

The Tenth Big Move: Towards the Optimal Modal Split

by

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## **AUTHOR'S DECLARATION**

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

## ABSTRACT

The Greater Toronto and Hamilton Area (GTHA) is currently experiencing a crippling traffic congestion problem. With an average daily commute time of 82 minutes, residents experience some of the longest commute times in North America (Metrolinx, 2008c, 2013a). The region is also facing explosive growth in its population and economy. It is expected to grow from roughly 6.5 million people today to 9 million by 2031. Several forces have contributed to the current congestion problem including: population growth, a lack of spending on transit infrastructure and operations, low-density development and a lack of co-ordination between land-use and transportation planning.

This study asks: *as population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?*

The problem is a wicked problem, and is essentially the symptom of several other problems. To address the complexity, a qualitative mixed-methods approach has been applied. Key informant interviews were held with planners, politicians, business leaders, and transportation advocates to understand local impacts, solutions and barriers. Next, a Policy Delphi was utilized to seek input from a panel of international experts on best practices. Finally, a local Design Charrette was held to seek creative ideas from a group of professionals and other participants.

This study finds strong local support for the priority actions referred to as the Nine Big Moves of the regional transportation plan. However it also identifies a gap, in that the plan is missing a transportation demand management (TDM) policy with a fiscal element to manage demand. Without this, the supply-side techniques proposed by the Big Move will have limited success in mitigating congestion in a growing region.

**RECOMMENDATIONS:** This study recommends the pursuit of a road pricing policy to be included in transportation plans – a policy which would replace the gas tax and charge road users a varying rate (peak/off-peak) for every kilometer that they drive. It would act as a dis-incentive to auto use, encouraging a shift in trips to alternate modes, routes, or times of the day. As a bonus, it could also generate funds to be re-invested in the transportation network. This would be the *tenth* Big Move which pulls together the other nine priority actions already in play. It is recommended that such a program could be implemented through a trial, first initiated with a pilot.

## ACKNOWLEDGEMENTS

*“Live as if you were to die tomorrow. Learn as if you were to live forever.” – Mahatma Gandhi*

In the time span invested in this master’s degree, I have done exactly that. With sincere gratitude, I wish to acknowledge a few of the many people who have not only provided academic support and encouragement, but enriched my life in many ways.

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Second, a heart-felt thank you goes out to my committee members: Dr. Jeff Casello and Dr. Pierre Filion. Thank you for working with me on tight timelines, your thoughtful review and comments. To the rest of the faculty and staff within the School of Planning, and our library staff whom I have had the privilege of working with: thank you for everything I have learned with your assistance.

Third, to the participants of my study: you are all very successful and distinguished individuals whose thoughts and opinions I highly respect. Thank you for taking time out of your busy days, and for your insights. I hope I have represented your collective views accurately, and have put forth recommendations that will be useful in addressing this problem of congestion.

To my closest friends: you are all amazing people whom I am truly fortunate to have in my life. To Bob, James, and Zaker: thank you not only for referring me into the program, but for your support along the way. A special thank you to Rob: perhaps one of the greatest benefits of this experience has been gaining you as both a colleague and friend. Thank you for being a sounding board for many of my ideas these last couple years.

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## DEDICATION

This work is dedicated to two remarkable women: the one who gave me life, ambition, and the ability to dream; and the one whom I will spend my life with.

Mom,

I have often said that if I could pursue my work with your level of dedication, there is nothing that I could not achieve in this world. I think back to your struggles I witnessed growing up: going back to school while raising four kids, re-entering the workforce, and working two jobs many-a-times. You led by example, and taught me more than a thousand journal articles or multiple degrees ever could. Thank you from the bottom of my heart for all that you've done.

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You met me at an interesting point in my life to say the least, while I was juggling many things. Your patience, relentless support and most importantly your love got me through all this. You are truly amazing in every possible way – thank you for being by my side. They say life is not about the destination, it's about the journey: I can't wait to take this journey with you.

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## Chapter 1 – Introduction

### 1.1 Introduction

Transportation is often referred to as the “lifeblood of cities” (Vuchic, 1999). This is because our transportation networks provide the essential link among our daily activities, and in the long run this shapes our cities. Extending this analogy, the Greater Toronto and Hamilton Area (GTHA) is experiencing high blood pressure leading to a blood clot, and potentially worse. The region is presently experiencing a crippling traffic congestion problem that is harming the economy, the environment, health and quality of life for the city-region’s residents.

This is a result of a transportation system that has not kept up with the largest and fastest growing metropolitan region in the country. The system is not balanced. Decades of under-investment in high capacity transit, and poor land use and transportation planning coordination, compounded with rapid population growth have left roadways clogged and inefficiently used. It is no wonder that transit expansion was *the* number one issue in the most recent 2014 municipal election (Toronto Region Board of Trade, 2014).

In 2008 Metrolinx – the region’s transportation authority – released its regional transportation plan (RTP) entitled *The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area*. This plan included ten strategies, and nine supporting priority actions referred to as “Big Moves” (Metrolinx, 2008c). A cornerstone of the plan is intent to build over 1,200 kilometres of rapid transit, tripling what existed at the time of its writing, so that over 80 per cent of residents will live within two kilometres of a rapid transit stop. Supporting policies include active transportation expansion, fare integration, transportation demand management (TDM) and other common transportation policies. This study was interested in determining how these policies will work to mitigate congestion in the GTHA.

### 1.2 Study purpose and research questions

This study examines the problems posed by peak period traffic congestion in the Greater Toronto and Hamilton Area, and explores solutions to help mitigate this problem as the region continues to grow in population. The intent is to identify solutions which can encourage a shift in modal split – solutions which encourage travellers to select a more efficient mode *more often* (not necessarily to give up their car entirely). There is a well-developed body of literature on the forces that cause traffic congestion; its

negative impacts on the economy, health of residents, and the environment; and mitigating techniques that manage for the supply and demand of road access. The literature however, lacks a local perspective and sensitivity to issues on the ground that enable or hinder the most effective policies from implementation.

The core research question this study seeks to address is:

**As population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?**

Sub-questions to support a response include:

- What are the impacts of traffic congestion?
- What are the causes of traffic congestion?
- What opportunities exist to encourage a shift from auto use to more efficient modes?
- What policy gaps (if any) exist in the regional transportation plan for the GTHA?
- What are the barriers to implementation of these policies?
- How can we overcome these identified barriers?

### 1.2.1 Grounding theories

The literature reveals that peak period traffic congestion is the result of several forces. First, Wardrop's First Principle of Traffic Flow Distribution states that each traveler will select the mode offering the lowest disutility to them – lowest cost, fastest travel time, greatest reliability, and safety (Vuchic, 1999). This individual pursuit leads to many travellers selecting to drive alone, at around the same time, along the same routes – overloading the transportation network and causing congestion. Wardrop's Second Principle states that the Social Optimum (SO) distribution of travelers is achieved when passenger distribution achieves a minimum average disutility. This occurs when the entire transportation network – including the road system, transit network and active modes are utilized in the mix that gets the most people to their destinations in the fastest, lowest cost, and most reliable means possible. The usual argument for expansion of transit networks is that transit is a more efficient mode of moving people, and the expectation is that by transporting a greater proportion of people by transit, congestion on the roads would ease.

However, theories offered by Downs (2004a, b, c) and Thomson have shown why extensive expansions of both road and transit networks in major cities around the world have failed to reduce traffic

congestion. The theory of triple convergence offered by Downs (2004a) shows that latent demand exists for the road network during the peak hours, and road capacity made available through an increase in transportation network supply is quickly utilized by other travelers who change their mode, route, or time of travel, returning the roadway to its previously congested state. Thomson's golden rule of urban transport further describes why transit expansion alone does not solve traffic congestion: "the quality of peak-hour travel by car tends to equal that of public transport" (Mogridge, 1997, p. 7). The speed of a transit trip acts as a regulator for overall travel time in the city. As long as a car trip is even slightly faster there will be enough travellers willing to switch from taking transit to driving. Building on Downs' theory, this force works to re-congest the road system.

This study draws upon these theories and expert input – both at the local and international level – to identify a policy gap in the Big Move, and recommend a policy to fill this gap.



### 1.3 Case study context

The Greater Toronto and Hamilton Area (GTHA) is Canada’s largest urban region. It is located in southern Ontario along the shore of Lake Ontario, and consists of two single-tier municipalities (Toronto and Hamilton), four regional municipalities (Halton, Peel, York, and Durham) and twenty four lower-tier municipalities (Map 1). While the City of Toronto reigns as the employment power-house, the GTHA is a poly-centric region with specialized clusters of employment areas such as a technology cluster in Markham to the north-east of the city, pharmaceuticals and banking in the west, and others throughout the region (Habib, 2014).

The population of the region is roughly 6.5 million people, forecasted to grow to 9 million by 2031, and further to 10 million by 2041 (Ontario Ministry of Infrastructure, 2006, p. 65). According to the Transportation Tomorrow Survey, the population averages 2.4 trips a day, 71 percent taken by car, 17 percent taken by transit, and 8 percent by walking or cycling (Figure 1). Unfortunately, the trend has also shown an increasing reliance on the automobile – between 1986 and 2006 auto trips grew by 56 percent in comparison with a population growth of 45 percent (Metrolinx, 2008c, p. 5). One factor which has been attributed to this increasing reliance on car travel is a low-density settlement pattern that has evolved over the last three decades – not unlike many other regions in North America. Another has been a lack of investment in high order transit to provide residents with travel choice.

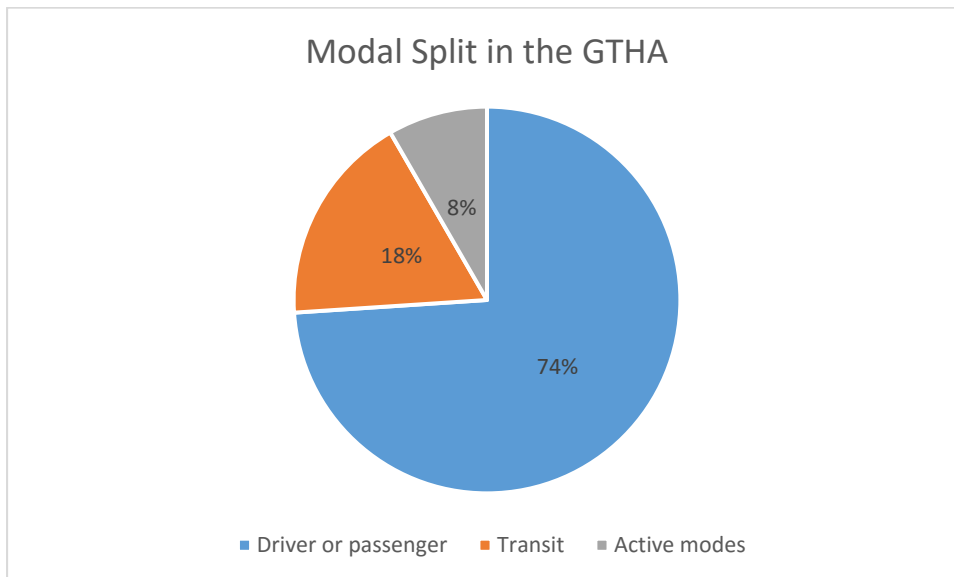
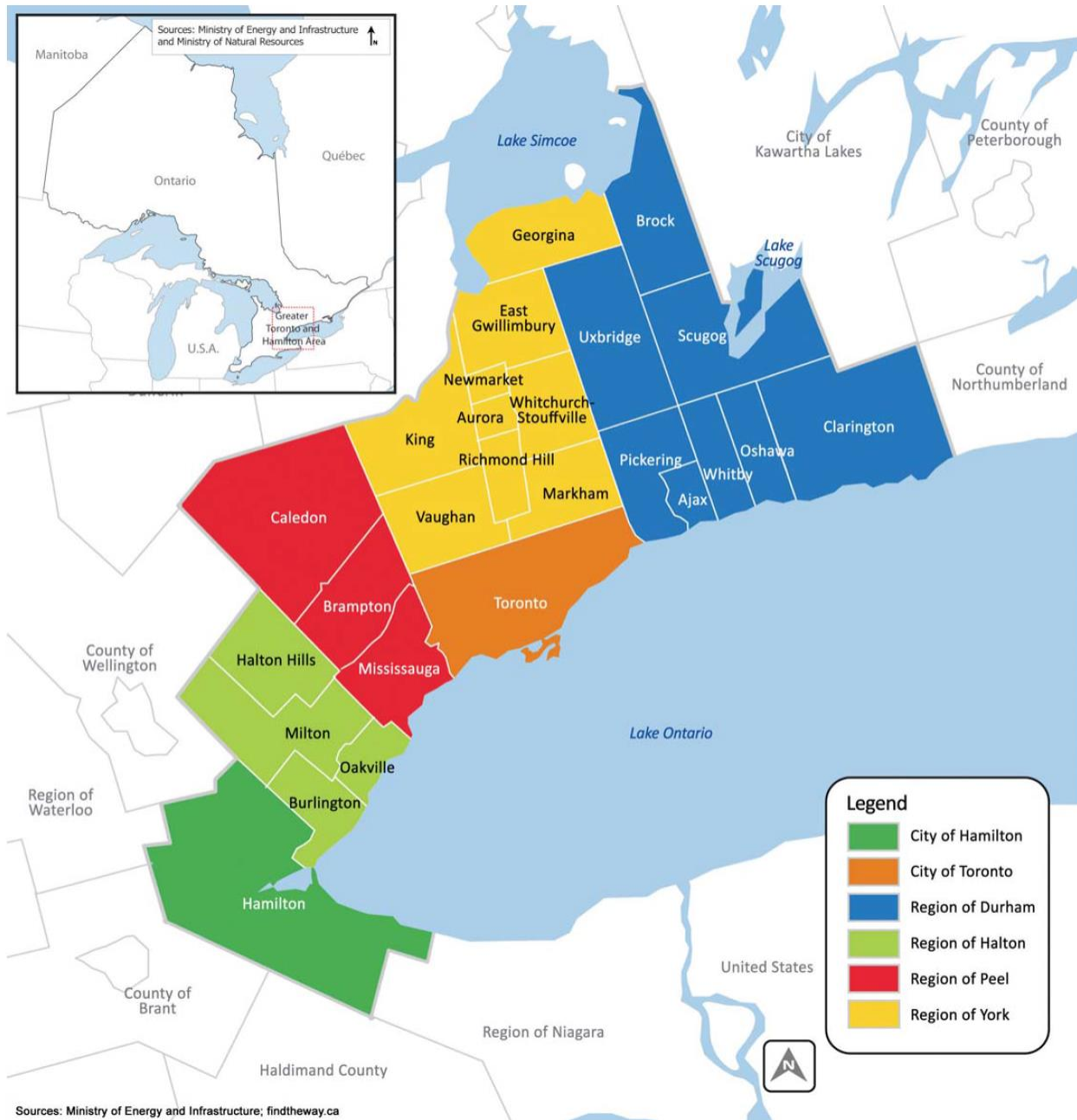


Figure 1 Modal split in the GTHA  
Source: data from Transportation Tomorrow Survey (University of Toronto, 2011, p. 6)



Map 1 Greater Toronto and Hamilton Area  
 Source: Metrolinx (2008c, p. 4)

Regional travel needs are currently served by a network of highways, and a mix of poorly connected transit networks (Map 2). Several highways provide east-west connectivity including the Queen Elizabeth Way (QEW) and the Gardiner Expressway to the south, Highway 403 and Highway 401 centrally through the region, and the Highway 407 Express Toll Route to the north. North-south travel is served by a few additional highways including Highway 410, Highway 427 and the Don Valley Parkway (DVP). All highways are public roads with “free” access with the exception of Highway 407 which is privately-owned, toll highway (Residential and Civil Construction Alliance of Ontario, 2011; Srivastava & Burda, 2015). It was originally built by the provincial government, and then sold to an investor. The highway was viewed to be innovative solution when it opened because usage is tracked through photographs of vehicle license plates or on-board transponders, and drivers don’t need to stop to pay a toll to access it. The toll varies depending on the time of day.

Transit offerings include a regional rail and bus network provided by GO Transit (under Metrolinx), and local transit offerings by nine separately-governed transit agencies. The Toronto Transit Commission (TTC) is the only local transit provider to include higher-order rail offerings (subway and streetcar) in their service mix, although this will change in the next decade as other municipalities have plans to institute light rail (LRT) projects.

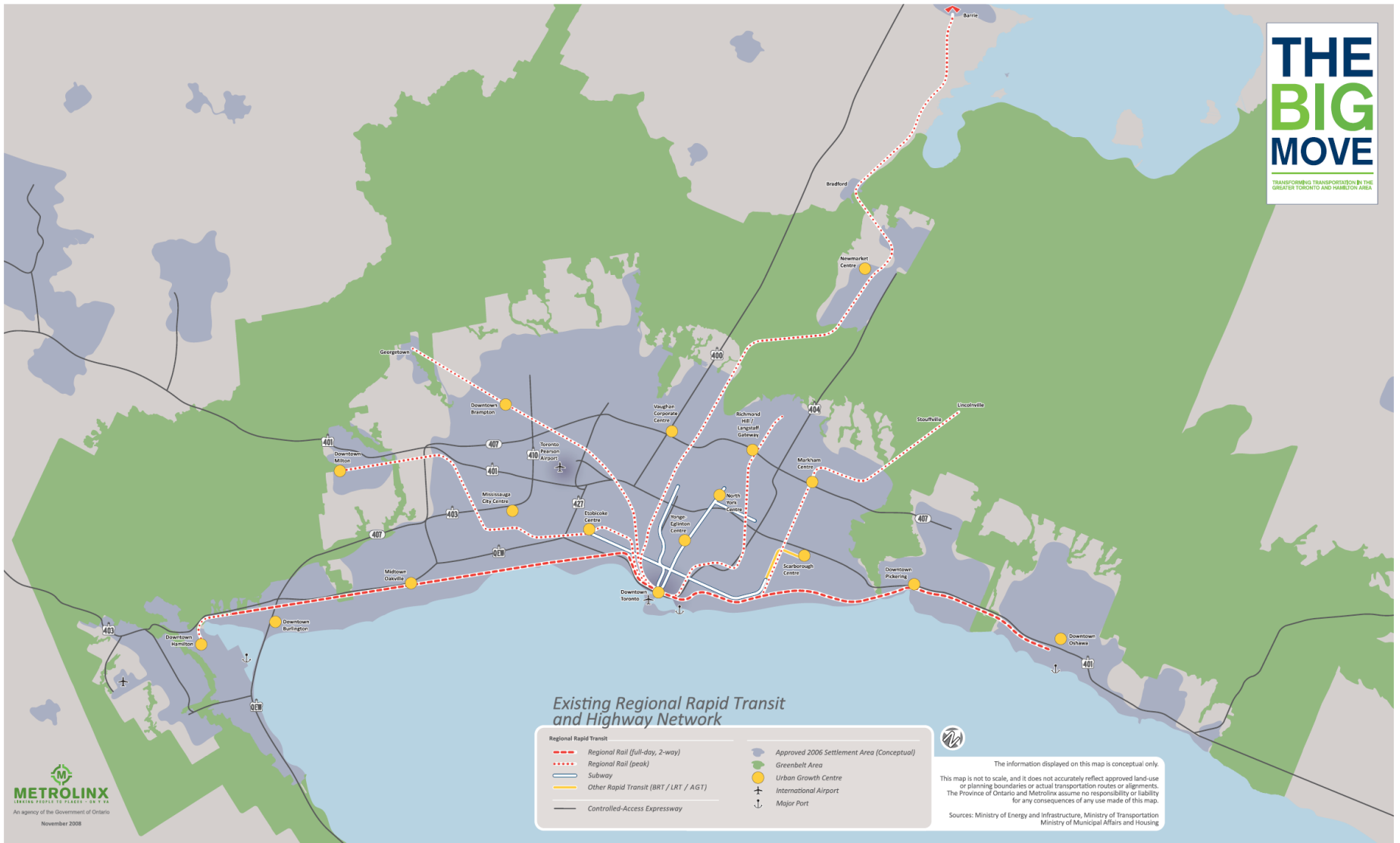
The regional transportation plan (The Big Move) produced by Metrolinx (2008c) includes several key goals:

- Build an additional 1,275km of rapid transit<sup>1</sup> service to the region, more than tripling the 500km that currently exists
- Increase the percentage of people living within 2km of a rapid transit stop from 42% to 81%
- Encourage a modal shift:
  - Increase the proportion of morning rush hour trips taken by transit from 16.5% to 26.3%
  - Increase proportion of morning rush hour trips taken by active modes from 9% to 12.5%
- Reduce the average time spent commuting from 82 minutes to 77 minutes

The plan has a budget of \$50 billion, with a significant focus on expanding transit infrastructure. While not fully-funded, there have been recent announcements by the federal and provincial governments that have committed funding for projects identified over the next decade. Now, if we build it will they come? And will the transit expansion effectively reduce traffic congestion?

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<sup>1</sup> Rapid Transit: Transit service separated partially or completely from general vehicular traffic and therefore able to maintain higher levels of speed, reliability and vehicle productivity than can be achieved by transit vehicles operating in mixed traffic (Metrolinx, 2008c, p. 88).



Map 2 Existing regional rapid transit and highway network in the GTHA  
Source: Metrolinx (2008c, p. 102)

## 1.4 Thesis Organization

The remainder of this thesis is structured as follows. **Chapter Two** provides a detailed review of relevant literature on the topic of traffic congestion causes, impacts, and available solutions attempted in other cities around the world. **Chapter Three** provides a document analysis of the planning framework in Ontario, including the PPS, the Green Belt, the Growth Plan, Metrolinx’s Big Move, and select municipal transportation plans. **Chapter Four** summarizes the study methodology, data collection procedures, and analysis methods to respond to the research question. **Chapter Five** presents findings of the three primary research methods: key informant interviews, the Policy Delphi, and the Policy Design Charrette. **Chapter Six** discusses the insights provided by this research, and presents a recommendation to fill the identified policy gap.

## Chapter 2 – Literature Review

### 2.1 Introduction

This study asks: *as population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?*

This chapter responds to three sub-questions to help understand the problem, and explore a number of solutions offered in the literature:

- What are the impacts of traffic congestion?
- What are the causes of traffic congestion?
- What opportunities (policies) exist to encourage a shift from auto use to more efficient modes?

This chapter establishes the theoretical framework which will be utilized to evaluate the Big Move and other transportation plans on their potential to reduce traffic congestion in the face of continued population growth in the region. It begins by highlighting the significance of the traffic congestion problem and its impacts to the region. Several theories are presented to explain the dynamics of traffic flow, human behavioural tendencies, and economic forces. Common solutions tried elsewhere are introduced for discussion. The chapter concludes that an effective traffic congestion strategy must include both supply-side and demand-side tactics, as well as a fiscal policy to mitigate against induced demand.

## 2.2 The Congestion Problem

Traffic congestion is defined simply as a state where demand for a road system exceeds the capacity for which it was designed, and the flow of traffic has been considerably reduced (Dachis, 2013; Weisbrod, Vary, & Treyz, 2003). We have all experienced this phenomenon we call being “stuck in traffic,” resulting in considerably longer travel times than would occur in free-flowing traffic. The impacts are grave and are well beyond the matter of lost time. There are additional economic, health, and environmental effects. This section will explore these costs, and some of the forces which have led to the high congestion levels experienced in the GTHA today.

### 2.2.1 Congested traffic moves fewer cars and people

Several theories and empirical observations of traffic flow demonstrate that the throughput of a lane *decreases* during congested conditions. Lighthill and Whitham (1955) describe this pattern as follows: as additional vehicles join a lane they can generally do so without interrupting free flowing speeds and the throughput of the lane increases, up to a point. Beyond this point, as additional vehicles enter the roadway average speed starts to decline. Eventually, enough vehicles enter the roadway that the average speed slows to congested levels. At these levels not only are individual drivers moving slower and taking longer to arrive at their destinations, but the total volume of vehicles moved per hour is *less* than at free flowing speeds (Figure 2).

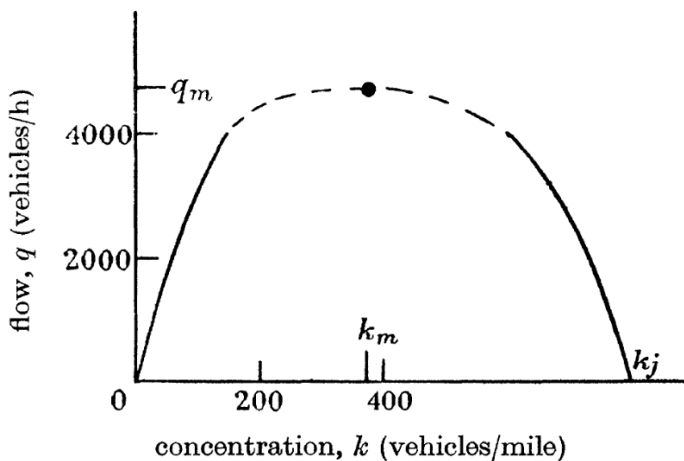


Figure 2 Flow-concentration curve for traffic flow

Source: Lighthill & Whitham, 1955, p. 323

### 2.2.2 The Economic impact of traffic congestion

The costs of traffic congestion in the Greater Toronto and Hamilton Area (GTHA) are incredibly high. To put a price tag on it: the region loses roughly \$11 billion per year (Dachis, 2013). With such a high cost, the Toronto Region Board of Trade reports that traffic gridlock is the number one public policy concern for the region's businesses (2014). On an individual level, the Pembina Institute estimates that these costs can reach \$800 a year in lost time and wages, plus an additional \$700 wasted on gas while idling in gridlock (2014). This is a complex area to research, as individual business managers typically don't have a line item to track costs of congestion (Weisbrod et al., 2003). To understand the impact we must look at the current opportunity costs and impact to productivity, employment and global competitiveness.

