash fares are slightly higher ($3.40). However, many riders purchase monthly passes, costing $113.75,[53] which works out to an average of $2.84, assuming 40 trips per month.

4.2.2 Modelling Approach

4.2.2.1 Model Specification

The generalized costs for the various travel modes were plotted against actual mode shares for the top 99 OD pairs in the Ottawa area in the AM peak period (each having over 1,000 daily AM peak work trips).

Logit models are widely used in transportation modelling and work by fitting real-life mode share data to observed inputs such as travel time and cost. These models are useful for predicting changes in mode choice resulting from changes in individual input factors. Advanced models can take into account personal attributes (such as income, sex and availability of a vehicle) and trip characteristics (such as cost and travel time), and isolate the impact of each factor on mode choice.

This study makes use of a relatively simple excel-based binary choice logit model, which is most useful in situations where a change in an input for a single mode (rather than multiple, network-wide changes) is being evaluated. The modelled probabilities are expressed as:

$$P_i = \frac{\exp(\beta G_i)}{\exp(\beta G_i)+\exp(\beta G_j)} \text{ and } P_j = \frac{\exp(\beta G_j)}{\exp(\beta G_i)+\exp(\beta G_j)}$$

where:

- P_i and P_j are the probabilities of choosing travel modes i and j
- G_i and G_j are the generalized costs of modes i and j
- β is a scale parameter (estimated by the model)
- exp is the exponential function

The modes evaluated were single-occupant auto, carpool (2+ person auto), public transit and cycling/other. In the case of carpooling, monetary costs were assumed to be divided evenly between both occupants, whereas each occupant was assigned the full time costs of commuting. A model was run separately both for work and non-work trips.

[53] OC Transpo, What it Costs.

The relationship between single-occupant auto and public transit was as expected – for OD pairs where the generalized cost of driving is high relative to transit, the share of transit users is greater. Thus, we predict that an increase in the generalized cost of driving (all else equal) will divert some drivers to public transit.

Four scenarios were modelled: a toll on the 417/174, a cordon charge, a parking levy and an increase in the gas tax.

No reliable relationship could be derived from the data for carpool vs. single-occupant auto, or for cycling/other vs. single-occupant auto. In the case of carpooling, OD pairs with the highest relative driving cost did not have higher levels of carpooling. This may be because many of these trips went to transit, although this would require a multinomial logit to evaluate, something that is beyond the scope of this study. For cycling, the subset of OD pairs was reduced to remove trips within a single zone, where walking would dominate. However, we did not find the generalized costs of driving and cycling to be predictive of cycling mode share overall, possibly due to other unseen factors (such as safety or terrain) affecting the attractiveness of cycling. Another factor hindering analysis of cycling is that the travel survey results do not differentiate between walking and cycling.

The modelling was performed initially for AM peak work trips, and then separately for AM peak non-work trips. For the latter category, a value of travel time of $6/hr was found to fit the data better, compared to the $14 used for work trips. This is consistent with theory in that the value of time savings is generally lower for non-work travel.

4.2.2.2 Scenarios Modelled

Specifically, four scenarios were modelled for their impacts on peak hour travel demand. Note that by focussing on this response (mode shift) and peak hour traffic only, we did not estimate the extent to which pricing tools could shift some traffic to other times during the day, either in addition to or instead of shifting traffic to other modes. The mechanisms, boundaries and other parameters of the various tools are as described in Chapter 3.

1) A toll on the 417/174 highways equivalent to $0.15/km.

2) A cordon charge in the central part of Ottawa equal to $5 per peak period entry. It is assumed the charge is also assessed to pass-through trips using the 417.

3) A parking levy equal to $2/parking spot. It is assumed this levy is passed on to all drivers only in those zones that already predominately have paid parking. Where parking is currently free, it is assumed the levy is absorbed by the landowner and not passed on to motorists.

4) An increase in the gas tax of $0.30 per litre.

In the future, as consideration is given to expanding Highway 417 capacity through the addition of new lanes, the feasibility of implementing a network of HOT lanes may grow.