#### **Productivity**

Economic theory shows that all economic activity is dependent on access to workers, input materials, and customers (Alstadt, Weisbrod, & Cutler, 2012). There is an obvious link between transportation networks and economic performance, because clogged street networks and inefficient transit networks limit business access to these critical materials and people. In contrast, an efficient network can greatly expand the reach of a business to a greater quantity and higher quality of skilled staff, material, and customers.

Productivity is a ratio of business output to production cost. These costs include staff, material, utilities, transportation and other services (Alstadt et al., 2012). Improving productivity would mean either the ability to produce more with the same inputs, lowering the cost of the inputs, or both. Improving the transportation network and its efficiency increases connectivity and market access for businesses to thrive.

A congested transportation network can reduce the ability of employers to attract skilled employees (best matching of skills), by reducing the catchment area for employees. There is a limit to the amount of time people are willing to commute on a daily basis for work – on average this caps out at about 40 minutes per one way commute (Alstadt et al., 2012). Statistics Canada found that the average daily two-way commute time in the Toronto CMA had already hit 79 minutes in 2005, and increased to 81 minutes by 2010 (Statistics Canada, 2005, 2011). Greater levels of road congestion increases travel time, which in turn decreases the distance people are willing to travel for work, thus there will be fewer people in the catchment area of any one business if the intensity of congestion continues to increase. With a



reduced selection of talent, employers may select less skilled or less qualified employees, reducing the quality or quantity of their output (Alstadt et al., 2012).

The impact of a reduced catchment area for talent is especially relevant for knowledge economy sectors, which rely on the agglomeration benefits often found in large cities. Much has been written about the effect of agglomeration economies, and their relationship with transportation (see for example: Dachis, 2013; Gill, Iacobacci, & Owusu, 2011; Majcherkiewicz, 2013; Sweet, 2013). In large cities, clusters of companies form in specific sectors. They benefit from access to a greater talent pool, capital, and knowledge sharing (Sweet, 2013). Essentially, firms can achieve economies of scale because they are located within easy access to many of their key inputs, even if they are a smaller firm. This sector relies on heavily specialized skill sets, drawn from as wide a catchment area as possible. Traffic congestion reduces the catchment area, thus reducing the economic effectiveness of a region.

Traffic congestion also impacts goods movement and the productivity of manufacturing, retail, and construction industries. This is therefore not just a problem for knowledge sector clusters in downtown Toronto, Markham and Mississauga, but also for warehousing and other sectors in the surrounding region. Even the process of building more compact and sustainable communities can be hindered with congestion that slows the movement of construction materials to the work site.

### **Unemployment**

Related to the previous discussion on productivity is the relationship of traffic congestion to unemployment. As discussed, increased congestion reduces the distance people are willing to travel to work and reduces the number of employees an employer can access. This leads to a reduction in the optimization of skills matching and can also lead to a greater portion of workers unable to find work to match their skill set altogether (Toronto Region Board of Trade, 2014).

Congestion can slow job growth – one U.S. study found that job growth slows when congestion levels raise above 4.5 minutes of delay per one-way auto commute (Sweet, 2013). This is concerning due to the fact that three areas of the GTHA – the City of Toronto and regions of Peel and York – were already exceeding this threshold in 2006, as shown in Table 1. Sweet’s study extrapolated the results for a hypothetical scenario, and estimated that job growth could cease once a city reached a commuter delay of 15 minutes per one-way commute.

REGION NAME	HOURS PER DAY	HOURS PER YEAR	MINUTES PER DAY, PER COMMUTER	HOURS PER YEAR, PER COMMUTER
City of Hamilton	9,002	2,340,523	4.8	21
Halton Region	24,314	6,321,584	7.8	34
Peel Region	88,844	23,099,566	11.1	48
City of Toronto	163,319	42,463,052	15.6	67
Region of York	64,596	16,794,912	12.9	56
Durham Region	30,419	7,909,060	8.8	38
<b>GREATER TORONTO AND HAMILTON AREA (GTHA)</b>	<b>357,759</b>	<b>93,017,276</b>	<b>11.5</b>	<b>50</b>

Table 1 Extent of excess travel delay in the GTHA, 2006

Source: Metrolinx (2008b, p. 12)

### **Regional and global competitiveness**

Global cities compete with each other for business and talent. The economic competitiveness of the GTHA (and other large Canadian cities) is dependent on access to resources and mobility (Roschlau, 2008). Metrolinx, the Transit Investment Advisory Committee, and many think tanks and trade organizations have highlighted competitiveness as a risk factor with continued traffic congestion (Alstadt et al., 2012; Metrolinx, 2013b; Schabas, 2013; Sweet, 2013; Toronto Region Board of Trade, 2014; Transit Panel, 2013c). The arguments include an impeded ability to attract international talent, and the free flow of goods through our transportation system. Access to transportation is one of the key decision points firms use when deciding where to place new office locations. The creative class is no longer tied down to the place they were born or educated, they will often seek to find the best job in any city in the world that meets their needs.

### **Responses of businesses to congestion**

Most business managers may view congestion in the region as a pervasive issue – a fact of life to deal with. To adapt to increasing levels of congestion, there are a number of responses businesses can take. With increasing costs of obtaining specialized labour or input materials, some businesses may shift their product mix, technology and labour mix, size of delivery areas, delivery schedule, or pricing policies. Others may choose to serve smaller, or more specialized markets. These adjustments only represent mitigating efforts – a loss of business productivity and reduced economies of scale can still have a dampening effect on the economy (Weisbrod et al., 2003).

### 2.2.3 The Health Impacts of Traffic Congestion

While the economic costs of congestion are large, considering only these direct costs would underestimate the overall societal impacts (J. I. Levy, Buonocore, & von Stackelberg, 2010). Traffic congestion can significantly increase population health risks. For drivers and passengers, the increased time commuting competes for time with family and more active pursuits, while the experience of being stuck in traffic adds to daily stress levels. Routine exposure to traffic congestion can impact mood, physiology, and task performance for drivers (Stokols, Novaco, Stokols, & Campbell, 1978). For both drivers and people living near major roadways, increased concentrations of vehicle emissions degrades ambient air quality increasing short term morbidity and long-term mortality risks (Zhang & Batterman, 2013).

#### **Driver and commuter stress**

The impacts of long commutes in general (Feng & Boyle, 2013), and commutes in consistently congested conditions (Evans, Wener, & Phillips, 2002; Levy et al., 2010) have been shown to increase stress, and have adverse mental health effects. Greater levels of commuting distance and time have been shown to have a strong correlation with increased systolic and diastolic blood pressure. This can impact mood upon arrival at work or home, induce feelings of annoyance, and create task performance deficits (Stokols et al., 1978).

Unpredictability in commute times increases this level of stress (Evans et al., 2002). In some cases, drivers may benefit from a feeling of control in their ability to pick an alternate route to keep moving or reduce their travel time. However, in other cases they are simply stuck on the highway. Public transit users may find delays equally frustrating, but may mitigate these delays and find them more acceptable if they are able to use the time productively for work or leisure (Feng & Boyle, 2013).

Although commuters may develop other coping methods over time, Feng and Boyle confirm in a 16-year longitudinal study in England the pervasive impacts of long commute time on mental health (2013). Their study involved the General Health Questionnaire (GHQ) with participants self-reporting measures of psychological distress. They found elevated risks of mental distress for car drivers who commuted 30 minutes or more, and public transit users commuting greater than 60 minutes. The stress of delays is borne disproportionately more by women drivers, potentially because women still bear a greater proportion of childcare and household responsibilities – travel delays for example add to the stress of picking up a child on time from daycare. Tennant is cited by Feng and Boyle, showing the most likely

adverse psychological outcome of work stress is depression – a serious outcome that should not be ignored.

### **Obesity**

Traffic also leads to indirect impacts on health. There is strong evidence correlating a lack of exercise to obesity (Banister, 2008). Long commutes and the design of the built environment which encourages a reliance on the car have in turn been linked to an increase in obesity rates (Ewing, 2013; Pembina Institute, 2011). While someone who commutes by car to work still has the option to incorporate exercise in their day, go to the gym, go for a walk or a run, the extended time delays posed by traffic congestion reduce the available time for these activities. Further, if commuters are tired or stressed as discussed above, they are less likely to fit physical activity into their day.

### **Exposure to emissions**

Many studies have confirmed that high concentrations of vehicle tailpipe emissions are detrimental to our health. They are a source of a number of air pollutants in urban areas, including: carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NO<sub>x</sub>), and particulate matter (PM). The exposure to these pollutants increase risks of morbidity and mortality for drivers, commuters, and those living or working near roadways (Zhang & Batterman, 2013). For example, a study in Southeast Toronto found exposure to PM<sub>2.5</sub> to have a positive correlation to hospital admission rates for various respiratory issues, including: asthma, bronchitis, pneumonia, and chronic obstructive pulmonary disease (Buckeridge et al., 2010). The World Health Organization found the impact of air pollution in Europe to be comparable to that of all fatalities due to traffic accidents, as a result of increased risks of cardiopulmonary and respiratory diseases (WHO, 2005). The risk of exposure is not avoided by travelling in a car with windows rolled up – consider one European study which showed that exposure to vehicle commuters was actually *greater* than cyclist commuters (Karanasiou, Viana, Querol, Moreno, & de Leeuw, 2014).

During congested traffic conditions the impact of air pollution on local environments is exacerbated for a few reasons. First, for commuters, their exposure to pollutants is increased with increased travel time. Second, the change of driving patterns (more stop-and-go motion) increases emissions as vehicles accelerate, slow down, and idle. Vehicle emissions are greater (per unit of distance) while accelerating versus cruising. Third, the lower speeds in congested traffic reduce vehicle-induced turbulence and consequently reduces the dispersion of pollutants. (Zhang & Batterman, 2013) These risks will vary by

local conditions – traffic volume, vehicle mix, density, urban form, weather, and other factors (Downs, 2004a).

The congestion impacts on health have been researched to a lesser extent than its economic impacts, however the available research does indicate that the potential health risks are significant enough to warrant inclusion in policy discussion for congestion mitigation (Feng & Boyle, 2013; Levy et al., 2010; Stokols et al., 1978).

#### 2.2.4 The environmental impacts of congestion

##### **Air pollution and climate change**

Vehicle emissions contribute various pollutants and carbon dioxide (CO<sub>2</sub>) to the atmosphere. Increased levels of carbon dioxide are positively linked to climate change. The impact of climate change is presently being experienced around the globe, and will only continue to get worse over the next century (IPCC, 2014). The three decades leading up to 2012 were likely the warmest 30 year period in the last 1400 years. Sea levels have risen in the twentieth century by about 19cm, and observed changes in climate – from more frequent and intense storms, to temperature extremes – have been unprecedented in decades (IPCC, 2014).

Transportation is a significant contributor of these emissions. Roughly 33% of greenhouse gasses emitted in Ontario comes from trucks, cars, ships, buses and airplanes (Metrolinx, 2008c). Total vehicle emissions are a factor of VKT and average vehicle speed. As previously pointed out in the discussion of vehicle emissions and health impacts, emissions vary greatly depending on average vehicle speed and traffic patterns. As congestion increases, average speed reduces, and individual vehicle speeds fluctuate with the constant acceleration and deceleration associated with stop-and-go traffic. These events cause a rise in CO<sub>2</sub> and other emissions relative to free-flowing traffic. At the other end of the spectrum, emissions also increase with excessive speed. The ideal is traffic moving at smooth, moderate speeds. Traffic congestion exacerbates the expulsion of greenhouse gas emissions and therefore climate change impacts of travelling by car. (Acutt & Dodgson, 1997; Barth & Boriboonsomsin, 2008)

Technical improvements to vehicles – making them lighter, smaller, more fuel efficient, or even moving to hybrid or electric vehicles – are unlikely to make a large impact on emissions reductions in the near future (Barth & Boriboonsomsin, 2008). It will take a number of years for the entire vehicle fleet to turnover, and in the meantime the volume of cars being added to our roadways are increasing. Even if

we do arrive at a point in the future where transportation by private vehicle produces zero greenhouse gas emissions, there are still a number of environmental concerns with high volumes of travel in private cars, especially single occupancy vehicles.

### **Water pollution**

Storm water pollution is increased with greater reliance on automotive transportation, due to runoff from the impervious surface of asphalt and concrete roadways (Newman & Kenworthy, 1996; Topalovic, Carter, Topalovic, & Krantzberg, 2012a). Even with zero-emission cars in the future (for example, the prospect of solar-powered cars), automobile use will still contribute soil and water pollutants including: road salts, melters, tire and brake dust, windshield washer fluid and other chemicals entering the waste water system. During severe storms, untreated sewage is added to the problem because many sewer systems can not manage the volume of water from runoff from impervious street surfaces and are often forced to mix untreated sewage and storm water through a bypass releasing it directly into the nearest waterway (Pollution Probe, 2013). To the extent that traffic congestion induces construction of additional road capacity, it is exacerbating the problem of water pollution caused by our roadways.

### **2.2.5 Land use implications**

Across North America, the car has transformed our cities. In catering to the needs of the driver, we have expanded our cities primarily with low-density, suburban form (suburban sprawl). It is a phenomenon that amplifies all of the problems mentioned above. The problem is not the automobile itself, but rather an overuse and dependence on it (Newman & Kenworthy, 1996).

Early North American cities were walking cities – similar to old Western European cities. In the latter part of the 19<sup>th</sup> century, they evolved with trains and trams enabling them to grow outward and create nodes like small ‘cities’, again with walkable neighbourhoods. Beginning around World War II however, and accelerating after it, the automobile became the dominant transportation choice. The car made it possible to develop in any direction, low-density housing became feasible, and the result is the sprawling suburban municipalities surrounding most North American cities (Newman & Kenworthy, 1996).

Some of the best farmland in all of Canada exists in southern Ontario and has been paved over due to urban expansion (Francis et al., 2012). This referenced study found that Ontario converted more than 20,000ha or 4.6% of productive agricultural lands over the two decades leading up to 2006. This is

troubling because three quarters of Canada's dependable agricultural land is concentrated between Saskatchewan, Alberta and Ontario. Conversion of farmland to suburban land uses threatens the sustainability of both local and national food supply. Again, to the extent that traffic congestion induces the building of additional road capacity, it exacerbates this problem.

### 2.2.6 Summary of congestion impacts

As discussed in this section, severe recurring traffic congestion negatively impacts the economy of a region, the health of its residents, and the environment. While *some* congestion is a sign of a prosperous economy, excessive congestion limits the competitiveness of a region by limiting the optimal matching of skills, reducing productivity, and can even hurt employment levels. High congestion levels increase the volume of pollutants in the air, and slow moving traffic concentrates these harmful emissions in local areas – leading to respiratory, heart health, and other issues. The natural environment is harmed through air pollution, and also through the conversion of land for highways and low-density land-uses known to fuel congestion.

Traffic congestion in the GTHA is an \$11 billion annual problem that must be addressed for the well being of current and future residents of the region. It is a planning problem with wide reaching social implications.

## 2.3 What causes traffic congestion?

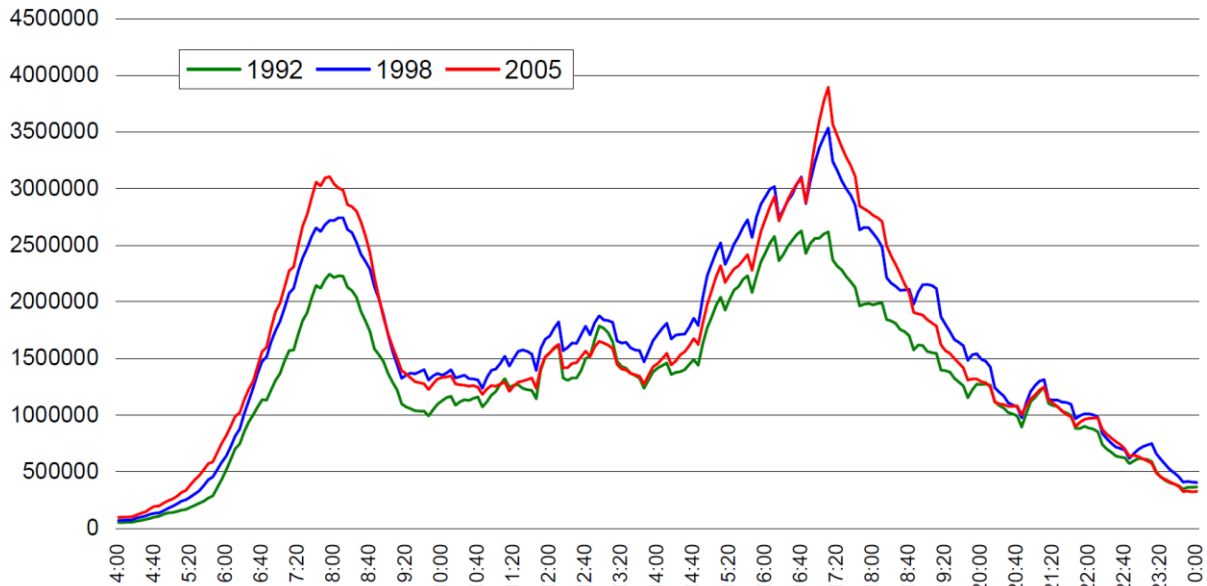
Traffic congestion, as defined previously, is a state where the demand for a road system exceeds the capacity it was designed to handle, and travel speed is greatly reduced or stalled. This can happen because of scheduled or random incidents, or on a recurring basis. Random congestion is caused by a road capacity being reduced by car accidents, road construction lane reductions, or inclement weather causing drivers to drive more cautiously with reduced speeds. Recurring congestion, occurs frequently during the weekday morning “rush hour” period from 7:00 – 9:00am and in the afternoons typically from around 4:00 – 7:00pm, as a result of a larger volume of people trying to access the road system than at other points in the day (Downs, 2004a; Zhang & Batterman, 2013). This study focuses on the latter.

### 2.3.1 Concentration of trips in time

Despite the modern conveniences of electric lights, personal computers, and telecommunications that would enable most of us to work almost any time of day or night, core “business hours” haven’t changed from the standard 9-5, 8-4 or similar variant that it has always been. This is partly because of natural human behaviour patterns, a desire to sleep at night, and be awake during daylight hours. It is usually the most efficient setup for most businesses to have their employees working and interacting around the same hours, and most efficient way for schools to have teachers teach the greatest volume of students if they all arrive at the same time. On a personal level, fixed or routine hours also favour families with young children to manage sleep and family time. In the GTHA, 65 percent of trips made during the morning peak of 6:00 – 9:00am are for a work or school commute – 46 percent for work, 21 percent for school (University of Toronto, 2011). This is not unique to the GTHA, a similar American statistic shows that in 2000 66.4% of workers who were employed outside of their homes in the US left for work between 6:00 – 9:00am (Downs, 2004a). The chart shown in *Figure 3* shows the typical spread of trips over a week day, indicating the morning and afternoon peak periods that we have all become accustomed to (Statistics Canada, 2005).



### Estimated number of persons moving, by time of the day, 1992, 1998 and 2005



Source: Statistics Canada, Generale Social Survey, 1992, 1998 and 2005.

Figure 3 Estimated number of persons moving, by time of the day

Source: Statistics Canada (2005, p. 9)

The result of this concentration of trips in time is that roads become overloaded beyond the capacity they are designed to handle, and transit vehicles become overcrowded. Spreading trips out over time – with more travellers opting to take discretionary trips at alternate times of the day would help to ease some of this congestion.

#### 2.3.2 Individual motivations in travel choice: mode and route

The majority of automotive trips in the GTHA are made in single occupant vehicles (SOV's) – the average car is transporting under 1.2 people during the peak period (Metrolinx, 2008c). There is also a considerable volume of chauffeuring – for example a parent driving a kid to school, and then driving back alone – 13% of morning peak hour trips are chauffeured trips (University of Toronto, 2011, p. 6).

Individual commuters making travel decisions such as these, to best suit their personal travel needs leads to a depletion of a common shared resource (road capacity), resulting in traffic congestion – a tragedy of the commons. The theory that describes how traffic is distributed through street networks based on travel time was first described by John Wardrop in 1952. Wardrop's First Principle of Traffic

Flow Distribution states that each traveler will select the mode offering the lowest disutility to them personally – lowest cost, fastest travel time, greatest reliability, and safety (Vuchic, 1999). This is known as Individual Equilibrium (IE). Unfortunately, this often leads to many travellers selecting to drive by themselves (rather than carpool or taking transit), at around the same time (morning and afternoon peak periods) on the same routes (major highways). When this happens, the aggregate disutility for all is *not* at its minimum. When these travellers exceed the free-flowing road capacity, traffic congestion ensues.

Wardrop's Second Principle of Traffic Flow Distribution states that a Social Optimum (SO) distribution of travellers is achieved when passenger distribution achieves a minimum average disutility, or lowest total disutility of transportation (Vuchic, 1999). When the Social Optimal split is achieved, the entire transportation network – including road capacity, transit network capacity, and active modes are utilized in the mix that gets the most people to their destinations in the fastest, lowest cost, and most reliable means possible. To achieve this, a greater proportion of vehicles travelling on the road must carry more than one passenger – carpools, higher capacity transit and active transportation must account for a greater portion of the mode share, and lastly some demand needs to be shifted away from peak hours.

### 2.3.3 Population factors

#### **Migration to cities**

There is a global trend in the movement of the world's population to cities, with 54 per cent of the world's population now living in urban regions – up from 30 percent in 1950 (United Nations, 2014). The UN forecasts that this trend will continue with 66 per cent of the world's population living in urban regions by 2050. In North America, the trend has resulted in 82 per cent living in urbanized areas.

#### **Population growth**

In terms of population size, the GTHA is Canada's largest urban region, and it is expanding fast. With a population of approximately 6 million, nearly one in every five people *in the entire* country lives in the GTHA. The region is on a trajectory to grow nearly 40%, adding an additional 2.5 million people by the year 2031 (Metrolinx, 2008c; Ontario Ministry of Infrastructure, 2006). The established mass has been a result of migration trends to cities, public policy on immigration, political and economic factors. Naturally, more people in the region has meant more people who need to travel to work, school, and other locations on a daily basis – increasing demand on the transportation network. Unfortunately, this increase in population has made a disproportionately higher use of the private automobile in their

modal choice - between 1986 and 2006 number of trips made by car increased 56% compared with a population increase of only 45% (Metrolinx, 2008c).

The City of Toronto has historically benefitted from several waves of international immigration, especially after the opening up of more inclusive immigration policies in the 1960s and 70s. In the present day, the city-region maintains its spot as an arrival city for the country. Canada receives about 250,000 immigrants every year, over 40% of these newcomers choose to make Toronto their new home (Hiebert, 2000). In 2006, foreign-born residents of Toronto represented 45.7% of the city's population. The settlement patterns of these individuals has a major influence on the evolving character of the city-region. The traditional settlement pattern was for new immigrants to settle in inner city neighbourhoods that served as gateway communities. As they accumulated wealth and assimilated into the broader society, they would begin to migrate to the suburbs. New immigrants are increasingly defying this pattern of their predecessors and settling directly in the outer suburbs. From 2001-2006, 41% of new GTA immigrants chose to settle in Halton, Peel, York or Durham regions rather than the traditional inner city immigrant enclaves – up from 29% in the 1991-1996 period. This is partly due to changes in immigration policies, aiming to attract highly skilled immigrants resulting in more affluent immigrants able to purchase a newer home (Lo, Shalaby, & Alshalalfah, 2011). Newcomers settling in the outer suburbs are more likely to drive to work than take transit, adding even more vehicles to the road and compounding the congestion problem.

#### 2.3.4 Low-density, suburban settlement

As they say, *“when you design a city for cars, it fails for everyone, including drivers”* (Roberts, 2015).

The trend across North America for low-density settlement at the urban fringes of most cities over the last 50 years is well documented and has been no different in the GTHA (Filion, Bunting, Pavlic, & Langlois, 2010; Harris, 2004). There is a positive link between the viability of transit and high density settlement, and an inverse relationship which increases the reliance on the automobile as densities decrease. This growth at low densities generates more automotive trips and VKT per resident than that of higher-density settlements, because places are spatially spread out and the only viable travel option for many residents is the private automobile (Cervero & Kockelman, 1997; Downs, 2004a).

Filion et al. (2010) computed census data from 1971 to 2006 which show an overall reduction in population density of the Greater Toronto Area from 3,681 residents/km<sup>2</sup> in 1971 to 3,349 in 2006 – an overall decrease of 9 percent. This trend has been a result of a greater proportion of the population

choosing to live in the outer suburban area (Figure 4). The study reveals that 38.5 percent of the GTA’s population now resides in the outer suburbs, compared with 15.4 percent in the inner city, and 33.1 percent in inner suburbs. While the core and inner suburban areas have experienced increased densities, the suburban fringe has remained relatively low density (Figure 5). Most new developments during this time have been built on the premise that residents and workers have access to a car (Soberman et al., 2006).