This is because it is typically more acceptable to the general public to implement High Occupancy Vehicle (HOV) or HOT lanes when new capacity is added (as opposed to repurposing existing unmanaged lanes). Although we do not explicitly model the impacts of the implementation of HOT lanes, we note that the implementation of such lanes would likely generate some portion of the impact of a broader road toll

Each scenario was modelled for the AM peak period only, before being extrapolated to cover the PM peak period as well. As such, the resulting mode shift estimates only cover travel demand during the peak period. Further, since we have only focused on the mode shift step of four typical steps used in travel demand modelling (as discussed at the start of section 4, our modelling does not consider the impact that any of the above tools might have on trip timing (shifting trips to off peak periods) or trip generation (eliminating trips altogether). Notably, the toll and cordon charge and, to a lesser extent, the parking levy could be limited to peak periods only.

The initial amounts of the toll charge, cordon charge, parking levy and gas tax increase were chosen somewhat arbitrarily and then adjusted during the modelling process so that the revenues generated from each tool from peak period auto travellers were roughly equal (as shown later in Figure 4-3). Although the primary purpose of this study is to estimate the impact of congestion pricing tools on reducing auto travel demand through mode shift to transit (as opposed to revenue generation), we nevertheless do estimate revenue generation from peak period auto travellers to put the different potential tools on relatively equal footing in that regard.

4.3 Modelled Impacts

Each of the four scenarios is expected to result in mode shifts, by making transit more attractive on a relative basis compared to driving. However, the impact on trip diversion is not uniform across the various scenarios. This is because mode shifts are most probable where transit is already competitive or close to competitive with driving, yet where the auto mode share is reasonably high. For example, large mode shifts are not anticipated between outlying areas with poor transit connectivity, nor for trips within Ottawa Centre, where 77% of AM peak work trips are by walking or cycling.

4.3.1 Mode Shift

Figure 4-1 shows the expected AM peak trip diversion to public transit, by scenario. The values take into account both work and non-work trips. Scenario 2 results in the greatest diversion to transit, at over 13,500 weekday AM peak trips. This would be nearly a 10% increase compared to the current 113,400 weekday AM peak trips by transit. By comparison, Scenario 4 would have the smallest impact on trip diversion, with only around 2,800 trips shifting to transit. This is because many of the drivers subject to the increased tax would not find transit to be as a viable alternative.

Figure 4-1: Peak Auto Trips Diverted to Transit, by Scenario

Scenario	*New AM Peak Transit Trips per Weekday*
Scenario 1: $0.15/km on 417/174 Highway	*7,906*
Scenario 2: $5 per entry peak cordon charge	*14,381*
Scenario 3: $2 parking levy	*9,343*
Scenario 4: $0.30 per litre increase in gas tax	*2,512*

Source: CPCS Analysis

4.3.2 Reduction in Vehicle Kilometres Travelled

Figure 4-3 shows the change in average workday AM peak auto VKT resulting from each scenario. VKT is derived by multiplying each diverted auto trip by its distance in kilometres. Scenario 2 would lead to the greatest reduction in auto VKT, and Scenario 4, the lowest reduction. Comparing Figure 4-1 and Figure 4-2, Scenario 3 (the parking levy) is associated with relatively high trip diversion but relatively lower auto VKT reduction, as many of the trips affected are shorter rather than longer trips. This is because Scenarios 1 and 2 affect work trips to a disproportionate extent (which are generally longer than non-work trips), compared to Scenarios 3 and 4.

Figure 4-2: Change in Auto VKT from Pricing Tools, by Scenario

Scenario	*Reduction in Average Workday AM Peak Auto VKT*
Scenario 1: $0.15/km on 417/174 Highway	*144,245*
Scenario 2: $5 per entry peak cordon charge	*189,103*
Scenario 3: $2 parking levy	*101,876*
Scenario 4: $0.30 per litre increase in gas tax	*36,364*

Source: CPCS Analysis

4.3.3 Revenue Generation

Figure 4-3 shows the revenue generation potential for the various alternatives. These are scaled over a year, assuming 5 days a week and 52 days a year. Note that the revenue covers both AM and PM peak periods where applicable (e.g. a driver would

pay a per-km toll in both peak periods, but only pay a cordon charge once). As seen, the four scenarios would generate a similar order of magnitude of revenue.