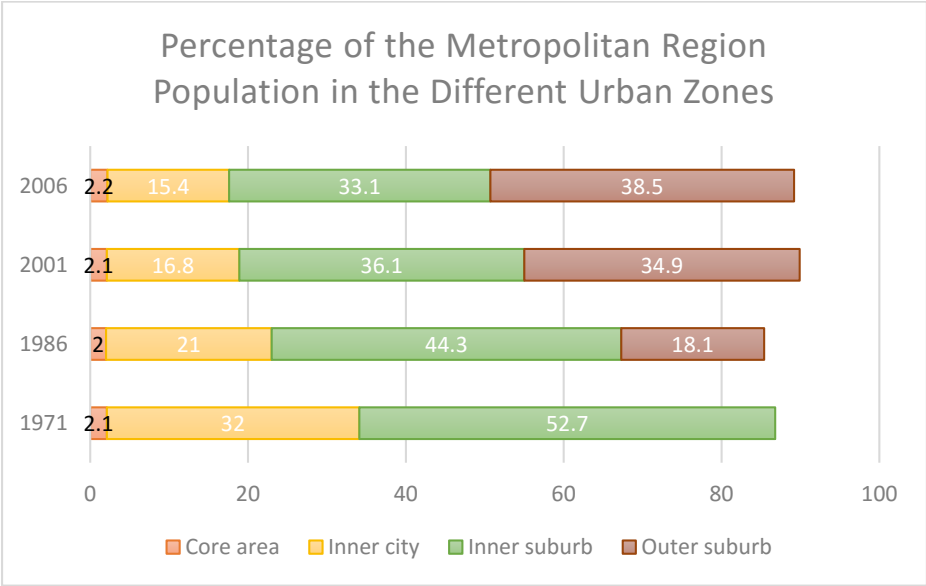


Figure 4 Percentage of the Metropolitan Region Population Residing in the Different Urban Zones  
 Source: Census data computed and presented in Filion et al., 2010

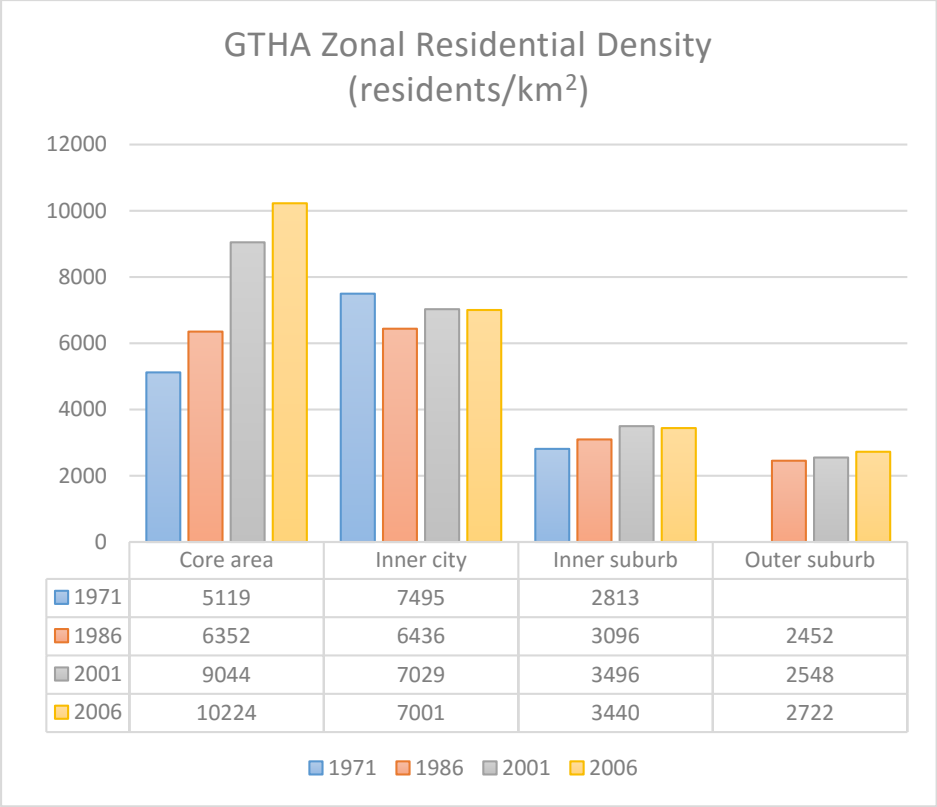


Figure 5 GTHA Zonal Residential Density

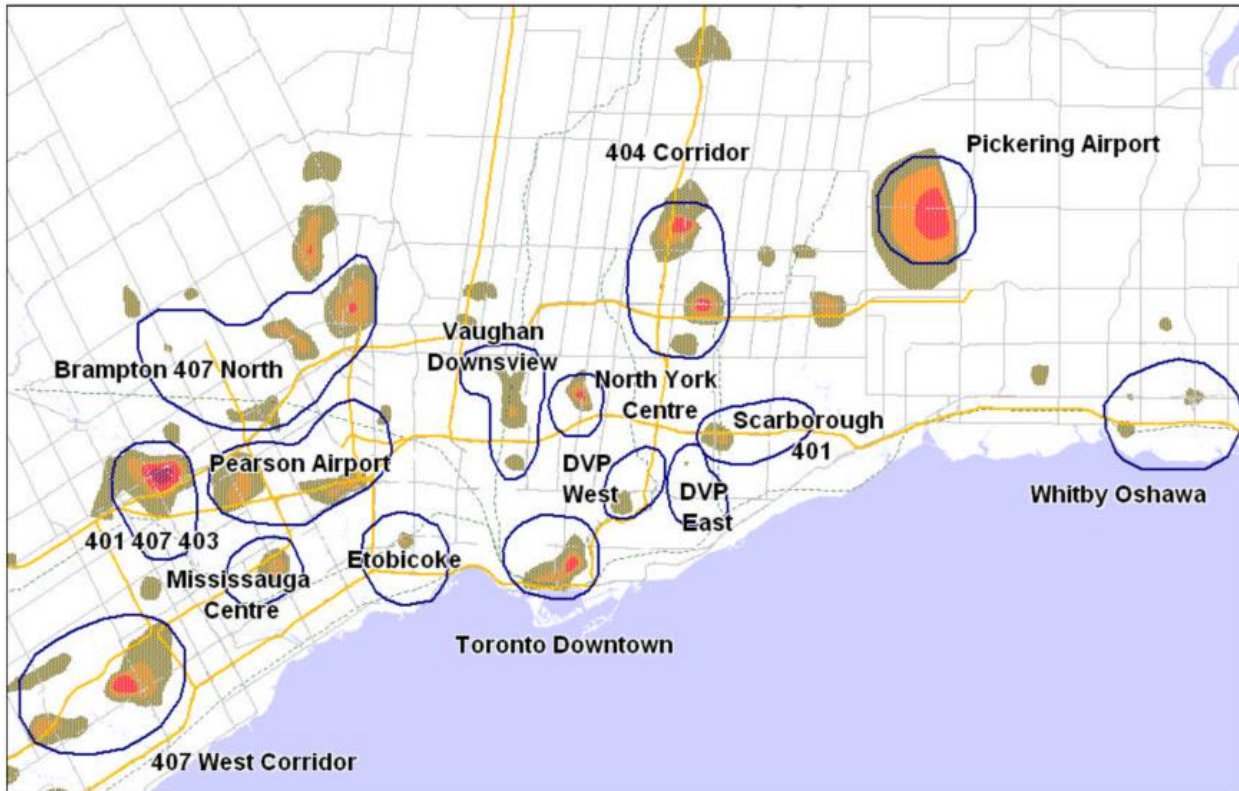
Source: Census data computed and presented in Filion et al., 2010

This shift makes things difficult for efficient transportation and transit planning. Cervero (2002) found in one study that higher densities and land-use mixtures significantly influenced mode choice in favour of transit, even after controlling for factors such as travel time and cost. Traditional neighbourhood designs with grid-iron streets and limited commercial parking were also shown to influence reduced vehicle use in favour of transit and other modes (Cervero & Kockelman, 1997). The trend needs to be reversed, and suburban areas in the region need to be retrofitted to designs that enable transit as a feasible option (Keesmaat, 2015).

2.3.5 Dispersion of employment uses

The Canadian Urban Institute (2011) reports that one third of all jobs in the region are now office jobs, and that more than half (54%) of the region’s 200 million square feet of office space is inaccessible by high-order transit in 2010. Newer office space has been built along the urban fringe in office parks. While there may be technology and other market sectors clustering in municipalities such as Markham

(to the north-east) and Mississauga (to the west) of Toronto, access to these offices are primarily served by the car, forcing an increased reliance on this mode. This problem may get worse as the polycentricism of employment centres continues to grow (Map 3).



Map 3 Possible new areas of employment growth by 2031

Source: Soberman et al., 2006, p. 5

### 2.3.6 Increased automotive ownership and VKT

North Americans own more cars now than even a generation ago, and this trend is no different in the GTHA. The Transportation Tomorrow Survey reports that vehicle ownership in the region has increased slightly to 1.5 vehicles per household in 2011, up from 1.4 in 2006 (University of Toronto, 2011).

Increased auto ownership has been the result of a number of factors including: dispersed land-use as just discussed, increased wealth, reduced cost of vehicles and the real cost of gas, effective marketing on the part of manufacturers, and a greater number of two-worker households (Habib, 2014).

Increased auto ownership has led to an increase in trips taken and vehicle kilometers travelled (VKT). Between 1986 and 2006 the GTHA experienced a 56 percent growth in number of trips taken by

automobile, exceeding population growth of 45 percent (Metrolinx, 2008c). Traffic volume has also increased faster than road capacity in recent years, causing traffic congestion to become progressively worse (Barth & Boriboonsomsin, 2008).

In a study reviewing the costs of road congestion in the GTHA, HDR Corporation compared the economically efficient number of vehicle kilometres travelled (VKT) to the actual VKT during the morning peak period for Toronto and surrounding regions (Metrolinx, 2008b). The results shown in Figure 6 below show a range of 13.7% - 15.4% greater volume of traffic than what would be economically efficient.

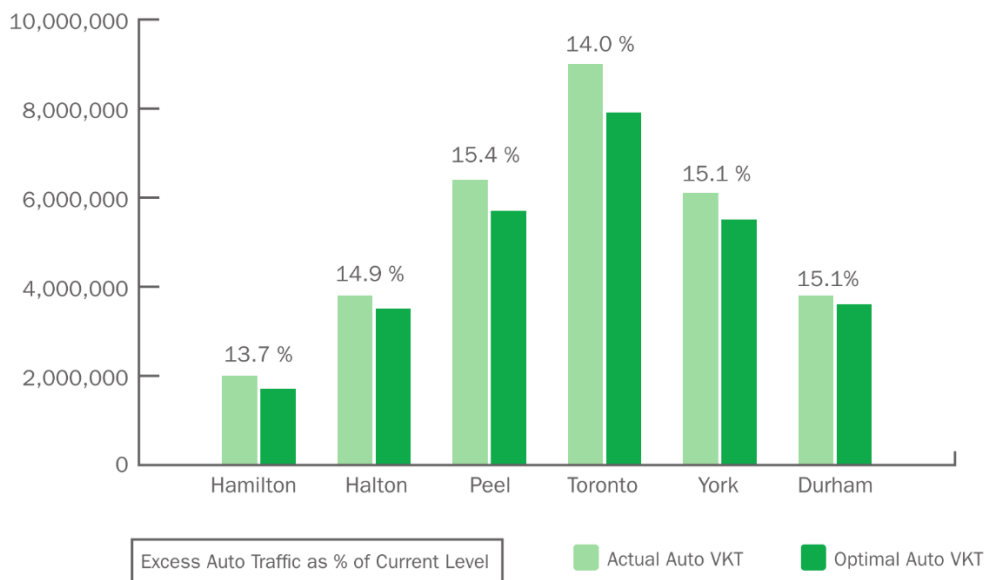


Figure 6 Excess Auto Traffic in the GTHA, 2006 (daily auto VKT in AM Peak Period)

Source: (Metrolinx, 2008b)

### 2.3.7 Lack of transit and other alternatives

The expansion of transportation, in particular public transit infrastructure has not kept pace with population and economic growth in recent decades. The GTHA has experienced a generation of limited investment in transit, with a downloading of responsibility for funding to lower levels of government, and a resulting patchwork of a disconnected transit network.

#### History of under-investment

The Martin Prosperity Institute has shown that since 1989, Ontario’s investments in transportation (both roads and public transit) have consistently lagged behind its provincial peers (Gilligan & Stolarick, 2013).

The GTHA has experienced nearly three decades of either no rapid transit expansion, or very limited expansion (Figure 7). The data presented by Metrolinx shows that Toronto built and expanded its subway system from the mid 1950's to 1980. The region had also continued to expand the regional rail (GO) network until about 1982 – enabling growth of the suburbs with access to jobs downtown. After this period there was very limited expansion of regional transit. The business community in particular has been very vocal over the last decade with requests for governments to return to building higher order transit to help alleviate congestion and improve connectivity in the region (Toronto Region Board of Trade, 2014). Without building these transit options, much of the region's growth in population has had to rely on the automobile as their prime mode of transportation.

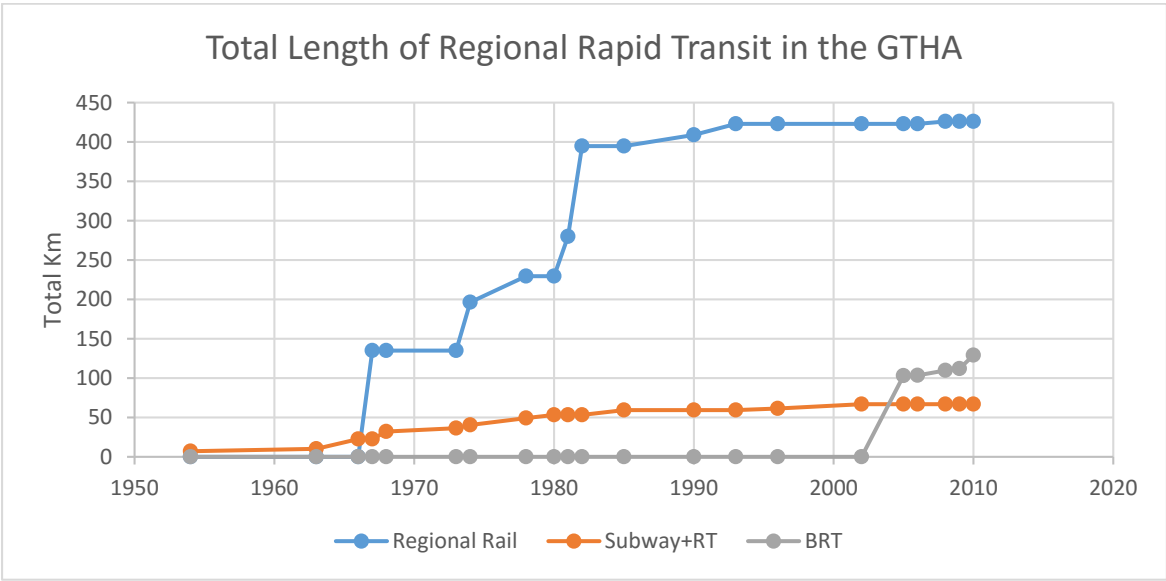


Figure 7 Length of Regional Rapid Transit in the GTHA  
 Source: Charted from data presented in Metrolinx (2013c)

**Neoliberal government policy, and competing needs**

Over the past several decades, we have been experiencing a world-wide trend towards neo-liberal public policy (Sager, 2011). This has resulted in numerous trends including the devolution of central government, and a shift towards competitive and market-oriented solutions. In the local context, the result has been consistent downloading of funding responsibilities from federal to provincial, and provincial to municipal levels of government. In turn, spending on infrastructure has not kept pace as local governments have not been able to find required funding to keep up with growth (Kitchen & Lindsey, 2013). Toronto's investment in public transit (as a percentage of GDP) was one of the lowest of peers in OECD countries (OECD, 2010).



At the national level, there has been a growing transit infrastructure funding gap in recent years, as shown by analysis from the Canadian Urban Transit Association in *Figure 8* below. Looking forward, the gap has increased \$1.8 billion from \$53 billion reported for the period 2012-2016 to \$56.6 billion for 2014-2018.

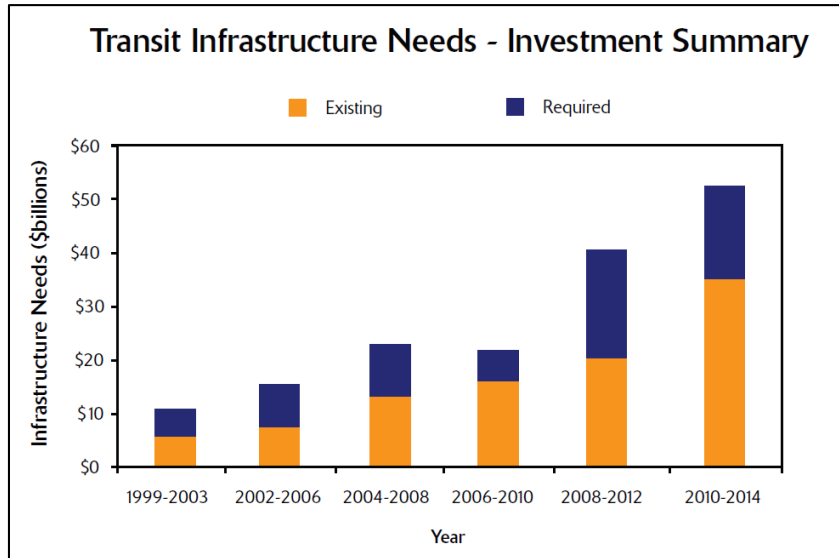


Figure 8 Transit Infrastructure Needs - Canadian cities  
 Source: (Canadian Urban Transit Association, 2010)

At the provincial level, Soberman et al. (2006) analyzed Ontario budgets from 1992 to 2006 and found a near doubling of spending on health care and increase in spending on education, along with an overall increase in the total budget. However, the Ontario government *reduced* their spending on transportation in the face of continued population growth during this time (Figure 9).

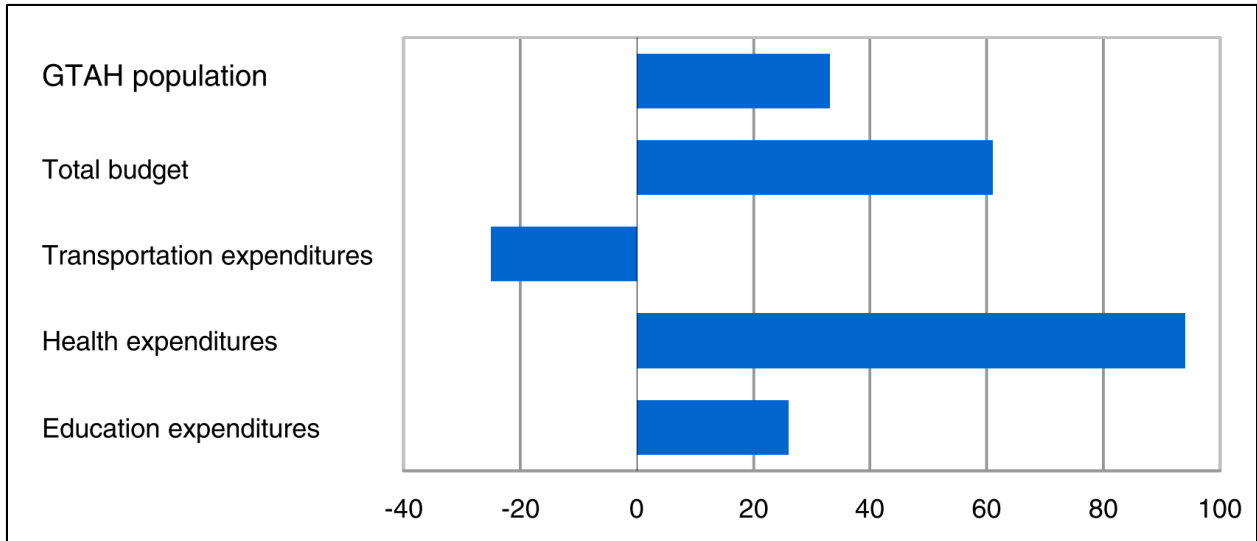


Figure 9 Percent change in selected elements of the Ontario budget 1992-2006

Source: Soberman et al., 2006, p. 2

### Disconnected transit

One in four trips in the GTHA crosses a regional boundary (Metrolinx, 2008c, p. 6). For these travellers, transit is often an unattractive option. The transit system is made up of nine separately-governed local transit agencies, and one regional transit provider (GO Transit). Travelling across boundaries is inconvenient, costly, and frustrating for many travellers. This is caused by a lack of information on how to access multiple systems, connections that introduce trip delays, and the requirement to pay multiple fares. Some of these issues are changing, with some initiatives of the Big Move to be discussed in this report. However, the issues with inter-municipal travel by transit have historically influenced a reliance on cars.

### 2.3.8 Summary of influences

This study investigates solutions for *recurring* traffic congestion, leaving incident caused congestion as a separate topic. Recurring congestion can be defined as a state where there is more demand for road access than a particular highway or the network is designed to handle. This is caused by a convergence of trips in time, mode, and space. There are many contributing factors to congestion, including:

- Population growth
- A concentration of trips in time
- Individual travel choice
- Low-density residential settlements, and dispersed employment
- Increasing automotive ownership, and vehicle kilometers travelled (VKT)

The GTHA is not unique in its challenge to fight congestion – there are many other large cities around the globe that have experienced similar effects (OECD, 2010). The next section will review several options that peer global cities have used in attempts to mitigate this problem.

## 2.4 Opportunities: congestion mitigation tactics

This section will discuss the common methods employed to mitigate traffic congestion around the world. Reducing and mitigating the severity of traffic congestion can be approached from two sides of the demand-and-supply equation: either increase supply of transportation options (more or wider roads, more transit capacity), reduce the demand of automotive traffic on the road system through a series of disincentives to auto-use and incentives for other modes, or both (Downs, 2004a). These tactics can be further categorized as system enhancements – actions which are mandated by the government at no additional cost to users, and fiscal or market based – tools which impact behaviour through price signals. Table 2 provides a summary of common methods employed world-wide.

The introductory review of the causes of traffic congestion would lead one to believe that it is an issue of supply – if we simply expanded our transportation network with more roads and transit facilities we could meet the demand, and reduce or eliminate congestion. However, as Vuchic states “the goal of improving transportation to ‘solve the highway congestion problem’ confuses symptom with cause. Congestion is a consequence of inappropriate policies and inadequate planning: it is not the fundamental problem of transportation” (Vuchic, 1999, p. 26). This section concludes with a revelation that would be surprising to anyone who is new to transportation studies – we cannot build our way out of congestion, the only effective method to beat it is to price road access.

	Supply-side	Demand-side (TDM)
<b>System enhancements and education</b>	<p><b>Expand transportation network capacity</b></p> <ul style="list-style-type: none"> <li>• Build more roads (adding lane capacity)</li> <li>• Build more transit capacity <ul style="list-style-type: none"> <li>○ New regional rail</li> <li>○ New subways</li> <li>○ New LRT service</li> <li>○ New BRT service</li> <li>○ New bus routes</li> <li>○ Increased frequency of service</li> </ul> </li> <li>• Expand active transportation network <ul style="list-style-type: none"> <li>○ Ex. Dedicated bike lanes</li> </ul> </li> </ul>	<p><b>Infrastructure</b></p> <p>To encourage car-pooling</p> <ul style="list-style-type: none"> <li>• HOV Lanes</li> <li>• Car-pool parking lots</li> </ul> <p><b>Transit incentives</b></p> <ul style="list-style-type: none"> <li>• Service improvements</li> </ul> <p><b>Regulations</b></p> <ul style="list-style-type: none"> <li>• Reducing parking supply</li> <li>• Driving restrictions (ex. license plate / driving day restrictions)</li> </ul> <p><b>Education</b></p> <ul style="list-style-type: none"> <li>• Encouraging telecommuting / work-from-home programs</li> </ul> <p><b>Land-use and transportation planning coordination</b></p> <ul style="list-style-type: none"> <li>• Transit oriented development (TOD)</li> <li>• Clustering high-density housing and employment near transit stops</li> <li>• Improving the job/housing location balance</li> </ul>
<b>Primarily Fiscal/Market - oriented</b>	<p><b>Toll roads</b></p> <ul style="list-style-type: none"> <li>• Converting HOV lanes to HOT lanes</li> <li>• Adding HOT lanes</li> <li>• Adding toll highways</li> </ul>	<p><b>Auto-use dis-incentives</b></p> <p>Tools which increase the cost of driving or owning a vehicle:</p> <ul style="list-style-type: none"> <li>• Increase the gas tax</li> <li>• Parking tax</li> <li>• Increase automobile licence fees</li> <li>• Road pricing and related tools</li> </ul> <p><b>Incenting reduced auto use</b></p> <ul style="list-style-type: none"> <li>• Parking cash out</li> <li>• PAYD insurance</li> </ul> <p><b>Transit incentives</b></p> <ul style="list-style-type: none"> <li>• Lower transit fares, fare free zones</li> <li>• Discounted transit passes</li> <li>• Fare integration across agencies</li> <li>• Fare-free zones</li> </ul>

Table 2: Congestion Mitigation Tools

Sources: Acutt & Dodgson, 1997; Downs, 2004; Timilsina & Dulal, 2010; Vuchic, 1999

### 2.4.1 Trying to solve the problem by building more roads

#### **The theory of triple convergence**

It is not possible – in a thriving metropolitan region – to significantly reduce traffic congestion in the long term by building more roads. This may seem counterintuitive – after all, if the problem is more people seeking access to a road system than it has capacity to handle, shouldn't more road capacity solve the problem? The reality is that new road capacity may help alleviate some congestion in the short-term, however that extra capacity is soon filled with more cars and subsequently the same roads become congested again. This additional travel demand is known as induced travel. The theory responsible for this is known as triple convergence, a term coined by transport analyst Anthony Downs in 1962 (Cervero & Hansen, 2002).

During a period of congestion, the demand for a roadway is greater than the volume of cars that are currently accessing it. There are typically additional users who are not using the roadway because they have decided it is not the most effective or efficient means of travel for them. These users have opted to travel at a different time, using a different route, or a different mode (such as public transit). In some cases, users may opt to not travel at all (such as working from home when they can), or to travel to an alternate (closer) location. When more capacity becomes available on a roadway though, many of these users who weren't using it previously now see an alternate viable option and chose to drive (Downs, 2004a). The additional highway capacity induces travel, with a large number of users making the following trip-making changes:

- 1) Choosing to make new trips (latent demand)
- 2) Taking longer journeys (for example, choosing to live further from work, or finding a job further from home)
- 3) Driving instead of taking transit (shift in mode)
- 4) Driving on the highway instead of local roads (route diversion)
- 5) Time shifting (choosing to drive during peak instead of just before, or after)

The vicious cycle of this theory has is depicted in Figure 10. The theory has proven out over the last few decades as LA has tried unsuccessfully over and over again to deal with its traffic congestion problem primarily with highway expansion (Vuchic, 1999).