Figure 4-3: Revenue Generated from Pricing Tools, by Scenario

Scenario	*Gross Annual Revenue Generated from Peak Users (2016 $ M)*
Scenario 1: $0.15/km on 417/174 Highway	$ 44.04
Scenario 2: $5 per entry peak cordon charge	$ 44.64
Scenario 3: $2 parking levy	$ 49.05
Scenario 4: $0.30 per litre increase in gas tax	$ 50.83

Source: CPCS Analysis

Note, however, that the gas tax in particular would likely generate significantly more revenue as the above figures only estimate the additional gas tax revenues generated from peak period users. If the charges in the other scenarios were limited only to peak periods, the gas tax would generate significantly more revenue than other charges.

Nonetheless, the cordon charge would appear to have the biggest impact in terms of trip diversion per dollar raised during peak hours. The gas tax, as a less targeted tool, would generate the lowest trip diversion per dollar raised. However, this does not factor in administration costs. As noted in sections 3.3.1 and 3.3.3, the cost of administering a cordon charge or electronic toll would likely be in the range of $30 to $40 million or more annually. This suggests that most of the revenue generated by these fees would be consumed by administrative costs.

On the other hand, depending on how it is administered, a parking levy would be much less costly (and nearly costless if administered crudely through an increase in parking lot property taxes and prices charged for City-owned lots), as would be the increase in the gas tax.

4.3.4 Scaling to Future Years

The above estimations are anchored in the base year of the TRANS survey data, which is 2011. As discussed in section 3.2.4.2, the Ottawa CMA is expected to grow significantly both in terms of residential and employment population through 2031. To roughly approximate the magnitude of the impacts in 2031, we scale all of the results above according to the expected CAGR of employment growth in the CMA to 2031. This method effectively assumes that travel demand in Ottawa will grow in proportion to residential and employment population growth. However, it does not consider the

fact that a disproportionate amount of that growth is expected to occur outside of the Greenbelt.

Figure 4-4: Expected Impacts of Congestion Pricing Tools, 2031

Scenario	*New AM Peak Transit Trips per Weekday*	*Reduction in Average Workday AM Peak Auto VKT*	*Gross Annual Revenue Generated from Peak Users (2016 $ M)*
Scenario 1: $0.15/km on 417/174 Highway	*10,577*	*192,962*	*$ 58.91*
Scenario 2: $5 per entry peak cordon charge	*19,238*	*252,971*	*$ 59.72*
Scenario 3: $2 parking levy	*12,498*	*136,283*	*$ 65.62*
Scenario 4: $0.30 per litre increase in gas tax	*3,360*	*48,646*	*$ 68.00*

Source: CPCS Analysis

4.3.5 LRT Ridership

As noted in section 3.2.3, the LRT is needed to allow transit to maintain its mode share as the City grows, as BRT capacity will have otherwise been exhausted by 2018. According to the business case prepared for the LRT, over 40% of all transit trips in the City would use the LRT for all or part of their journey. However, of the scenarios above, the cordon charge (especially) as well as the toll and parking levy disproportionately affect mode shares for trips destined for Ottawa Centre and the Ottawa Inner Area, as well as the adjacent districts.

For this reason the bulk of the shift in mode share estimated for each of these scenarios are expected to boost LRT ridership. To put these figures into context, the most recent LRT forecasts (including Stage 2) estimated that system-wide OC Transpo ridership would increase to approximately 147,000 riders daily in the AM peak. At the high end, the additional 19,000 AM peak riders that would be gained through a cordon charge represents a 13% increase in ridership, while the parking levy and toll scenario increases are equal to approximately 8.5% or 7% ridership increases, respectively.

Chapter 5

Conclusion

Based on our analysis, a parking tax or levy is likely to be the most appropriate congestion pricing tool for Ottawa when giving primary consideration to reducing auto VKT and encouraging mode shift from auto to transit. While this tool may not be as effective as a cordon charge for this purpose, it is technically easier and less costly to implement.

While our analysis presents plausible estimates of the mode shift and transit share ridership impacts of various potential congestion tools, we note or reiterate the following considerations and limitations that can alter the expected outcomes, including but not necessarily exclusive to: residential and employment location responses; fuel economy impacts on gas tax revenues; declining technology costs; potential changes in trip timing and route choices; and factoring in other social and political priorities.