There are some critics of this theory, who believe that induced traffic models confuse and conflate cause-and-effect. They would say that there is a simultaneous relationship, as more traffic will signal

the need for more roads, and once built they are simply addressing pent-up demand. It can also be argued that road expansion fails to keep pace with the growing demand for additional road capacity. One study in California analyzed 22 years of observations for 34 urban counties in California to test the theory. The study found that road supply has been both a cause and effect in relation to VMT (it has both induced-demand and been the result of induced-investment). However, the effects of lane-mile additions on VMT were found to be stronger than the opposite, confirming the theory of triple convergence (Cervero & Hansen, 2002).

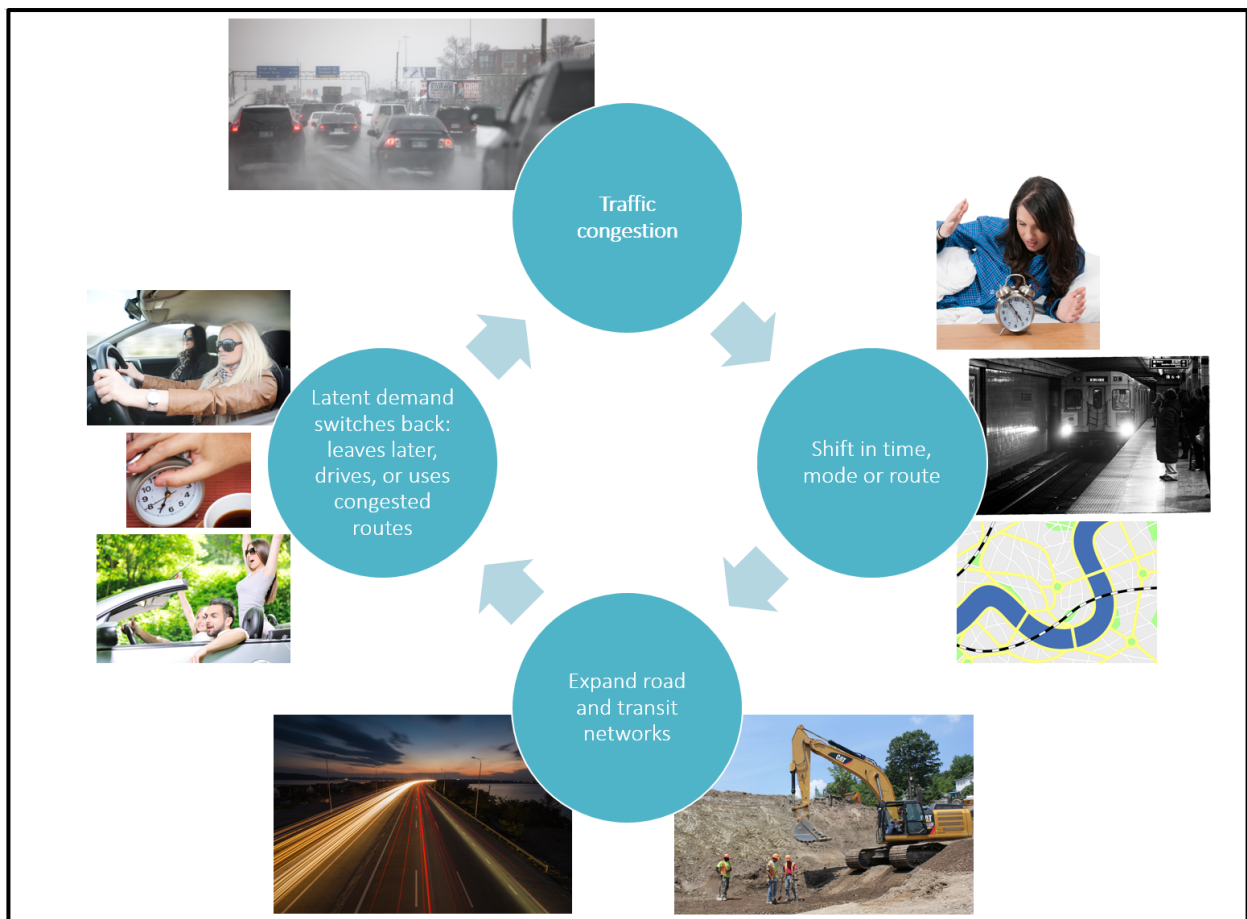


Figure 10 The theory of triple convergence

## 2.4.2 Supply side solutions: transit and alternative mode incentives

As the city's population continues to grow, new residents will add to the number of required trips.

Supply-side solutions which expand or improve the transit and active transportation networks provide an alternative to roadway expansion that can handle a greater volume of travellers more efficiently.

This section will provide an overview of several supply-side strategies.

### 2.4.2.1 Transit network expansion

Business leaders, transit advocates, environmentalists, and others have made increasingly louder requests to build high-order transit infrastructure in the GTHA to fight the growing congestion problem (see for example: Canadian Urban Transit Association, 2010; Evergreen, 2013; Toronto Region Board of Trade, 2014). CivicAction ran a campaign called "Your32" whose prime message was that the transit expansion proposed in the Big Move needed to be built to reduce congestion and save commuters 32 minutes a day<sup>2</sup> (2013). And the City of Toronto has an ongoing public engagement and education project called "Feeling Congested" which proposes transit expansion to relieve congestion on both the roads and transit networks (2013). The following will discuss the core reasons these groups believe that transit expansion will help to mitigate traffic congestion.

#### Higher Capacity

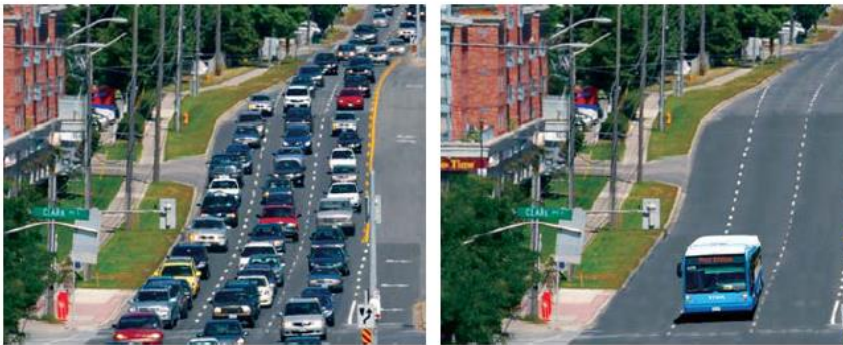
The prime reason advocates state that transit helps reduce traffic congestion is that transit vehicles carry many more passengers, providing a more efficient mode of transportation as opposed to single occupant vehicles. A classic example which depicts this is shown in

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<sup>2</sup> The full message was: "32 represents the number of minutes per day, on average, that you'll save on your commute once *The Big Move* is fully realized – that's eight days a year or about two years over the course of your life. It is the difference between the average commute time if *The Big Move* is funded and built over the next 25 years (77 minutes), and the commute time if no comprehensive system is in place over the same time (109 minutes; Source: Metrolinx)." This forward looking time savings at a future state wasn't clearly understood. Many people interpreted the message as saying transit expansion would reduce their *current* commute times.



Figure 11 – a typical city bus can carry 40 passengers seated or up to 70 passengers with some standing, in comparison the road space required for 70 separate cars is considerably greater. Table 3 shows a comparison of the passenger carrying capacity of efficient transit modes. During peak hours a trip by car consumes about 25 times more area than a trip by bus, and 60 times more than a trip on a rail line (Vuchic, 1999, p. 86). There are however, some limitations to capacity of labour-intensive transit systems in North America, because labour rates are higher than other parts of the world (such as South America), where bus rapid transit systems have been very successful. When travellers perceive public transit as being accessible, and transit stops are near their home and work place they are more likely to commute to work via this mode (Badland, Garrett, & Schofield, 2010). Expanding the higher order transit network could encourage more people to switch to this mode.



Transit uses much less road space than single-occupant vehicles. At full capacity, a standard 40-foot bus is about 10 times as space-efficient as a typical car.

Figure 11: Capacity of a bus vs. SOVs

Source: Metrolinx (2008c)

Mode	Passenger carrying capacity per vehicle	Throughput per hour (at max capacity)
Highway Driving (single occupant vehicles)	1	2,000
HOV 2+ lane (double occupancy vehicles)	2	4,000
Bus	Standard: 40-70 passengers Articulated bus: up to 200	2,000 – 5,000 passengers per hour (in peak hour, per direction)
Bus Rapid Transit (BRT)	Standard: 50-60 passengers Articulated bus: up to 200	2,000 – 20,000 per hour
Street car	74 passengers	
LRT	170 – 320, depending on implementation	2,000 – 25,000 per hour
Subway	100 passengers per car * 10 cars = 1,000 per train	25,000 – 40,000 per hour (in peak hour, per direction)
Regional Rail	160 passengers per car * 12 cars = 1900 per train	2,000 – 20,000 per hour
Regional Express Rail (RER)	Same as regional rail, with higher frequency	25,000 – 40,000 per hour

Table 3: Mode capacity comparison

Source: (Casello, 1999; Cervero, 2013; Metrolinx, 2008d, 2014)

### Matching technology to need

Great debates are constantly held regarding what the ideal technology should be for a new transit line – with politicians, transit advocates, and other groups pitching for subway, light rail (LRT), bus rapid transit (BRT), or other specific technology. There is often a tendency to consider one mode of transportation as "the best", and to favour that mode in planning and financing (Vuchic, 1999). This has been seen in recent debates in Toronto over the Scarborough subway extension. An analysis of different transit technologies is out of scope for this project – for a summary of transit technology options refer to the Metrolinx Transit Technology Backgrounder (2008d). There are many variables that will affect the overall transit experience and travel time for riders, these include: average speed, station spacing, grade

separation, headway (the time between trains), dwell time (amount of time a vehicle stays at a station), automated/non-automated operation, and capacity.

Population densities, travel patterns, and travel needs are not uniform across the region. Diverse needs are best met by providing a variety of services and different systems or modes of transportation (Vuchic, 1999). In Toronto, residents are typically only familiar with three modes of public transit: the bus, streetcars, and subways. Based on this familiarity, and lack of knowledge of newer options, there is a strong preference for subway expansion by residents. However, in many cases the more appropriate mode may be an LRT or BRT line which could provide greater frequency of service and would be an improvement over current bus service because the vehicles travel in a dedicated right-of-way (they don't have to contend with mixed traffic). Lastly, with faster construction times of "lighter" systems, the construction of BRT and LRT lines could come online faster than systems with longer construction timelines.

#### *2.4.2.2 Transit service improvements*

The previous discussion summarized infrastructure expansion – building new transit services through new rail lines, new bus routes, and other expansion activity. There are a number of actions that a transit operator can take to improve their *existing* service on their current network. These are discussed briefly here:

##### **Increasing transit frequency**

Improved regularity (frequency) of transit service reduces waiting and transfer times, which increases appreciation of the service for existing travelers and attractiveness for choice riders (van Oort & van Nes, 2009). The most preferable level of service would be at a "walk-out-and-wait" level, where buses and trains came every 10 mins or more frequently, thereby passengers could just walk out to the stop and not need to worry about checking a schedule, and wait times for transfers are minimal.

##### **Increasing service reliability**

Service reliability is the level of assurance that a transit vehicle will arrive on schedule, and deliver passengers to their destination on time. When buses arrive at intervals greater than every ten minutes, riders will check schedules and arrive at the bus stop close to the scheduled time, which increases the importance of service and schedule reliability in mode choice (Bowman & Turnquist, 1981). Improving service reliability has been shown to attract choice riders to transit (van Oort & van Nes, 2009).

Improving reliability can begin with operational efficiency actions within a transit service itself. Greater gains however, can be achieved through coordination with city planning and transportation departments. The use of transit priority signalling can help reduce wait times at intersections for transit vehicles and improve transit schedule reliability. Dedicating bus lanes and allowing buses to use HOV lanes on highways also helps with increasing speed and reliability of the service, as vehicles don't have to contend with mixed traffic.

### **Amenities**

Improving the transit experience could include other options such as more comfortable shelters, washrooms at stations, more comfortable seats, WiFi access on vehicles, and other options. However, several studies have shown that the most important variables to attract choice transit riders are frequency and reliability of service (Beirão & Sarsfield Cabral, 2007; Paulley et al., 2006).

#### *2.4.2.3 Limitations of transit expansion and service improvements*

##### **Reducing traffic congestion is not a valid reason for expanding transit capacity**

Downs writes that extensive transit systems have been built since 1950 in San Francisco, Washington and Atlanta, yet peak-hour traffic congestion did not decline in these regions (2004a). He explains that the law of triple convergence is responsible for this: any road capacity made available through a diversion to a new transit system is replaced by other drivers who had previously travelled on other routes, times, or modes over the long run. This is partly because the expanded transportation capacity encourages more businesses and people to move into the region – the capacity expansion causes induced demand.

Transit expansion *does* provide a number of positive benefits (Downs, 2004a):

- As a mode with greater efficiency, the transit system will move more people
- Transit provides mode choice – especially for people who can not drive for age, disability, financial or other reasons
- Transit provides connectivity – connecting more people to jobs, improving the economy
- Transit riders receive health benefits from the walk to and from the transit stop
- The per capita green house gas (GHG) emissions is lower for transit riders, than SOV drivers

The above are all valid reasons for transit expansion, and service improvements to attract more riders to the mode of transport. Reducing traffic congestion in the long run however, is not a goal that transit expansion can deliver on its own.

### **Improving travel times**

There is one situation in which improved transit infrastructure would assist in reducing travel times on the roads, which is less discussed by advocates and the media. This can occur when the majority of peak hour commuting takes place on transit, and the overall travel times by transit are improved. This was observed by Mogridge (1997) in his historical analysis of the Downs/Thomson hypothesis and traffic patterns in London. The observation is analogous to a lowest common denominator or weakest link argument.

Mogridge quoted one of Thomson's golden rules of urban transport: "the quality of peak-hour travel by car tends to equal that of public transport" (1997, p. 7), and describes the forces at play as follows. On a congested transportation network, if road capacity is expanded a certain number of transit riders who have the choice will shift to driving. These added drivers will impede others until the flow of traffic is reduced to previous congestion levels. In London's example, the capacity of their transit system is so great that there are always enough passengers willing to shift to driving that would negate any improvements in speed from building more or wider roads. On the flip side of the equation if travel time on transit is improved, drivers will switch over to transit. However, with a network of fixed-rail transit on separated rights-of-way, the transit system doesn't become slower with more travelers – it only becomes more crowded. Therefore, travelers will switch back and forth until a rough equilibrium is reached between roads and transit, and any system improvement which reduces the travel time on transit will in effect improve the average travel time for driving as well.

The limitations to this theory are 1) that it only applies to dense cities with very extensive transit networks, and 2) it is difficult to improve the travel time on a transit network. Downs (2004a) argued that American cities – with perhaps the exception of New York – do not have the densities and transit systems to align with this theory. Neither do Canadian cities, one can assume. In London's case, Mogridge (1997) observed that the average travel time on their transit system had not fallen for a century, and thus their road traffic had also not changed much over that time.

#### 2.4.2.4 Active network expansion

The share of public transit use in Toronto is comparable to several European cities such as London and Berlin (Figure 12). However, Toronto experiences a greater reliance on cars than these regions. The OECD (2010) reports that this gap has been filled by a greater reliance on active modes in other regions.

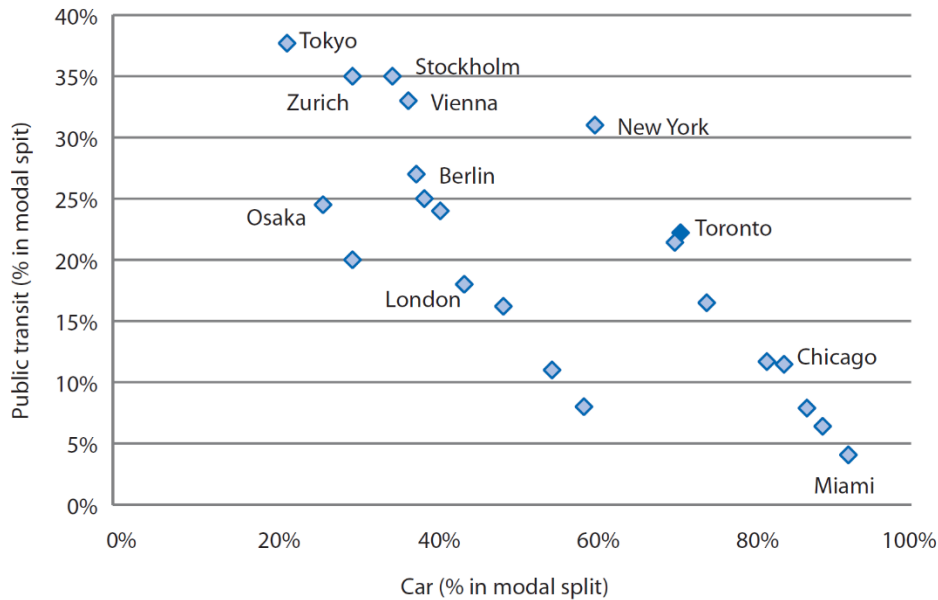


Figure 12 Public transport and car transport as % of modal split - international city comparison

Source: OECD (2010, p. 95)

Active modes of transportation include cycling and walking. Diverting traffic to these modes provides benefits in congestion relief by taking vehicles off the road, helps achieve sustainability goals, and provides health benefits to travelers who select this mode (Sallis, Frank, Saelens, & Kraft, 2004). As the largest barrier to cycling adoption is a fear of safety in mixed traffic, expanding the network of marked and separated cycle lanes can encourage a shift to this mode (Gössling, 2013). Pucher, Dill, and Handy (2010) provide an extensive list of infrastructure enhancements that can encourage cycling in their study – see sampling shown in *Table 4* below. After reviewing fourteen case studies across North America, they conclude that the adoption of a comprehensive package of interventions leads to large increases in the number of bicycle trips and mode share for cycling.

Cycling Infrastructure element	Description
<b>On-road bicycle lanes</b>	A narrow lane to the right of regular vehicle traffic lanes, designated by a white stripe, bicycle icon on pavement, and signage Coloured lanes may be used to make lanes more visible to motorists (eg. Green painted lanes)
<b>Contraflow bike lanes</b>	These lanes allow cyclists to travel in the opposite direction on one-way streets, enabling two-way travel on one-way streets
<b>Signed bicycle routes</b>	A shared roadway, designated through signage as a preferred route for cycling
<b>Cycle tracks / raised bike lane</b>	Similar to bike lanes, but more physically separated / protected from motor vehicles through a curb, posts, vehicle parking, or other barriers
<b>Shared lane markings</b>	Also known as “sharrows”, these markings alert drivers to the potential presence of cyclists, and show cyclists where to ride
<b>Bike boxes</b>	These boxes can be marked at a signalized intersection, in front of the vehicle lane. They allow a cyclist to move ahead of left-turning vehicles at a red light, giving them a head start through the intersection
<b>Off-street paths</b>	Recreational trails shared by pedestrians, roller-bladers, and cyclists. Offers alternate routes from the street network
<b>Bike parking</b>	These can include posts for locking a bike, sheltered parking, and bike lockers at transit stations
<b>Showers at workplaces</b>	Not necessarily part of the public infrastructure, but an important component to consider, and encourage through policy

Table 4 Sampling of cycling infrastructure elements

Source: Pucher, Dill and Handy (2010, pp. 108–11)

Copenhagen is the international city most famous for the use of cycling in their transportation network. Gössling’s study (2013) showed that this shift towards cycling acceptability and adoption occurred over several decades, starting in the 1970s. Efforts utilized to encourage the shift there included: infrastructure development such as new cycle lanes, “cycle super highways” (widened cycle paths to accommodate more cyclists), and additional parking for bicycles. A number of additional measures were taken such as allowing bicycles on trains; running marketing campaigns to promote cycling as fun, fast, comfortable and safe; and actively communicating goals on trip shares, cycling speed, and perceptions of safety.

Land-use planning has a significant impact on the adoption of cycling and increased walking – compact development helps reduce the distance between trip origins and destinations (Pucher et al., 2010).

Improved sidewalks, crosswalks and signalling at intersections, and a mix of uses all help to encourage more walking (Karim, 2015). According to the Transportation Tomorrow Survey, walking and cycling (combined) represents an 8% mode share across the GTHA (University of Toronto, 2011, p. 6).

#### *2.4.2.5 Lower fares*

Transit operators in the GTHA currently recover 70-80% of operating costs from the fare box, which is high in comparison to other North American cities (Kitchen & Lindsey, 2013). Lowering fares is one method to attract riders. The Toronto Transit Commission has recently taken the step to eliminate fares for kids under twelve, partly to attract long-term riders and as part of a broader plan at the City to tackle poverty reduction.

There are several arguments that justify subsidizing fares (Kitchen & Lindsey, 2013; Roschlau, 2008; Ubbels & Nijkamp, 2002). One is an argument of 'equity' – the redistribution of income to lower-income groups. Critics of this argument suggest that the effectiveness of this argument depends on the extent to which these groups use transit, and that there are less distortionary ways to accomplish this goal. Secondly, there is the argument known as the 'second-best' approach which states that as long as roads are not charged according to their full cost (construction, maintenance, and environmental externalities), it is only fair to subsidize transit as its substitute.

The elasticity of transit fares is fairly low, averaging -0.4 in the short run (Paulley et al., 2006). This indicates that fare reductions are unlikely to encourage large shifts in demand. A substantial reduction on the other hand, could encourage over-use of the transit system and eventually force over-investment in it (Kitchen, 2008). Cervero's study showed that potential riders respond more to service improvements than they do to discounts in fares (1990).

The impact of a small fare reduction on congestion would also be negligible – as long as the costs of alternatives remained fairly constant. One study compared the efficiency of an increased transit subsidy against the options of a single-lane toll or a gas tax increase, and found the transit subsidy to be inefficient (Parry, 2002). While the subsidy effectively raised the relative cost of driving in comparison to transit, it did not differentiate by time of day or route. Therefore, those who may have previously opted to drive at a different time or along a different route, would revert to driving on the highway at peak hour. However, transit fares that vary by time-of-day could assist with reducing peak period transit crowding.



### 2.4.3 Transportation Demand Management

The preceding section discussed a number of supply-side solutions which increase the number of efficient transportation options for travelers to choose, and the passenger carrying capacity of those systems. While many of these options are necessary, a congestion mitigation strategy is incomplete without the inclusion of tactics to help reduce auto use during the peaks. Transportation Demand Management (TDM), or Travel Demand Management as it is sometimes called refers to a portfolio of strategies that encourage a shift in demand towards more efficient modes such as carpooling, transit, cycling and walking, and spreading trips out throughout the day to make more efficient use of the road network (City of Hamilton, 2005; Meyer, 1999; Stewart & Pringle, 1997). Without these tactics, the law of triple convergence would kick in and any road capacity made available through supply side efforts would be quickly re-consumed by travelers switching back to driving or altering the time or route of their trips.

This section will cover several common TDM strategies. Several of these strategies overlap with supply side solutions. For example, a High Occupancy Vehicle (HOV) lane strategy can involve adding a new lane to a highway, or converting an existing lane to HOV use.

#### 2.4.3.1 Employer programs

Large employers and government institutions such as schools can be significant trip generators. An opportunity exists to work with these organizations to help shift travel patterns. Travel plans can be developed independently by the organization, or in collaboration with a planning department of a municipality (Banister, 2008). These plans can include elements such as (Robinson, 1997):

- Employee education programs
- Alternate working hours
- Work-from-home / tele-commuting options / option to work from satellite offices
- Ride matching programs for carpooling
- Free shuttles from corporate campus to nearest transit station
- Parking cash-out (a cash incentive to give up a parking spot)
- Transit pass incentive (the option to receive a transit pass in lieu of a parking spot)

#### 2.4.3.2 Parking

Parking strategies are a crucial element of a transportation plan. If parking is freely available (in quantity and cost), attempts to encourage carpooling and transit use will be a very difficult task (Badland et al.,

2010; Robinson, 1997). Pricing this aspect of the driving experience appropriately, or reducing the supply of parking spaces makes driving less desirable or more difficult, creating a dis-incentive for auto use.

### **Pricing of parking**

As most parking is provided “free” – especially in suburban office parks, shopping malls and plazas - the cost of parking is subsidized by other services (Blais, 2010). Charging for parking in these cases helps bring the cost of driving in line with true costs (Shoup, 1993). Governments can increase the cost of parking through a parking levy. Charges may need to be significant however, to have a strong impact – one simulation study by Dasgupta of five British cities found that doubling parking charges lead to a reduction in car share from 56% to 43% (as cited in Acutt & Dodgson, 1997, p. 30). One concern with this option is that some businesses may choose to absorb the parking levy rather than passing the fee on to customers and employees.

### **Parking availability**

An even greater impact on car use can be achieved by reducing parking availability. This can be achieved by changing land use by-laws for new construction and redevelopment, shifting from minimum parking to maximum parking requirements. Dasgupta’s study cited above showed that halving parking spaces would be more effective than doubling parking charges for reducing car use (as cited in Acutt & Dodgson, 1997, p. 30). Addressing parking supply and pricing is viewed as a critical policy element – without it, other TDM initiatives to reduce congestion may be negated (Robinson, 1997).

#### *2.4.3.3 Vehicle Use Restrictions*

Limiting the use of some vehicles – for example licences plates that start with a specific letter or digit being banned from road access one day a week – have been used in places such as Athens, Mexico City and Santiago to combat severe congestion. A disadvantage is that travellers with a higher value of time are impacted equally, in comparison with those who have a lower value of time. Another disadvantage is that some commuters may simply purchase a secondary vehicle to circumvent the ban (Acutt & Dodgson, 1997). Lastly, this may leave some people without any travel options if there is no transit alternative available to them.

#### *2.4.3.4 Gas Tax increase*

A gasoline or fuel tax is commonly used world-wide to raise funds for road maintenance and expansion, or general government revenue. By raising the cost of driving, the gas tax also provides a dis-incentive to driving. It can therefore help reduce VKT, emissions, and traffic congestion (Timilsina & Dulal, 2010). The effect applies to a broad portion of the population – one study showed that a ten percent increase in fuel prices could cause 75% of Canadian households to reduce their vehicle kilometers driven within one year (Eltony, 1993). Others may adapt by switching to a more fuel efficient vehicle for their next purchase, with a smaller proportion who have inelastic demand and will not change their behaviour based on price. While North Americans complain about the cost of gas, the reality is that we pay some of the lowest rates in the world. Rates in the UK are about \$1.00 more per litre compared to Ontario prices, a difference which is almost entirely the result of higher gas taxes (Schabas, 2013).

There are three key concerns with increasing the gas tax: it doesn't target specific geographies where congestion is a problem, it can be regressive, and over time it becomes less effective. Kathleen Wynne, the premier of Ontario vowed not to increase the gas tax because she did not want to ask "the people of North Bay to pay for transit in the GTA" (Brennan, 2014). In cases where lower income individuals do not have access to transit as an alternate, increased gas taxes can be viewed as regressive because they constitute a larger portion of income for these individuals. This is countered by the fact that poorer people drive less than those with higher incomes (Lindsey, 2007). Lastly, with the increased fuel efficiency of newer vehicles, and an increasing number of hybrid and electric vehicles on the road, gas tax revenues will decline over time (Eltony, 1993; Jaffe, 2014).

#### *2.4.3.5 Tolls and road pricing*

Using tolls to charge for access to a roadway has been commonplace in the US for years. Often, they are used to help finance the construction and maintenance of bridges, tunnels, or specific highways. Residents in the GTHA are now familiar with the highway 407 Express Toll Route, which was deemed an innovative system when it opened because it uses a combination of camera and transponder technology to capture data on vehicles accessing the highway to charge motorists for its use, rather than forcing drivers to stop to pay a fee at toll booths (Small & Yan, 2001).

In Western Europe and in Singapore however, tolls have been commonly utilized as a method to reduce congestion. There is an opportunity to use these policy tools in the GTHA context to reduce traffic congestion by providing a disincentive to drive, and encouraging a shift to transit or alternate modes, while simultaneously raising funds for transportation system improvements. Pricing by time-of-day can

also help spread out demand throughout the day. People who have flexible work schedules may opt to drive during the off-peak time to save money. These tools are particularly effective maintaining congestion reductions by avoiding the effects of triple convergence – those who previously travelled at different times, on a different route or mode remain dis-incented to utilize the additional road capacity because of fees involved. Following is a summary of common examples of tools in this category: high occupancy toll (HOT) lanes, congestion charging (CBD cordons), and road pricing – the concept of charging for *all* vehicle kilometers driven.

### **High Occupancy Vehicle (HOV) and High-Occupancy Toll Lanes (HOT)**

#### **HOV lanes**

High Occupancy Vehicle (HOV) lanes have been added to many congested highway systems across North America. They allow vehicles with two or more commuters to travel unobstructed in a specially marked parallel lane, typically at higher speeds than (single-occupant) vehicles delayed in congested traffic in the main part of the highway. HOV lanes are best used when there is currently delay due to congestion and the proportion of high occupancy vehicles is also high (Dahlgren, 2002). Advocates say that HOV lanes can assist in achieving a more socially optimal or efficient use of transportation infrastructure because an HOV lane used to capacity can nearly double the passenger throughput versus a mixed-use lane. The drawbacks of this option are: higher cost to implement (than mixed-flow lanes), cost of enforcement, and potential for low utilization (Dahlgren, 2002).

#### **HOT lanes**

A High Occupancy *Toll* (HOT) lane adds the option for single occupant vehicles not meeting the HOV restriction to also utilize the HOV lane, by paying a toll (Finkleman, Casello, & Fu, 2011). Interest is growing for this option because of its ability to increase the utilization of underutilized HOV lanes, and generate revenue which can be used for transportation system improvements (Dahlgren, 2002). The first HOT lanes were implemented on State Route 91 in Orange County, California in 1995. They are called “value-priced lanes”, their users experience no delay and they have helped reduce travel delay from an average of 30-40 minutes to 12-13 minutes on the highway’s regular mixed-traffic lanes (Sullivan as cited in Dahlgren, 2002, p. 239).

Adding an HOT lane creates product differentiation in highway options, similar to train and air travel first-class tickets. All commuters are not equal – there is heterogeneity in the way different commuters value their time. Those with a higher value of time (VOT) can benefit from travelling at faster speeds in

the HOT lane by paying a toll (Small & Yan, 2001). Also, vehicles with multiple passengers inherently represent a higher summed VOT than single-occupant vehicles, and therefore deserve priority over SOVs. This allows individual travellers to select an option which best suits their needs.

Like HOV lanes, drawbacks to HOT lanes include cost and complexity to implement and enforce, with a greater cost for tolling equipment. Revenues generated from the lanes however can be used to recover these costs and generate additional revenue which can potentially be used for transportation system improvements. The most common concern with this option is an unwillingness to pay what is viewed as an “additional tax” for something that was previously free (highway travel). This can be countered by offering an HOT lane as an *additional* lane (new construction) rather than removing a lane.

HOT lanes are best used when traffic congestion exists and the initial proportion of multiple occupancy vehicles is low (Dahlgren, 2002). This situation yields a greater utilization than an HOV-only lane because it allows for a greater mix of vehicles utilizing the lane, with the added benefit of revenue generation. If HOT lane performance is reduced, tolls can be increased (or varied by time of day to reduce the number of SOV drivers, or the HOV rule can be increased to a three person minimum to reduce the number of two-person vehicles accessing the lane for free.

### **CBD Cordon and Congestion Charges**

A Central Business District (CBD) Cordon or Congestion Charge is a toll that is applied to major routes entering a CBD. Such schemes have been applied in central London in the UK; Stockholm in Sweden; Bergen, Oslo and Trondheim in Norway, among other European cities; and Singapore in Asia (Eliasson, 2014; Timilsina & Dulal, 2010; Ubbels & Nijkamp, 2002). Tolls applied on bridges entering New York City can also be considered a form of a CBD cordon. In the London example, drivers pay a daily charge for entering the CBD between 7:00am – 6:30pm, and are entitled to unlimited in-and-out privileges without further fees. This fee started at £5 when it was introduced in 2003, and increased to £8 in 2005.

Transport for London claims that the introduction of this charge led to a 12% reduction in traffic heading to the CBD, with 50-60% of this volume shifting to public transit (Timilsina & Dulal, 2010).

If this were applied in the Toronto example the southbound lanes of the Don Valley Parkway as well as the Gardiner Expressway could be tolled. This toll would provide a dis-incentive to auto use to get to the core of the city. As downtown Toronto is served with high quality transit through subway lines, GO train regional rail service, and other options, many commuters would see value in shifting their mode to transit.

## Road pricing

Road pricing – also known as road usage charging – is a concept of charging drivers for *all* vehicle kilometers travelled which has begun to garner greater attention in the economic and transportation academics, and planning practitioners. It was conceived as a method to augment and potentially replace the gas tax. With this method, drivers could pay variable fees depending on distance, time of day, and location.

Road pricing is akin to a gas tax, in that it charges a motorist for use of a vehicle – to help balance some of the social externalities of operating a vehicle, and help fund road maintenance and expansion. The gas tax however, has two inefficiencies which a road pricing scheme can help overcome: more fuel efficient and electric vehicles negate the effectiveness of this tax over time, and the gas tax doesn't differentiate between time or location.

With on-board vehicle tracking systems, a road pricing program can be set up to charge drivers variable rates – increasing fees for travelling in central city areas and during peak time periods. This can provide a dis-incentive to auto use where and when it matters most – on congested roadways during peak periods. The state of Oregon recently piloted a road usage charge program, and has passed legislation to implement a state-wide program in 2015 (Oregon Department of Transportation, 2013).

In addition to providing a dis-incentive for auto use, and encouraging time of travel or mode shifting to transit, road pricing has the potential to provide significant funds for transportation network maintenance and expansion. For these reasons, economists are enthusiastic about road pricing policy, however a major barrier is that it will be politically challenging to implement (King, Manville, & Shoup, 2007).

## 2.5 Evaluation and financing

There are many factors to consider when deciding upon the mix of strategies to apply in addressing traffic congestion, or any other social problem. Public policy can be evaluated by its ability to meet goals related to effectiveness, efficiency, and equity. Taylor (2004) argues that the performance of the resulting transportation system is inextricably linked with policies for financing it. He states that geographic equity in the expenditure of transportation investments is the overriding concern in the political debate. To understand this connection we must evaluate both program performance and system performance (*Table 5*). Evaluation criteria related to program performance measures how well a policy meets tests of political acceptability and administrative ease. These questions are often the central focus of policy debates on transportation finance. System performance on the other hand, measures how financing mechanisms influence the use and performance of the transportation system.

This section will discuss evaluation criteria related to effectiveness, efficiency and equity of transportation policies and their results on system performance. As Taylor shows, the taxes, fares, tolls and other charges paid by travelers affect where, when, how and how often they chose to travel.

	System performance	Program performance
Effectiveness	<ul style="list-style-type: none"> <li>• Optimizes utilization of existing capacity</li> <li>• Lowers transportation costs and promotes economic development</li> </ul>	<ul style="list-style-type: none"> <li>• Is politically feasible: has stable political support, is popular with voters, and has little opposition from powerful stakeholders</li> <li>• Revenues generated meet needs and are stable and predictable</li> </ul>
Efficiency	<ul style="list-style-type: none"> <li>• Optimizes provision of transportation service for a given level of expenditure</li> </ul>	<ul style="list-style-type: none"> <li>• Has low administrative and overhead costs relative to the revenue collected</li> </ul>
Equity	<ul style="list-style-type: none"> <li>• Provides all users with transportation access, regardless of circumstances (age, income, disability, etc)</li> <li>• Is progressive based on ability to pay</li> <li>• Charges users in proportion to the costs they impose on the system and society</li> </ul>	<ul style="list-style-type: none"> <li>• Is perceived as treating places and jurisdictions fairly</li> <li>• Major stakeholders and interest groups perceive they are treated fairly</li> </ul>

Table 5 Program performance and system performance criteria

Source: Taylor (2004, p. 299)

### 2.5.1 Effectiveness

#### Impact on modal split

Effectiveness refers to accomplishing one’s goals (Smirnova, 2014). This study will be evaluating strategies on their effectiveness in mitigating traffic congestion. Reducing congestion will require a shift in travel patterns (a shift in time, mode, or space). The most effective methods to do so will involve auto-use dis-incentives as well as incentives for other modes (Ubbels & Nijkamp, 2002). However it is important to note that most of these strategies are drawn upon to address several goals such as improving connectivity, reducing travel time, lowering greenhouse gas emissions, and even boosting the economy through construction projects.



## **Yield**

When evaluating investment tools (taxes, tolls, and other user charges) as part of a transportation strategy, yield is an important measure of effectiveness. For example, comparing the value of revenue that can be generated from a sales tax to fund transit expansion versus a parking tax which may have a more direct impact on modal split but contribute less to the funding goal.

Fiscal tools will also vary in their consistency of funds generated. Short-term, and long-term consistency should be considered. For example, corporate income taxes will vary with the performance of the economy, and gas taxes are fairly consistent in the near term, however over time they will be reduced with fuel efficiency and hybrid and electric vehicles growing in popularity.

### **2.5.2 Efficiency**

Efficiency refers to achieving greater outputs with fewer inputs. Smirnova (2014) discussed how this can be intertwined with effectiveness. For example, a transit infrastructure project that moves more people than an alternate can be considered more efficient, and if moving more people is a goal of the governing transit agency it would also be considered more effective.

#### **Technical efficiency**

“Technical efficiency implies being on the boundary of a production possibilities frontier” (Peters & Gordon, 2008, p. 381). If a highway lane can move 2,000 cars per hour, the greater volume of time that it is functioning at that level, the more efficient it is. As shown earlier, congestion reduces the throughput of roads and therefore any solution which helps match demand to the capacity of the transportation network will improve its technical efficiency.

#### **Ease of administration**

All fiscal tools have administrative costs associated with collecting funds, and some have added enforcement costs. For example an increase in the gas or retail tax across the province may be fairly efficient to administer, but a segregated tax that only applied to the GTHA or the addition of manual toll booths would add complexity and cost to the administration of the tool. The extent to which these costs can be minimized increases the value taxpayers receive for their money, and the administrative efficiency of the program.

### 2.5.3 Equity

In formulating transportation policy, one common goal is to create a system where no single group is paying more than their “fair” share. The difficult, and somewhat subjective part is figuring out what is fair and equitable. There are two dimensions of equity to consider – vertical and horizontal. Vertical equity refers to fairness across income levels and social positions, whereas horizontal equity refers to fairness in treatment of people with similar social status (Kitchen & Lindsey, 2013; Peters & Gordon, 2008).

#### **Vertical equity**

While the social ideal to be measured against can be subjective, some degree of progressive policy is generally preferred so that lower-income people are not disproportionately burdened with new fees. For example, if a new toll is effective in reducing congestion by dissuading most lower-income individuals from driving (because it is unaffordable), but most mid and higher income commuters continue to drive, the policy may be viewed as vertically inequitable. The policy would be deemed regressive because it represents a disproportionately high portion of income for lower-income people. Vertical equity concerns are important, however an argument can be made that cost burdens should be addressed through income policy, rather than by altering the costs of services (Kitchen & Lindsey, 2013).

#### **Horizontal equity**

Achieving horizontal equity ensures that those who pay also benefit from the service (Hertel, Keil, & Collens, 2015). If for example, development charges (DCs) charged to a developer to help fund a transit project provides benefits to the site, it can be viewed as horizontally equitable. If however DC’s are paid to fund transit in another part of the city or region, it can be deemed inequitable.

### 2.5.4 The benefits based model

Kitchen and Lindsey discuss the importance of pricing mechanisms to complete a transportation policy:

“...additional investments will not guarantee a high quality transportation system unless the system is appropriately used. Without efficient pricing of public transit and roads, users will not make appropriate decisions about how often to use it, where to live, and so on...” (2013, p. 6).

A large body of evidence supports the “benefits-based” or “user-pay” model as the most appropriate method to raise funds for infrastructure projects (Gill, 2014; Kitchen & Lindsey, 2013). The principle of

this model is simple: those who benefit from infrastructure and services should pay for it. Congestion mitigation strategies that include fiscal policies align with the benefits based model, as follows:

### **Efficiency**

Economic efficiency is achieved when the “user fee or price per unit of output equals the extra cost of the last unit consumed” (Kitchen & Lindsey, 2013, p. 16). Road access is not presently charged this way, nor is transit use. Altering prices to reflect the full cost of these transportation services is efficient and sends price signals to users. These price signals encourage a shift in user behaviour, such that trips with lower values of time are diverted away from peak hours, or onto other modes and routes. The shifted behaviour helps achieve efficiency in the transportation system by spreading the demand out.

### **Accountability and transparency**

Accountability is achieved when the fees paid are closely linked to the use of a service (Kitchen & Lindsey, 2013). General income and retail sales taxes are poorly linked to the services received for them. Additionally, a user charge levied by an organization responsible for providing the service raises the accountability of that government service provider. Transparency can be achieved if users have access to information about how the price of a service is set and how funds are spent.

### **Equity**

Congestion mitigation strategies that include a fiscal element (such as gas taxes, parking levies, tolls and road pricing) score well on a horizontal equity scale as the charge is directly aligned with the service received (Kitchen & Lindsey, 2013). Vertical inequity concerns are mitigated if funds generated from such a scheme are recycled to improving public transit which is used to a greater extent by lower income individuals.

## 2.6 Key themes for public acceptance

Public acceptance is critical for the successful implementation of a congestion mitigation strategy.

Factors which improve public acceptance of a scheme include: perception of benefits and effectiveness, perception of fairness, trust and timing.

### **Perception of benefits and effectiveness**

Transportation policies that involve a pricing component (tolls or otherwise) tend to receive low public acceptance at the start, not because users expect the plan to impact them negatively, but because they are not convinced that transport pricing policies will actually be effective in reducing congestion – they don't believe they will receive a benefit (Schuitema, Steg, & Rothengatter, 2010). To increase public acceptance for a strategy it is important to communicate wider societal benefits such as an increase in employment, environmental and health benefits, however these should not override the primary objective of reducing congestion (Banister, 2008).

### **Communication and framing of the message**

How a message is framed can improve or detract from how well it is received. Eliasson borrowed an attitude formation framework from social psychology to discuss this (Eliasson, 2014). If a person is posed a question where they don't have a pre-existing attitude they will form an attitude by associating the question to another issue for which they do have a well-developed attitude. The example he gives is that a congestion charge introduced as a "road toll" conjures negative attitudes, versus an "environmental charge" can be attributed to a positive attitude.

### **Perception of fairness and equity**

The public will view a policy directed at reducing car use as unfair if there are no viable alternatives (Pridmore & Miola, 2011). As discussed earlier, where congestion strategies involve charges, a portfolio of schemes should be selected which are both vertically and horizontally equitable. Schemes which have a high degree of direct connection between user or benefactor and payee are considered horizontally equitable. Progressive schemes which mitigate for ability to pay are considered vertically equitable.

## Trust

The public needs to trust the government agencies implementing congestion strategies. This is especially important for schemes involving charges and payments – the public wants to know how their money is being spent, and needs to trust that it will be used efficiently.

Related to the topic of trust is alignment with broader societal values and norms – people would be unwilling to reduce their vehicle use if they don't believe others will do the same, they need to believe they are not acting alone (Pridmore & Miola, 2011).

## Timing

Strategies involving controversial policies should be implemented in stages (Banister, 2008). Goodwin (2006) offers a model of typical public acceptance patterns for congestion charging schemes (Figure 13). The model is applicable to other types of congestion policies involving fees (Pridmore & Miola, 2011). The model describes public acceptability over time occurring in three phases. First, there is recognition of a problem and increasing support for the proposed policy. This support builds until there is enough support for the policy to be approved by politicians. Second, as further details emerge about the policy support starts to fall, as people realize how much they may have to pay or debates occur about the potential effectiveness of the scheme. Third, once the policy is implemented successfully and people experience benefits acceptability increases again.

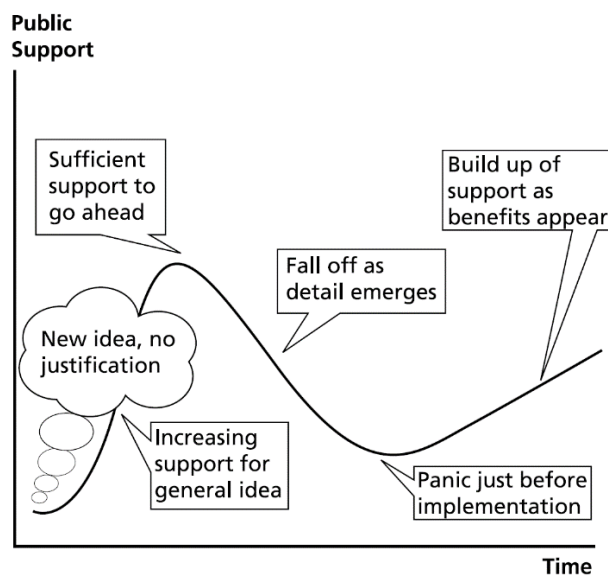


Figure 13: Goodwin's Cycle of public acceptability

Source: Goodwin, 2006

Eliasson (2010) builds on Goodwin's model and discusses the importance of timing related to elections and referendums. Similar to Goodwin's model, he states that a significant proportion of the population is willing to support congestion pricing, that support decreases as details of the plan emerges, and again increases once the system is in place. He summarizes his formula with two statements "acceptability decreases with detail," and "familiarity breeds acceptability" (p. 9). He therefore suggests that elections and referendums which ask the public for their vote should be carefully timed either before specific details are worked out, or after a pilot or trial is already in place and they have had a chance to see its impact.

### 2.6.1 Some examples

Two examples are commonly referenced in the literature as examples which demonstrate the themes in public acceptance discussed above. Those are the Stockholm and Edinburgh congestion charging schemes.

#### **Stockholm**

A congestion charging (CBD cordon) program was successfully introduced in Stockholm in 2006 through a trial. It was not a straightforward implementation however, originally depicted as "the most expensive way ever devised to commit political suicide" (Eliasson, 2008, p. 395) in the media, it became a success story. The idea was originally proposed in the early 1990s, with support from environmentalists (Eliasson, 2014). The trial was brokered through an agreement with the Green party in exchange for their support of the governing party. Opponents of the program suggested a referendum, which was agreed to by the governing party. It was decided that the referendum would be held after the next election – the governing party felt that voters would be open to voting them back in, and then vote against the congestion charge if they so desired – this timing turned out to be of critical importance (Eliasson, 2014). The six month congestion charging trial, coupled with an increase in transit service was instituted in January of 2006 with immediate reductions in traffic of around 22 percent, translating to congestion reductions of 30-50 percent. Public acceptance increased, reports in the media became more positive, and in the referendum in September of the same year a 53 percent vote in favour of keeping the program was received. The program was re-introduced permanently in August 2007, with funds earmarked for road and transit investments.

This rise and fall, and rise again of public support aligns with Goodwin's model presented above, and proves Eliasson's statement that "familiarity breeds acceptance". A trial enables the public to have experience with a new program, and overcomes the fear associated with a program that is forced on the

public permanently. The timing of elections was critical: the trial began in one electoral term, and referendum conducted in the next – separating the public vote for the party and the vote for the congestion charging program. These insights provide valuable lessons for other regions interested in implementing a controversial congestion scheme<sup>3</sup>.

### **Edinburgh**

In stark contrast to the Stockholm experience, Edinburgh's attempt at introducing a congestion charge involving a referendum is highlighted as a failure in the literature. The City held a referendum in 2005 which resulted in an over 60 percent 'no' vote (Musselwhite & Lyons, 2009). Holding a referendum on the policy prior to implementation did not give the public the opportunity to experience its benefits, and therefore they voted against a tax on a good that was previously free (road access).

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<sup>3</sup> Additional useful tips are provided in: Eliasson (2010)

## 2.7 Summary and gaps in the literature

This review of transportation, economic and related literature has highlighted a number of themes which frame the traffic congestion problem, and identifies a number of potential solutions:

- **The impacts of congestion:** include economic, health, and environmental impacts
- **Recurring congestion is a result of:** a concentration of trips in time, route, and mode
- **Factors which have influenced increased congestion in the GTHA include:**
  - Continuous and rapid increases in population, through immigration and other factors
  - A strong economy
  - Land-use patterns that encourage auto dependency
  - A history of nearly three decades spent investing in highway rather than transit infrastructure
- **Opportunities to mitigate traffic congestion include:**
  - Increasing the supply of transportation infrastructure and quality of transit service
  - Transportation demand management tactics to reduce or shift demand for road access, such as educational programs, parking taxes and restrictions, and various types of road tolls and user charges
- **Challenges to implementing the above solutions include:** political and public acceptance issues

In closing this review, a number of gaps become apparent, which this study seeks to address. The following questions persist:

- What would be the most effective congestion mitigation strategies for the GTHA? What strategies should Metrolinx and related organizations prioritize over the next ten years?
- How can another city-region apply the learnings from the introduction of the Stockholm and London congestion charging schemes to implement alternate schemes with a fiscal element?
- How can a city-region overcome political barriers in implementing new congestion mitigation strategies?



## Chapter 3 Transportation Planning in the GTHA

This section applies theory gathered in the preceding literature review to discuss the planning framework applicable to the Greater Toronto and Hamilton Area. This will set the context for further investigation. The key land-use and transportation planning documents for the region are: the Provincial Policy Statement (PPS), the Green Belt, the Growth Plan (Places to Grow), and Metrolinx's Big Move and Investment Strategy. A full, systematic review of policies related to alleviating congestion in all Official Plans and Transportation Master Plans across the GTHA was beyond the scope of this study, however a review of a sampling of these plans indicates common approaches at the local level.

The literature reviewed indicates that a growing city must utilize both supply side and demand side tactics to manage growth in traffic and mitigate congestion. Soberman et al. reviewed transportation challenges facing the Greater Toronto Area around the same time that Metrolinx was created and summed up the situation as follows:

“Unless there are radical changes in travel behaviour by GTA residents, even with aggressive expansion of transit service throughout the GTA, the net impact of these projected increases is that severe overcrowding (congestion) can be expected on roads throughout the GTA.”

(Soberman et al., 2006, p. 32)

This section will discuss the transportation plans for the region to identify how the region plans to improve the transportation network, and ask whether or not behaviour change (transportation demand management) techniques have been incorporated in current plans.

### 3.1 Planning Framework

This section reviews the current planning framework that impacts regional transportation planning in the GTHA. Planning for future land use is heavily influenced by two provincial plans: the Greenbelt Plan and the Growth Plan (more commonly known as “Places to Grow”). Metrolinx’s Big Move represents the current plan of record for regional transportation planning. According to Metrolinx, the three plans complement each other and will “lead to the development of more compact and complete communities that make walking, cycling and transit part of everyday life” (Metrolinx, 2008c, p. 2). In implementing the Big Move, Metrolinx will need to work with local municipalities on coordinating individual transportation plans. One such evolution will be the incorporation of elements of Toronto Mayor John Tory’s Smart Track plan – which was a major component of his election platform when he was elected in October of 2014.