We also note that there are other tools and strategies that can be effective in reducing road congestion and improving mobility more generally through increasing the efficiency of use of the current transportation infrastructure. Of particular note is the fact that Ottawa's auto passenger mode share, while respectable by Canadian standards, illustrates that there is a great deal of transportation capacity that continues to go unused. Strategies and policies designed to take advantage of this capacity have the potential to generate significant bang for the buck.

5 Conclusion

5.1 Congestion Pricing Tools for Ottawa

Based on our analysis, a parking tax or levy is likely to be the most appropriate congestion pricing tool for Ottawa when giving primary consideration to reducing auto VKT and encouraging mode shift from auto to transit. While this tool may not be as effective as a cordon charge for this purpose, it is technically easier and less costly to implement.

Based on our analysis, a parking tax or levy is likely to be the most appropriate congestion pricing tool for Ottawa when giving primary consideration to reducing auto VKT and encouraging mode shift from auto to transit.

As technology costs fall, a cordon charge or electronic toll could become more suitable in the future. An increase in the gas tax, although easy (technically, not necessarily politically) to implement, would be less effective than other tools as it is unable to target specific users by time or place. Moreover, as automobile fuel efficiencies increase, the effectiveness of the gas tax will continue to decline in the future.

5.2 Considerations and Limitations

While our analysis presents plausible estimates of the mode shift and transit share ridership impacts of various potential congestion tools, we note or reiterate the following considerations and limitations that can alter the expected outcomes.

5.2.1 Static vs. Dynamic Projections

The above projections are “static” as opposed to “dynamic”, as (other than projecting mode share responses) they do not attempt to factor in land use and other responses to the various congestion pricing tools. In particular, they do not attempt to factor in changes in residential and employment locations that may occur in response to changes in generalized transportation costs. If these responses were factored in, for example, some employment could get redistributed from destination zones disproportionately affected by a new congestion pricing tool.

5.2.2 Rising Fuel Efficiency

As noted in section 3.3.4, automobile fuel economy has and will continue to improve. As such, the effectiveness of a gas tax both in terms of changing behaviour and raising revenue will erode over time. The results that are extrapolated to 2031 do not factor in this in. Doing so would increase the gap between the gas tax scenario and the other scenarios in terms of its effectiveness in encouraging mode shift.

5.2.3 Technology Costs

As indicated in section 4.3.3, additional revenues that would be expected from a cordon charge or toll would likely be offset to a large extent by administration costs. However,

in the future it is possible and even likely that technology costs will decline (as revenues increase).

Although revenue generation is not the primary motivation of this study, the viability of any congestion pricing tool would naturally increase as implementation costs decrease. As such, as technology costs decrease the viability of a cordon charge or toll will increase.

5.2.4 Changes in Trip Time and Routes

As noted in chapter 3, congestion pricing tools can generate responses from travellers other than mode shift, including changes to the timing of trips and changes to the routes that they take. For example, a cordon charge that only applies at a specified time of day may encourage auto travellers to shift the timing of their trips earlier or later in order to avoid the charge. Or, a toll on the 417 may encourage auto travellers to take alternate routes to their destinations to avoid the toll. These responses are not factored into our analysis.

5.2.5 Considerations for Other Priorities and Strategies

This report identified congestion pricing tolls that would likely be effective in reducing auto VKT and encouraging mode shift to transit in Ottawa, while primarily giving consideration to the City's geography, travel times and costs by mode of transportation and the costs of implementing each of the tools. There are numerous other priorities that were not considered in this report, including equity considerations and other political priorities. These priorities were not considered solely for the purpose of managing the scope of this research, rather than as a comment on their relative merits.

Finally, we note that there are other tools and strategies that can be effective in reducing road congestion and improving mobility more generally through increasing the efficiency of use of the current transportation infrastructure.

Of particular note is the fact that Ottawa's auto passenger mode share, while respectable by Canadian standards, illustrates that there is a great deal of transportation capacity that continues to go unused. Given that a large number of commuters are travelling between similar origins and destinations and similar times each day, this unused capacity represents an opportunity to increase mobility in the City. This unused capacity is the result of the fact that although there is often little or no room to accommodate additional vehicles on our roads during peak hours, there is capacity to accommodate more passengers as most vehicles have three or four empty seats during these hours.