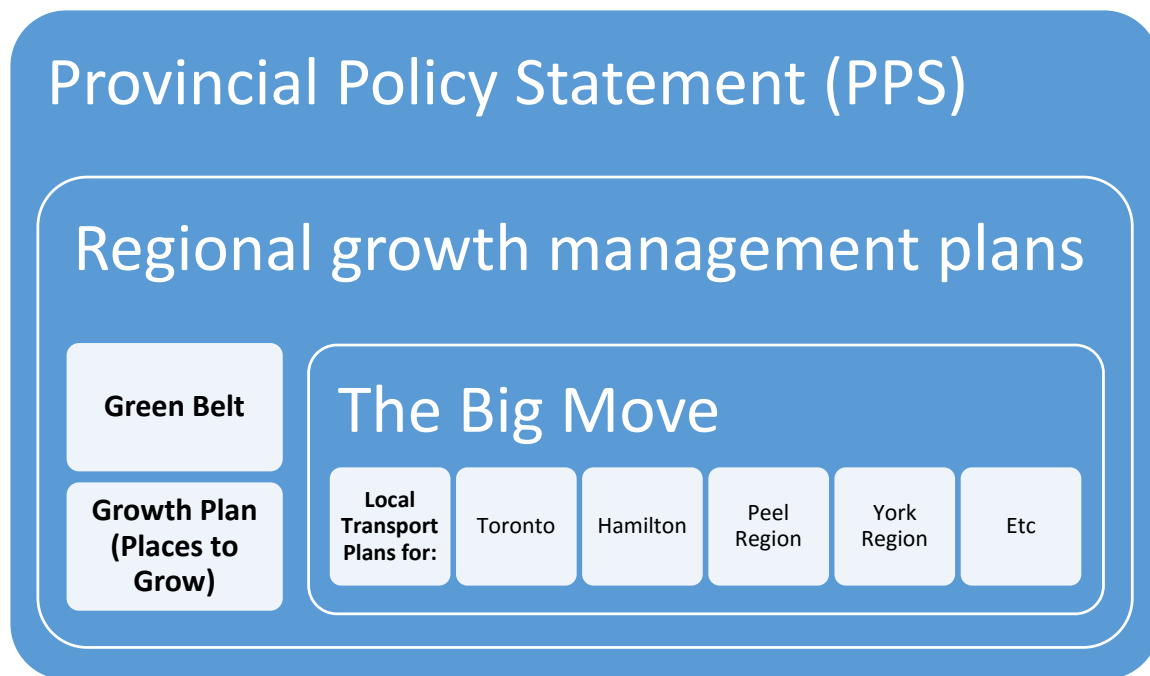


Figure 14 Planning Policy Framework in Ontario

### 3.2 Provincial Policy Statement (PPS)

The Provincial Policy Statement, 2005 (PPS, 2005) provides a policy foundation on matters concerning land-use planning in the Province of Ontario. It aims to mitigate traffic congestion by focussing growth in existing settlement areas and prioritizing compact form, intensification and redevelopment. It mandates that expansion of settlement area boundaries can only occur after a comprehensive review (Ontario Ministry of Municipal Affairs and Housing, 2005). Such a comprehensive review must prove that infrastructure (including transit and transportation corridors and facilities) are available or planned.

### 3.3 The Green Belt

The Green Belt is an urban growth boundary surrounding urbanized areas of the Greater Toronto and Hamilton Area. It has been in place since 2005. As previously discussed, the sprawling low-density development pattern of the last half-century has chewed up some of the most valuable agricultural land in southern Ontario, while contributing to traffic congestion and other urban ills. The vision of the Green Belt Plan is to provide “a broad band of permanently protected land” which “...protects against the loss and fragmentation of the agricultural land base... gives permanent protection to the natural heritage and water resource systems that sustain ecological and human health... and provides for a diverse range of economic and social activities associated with rural communities” (Ontario Ministry of Municipal Affairs and Housing, 2005, p. 4). Explicitly, the plan spells out where development can *not* go. Implicitly, and in conjunction with the Growth Plan, this means that the GTHA must accommodate future growth through intensification – infilling and building up, rather than out. Refer to *Map 4* below – the green shaded areas represent areas where residential expansion cannot take place (with a few exceptions typically related to housing for agricultural use).

Because of the potential impact on encouraging more compact development, Jenifer Keesmaat – the Chief Planner of Toronto says that urban growth boundaries are “not just good planning, they are in the national interest” (Keesmaat, 2015, p. 3). And, the Green Belt is showing signs of success in its first decade of implementation. Along with the associated Growth Plan, Oak Ridges Moraine Conservation Plan (ORMCP), and the Niagara Escarpment Plan (NEP), the Green Belt Plan is currently under a mandated ten-year review. The initial results from the Performance Indicators report for the Green Belt Plan shows that the majority of new development is being directed to existing settlement areas, and

away from agricultural and environmentally sensitive lands (Ontario Ministry of Municipal Affairs and Housing, 2015). For example the report shows that new growth (by units) occurring outside of settlement areas was reduced to 1.1% in the 2006-2011 timeframe, from 4.1% in the 2001-2006 timeframe (p18). The Green Belt is influencing more compact development, however this may actually result in increased congestion in the near term, if there is not an associated increase in transportation infrastructure – more people moving around on the same transportation network will result in congestion.

Some limitations of the Green Belt include the fact that infrastructure (such as roads and railway lines) are permitted within the Green Belt – thus enabling development to leapfrog the Green Belt over time. Therefore the transportation connections between municipalities on either side of the Green Belt will need to be carefully examined so that the problem of congested regional highways isn't repeated in future with highways that traverse the Green belt.



Map 4 The Green Belt and Urban Growth Centres

Source: Ontario Ministry of Infrastructure, 2006

### 3.4 The Growth Plan

The Growth Plan for the Greater Golden Horseshoe is a strategic plan that was established in 2006 to guide future growth in this region. The Plan can help mitigate future traffic congestion through improved land-use planning. In particular, the Plan encourages intensification – development and redevelopment of communities with greater residential and employment densities which are conducive to improved transit services (Ontario Ministry of Infrastructure, 2006).

The Plan gains its powers through the Places to Grow Act, 2005. The Act has four purposes which include: enabling economically and environmentally sustainable decisions about growth; making efficient use of infrastructure; enabling planning that reflects an integrated approach across natural and municipal boundaries; and to ensure achievement of a long term vision (Government of Ontario, 2005). The Act enables the provincial government to designate an area as an urban growth centre, which is a defining characteristic of the subsequent Growth Plan.

The Growth Plan acknowledges a number of challenges facing the GGH region, including one of the key issues this study is investigating: “attractive and efficient public transit is difficult to introduce into sprawling communities, and this limits our ability to respond effectively to growing traffic congestion issues” (Ontario Ministry of Infrastructure, 2006, p. 9). The policies of the Growth Plan deal with population forecasts and land use (“Where and How to Grow”), servicing this growth (“Infrastructure to Support Growth”), and the environment (“Protecting What is Valuable”).

#### **Population forecasts**

The Growth Plan set out to maintain a 25 year planning horizon (Ontario Ministry of Infrastructure, 2006). When released in 2006 it included a population forecast out to 2031 for the GTHA municipalities (the City of Toronto, City of Hamilton, and regions of Halton, Peel, York, and Durham), as well as the outer ring municipalities. The GTHA population was forecasted to grow to 8.6 million by 2031 at that time. In 2013 an update to the Plan was released, adjusting the 2031 forecast to 9 million, and extended to 2041 with a forecast of 10.1 million.

#### **Directing growth**

The Growth Plan directs a significant portion of new growth to existing built-up areas of municipalities, through intensification. The Plan sets a target for intensification: “a minimum of 40 percent of all residential development occurring annually within each upper and single-tier municipality will be within

the *built-up area*” as of 2015 (Ontario Ministry of Infrastructure, 2006, p. 16). The Plan also identifies urban growth centres to focus development and accommodate major transit infrastructure – these growth centres are mostly the downtown centres of each municipality. By 2031, the urban growth centres within the City of Toronto are expected to obtain a density target of 400 residents and jobs (combined) per hectare, while urban growth centres in most of the surrounding municipalities have a target of 200 residents and jobs per hectare, including: Brampton, Burlington, Hamilton, Milton, Markham Centre, Mississauga City Centre, Midtown Oakville, Downtown Oshawa, Downtown Pickering, and Vaughn Corporate Centre. The built-up area, and urban growth centres are identified in *Map 4*.

The Growth Plan seeks to guide future growth to be more conducive to transit by increasing density across the built-up area. It states that official plans of municipalities will designate intensification corridors and major transit station areas. These major transit station areas are expected to accommodate multiple modes including access by pedestrians, cyclists (including bicycle parking), and commuter pick-up/drop-off areas.

### **Opportunities**

The Green Belt Plan and the Growth Plan are undergoing a joint review by the responsible provincial Ministries as part of a planned 10-year review in 2015. There are a number of opportunities for improvement. In their review of the Growth Plan, Neptis researchers found that the rate of greenfield development had already begun slowing in the decade prior to 2001, suggesting that the market may have been ahead of this policy and there is room for the Growth Plan to set more ambitious intensification targets (The Neptis Foundation, 2015). This same report found that the composition of housing stock in Toronto has not changed much between 1991 and 2011 – while mid-rises and townhomes now make up approximately 50 percent of housing stock in Vancouver, this amounts to little more than a quarter in Toronto. Encouraging an increase of this type of higher-density development which provides affordable housing options for young families and newcomers would also enable more wide-spread transit service. Toronto has been successful with its downtown condo boom, which has been beneficial for transit and active modes in the core, however if density were spread across the region this would better enable transit services and in turn assist in reducing traffic congestion.

Another opportunity for improved implementation of the Growth Plan would be more explicit direction for land-use and transit planning coordination. Section 2.2.5 of the plan does state that major transit

station areas and intensification corridors will be designated in official plans, however there are no directives that tie this back to density targets, or other transit-supportive measures. For example, a target could be put in place that every new residential development must be within 2km of a current or planned higher-order transit stop. Section 2.2.6 of the Plan discusses Employment Lands but provides no guidance for transit or transportation – a directive could be added to ensure all new employment locations are accessible by transit.

### 3.5 Transportation Plans

The following sections discuss transportation plans – first the Regional Transportation Plan produced by Metrolinx, followed by a sampling of transportation plans from individual municipalities and regions that comprise the GTHA. Prior to entering this discussion, it is useful to identify what a transportation plan is. Soberman et al. provide a helpful definition (2006, p. 13), stating that a transportation plan comprises five distinct elements:

1. Routes on maps defined by technology (roads and transit, by category), and specific location.
2. A clear statement of priorities for capital investment in these routes that corresponds to the most pressing needs
3. Associated policies for the management and delivery of transportation service, most notably:
  - Transportation demand management (TDM) measures, such as high occupancy vehicle (HOV) lanes, and
  - Policies regarding the use of road space by automotive traffic and transit, such as transit priority schemes and parking regulations
4. Consistent land use policies regarding the location and density of growth and redevelopment of population and employment areas
5. A financial model for meeting capital and operating costs

It is clear from this definition that a complete and effective transportation plan will include strategies to supply a mix of transportation options, manage demand, and integrate land-use and transportation planning. Soberman's report speaks to the importance of such a plan noting that in the absence of a plan officials may make decisions primarily on political grounds. This review of transportation plans in the GTHA will indicate that plans are fairly complete in proposing an evolution of the transportation network and identifying a need to coordinate land-use planning. Where these plans lack is in the area of effective transportation demand management techniques that include fiscal tools (such as tolls or road



pricing). A separate investment strategy was created to accompany the regional transportation plan (although it was not followed), while lower-level transportation plans lack financing models.

### 3.6 Metrolinx, the Big Move, and the Investment Strategy

As previously discussed, the problem of traffic congestion is a *regional* problem – it does not respect municipal boundaries. The province recognized that addressing this problem required coordination at a level above individual municipalities, and established Metrolinx as a regional transit authority in 2006. Metrolinx has since produced two key strategic plans which are integral to this discussion – the Big Move (a regional transportation plan), and an investment strategy to recommend methods of funding transit expansion and operations related to the Big Move.

#### 3.6.1 Metrolinx

Metrolinx was established in 2006 as a Crown agency responsible for regional transportation planning in the GTHA. The Metrolinx Act (originally called the “Greater Toronto Transportation Authority Act”) gave the agency three key objectives (Government of Ontario, 2006):

1. Lead and coordinate the planning, financing, development, and implementation of a multi-modal transportation network
2. Act on behalf of Ontario municipalities, as a central procurement agency for transit vehicles and related equipment, facilities, technology, facilities and supplies
3. Manage the regional transit system (GO Transit)

Through building regional transit, coordinating with local transit agencies, helping to coordinate land-use and transportation planning, and implementing active transportation and demand management programs, Metrolinx is well positioned to improve connectivity within the region and impact traffic congestion. The agency has implemented PRESTO, an electronic fare card intended to enable seamless transfer across transit systems; took over GO Transit, the regional public transit service for the GTHA in 2009; and built the UP Express, a train linking Pearson airport with Union Station downtown in 2015, (Metrolinx, 2015).

### 3.6.2 The Big Move

Metrolinx released a Regional Transportation Plan (RTP) in November 2008 called *The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area*. It is a long-term strategic plan for an integrated, multi-modal regional transportation system, more commonly referred to simply as the “Big Move.” This plan is a critical element in the planning framework for addressing traffic congestion in the region.

The Big Move was compiled after a series of public consultations, and discussion papers. The cornerstone of the plan is a tremendous increase of rapid transit infrastructure in the region over the next 25 years. Key highlights include (Metrolinx, 2008c):

- A plan to build over 1,200 km of rapid transit (more than triple what existed at time of release)
  - Provide over 80 per cent of residents a rapid transit stop within 2km of their home
  - An emphasis on areas with greater numbers of senior and low-income people
- A goal to *reduce* average commute times (even as population is projected to increase)
- Connect more residents to jobs that were previously too inconvenient to reach by transit
- Integrate transit fares across the region (with the PRESTO smart card)
- Improved information systems to encourage smarter choices

The vision of the Big Move is expressed in a series of targets quantifying goals they hope to achieve in twenty five years, one of which is to accommodate 50 percent more people in the region with *less* congestion than is experienced today (Metrolinx, 2008c). This aligns with the Metrolinx vision to “transform the way the region moves” (Metrolinx, 2015). To achieve identified goals and objectives, the Big Move includes ten strategies and nine priority actions which will be discussed here.

Metrolinx dubs their priority actions the “Nine Big Moves” of the plan, which are expected to deliver “the largest and most transformational impact on the GTHA’s transportation system” (Metrolinx, 2008c, p. 21). These Big Moves align with six of the strategies in the plan, as show in *Figure 15*. Three of these priority actions align with strategy number one “build a comprehensive regional rapid transit network”, indicating that this is primarily a plan for transit expansion. The ninth Big Move “an Investment Strategy to provide immediate, stable, and predictable funding,” would support all strategies, but primarily provide the funds needed for transit infrastructure expansion and operations.

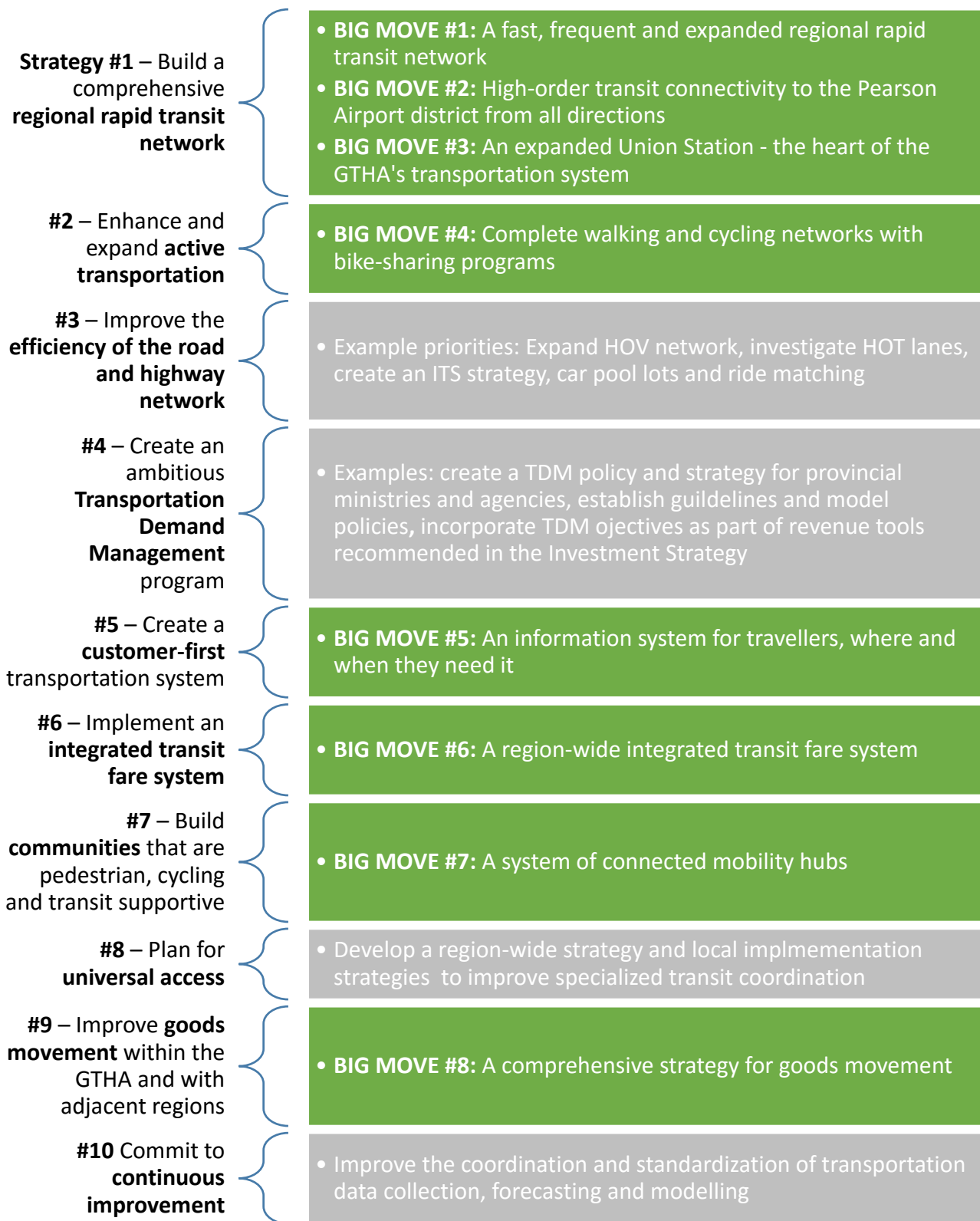


Figure 15 Metrolinx Big Move Strategies and Priority Actions

Source: chart compiled from data presented in the Metrolinx Big Move RTP (2008)

## **Potential policy gap**

If all strategies in the Big Move were fully implemented, the next biggest opportunity to impact a reduction in traffic congestion would be an expansion of transportation demand management (TDM) techniques to include market-based dis-incentives to auto use.

The list of priority actions listed under Big Move Strategy #4: “Create an ambitious transportation demand management program” are primarily soft actions related to creating TDM policies and guidelines, and encouraging adoption by various private and public sector organizations. The policies centre around education and integration with land-use planning. The two market-based or fiscal policies hinted at within this section of the plan are to encourage employers to offer a cash out in lieu of subsidized or free parking (action 4.4), and to incorporate TDM goals and objectives as part of any revenue tools recommended in the Investment Strategy (action 4.5).

### **3.6.3 Investment strategies**

The mix of investment tools selected to fund transportation infrastructure construction, maintenance and operations can have a significant impact on the efficiency of the network. By providing dis-incentives for auto use or incentives for transit use, several investment tools can impact modal split and help to reduce congestion. Investment tools that encourage more compact development and coordination between land-use and transportation planning can also help to mitigate congestion indirectly.

This section will briefly summarize the investment tools reviewed and recommended by Metrolinx, the Transit Investment Advisory Panel, and finally the tools selected by the provincial government whom Metrolinx is an agency of. The review indicates that gaps exist to ensure greater local accountability of decision making for transit projects, and encourage more efficient use of the transportation network through alternate revenue tools.

#### **3.6.3.1 Metrolinx Investment Strategy**

The Big Move is a \$50 billion plan. Metrolinx estimates that they will need roughly \$2 billion a year over twenty five years to implement this regional transportation plan – to cover capital costs alone. The ninth strategic priority of the plan was for Metrolinx to create “an investment strategy to provide immediate, stable and predictable funding” (2008a, p. 21).

Metrolinx released its Investment Strategy in May, 2013. The document entitled “Investing in Our Region” provided an update on the Big Move first wave and next wave projects, discussed the public consultation process used to build the plan, methods Metrolinx plans to use to build trust and accountability, and outlined the need for federal government involvement. The last section of the document describes the mix of investment tools that Metrolinx was recommending (Metrolinx, 2013a):

- 1% increase to the HST,
- 5 cent per litre increase to the gas tax
- an average 25 cent levy on off-street business parking, and
- an increase in development charges.

In building its Investment Strategy, Metrolinx reviewed a number of additional revenue tools which have been used worldwide. Some of these tools also act as a dis-incentive to auto use, and others are general taxes which do not directly relate to transportation choices as shown in Table 6 below.

Investment Tools Considered	
Dis-Incentive to Auto Use	No Direct / Limited Connection to Transportation
<ul style="list-style-type: none"> <li>• Auto Insurance Tax</li> <li>• <b>Business Parking Levy</b></li> <li>• Car Rental Fee</li> <li>• Carbon Tax</li> <li>• Cordon Charge</li> <li>• Driver’s License Tax</li> <li>• <b>Fuel and Gasoline Tax</b></li> <li>• High Occupancy Toll (HOT) Lanes</li> <li>• Highway Tolls</li> <li>• New Vehicle Sales Tax</li> <li>• Parking Sales Tax</li> <li>• Vehicle Kilometres Travelled (VKT) Fee</li> <li>• Vehicle Registration Fee</li> </ul>	<ul style="list-style-type: none"> <li>• Business Payroll Tax</li> <li>• Corporate Income Tax</li> <li>• <b>Development Charges</b></li> <li>• Hotel and Accommodation Levy</li> <li>• Income Tax</li> <li>• Land Transfer Tax</li> <li>• Land Value Capture</li> <li>• Property Tax</li> <li>• <b>Sales Tax</b></li> <li>• Tax Increment Financing (Special Assessment Districts)</li> <li>• Transit Fare Increases<sup>4</sup></li> <li>• Utility Levy</li> </ul>

<sup>4</sup> Transit fare increases can be a dis-incentive to transit use, and in effect encourage auto use

Table 6 Investment tools considered by Metrolinx prior to finalizing the Investment Strategy

Source: List is from the Metrolinx Investment Strategy (2013a), categorized by study author.

The Canadian Centre for Policy Alternatives produced a report that reviewed a number of these potential revenue tools and concluded that none of the options on their own could generate the volume of funds required (Mackenzie, 2013). They recommended that a mix of revenue tools be utilized. Their suggested mix would include at least three different revenue streams:

1. A general stream that is robust enough to provide a significant proportion of funding required
2. A mid-level stream that combines policy benefits with revenue raising capacity, and
3. One or more smaller revenue sources whose primary role is an expression of transportation policy

This guidance aligns with achieving vertical and horizontal equity, through a mix of policies as discussed earlier in section 2.5 (Evaluation and financing). The proposed revenue mix in the Metrolinx Investment Strategy meets this guidance. The plan included a high-revenue generating general revenue stream (an increase to the HST), a mid-level stream that provided a mix of policy and revenue generation (development charges to encourage compact development), and two streams which met the transport policy goal of encouraging a shift in modal split (a parking levy and increase to the gas tax). For further discussion of these tools, please refer to Appendix A.

### *3.6.3.2 The Role of the Transit Investment Advisory Panel*

The Transit Investment Advisory Panel (also referred to as the Transit Panel), was an independent panel established by Premier Wynne in September of 2013 with the mandate to engage the public on the investment tools recommended by Metrolinx and advise the Province on how to respond to the Investment Strategy (Transit Panel, 2013a). The panel proceeded to complete an extensive public engagement process and produced three informative discussion papers. Their final recommendations included two options to deliver the required funding, in a similar mix to the above. The general taxes recommended by the Transit Panel included modest increases to the Corporate Income Tax, and either a small increase or redeployment of a small portion of HST revenue (Transit Panel, 2013c). Although neither of their proposed options included a parking levy (as recommended by Metrolinx), both options did include a phased approach to increasing the gas tax which would provide a dis-incentive to auto use.

### *3.6.3.3 Chosen investment tools*

In April of 2015, the Ontario Provincial Government announced their new plan for investing in transit over the next decade through their “Moving Ontario Forward Plan” (Ontario Ministry of Finance, 2015). The commitments included \$16 billion of investments for transit projects in the GTHA. In the lead up to the plan Premier Wynne was quoted as saying she would “not ask the people in North Bay to pay for transit in the GTA,” indicating that she was against general taxes across the province. The announced plan drew its funding from a diversion of 7.5 cents per litre on the 14.7 cent gas tax (no increase), repurposing of revenues from HST charged on the gas tax, and “dedicated proceeds from targeted revenue measures” (Ontario Ministry of Finance, 2015). There was also an indication to work with the federal government to secure additional funding, and an earmarking of future revenue from HOT lanes when implemented. The potential revenue from future HOT lanes was the only revenue tool planned that would provide a dis-incentive to auto use. The diversion of funds from the existing gas tax would not provide any further dis-incentive to driving, as the tax rate was to stay stagnant.

The narrative of investment tools proposed and ultimately selected provides an indication of the political climate and perceived public acceptance rate for new charges directly related to transportation.

### 3.7 Transportation plans within the region

This section reviews a sampling of transportation plans within the region. The City of Toronto, the Region of York, and Peel Region have been selected as they appear to have the most advanced transportation plans, and are also the municipalities with the largest employment centres.

#### **City of Toronto**

The City of Toronto has taken the unique approach of integrating their transportation plan into their Official Plan (OP). Jennifer Keesmaat, the Chief Planner of Toronto discussed the strategy behind this move on an interview on CBC's Metro Morning radio show (Galloway, 2014). She stated that once the transportation plan is part of the official plan it would no longer be possible to have a motion at city council to change the strategy for transit – such a decision would need to go through an official plan review, which requires a public process. The approach may effectively overcome some political hurdles in future. The City's current official plan was originally adopted by City Council in 2002, with updates in 2006 and 2015. Section 2.2 of the Plan speaks to the integration of land-use and transportation planning.