This is especially true today and into the future, as emerging technologies (such as ridesharing applications) make it easier and cheaper than ever before for travellers to quickly communicate and coordinate with one another. Due to the high costs that

governments incur to provide transportation capacity (as noted in chapter 2), strategies and policies designed to take advantage of existing capacity have the potential to generate significant cost savings.

5.3 Conclusion

The purpose of this report was to identify specific road, mobility, or congestion pricing tools suitable to the Ottawa context that would help reduce traffic congestion and increase transit ridership. A parking tax or levy is likely to be the most appropriate tool for Ottawa when giving consideration to these factors. More broadly, the City should look for new and innovative ways to make better use of all existing transportation infrastructure.

Appendix A

AM Commute Flows and Mode Shares

2011 AM Commute Flows and Mode Shares

Origin	Destination	Total	AutoDriver Share	AutoPass Share	Transit Share
050 - Ottawa Inner Area	*001 - Ottawa Centre*	*8100*	*16.0*	*3.7*	*18.5*
500 - Kanata / Stittsville	*500 - Kanata / Stittsville*	*7400*	*85.1*	*4.1*	*2.7*
300 - Orléans	*001 - Ottawa Centre*	*7000*	*27.1*	*5.7*	*65.7*
050 - Ottawa Inner Area	*050 - Ottawa Inner Area*	*5500*	*27.3*	*5.5*	*16.4*
140 - Alta Vista	*140 - Alta Vista*	*5400*	*61.1*	*7.4*	*13.0*
300 - Orléans	*140 - Alta Vista*	*4700*	*76.6*	*6.4*	*17.0*
300 - Orléans	*300 - Orléans*	*4700*	*68.1*	*6.4*	*10.6*
200 - Merivale	*001 - Ottawa Centre*	*4200*	*40.5*	*11.9*	*47.6*
200 - Merivale	*200 - Merivale*	*4100*	*61.0*	*7.3*	*12.2*
500 - Kanata / Stittsville	*001 - Ottawa Centre*	*4100*	*34.1*	*4.9*	*61.0*
140 - Alta Vista	*001 - Ottawa Centre*	*3700*	*29.7*	*8.1*	*56.8*
240 - Ottawa West	*001 - Ottawa Centre*	*3700*	*21.6*	*5.4*	*59.5*
260 - Bayshore / Cedarview	*260 - Bayshore / Cedarview*	*3700*	*64.9*	*5.4*	*10.8*
425 - South Nepean	*001 - Ottawa Centre*	*3600*	*30.6*	*2.8*	*66.7*
500 - Kanata / Stittsville	*260 - Bayshore / Cedarview*	*3400*	*88.2*	*2.9*	*5.9*
260 - Bayshore / Cedarview	*001 - Ottawa Centre*	*3200*	*25.0*	*6.3*	*65.6*
180 - Hunt Club	*001 - Ottawa Centre*	*3100*	*29.0*	*6.5*	*61.3*
625 - Hull Périphérie	*625 - Hull Périphérie*	*3000*	*70.0*	*6.7*	*10.0*
100 - Ottawa East	*001 - Ottawa Centre*	*2900*	*24.1*	*13.8*	*48.3*
180 - Hunt Club	*140 - Alta Vista*	*2900*	*69.0*	*10.3*	*17.2*

Origin	Destination	Total	AutoDriver Share	AutoPass Share	Transit Share
425 - South Nepean	*200 - Merivale*	*2900*	*79.3*	*3.4*	*10.3*
050 - Ottawa Inner Area	*140 - Alta Vista*	*2700*	*59.3*	*7.4*	*22.2*
001 - Ottawa Centre	*001 - Ottawa Centre*	*2600*	*11.5*	*0.0*	*11.5*
700 - Aylmer	*001 - Ottawa Centre*	*2600*	*26.9*	*15.4*	*53.8*
800 - Pointe Gatineau	*001 - Ottawa Centre*	*2600*	*19.2*	*7.7*	*73.1*
200 - Merivale	*140 - Alta Vista*	*2500*	*68.0*	*8.0*	*16.0*
625 - Hull Périphérie	*001 - Ottawa Centre*	*2500*	*24.0*	*12.0*	*60.0*
800 - Pointe Gatineau	*800 - Pointe Gatineau*	*2500*	*72.0*	*12.0*	*4.0*
820 - Gatineau Est	*820 - Gatineau Est*	*2500*	*88.0*	*4.0*	*0.0*
260 - Bayshore / Cedarview	*240 - Ottawa West*	*2400*	*50.0*	*8.3*	*37.5*
200 - Merivale	*050 - Ottawa Inner Area*	*2300*	*47.8*	*4.3*	*39.1*
260 - Bayshore / Cedarview	*200 - Merivale*	*2300*	*65.2*	*13.0*	*17.4*
625 - Hull Périphérie	*600 - Île de Hull*	*2300*	*39.1*	*13.0*	*30.4*
800 - Pointe Gatineau	*625 - Hull Périphérie*	*2300*	*87.0*	*4.3*	*4.3*
140 - Alta Vista	*050 - Ottawa Inner Area*	*2200*	*50.0*	*9.1*	*31.8*
300 - Orléans	*050 - Ottawa Inner Area*	*2200*	*59.1*	*4.5*	*36.4*
500 - Kanata / Stittsville	*200 - Merivale*	*2200*	*86.4*	*9.1*	*4.5*
820 - Gatineau Est	*800 - Pointe Gatineau*	*2200*	*81.8*	*13.6*	*4.5*
200 - Merivale	*240 - Ottawa West*	*2100*	*57.1*	*9.5*	*19.0*
300 - Orléans	*120 - Beacon Hill*	*2100*	*81.0*	*4.8*	*9.5*
425 - South Nepean	*260 - Bayshore / Cedarview*	*2100*	*81.0*	*9.5*	*4.8*
425 - South Nepean	*425 - South Nepean*	*2100*	*71.4*	*19.0*	*4.8*

Origin	Destination	Total	AutoDriver Share	AutoPass Share	Transit Share
425 - South Nepean	*140 - Alta Vista*	*2000*	*75.0*	*10.0*	*15.0*
700 - Aylmer	*600 - Île de Hull*	*2000*	*50.0*	*15.0*	*35.0*
800 - Pointe Gatineau	*600 - Île de Hull*	*2000*	*40.0*	*20.0*	*40.0*
050 - Ottawa Inner Area	*200 - Merivale*	*1900*	*42.1*	*5.3*	*36.8*
100 - Ottawa East	*100 - Ottawa East*	*1900*	*42.1*	*5.3*	*10.5*
240 - Ottawa West	*240 - Ottawa West*	*1900*	*52.6*	*0.0*	*5.3*
300 - Orléans	*100 - Ottawa East*	*1900*	*73.7*	*10.5*	*15.8*
845 - Buckingham / Masson-Angers	*845 - Buckingham / Masson-Angers*	*1900*	*78.9*	*5.3*	*0.0*
180 - Hunt Club	*180 - Hunt Club*	*1800*	*83.3*	*5.6*	*5.6*
260 - Bayshore / Cedarview	*050 - Ottawa Inner Area*	*1800*	*61.1*	*0.0*	*33.3*
260 - Bayshore / Cedarview	*500 - Kanata / Stittsville*	*1800*	*83.3*	*0.0*	*11.1*
425 - South Nepean	*500 - Kanata / Stittsville*	*1700*	*94.1*	*0.0*	*0.0*
560 - Rural West	*500 - Kanata / Stittsville*	*1700*	*94.1*	*0.0*	*0.0*
100 - Ottawa East	*050 - Ottawa Inner Area*	*1600*	*43.8*	*6.3*	*25.0*
100 - Ottawa East	*140 - Alta Vista*	*1600*	*62.5*	*12.5*	*18.8*
120 - Beacon Hill	*001 - Ottawa Centre*	*1600*	*43.8*	*6.3*	*43.8*
180 - Hunt Club	*200 - Merivale*	*1600*	*68.8*	*6.3*	*25.0*
200 - Merivale	*260 - Bayshore / Cedarview*	*1600*	*68.8*	*12.5*	*12.5*
240 - Ottawa West	*050 - Ottawa Inner Area*	*1600*	*37.5*	*12.5*	*31.3*
650 - Plateau	*001 - Ottawa Centre*	*1600*	*31.3*	*6.3*	*50.0*
650 - Plateau	*625 - Hull Périphérie*	*1600*	*87.5*	*0.0*	*6.3*