Transit expansion, goods movement strategies, and a bike plan were included in the OP. Nine demand management techniques were discussed in the Plan (City of Toronto, 2015c, pp. 2–28), including:

- Promoting car pooling and ride sharing
- Expanding the volume of HOV lanes
- Active transportation programs
- Marketing public transit
- Working with employers
  - to provide transit fare incentives
  - promote flexible working hours, encourage telecommuting, and
  - creation of Transportation Management Associations (TMA's)
- Parking supply and management strategies
- Smart card technology for transit fares
- Application of Intelligent Transportation System (ITS) innovations

This list of soft approaches to managing demand relies primarily on educating the public. The policies included in the transportation section of the Plan (section 2.4) reflect the above. Through the City of Toronto Act, the City stands apart as the only municipality in the province with the rights to leverage



tolls and user fees. However, fiscal tools (such as parking charges, or tolls) were *not* included in Toronto's Official Plan. The notable exception is Policy 3F:

“3. The City will show leadership within the region in the implementation of TDM measures to reduce auto dependence and rush-hour congestion in the road and transit networks by:

f) working with Metrolinx to pursue a region-wide study of road pricing to reduce congestion and better manage traffic”

Research for this paper has not found evidence that this study of road pricing options has been initiated by the City of Toronto or Metrolinx, however on a related measure City Council has recently requested a study of tolling options (City of Toronto, 2015a).

### **Region of York**

“York Region recognizes that each transportation trip begins and ends with a pedestrian trip, and is committed to designing a transportation system that promotes an active lifestyle and community well being” (Regional Municipality of York, 2009, p. 90). It's a tall order, but the primarily suburban region has decided to put pedestrians and transit first in its planning. York's Transportation Master Plan (TMP) includes both supply-side and demand-side congestion mitigation tactics. Provincial plans are mentioned to extend Highway 427 and 404, to relieve pressure off Highway 400. Transit improvements are discussed, including the use of transit priority signalling to make more efficient use of their bus system. As with Toronto, the TDM programs mentioned tended to be education-based, such as encouraging all employers to implement TDM programs.

Interestingly, there is a section in the York Region TMP that specifically discusses congestion pricing. It provides an overview of London's implementation of the scheme, and a number of 'lessons learned.' They conclude that York Region would be a difficult area to implement a London-style (CBD cordon) congestion pricing plan – because it has multiple business centres. They state that for such a plan to be feasible there must be a destination with “critical mass”, and a plan to deal with through traffic (Regional Municipality of York, 2009). They suggest that Metrolinx may be considering such a scheme at a regional scale, where it would be more effective, and that York Region should follow the lead set by Metrolinx.

## Region of Peel

Residents of the Region of Peel were experiencing the third highest levels of congestion delay in the GTHA in 2006, averaging 11.1 minutes (Metrolinx, 2008b). This region covers three municipalities to the west and north-west of Toronto: the cities of Mississauga and Brampton, and the Town of Caledon. Unlike York Region, transit service in Peel is provided by the individual municipalities rather than at the Region level.

Peel Region issued an amendment to their Official Plan to provide several updates to help ‘guide the development of a safe, convenient and efficient transportation system in Peel’ (Peel Region, 2005, p. 3). One of the policies amended (5.6.2.5) was specific to Transportation Demand Management:

“Work with area municipalities, neighbouring municipalities, other levels of government and non-governmental agencies to implement Transportation Demand Management programs” (2005, p. 5).

Through this amendment they acknowledge that the Region is becoming increasingly auto dependent, with single occupant trips increasing and transit share declining. TDM measures listed through the amendment however included primarily soft measures such as education programs and working with employers. A series of car pooling, van pooling, and ride-sharing options are listed in Policy 5.6.9.2.3, and there was discussion of adding HOV lanes to highways in the Region. Although these policies indicate efforts to attack congestion by managing the demand side of the equation, no fiscal tools were discussed.

### 3.8 Summary

Through a review of the planning policy framework and a scan of transportation plans within the GTHA, there are number of policies which indicate improved land-use and transportation planning going forward. The PPS provides high level guidance, the Green Belt restricts further growth of the urban area, and the Growth Plan directs future growth to existing built-up areas. The transportation plans of municipalities sampled in this study indicate an acceptance of demand-side techniques to manage congestion, however such policies are more applicable at the regional level. The apparent gap is a lack of demand management policies that involve a fiscal element – parking charges, tolls, or other fees which have been shown to be most effective in encouraging a shift in modal split and mitigating congestion. Chapter Four introduces the primary research methods used to explore opportunities and gaps in the local context.

## Chapter 4 – Research Methodology

### 4.1 Introduction

This study utilizes a qualitative, mixed-methods approach to answer the complex research question:

**As population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?**

Sub-questions to support a response include:

- What are the impacts of traffic congestion?
- What are the causes of traffic congestion?
- What opportunities exist to encourage a shift from auto use to more efficient modes?
- What policy gaps (if any) exist in the regional transportation plan for the GTHA?
- What are the barriers to implementation of these policies?
- How can we overcome these identified barriers?

### 4.2 Research methods

The problem is a “wicked” social policy and planning problem. It is a problem with a high degree of complexity, many variables, and an almost endless list of potential solutions. A major component to seeking a resolution is defining (and refining) the problem itself (Rittel & Webber, 1973). This problem is best approached with qualitative, iterative methods that allow the researcher to involve multiple participants in order to unpack the problem from different perspectives, and evolve the approach as more is learned throughout the process. A qualitative, mixed-methods approach has been utilized for the purpose of this study through four research methods:

1. A document analysis of transportation planning documents in the GTHA
2. Key informant interviews with local subject matter experts
3. A policy Delphi (multi-round survey panel) with global leading experts
4. A Design Charrette that incorporates the views and lived experience of everyday citizens

These four methods help us to understand both the problem space and the solution space, exploring six sub-questions as shown in Table 7.

## Methods of data collection

Research Sub-question		Methods				
		Literature Review	Document Analysis	Key Informant Interviews	Delphi	Design Charrette
1	<b>What are the impacts of traffic congestion?</b> (Why is this important?)	X	X	X		
2	<b>What are the causes of traffic congestion?</b> (How did we get into this mess?)	X	X			
3	<b>What opportunities exist to encourage a shift in modal split?</b> (What supply side, demand side, fiscal, and non-monetary policies exist? How do they help?)	X	X	X	X	
4	<b>What policy gaps (if any) exist in the regional transportation plan for the GTHA?</b>		X	X	X	
5	<b>What are the barriers to implementation of these policies?</b> (What are the public acceptance, political, and other barriers?)			X	X	X
6	<b>How can we overcome these identified barriers?</b> (What new ideas do we have for policies or processes? How can we test for public and political acceptance, prior to formalizing these plans?)			X	X	X

Table 7 Methods of data collection

The literature review is a secondary research method that helps inform our world view of the problem – gaining an understanding of the impacts of traffic congestion, causes, and methods applied elsewhere to mitigate. Primary research is used when addressing an abstract problem within a specific context. It allows the researcher to focus on specific issues, and gives greater control over the audience and questions asked. In this case, three qualitative methods have been chosen to work with participants who understand the GTHA context to understand applicability of existing solutions and collaboratively suggest new ideas. Key informant interviews are a primary, qualitative research method selected to gain a greater understanding of the traffic congestion problem, and understand how applicable potential solutions would be to the GTHA case study. Key informant participants were invited back to attend a policy design charrette where they were asked to collaborate with local residents to recommend solutions. In the interim, a Policy Delphi was used to solicit input from an international panel of experts.

### 4.3 A Wicked Problem

This study's research question seeks to address a "wicked" problem. Rittel and Webber describe planning and social policy problems as "wicked" problems in comparison to "tame" problems that scientists and engineers deal with (1973). A key differentiator is the definability of problems – in the natural sciences one can clearly define a problem within specific boundaries, whereas a planning problem such as this is ill-defined and relies on political judgement for resolution. As well, social problems such as this are never fully solved. Instead, they are *re-solved* over and over again. The term wicked is used to describe the problem as vicious, tricky and challenging (Rittel & Webber, 1973). These are important considerations. Of the ten distinguishing properties of wicked planning problems described by Rittel and Webber, three are mentioned here to describe why qualitative, iterative, and collaborative research methods have been selected for this study:

#### **There is no definitive formulation of a wicked problem**

A person's understanding of a wicked problem is dependent on their idea for solving it. To describe the problem in detail, an exhaustive list of conceivable solutions must be developed ahead of time. Finding the problem, and finding the solution are intertwined. Every definition of the problem leads to a new conceivable solution or re-solution (Rittel & Webber, 1973).

### **Every wicked problem is essentially unique**

While one city may share many similarities to another with social problems, there is often an additional distinguishing property that sets it apart (Rittel & Webber, 1973). Although the GTHA is a case study used in this project, we can not simply assume that applying solutions researched from other parts of the globe will be effective here. For example, congestion pricing (through a cordon scheme) has been shown to effectively reduce congestion in several western European cities. If applied in the GTHA today, we may find that it is not effective in achieving a major modal shift because other feasible transit alternatives do not exist for many commuters to switch to. We must therefore look at a number of possible solutions with an understanding of what makes the GTHA context unique.

### **Every wicked problem can be considered to be a symptom of another problem**

Problems can be described as a gap between a desired or ideal state and the current state. The process for resolving a problem begins with the search for causal explanation of the gap. Removing that cause presents another problem of which the original problem was a symptom. Problems are therefore symptoms of higher level problems, and to have the greatest impact we must seek to solve problems on as high a level as possible (Rittel & Webber, 1973).

The theory of triple convergence tells us that it is near impossible to solve traffic congestion by adding more roads, because latent demand always creeps back in to fill the added capacity. This indicates that the higher level issue is an imbalance in the volume of people who choose to drive over taking transit or other modes. Resolving this issue leads to a complex combination of potential demand and supply side solutions, and problems which are best unpacked through mixed methods, with the participation of those who know the problem best – those that are closest to it.

## 4.4 Research design

This section describes the research methods employed in this study, which included three primary stages: key informant interviews, a Policy Delphi, and a Policy Design Charrette. Following this, sampling and recruitment methods will be discussed, along with data management, analysis, and ethical considerations.

### 4.4.1 Key informant interviews

Both structured and semi-structured interviews provide a flexible and adaptable way of finding new information. Key informant interviews were selected as the investigative method for the first phase of primary research in this study, primarily because of the complexity of this problem. In relation to the properties of a wicked problem discussed above, interviews were sought to: help refine the problem definition, understand how solutions used elsewhere may or may not work in the GTHA case, and untangle the causal trail to unpack the problem at the highest level possible.

Bernard (2000), Palys and Atchison (2008), and Robson (2002) provide many benefits, as well as several challenges and limitations of key informant interviews:

#### **Benefits**

- They provide insights not otherwise available in the public realm
- They provide the opportunity to collect various types of qualitative data including: insights, opinions, attitudes, experiences, processes, and behaviours
- They offer the ability to modify the line of questioning, and follow up on interesting responses
- They provide an opportunity to build rapport with respondents
- They add credibility to the research through an ability to cite reputable sources
- Higher rate of participation for face-to-face interviews (80-90%)

#### **Challenges and limitations**

- Logistical challenges: potential participants may not respond, it may be difficult to coordinate availability (busy work schedules)
- The flow of conversation may lead to different topics between different respondents
- In-person interviews are a very time-intensive method – both for the initial interview, as well as time spent transcribing and coding results
- Respondents may seek confidentiality and anonymity (may not be able to quote sources)

## Design

An interview is simply a conversation with a purpose (Bingham & Moore, 1931). In this regard, a process was followed to ensure that the interviews were both tested and ultimately conducted to explicitly address both the primary and secondary research questions. To achieve this, several steps were taken: first a script was developed and reviewed with qualitative research experts; second a pilot interview was conducted with a participant from several stakeholder groups; finally the script was edited based on feedback and the updated version was used for the remainder of the interviews. More specifically, the script consisted of a question bank that could be referred to throughout the interview (Table 8). As a semi-structured interview format was used, these initial questions formed baseline questions which were used to advance the conversation based on participant responses.

Interviews were conducted primarily in-person, at a location and time that was convenient to the participant – for example, some interviews were conducted in coffee shops, while others were conducted more formally in the offices of participants. When logistics posed a challenge, telephone interviews were utilized for some participants. In both cases, the conversation was audio-recorded and later transcribed for accuracy. The researcher also took notes during the interview as a recommended best practice (Palys & Atchison, 2008), and compared with transcription data during the analysis phase.



**Semi-structured Interview Script:**

KEY QUESTIONS	PROMPTS / PROBING QUESTIONS	RATIONALE
<b>Category #1: Grounding questions</b>		
<ul style="list-style-type: none"> <li>• Can you tell me about your average commute?</li> <li>• How and why do you decide to use the modes you use to travel to work?</li> <li>• What do you not like about your commute?</li> </ul>	<ul style="list-style-type: none"> <li>• What is your biggest frustration with regards to your commute?</li> <li>• How does traffic congestion impact you?</li> <li>• How do you define traffic congestion?</li> <li>• What do you think is the root cause of congestion in the GTHA?</li> </ul>	<ul style="list-style-type: none"> <li>• Introductory “ice-breaker” questions are standard practice to warm up the participant</li> <li>• These questions help the participant to think about, and relate to the problem</li> <li>• Responds to research sub-question #1: What is the impact of traffic congestion?</li> </ul>
<b>Category #2: Opportunities</b>		
<p>Un-prompted ideas:</p> <ul style="list-style-type: none"> <li>• What can be done to help alleviate the traffic congestion we are currently experiencing?</li> <li>• How would you envision our transportation network in 25 years?</li> </ul> <p>Feedback on current plans:</p> <ul style="list-style-type: none"> <li>• Are you aware of the “Big Move”?</li> <li>• If fully implemented, how effective do you believe the Big Move will be in meeting its goals related to:               <ul style="list-style-type: none"> <li>○ Traffic congestion</li> <li>○ The economy</li> <li>○ Health and quality of life</li> <li>○ The environment</li> </ul> </li> </ul>	<p>[Prompt]</p> <ul style="list-style-type: none"> <li>• What types of system changes would help? (ie. more roads, more transit capacity)</li> <li>• What types of policies would help?</li> </ul> <p>[Prompt]</p> <ul style="list-style-type: none"> <li>• Why/why won’t the plan affect change?</li> </ul>	<ul style="list-style-type: none"> <li>• Asking about personal ideas first, before feedback on specific tactics helps prevent leading the participant. It helps gather information that they may not have volunteered if they start focussing on specific solutions.</li> </ul>

KEY QUESTIONS	PROMPTS / PROBING QUESTIONS	RATIONALE
<ul style="list-style-type: none"> <li>In April, Premier Kathleen Wynne announced that the provincial government will invest \$49.8 billion in the GTHA transport network over the next decade. Do you believe this cash infusion will solve the gridlock?</li> <li>What additional congestion mitigation tactics or strategies are you aware of? How could these apply to the GTHA?</li> <li><b>What tools or strategies would be most effective in encouraging a shift in modal split?</b> (ie. More drivers of single occupant vehicles opting to take transit, car pool, or use active modes rather than drive).</li> </ul>	<p>[Probe]</p> <ul style="list-style-type: none"> <li>Why or why not?</li> <li>What else needs to be part of the solution?</li> </ul>	<ul style="list-style-type: none"> <li>Responds to research sub-question #3: What opportunities exist to encourage a shift in modal split?</li> <li>Responds to the core research question: <i>as population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?</i></li> </ul>
<b>Category #3: Barriers/Challenges</b>		
<ul style="list-style-type: none"> <li>What are the barriers to implementation for the policies we have discussed?</li> </ul>	<ul style="list-style-type: none"> <li>Examples: <ul style="list-style-type: none"> <li>Public acceptance barriers</li> <li>Political barriers</li> </ul> </li> <li>[Probe] <ul style="list-style-type: none"> <li>Can you tell me a bit more about this?</li> <li>Can you give me some examples?</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Gathering an in-depth understanding of the barriers is a cornerstone point of this research. It will feed into the design charrette.</li> <li>Responds to research sub-question #6: What are the barriers to implementation of these policies?</li> </ul>

KEY QUESTIONS	PROMPTS / PROBING QUESTIONS	RATIONALE
<b>Category #4: Recommendations and New ideas</b>		
<ul style="list-style-type: none"> <li>• How do you think we can overcome the barriers we have discussed?</li> <li>• What role do the following stakeholder groups play in the solution? <ul style="list-style-type: none"> <li>○ Transportation and land-use planners</li> <li>○ Government officials</li> <li>○ Business leaders</li> <li>○ The public</li> </ul> </li> </ul>		<ul style="list-style-type: none"> <li>• Responds to research sub-question #7: How can we overcome these identified barriers?</li> <li>• These stakeholder groups have been identified in the literature as influencers and decision makers. An understanding of their role will influence design of the Charrette.</li> </ul>
<b>Follow-up Questions</b>		
<ul style="list-style-type: none"> <li>• What additional articles or reports would you recommend I read?</li> <li>• Who can you refer me to, to continue this conversation and build on what we have discussed?</li> </ul>		<ul style="list-style-type: none"> <li>• A snowball sampling approach is helpful in recruiting more participants</li> </ul>
<b>Demographic questions:</b>		
<ul style="list-style-type: none"> <li>• Have you / how often do you use the 407?</li> <li>• Where do you live?</li> <li>• Where do you work?</li> <li>• What type of work do you do? / What is your job title?</li> <li>• Do you have kids living at home? (#, ages)</li> <li>• [Male/female]</li> <li>• [Identify stakeholder group]</li> </ul>		<ul style="list-style-type: none"> <li>• The literature states that “familiarity breeds acceptance” with certain schemes. This question will test a correlation of 407 (toll highway) users with support of tolling roads to ease congestion.</li> <li>• Tests coorelation of certain viewpoints with residency, occupation types, and lifestyles</li> </ul>

Table 8 Semi-structured interview script

#### 4.4.2 The Policy Delphi

A Policy Delphi is a tool used to gather input from a group of experts to help understand options and supporting evidence on policy decisions. Traditionally, the Delphi method was used to obtain consensus among experts on technical topics; however the Policy Delphi has since evolved as a method which “seeks to generate the strongest possible opposing views on the potential resolutions of a major policy issue” (Turoff, 1975, p. 80). While reaching absolute consensus through this method is unlikely, it does offer analysis and a deeper understanding of the available options (McGeoch, Brunetto, & Brown, 2014; Turoff, 1975). In this study, the Policy Delphi tool was used to involve international experts on the topic of congestion mitigation techniques. In this particular case, an expert panel agreed to respond to two or more rounds of Delphi analysis – through a series of online surveys. After each round, the responses were synthesized, analyzed, and presented back to respondents in the following round. Participants were then provided the option to respond to synthesized statements from the peer group, and new questions as the study unfolds (Figure 16).

There are many benefits, and a few limitations of the Policy Delphi as a research method (Franklin & Hart, 2006; McGeoch et al., 2014; Turoff, 1975):

##### **Benefits**

- Generates an understanding of opposing views of a major policy issue
- Ensures all possible options have been tabled for consideration
- Input from experts who may be geographically dispersed
- Participants remain focussed on the problem, because of structured communication
- The benefits of a participatory process, without the risk of group think (participants provide their own un-biased input, prior to reading the views of their peers)
- Avoids the possibility of face-to-face debates and undue influence of dominant personalities
- Can be used to estimate the impact and consequences of a chosen alternative

##### **Challenges and Limitations**

- Difficulty in developing an accurate initial questionnaire to start the process
- Lack of outcome data, other than statistical profile of participant opinions
- May not reach consensus, if that is desired

## Design

To disseminate a survey to a geographically dispersed group of participants, an online survey method was chosen. Survey Monkey, a popular online surveying tool was selected. As with the key informant interviews, a survey was drafted and peer reviewed with a qualitative research expert. The questions were based on gaps identified in the literature, and initial insights gained from the first round of key informant interviews. The first round survey used in the Delphi is available in Appendix C. One of the core questions asked of the Delphi panel was a question to rate a number of congestion mitigation techniques on their likelihood to impact congestion levels in the GTHA. This question utilized a five-point Likert scale to measure participants positive or negative ratings for each strategy. Other questions required open-ended responses, and were analyzed in a similar method to interview responses.

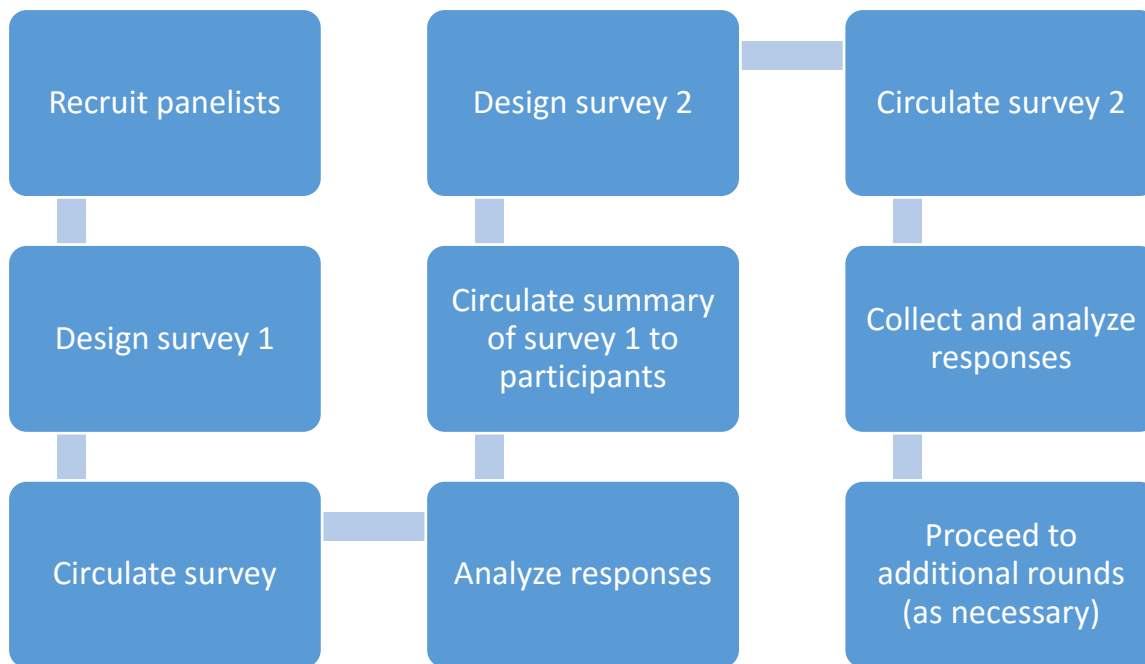


Figure 16 Policy Delphi process

Participant responses to the first survey were synthesized into a brief report, and circulated to participants. Following this, a second round survey was initiated to probe on potential solutions that were suggested. Of the eighteen original panelists, nine participated in the second round of the panel.

#### 4.4.3 The Policy Design Charrette

Most urban planners who have participated in public engagement events are familiar with design charrettes – a method where stakeholders are gathered into groups, guided through a discussion of a particular issue, and allowed the opportunity to collaborate on a solution together. As an example, they are often used when the public’s input is sought on appropriate uses for public space. Increasingly, this format of engagement has also been used to obtain public input on policy issues.

Several benefits and a few limitations of this method are apparent from a review of several charrette case studies (City of Toronto, 2015c; Curtis & Punter, 2011; Denver, 2011; Walker & Seymour, 2008) :

##### **Benefits**

- Work through multiple issues simultaneously, with experts and the public;
- Explore multiple design alternatives very quickly, and receive instant feedback;
- The ‘power of the collective’ – the added benefits of group conversation in brainstorming;
- New ideas which could not have been harnessed through other methods such as surveying or 1:1 interviews;
- Ability to perform an educational function – informing participants on key issues

##### **Limitations**

- Limited by number of participants in comparison to a larger quantity of participants that could be reached through methods such as an online survey
- Group setting limits privacy/confidentiality – participants may not share the depth of information they would be willing to share in an alternate setting
- Time limitations

##### **Design**

A workshop was held with participants to collaboratively identify new solutions to the problems posed by traffic congestion. A design charrette can be a day-long or multi-day process. In the interest of minimizing the impact of participant time, the workshop was limited in time to one evening.

Participants were guided through a discussion that allowed them to start with individual thoughts, discuss their ideas in groups, and build upon the ideas of others. A facilitator guide was created to manage the flow of activities, and is available in Appendix D.

#### 4.4.4 Sampling and recruitment methods

It was important to connect with subject matter experts who could provide an informed opinion on the professional practice of transportation planning, land-use planning, and related issues. A non-probabilistic sampling technique is used when it is important to select strategically chosen participants (Palys & Atchison, 2008). This technique was utilized to target potential candidates for this study. An initial sample size of fifteen to twenty five interview participants was targeted based on guidance in the literature (Flick, 2007; Gray, 2009; Trainor & Graue, 2013). Subsequently, there was significant interest and a high acceptance rate from invitation letters. A cap of fifty interview participants was established, partly due to study time limitations, and the final count was forty seven. The targeted sample sizes of 12-18 participants for the Policy Delphi and Policy Design Charrette were met. One concern was data saturation – the concept that beyond a certain number of participants there is little new information being received by the participant base (Gray, 2009; Trainor & Graue, 2013). To account for this, the researcher analyzed participant data throughout the research process, and the focus of questions asked was shifted to new areas of concern – such as political barriers – after core issues were highlighted by earlier participants.