Origin	Destination	Total	AutoDriver Share	AutoPass Share	Transit Share
820 - Gatineau Est	*001 - Ottawa Centre*	*1600*	*31.3*	*12.5*	*62.5*
820 - Gatineau Est	*600 - Île de Hull*	*1600*	*37.5*	*12.5*	*43.8*
140 - Alta Vista	*200 - Merivale*	*1500*	*66.7*	*13.3*	*13.3*
260 - Bayshore / Cedarview	*140 - Alta Vista*	*1500*	*86.7*	*0.0*	*6.7*
500 - Kanata / Stittsville	*050 - Ottawa Inner Area*	*1500*	*60.0*	*6.7*	*33.3*
700 - Aylmer	*700 - Aylmer*	*1500*	*80.0*	*6.7*	*0.0*
240 - Ottawa West	*200 - Merivale*	*1400*	*50.0*	*14.3*	*7.1*
300 - Orléans	*600 - Île de Hull*	*1400*	*57.1*	*0.0*	*35.7*
425 - South Nepean	*240 - Ottawa West*	*1400*	*57.1*	*7.1*	*35.7*
500 - Kanata / Stittsville	*140 - Alta Vista*	*1400*	*78.6*	*7.1*	*14.3*
500 - Kanata / Stittsville	*240 - Ottawa West*	*1400*	*71.4*	*14.3*	*14.3*
300 - Orléans	*240 - Ottawa West*	*1300*	*69.2*	*7.7*	*23.1*
400 - South Gloucester / Leitrim	*140 - Alta Vista*	*1300*	*76.9*	*7.7*	*7.7*
650 - Plateau	*600 - Île de Hull*	*1300*	*30.8*	*7.7*	*53.8*
820 - Gatineau Est	*625 - Hull Périphérie*	*1300*	*76.9*	*15.4*	*7.7*
050 - Ottawa Inner Area	*240 - Ottawa West*	*1200*	*41.7*	*16.7*	*33.3*
050 - Ottawa Inner Area	*600 - Île de Hull*	*1200*	*33.3*	*8.3*	*25.0*
120 - Beacon Hill	*120 - Beacon Hill*	*1200*	*66.7*	*0.0*	*0.0*
300 - Orléans	*200 - Merivale*	*1200*	*83.3*	*0.0*	*8.3*
360 - Rural Southeast	*140 - Alta Vista*	*1200*	*83.3*	*8.3*	*0.0*
425 - South Nepean	*050 - Ottawa Inner Area*	*1200*	*66.7*	*0.0*	*33.3*
120 - Beacon Hill	*140 - Alta Vista*	*1100*	*81.8*	*9.1*	*9.1*

Origin	Destination	Total	AutoDriver Share	AutoPass Share	Transit Share
180 - Hunt Club	*050 - Ottawa Inner Area*	*1100*	*54.5*	*0.0*	*36.4*
240 - Ottawa West	*140 - Alta Vista*	*1100*	*63.6*	*0.0*	*27.3*
450 - Rural Southwest	*450 - Rural Southwest*	*1100*	*90.9*	*0.0*	*0.0*
560 - Rural West	*560 - Rural West*	*1100*	*90.9*	*9.1*	*0.0*
750 - Rural Northwest	*750 - Rural Northwest*	*1100*	*90.9*	*9.1*	*0.0*
050 - Ottawa Inner Area	*100 - Ottawa East*	*1000*	*40.0*	*0.0*	*50.0*
100 - Ottawa East	*200 - Merivale*	*1000*	*60.0*	*10.0*	*30.0*
200 - Merivale	*500 - Kanata / Stittsville*	*1000*	*80.0*	*0.0*	*10.0*
360 - Rural Southeast	*360 - Rural Southeast*	*1000*	*80.0*	*0.0*	*0.0*
700 - Aylmer	*625 - Hull Périphérie*	*1000*	*80.0*	*20.0*	*10.0*
800 - Pointe Gatineau	*050 - Ottawa Inner Area*	*1000*	*60.0*	*10.0*	*30.0*
800 - Pointe Gatineau	*820 - Gatineau Est*	*1000*	*100.0*	*0.0*	*0.0*
840 - Rural Northeast	*625 - Hull Périphérie*	*1000*	*90.0*	*10.0*	*0.0*
840 - Rural Northeast	*840 - Rural Northeast*	*1000*	*90.0*	*0.0*	*0.0*

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