#### Participant selection:

The World Bank lists several stakeholder groups who should be consulted in developing a transportation sector strategy (Lee & Hine, 2008) and this guidance was used to select stakeholders to represent a range of local and regional interests for this study, as indicated in Table 9 below:

Stakeholder Group	Number of Participants	Examples
Urban Planners	21	<ul style="list-style-type: none"> <li>• Planners with municipalities               <ul style="list-style-type: none"> <li>○ Transportation Planners</li> <li>○ Transit Planners (with local transit agency, Metrolinx, or a municipality or region)</li> <li>○ Land-use planners</li> </ul> </li> <li>• Consultants               <ul style="list-style-type: none"> <li>○ Public consultation practitioners</li> <li>○ Transit planning consultants</li> <li>○ Land-use planning consultants</li> </ul> </li> </ul>

<b>Other civil servants</b>	5	<ul style="list-style-type: none"> <li>• Civil servants employed in applicable roles in related departments in the provincial government – ex. within Infrastructure Ontario</li> <li>• Leaders in applicable non-planning roles at area municipalities or transit agencies – ex. business analyst roles</li> </ul>
<b>Elected officials</b>	6	<ul style="list-style-type: none"> <li>• Elected politicians <ul style="list-style-type: none"> <li>○ MPP of Transportation (office of)</li> <li>○ City councillors in multiple GTHA municipalities / regions</li> </ul> </li> </ul>
<b>Business leaders and others</b>	6	<ul style="list-style-type: none"> <li>• Business Improvement Associations (BIA's)</li> <li>• Chambers of Commerce</li> <li>• Board of Trade</li> </ul>
<b>Transit/transport advocates and subject matter experts</b>	9	<ul style="list-style-type: none"> <li>• Associations <ul style="list-style-type: none"> <li>○ Canadian Urban Transit Association (CUTA)</li> <li>○ Canadian Automobile Association (CAA)</li> </ul> </li> <li>• Civic leaders <ul style="list-style-type: none"> <li>○ Civic Action</li> </ul> </li> <li>• Research groups – think tanks and academics</li> </ul>
<b>Media</b>	1	<ul style="list-style-type: none"> <li>• Media consultant</li> </ul>
<b>Total</b>	<b>48</b>	

Table 9 Key informant interviewee stakeholder groups

### **Sampling strategy 1 – Targeted sampling (purposive or judgement sampling)**

Targeted sampling involves intentionally selecting people who are most relevant to the study. The stakeholder listing discussed above was used to identify potential participants. A variety of methods were used to create a contact list, including: personal and professional networks, persons whom the researcher met at conferences and public consultation events, and authors of studies and reports reviewed in the first phase of research. An invitation letter was drafted and sent by email to potential participants, requesting their input (see sample in Appendix B). This letter introduced the purpose of the study, indicated that participation was voluntary, and that participants could withdraw their participation at any time – including post interview. The letter also provided an FAQ (frequently asked questions) list, and a consent form (Appendix B). This recruiting method was used for all three primary research methods: key informant interviews, the Policy Delphi, and the Policy Design Charrette. In the case of the Charrette, prior study interviewees were invited back, and asked to share the Charrette invite with friends and colleagues.



### Sampling strategy 2 – Chain referral (snowball sampling)

The chain referral method is used when potential participants are hard to find – whether there are just too few of them, or they are hard to identify. The method involves asking initial study participants to refer others whom they feel may be relevant to the study (Flick, 2007). The technique is commonly used when a purposive or non-probabilistic sampling method is chosen for qualitative research. In the context of this study, the snowball method helped to increase participation rates for difficult to reach, high-profile participants.

### Sampling strategy 3 – Social media

The last sampling method used to recruit participants asked the social network of the researcher to self-identify themselves as subject matter experts and ultimately volunteer for the study. On Twitter, the researcher made several public posts with hashtags such as #GTHA, #traffic, and the popular #TOPoli tag (Figure 17). These hashtags provided exposure to locals who are engaged in conversations on the topic. The content of the tweets directed questions to planners and other experts, with a brief explanation of the study and asked them to connect if they would like to participate. Figure 18 shows an example of a post on LinkedIn, again an attempt by the researcher to reach out to his professional network for input. In this case, an article about the study written by the researcher in the OPPI (Ontario Professional Planners Institute) journal was also shared. Lastly, for interview participants who were Twitter users (and provided permission) a thank-you tweet was posted mentioning their name after the interview. This combination of methods was successful in garnering significant interest in the study.



Figure 17 Sample study recruitment tweet



Figure 18 Sample study recruitment post on LinkedIn

#### 4.4.5 Interview Participant List

In total, forty eight local participants were interviewed. The list of participants is listed here:

First Name	Last Name	Role	Organization
Moaz	Ahmad	Independent Transit Advocate	GTA MOVE Network
Natasha	Apollonova	VP, Policy	Toronto Region Board of Trade
Maria	Augimeri	Toronto City Councillor for Ward 9 (York Centre)	City of Toronto
Antoine	Belaieff	Director, Regional Planning	Metrolinx
Colin	Best	Milton Councillor for Wards 2, 3, 4, & 5. Regional Councillor	Town of Milton
Matt	Boscariol	(Former Planning & Special Assistant to the Chair of the TTC)	(City of Toronto)
Cherise	Burda	Ontario Director	Pembina Institute
John	Campbell	Toronto City Councillor for Ward 4 (Etobicoke Centre)	City of Toronto
Raymond	Chan	Government Relations Specialist	CAA South Central Ontario
Eric	Chu	Transit Planner	Toronto Transit Commission
Josh	Colle	Chair of the TTC. Toronto City Councillor for Ward 15 (Eglinton-Lawrence)	City of Toronto
Martin	Collier	Founder	Transport Futures
Tricia	Collingwood	Senior Transportation Planner	Town of Oakville
David	Cooper	Senior Transportation Planner	City of Toronto
Antonio	De Franco	Planner	Urban Strategies Inc.
William	Denning	Manager, Transportation Economics Office, Strategic Policy and Transportation Economics Branch	Ontario Ministry of Transportation
Vijay	Gill	Assistant VP, North America	CPCS

First Name	Last Name	Role	Organization
Anne	Golden	Chair	Transit Investment Advisory Panel
Antonio	Gomez-Palacio	Principal	Dialog
Brendon	Hemily	Consultant	(Independent Public Transit Consultant)
Hilary	Holden	Director, Transit and Sustainable Transportation	City of Toronto
Charissa	Iogna	Planner, Transit Implementation Unit	City of Toronto
Lyndon	Johnson	PR consultant	Think Differently
Sumeeta	Kapur	Advisor of the Executive Vice President, Project Delivery - Social and Transportation	Infrastructure Ontario
Dewan	Karim	Senior Transportation Planner	City of Toronto
Alina	Kelly	Principal (and former transit planner)	AKelly Consulting
Mark	Kryzanowski	Senior Transportation Coordinator	Town of Newmarket
Patrick	Leclerc	President and CEO	Canadian Urban Transit Association (CUTA)
Rishi	Lukka	Transportation Consultant - Planning, Engineering & Economics	Arup
Cameron	MacLeod	Executive Director	CodeRedTO
Andy	Manahan	Executive Director	Residential and Civil Construction Alliance of Ontario
Andrew	Miller	Strategic Leader	City of Mississauga
Steve	Munro	Independent	Transit Advocate
Liz	Nield	CEO	LURA Consulting
Dana	O'Born	Policy Analyst, Office of Steven Del Duca - Minister of Transportation	Government of Ontario
Andria	Oliveira	Transportation & Infrastructure Policy Planner	City of Brampton
James	Perttula	Program Manager, Transportation Planning	City of Toronto
Joanne	Phoenix	Manager, Planning and Accessible Services	Town of Oakville
Hans	Riekkö	Senior Transit Planner, Transit Implementation Unit	City of Toronto
Maureen	Shuell	(Previously, Director of Communications, Events and Publications)	(Canadian Urban Transit Association)
Michael	Sutherland	Director, Economic Analysis & Investment Strategy	Metrolinx
Sarah	Thomson	Executive Director	Transit Alliance
Brian	Titherington	Director, Roads & Traffic Operations	York Region

First Name	Last Name	Role	Organization
Peter	Topalovic	Project Manager - Transportation Demand Management	City of Hamilton
Melissa	Tullio	Communications Advisor / Project Coordinator	Ministry of Municipal Affairs and Housing
Mark	VanderSluis	Project Leader, Transportation Planning	City of Mississauga
Nithya	Vijayakumar	Transportation Analyst	Pembina Institute
Linda	Weichel	VP, Initiatives	CivicAction

Table 10 Interview Participant List

#### 4.4.6 Policy Delphi panelist list

Eighteen panelists provided input on the Policy Delphi. These panelists corresponded from around the world including places as far as Sydney in Australia; London and Edinburgh in the UK; San Francisco, Portland and Washington in the USA; among other places in the Netherlands, Germany, and around Canada. A partial list of participants is provided below:

First Name	Last Name	Role	Organization	Country
Alison	Pridmore	Principal Consultant	Ricardo-Aea (previously: European Commission - Joint Research Centre, Institute for Environment and Sustainability)	UK
Almos	Tassonyi	Executive Fellow, Director - Urban Policy Program	School of Public Policy, University of Calgary	Calgary
Barry	Ubbels	Transport Economist	SEO Economic Research	Netherlands
Ceilia	Gresswell	Procurement Assurance Advisor	Department for Transport	UK
Chris	Higgins	PHD Candidate	McMaster University	Canada
David	Hensher	Director, Institute of Transport and Logistics Studies	University of Sydney Business School	Australia
George	Hazel	Director	George Hazel Consultancy	UK
Harry	Kitchen	Professor Emeritus	Trent University	Canada
Jan	Riel	Professor of Transport Planning and Traffic Engineering	Hochschule Karlsruhe Technik und Wirtschaft University of Applied Sciences	Germany
Jeff	Wood	Principal	The Overhead Wire	USA
Matthias	Sweet	Assistant Professor	Ryerson University	Canada
Micahel	De Percy	Senior Lecturer, Faculty of Business, Government and Law	Institute for Governance and Policy Analysis, University of Canberra	Australia
Rick	Rybeck	Director	Just Economics LLC	USA
Sam	Bucovetsky	Professor	York University	Toronto
Sean	Hertel	Independent transportation consultant	York University	Toronto
Scott	Lazenby	Adjunct Associate Professor	Portland State University	USA
Tom	Weyandt	Senior Policy Advisor for Transportation	City of Atlanta	Atlanta

Table 11 Policy Delphi - Partial Participant List

## 4.5 Data Management and Analysis

### **Recording and transcribing of interviews**

With participant permission, key informant interviews were audio recorded<sup>5</sup>. Most interviews were held in person, and recorded with an Apple iPad® app, whereas a conference line<sup>6</sup> with a recording feature was used for a couple interviews conducted by telephone. The MP3 file for these interviews has been stored in an encrypted folder on the researcher’s hard drive, and will be destroyed two years after successful defense of this thesis. Following each meeting, audio recordings were transcribed into a Microsoft Word® document. Creating an audio record of key informant interviews enabled the researcher to be more attentive during the interviews, and improved the accuracy of data collection (May, 2002).

### **Interpreting Policy Delphi input**

Two rounds of online surveys were conducted with the Policy Delphi panelists. In both rounds, the output was downloaded in PDF and spreadsheet formats, with individual responses separated. Output of the Delphi was analyzed in a similar manner to interview responses.

### **Interpreting the Charrette input**

The Charrette provided visual outputs that reinforced findings in other research methods – such as maps that indicate where congestion is worst. New participant data such as user personas and a rating activity were captured through a series of photographs of the event. A volunteer was utilized to take notes during group presentations for the Charrette – these notes were included in the analysis. The examples presented by Charrette participants are included in the Findings chapter.

### **Coding and Analysis**

Data analysis was managed through several phases. First, interview transcripts and Delphi responses were read and a few sample quotes were extracted where there was relevance in identifying the participant who provided the quote – permission to use quotes was sought separately. Next, each transcript was given a code indicating the participant group and a unique identifier (ex. “planner6”), and the participant’s name was removed from the document. Transcripts scrubbed of participant identifiers

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<sup>5</sup> There were three exceptions to this: two participants declined audio recording – notes were utilized in place, and a third participant chose to respond to the interview questions through a written response which was captured and analyzed in concert with transcriptions of other participant notes

<sup>6</sup> [www.calliflower.com](http://www.calliflower.com)

were imported into the Nvivo 10 software package for analysis. This software program enables a researcher to separate out groupings of statements, by tagging quotes of similar themes. A coding scheme was developed for this exercise. First level codes included: “the congestion problem”, “solutions”, “barriers”, and “recommendations.” The nine priority actions of the Big Move were utilized to create sub-coding schemes for solutions, and responses were also separated by short-term and near-term recommendations. Where participant insights did not fit an existing code, a new code was created. The groups of narrative were analyzed separately, and many of these examples and quotations have been shared in the Findings chapter to explain themes being presented.

#### 4.6 Ethics

Ethical concerns with qualitative research studies such as this include: managing researcher bias, and participant confidentiality. Each participant involved in the study has an opinion on the topic, the researcher must be careful not to allow his own opinion to influence the responses or interpretation of the data. Also, participants in positions of power may have political or professional concerns with the confidentiality and anonymity of opinions they have expressed.

Several steps have been taken to minimize researcher bias. First, the interview script was reviewed by qualitative research experts to remove potentially leading questions. Second, care was taken when asking probing questions to utilize open-ended, non-leading questions. Lastly, transcribing and coding data has helped to minimize potential for selective note taking and data collection during the interview.

A commonly used to protect participant confidentiality is the process of anonymisation (Wiles, Crow, Heath, & Charles, 2008). This was practiced by coding responses – separating identifiable data from transcripts.

#### 4.7 Summary of methods

This chapter has identified and described the nature of wicked problems, and has made an argument that traffic congestion is such an issue. Subsequently, several qualitative research methods are described to detail how the primary research question was addressed. This included stakeholder interviews, a Policy Delphi panel, and a Policy Design Charette. Furthermore, consideration was given to data analysis and ethics, both of which were also described previously. The remainder of this thesis focuses on the results of these research methods. Chapter 5 presents the findings, while Chapter 6 presents the analysis and subsequent recommendations.

## Chapter 5 – Findings

### 5.1 Introduction

This study asks: *as population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?* Through a highly participatory mixed-methods approach, the study highlights a number of ideas and potential solutions to mitigate congestion in the Greater Toronto and Hamilton Area that encourages travellers to choose a more efficient mode, *more often*. Many of these solutions offered by participants are common approaches discussed in the literature, and align directly with strategies outlined in the Big Move, bolstering support for that plan. However, this research notes a gap in the local conversation and policy framework. The Big Move is missing a critical strategy to mitigate congestion: road pricing.

#### The five key findings of the study are:

1. There is strong support for Places to Grow and the Big Move from local respondents
2. The most frequently discussed strategies to shift modal split in the short term are:
  - fare integration
  - increased frequency of transit service – particularly in the suburbs, and
  - expansion of the active transportation network – particularly in the downtown core
3. The most frequently discussed strategies to shift modal split over the long term are:
  - transit infrastructure expansion and
  - improved land-use and transportation planning coordination
4. The **missing strategy** that would tie together all other strategies of the Big Move to effectively manage traffic congestion is **road pricing** – what this report calls the “tenth big move”
5. The participant base – both locally and internationally – would support an **incremental approach** to introducing road pricing, starting with a pilot project

This chapter summarizes the top traffic mitigation solutions, major barriers, and recommendations to overcome barriers gathered through local expert interviews. Strategies for the short-term are discussed first, followed by longer-term recommendations. Through the Delphi panel, international expertise identifies that the number one strategy for mitigating traffic congestion is a road pricing strategy that assists in encouraging a positive shift in modal split, managing demand and effectively overcoming the issue of triple convergence.

It appears that road pricing is *not* currently given significant consideration at the local level – perhaps because of the view that transit infrastructure needs to be upgraded to provide a viable option to driving before such a strategy can be implemented. This topic will be explored further in the next chapter, along with a recommendation for implementing the strategy.

**A note on references in this report:**

This chapter will present findings from participant interviews and other study methods. In some cases, permission was received to present a direct quote and identify the participant. In other cases, to protect the anonymity of participants a coded identifier is used in the reference. For example the reference “(Planner3)” would indicate the third planner spoken to in the research process. Referencing in this manner provides the reader some knowledge of the stakeholder’s background and expertise, while protecting their identity.

Participants were grouped according to the stakeholder groups shown in Table 12 below:

Reference	Stakeholder group description	Example agencies or roles
Advocate	Transportation advocate	Ex. A participant from the Transit Alliance, CAA, or other advocacy group
Gov	Other civil servant	Infrastructure Ontario, other non-planner role
Media	Media	Reporter, columnist, or related industry rep
Planner	Urban Planners	Transportation or transit planner with a municipality or transit agency. Urban planning consultants with relevant transportation, transit, land-use, and public consultation experience
Politician	Municipal or provincial politician	Councillors from wards across the GTHA, an MPP, or representatives from their offices
Researcher	Researcher	Research institution such as the Pembina Institute or a university

Table 12 Stakeholder groups

Participants of the Delphi panel are referred to as “panelists” in this report, separating them from interview and charrette participants. Data from the Charrette is presented in aggregate – participants are not uniquely identified.



## 5.2 The congestion problem from a local perspective

This section will outline several insights from this study's interviews that help frame the local perspective of the traffic congestion problem:

1. We accept that *some* congestion is a sign of a healthy and prosperous economy
2. Current congestion levels have caused some to alter their travel patterns, avoiding trips
3. Congestion is worst around the periphery – on the major highways and regional roads
4. Congestion has been getting worse in recent years – a trend which is expected to continue
5. Transit expansion is hailed as the solution

### ***Some* congestion is a sign of a healthy and prosperous economy**

Almost every local participant stated that the Greater Toronto and Hamilton Area has a major traffic congestion problem – 96% of those who were asked the question agreed that it is a problem, and went on to describe some of the harmful economic, environmental, and health impacts written about earlier. Many participants also emphasized that *some* congestion is a sign of a healthy and prosperous economy – it means that there are jobs in the region which are attracting new residents, and travel patterns will inevitably lead to some congestion. Downs (2004c) would suggest that congestion is even an essential mechanism to cope with excess demand for road space, and refers to it as a balancing mechanism. Interview participants made frequent comparisons to Detroit – a place they say has neither a congestion problem, nor a prosperous economy. Participants say they accept *some* level of congestion to accompany the strong economy that the GTHA enjoys. The goal should therefore not be to eliminate congestion entirely, but to provide residents with as many options as possible to minimize the impact on themselves (Planner7, 2015).

As this project seeks to encourage a positive shift in modal split, participants were asked how they would define the optimal split. One example given speaks to prioritization of people and goods over cars:

“The optimal would be where you could have the road capacity such that there would be free movement for prioritized vehicles – deliveries and bikes and multiple occupancy vehicles, if they could move around with a predictable and reliable journey time, then that would be what I would say is the optimal.” (Planner12, 2015)

These findings reinforce the goal of the project to mitigate traffic congestion through encouraging a shift in modal split such that *more* people are meeting their travel needs through opting to take a more efficient mode *more often*. This also aligns with the goal of the Big Move related to efficiency and effectiveness, and their objective to provide “optimized use of all travel rights-of-way by commercial vehicles through a range of incentives and disincentives” (Metrolinx, 2008c, p. 18).

### **Congestion is forcing a change of lifestyle and trip avoidance**

Many interview participants indicated that they already try to avoid travelling during peak periods – to avoid congestion on both the roads and the transit system. Participants also discussed that current congestion levels force them to cancel some trips they would have otherwise taken. Some examples of these comments:

“And depending on where I go I try to avoid rush hour. If someone's asking to meet them at 9 o'clock, and it's downtown, I usually think 'no, I don't need to do that.' We're going to meet for an hour, I try to travel off-peak, if I can” (Advocate1, 2015).

“I usually try to avoid peak periods whenever I can - if I can orchestrate meetings to avoid them, I will. It depends where I have clients, for instance I've been working with a client in Mississauga for the last year and a half... So, I've had to allow two hours each direction to be sure. And sometimes I was there early, and sometimes I barely made it. Which is crazy, because it shouldn't be more than 45 minutes in my opinion. That would have been my normal allotment to travel to Mississauga City Hall from here... so I was always allowing huge windows because you can't be late for meetings” (Other1, 2015).

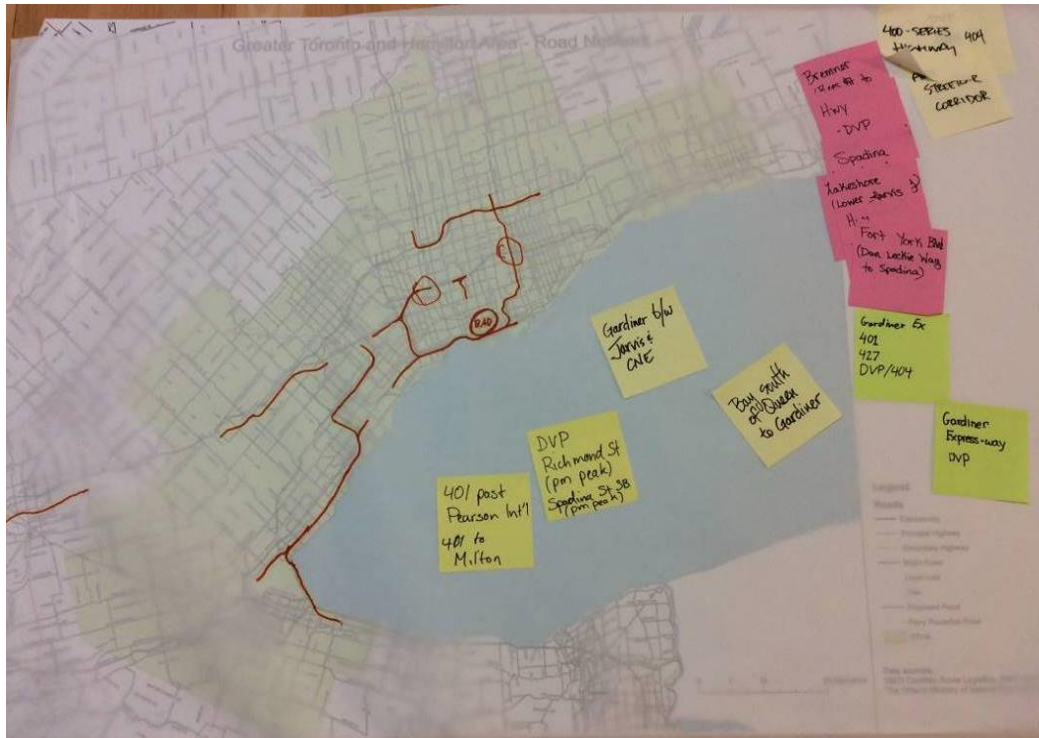
“I try to avoid the 401. If I need to be going anywhere that's east of the city, I try to avoid the 401 like the plague. Anytime I have to travel to the airport I'm also very specific. I take an airport car to the airport. I'm very specific about which highway to use because I know there are HOVs on 403. There's nothing on the QE” (Planner4, 2015).

These comments reinforce the point that congestion can act as a balancing mechanism, forcing a shift in time or mode for some trips. Forcing the cancellation of important trips however, is a negative impact we should be correcting for.

### **The most severe congestion problem is on the major highways and regional roads**

The majority of interviewees and charrette participants believe that the region's congestion problem is primarily along major 400 series public highways, the Don Valley Parkway, Queen Elizabeth Way (QEW) and the Gardiner Expressway. Participants describe congestion as a suburban problem. Within the core of the City of Toronto four elements are at play: 1) an expectation of a certain constant volume of traffic, 2) a gridded street network that enables drivers to mitigate congestion through choice of alternate routes, 3) a frequent and reliable transit service which provides a reasonable alternative to the car in this area of the city, and 4) active transportation options. The problem that needs the most attention is the east-west connectivity of the region which is serviced by three highways (the QEW/Gardiner Expressway, Highway 401, and the tolled Highway 407) with no parallel high-order transit service aside from the Bloor subway line and the Lakeshore GO Transit line in the south. There is now almost a constant delay on Highway 401 with the morning and evening peaks spreading across nearly the entire day.

The opening activity for this study's policy design charrette asked participants to mark areas of greatest congestion in red on a map of the GTHA – see *Map 5* and *Map 6* for examples. These maps provide a visual showing that residents believe the most severe congestion is a problem experienced on regional highways.



Map 5 Charrette "heat map" – participants marked areas of severe congestion in GTHA



Map 6 Charrette "heat map" – participants marked areas of severe congestion in GTHA

### **Congestion has been getting worse in recent years – and is expected to continue**

During the introductory section of the interview, many participants were asked how they felt congestion was trending in the region. Nearly unanimously, they stated it was getting worse. Some planners were uncomfortable answering the question, recommending that we should review traffic count data to verify, however they agreed that the public *perception* was that it is slowly getting worse. They also stated it is likely that the trend is worsening because of the immense population growth, coupled with the fact that there has been minimal transportation network expansion over the last couple decades.

A unifying viewpoint among all participants is that if the region doesn't do *something* this worrying trend will continue, and congestion will worsen as the region grows from its current population of roughly 6.5 million people to the forecasted 9 million people in 2031.

### **Transit expansion is hailed as the solution**

When participants say that the region needs to do *something* most are specifically referring to high order transit expansion – Big Move One “Build a Comprehensive Regional Rapid Transit Network” (Metrolinx, 2008c). Most view the prime source of the congestion problem to be a lack of transit options. Suburban GTHA residents live in car-dependent neighbourhoods, and have no viable alternate to driving:

“Anecdotally, I think the challenge you have here is that most parts of the region is rather built out. And if you look at the chronology of how transportation infrastructure was ever developed and built here, you looked at the '50s, '60s and '70s when you had the construction of the 400 series highways, you had pretty minimal, like you had some transit investment in terms of building a bit of a skeletal transit network with the subway. But the issue we've had here is we have a missing generation of investment in different modes. And particularly transit. Transit suffered.” (Planner1, 2015)

“...it's not convenient for people to take transit... So, I think the connectivity of the entire system as you look from a systems level, that's the biggest barrier for people taking transit to work.” (Gov1, 2015)

“The 905 region has to stop its craze towards urban sprawl. The LRTs must be built and used - especially in suburban areas. The suburban areas of Toronto such as outer Scarborough, North

York, and Etobicoke. And the LRTs that are currently being built and planned in the York and Peel Regions, they have to be prioritized.” (Politician3, 2015)

“...So whether it is extending or creating the LRT along the Waterfront, the Finch West LRT, Sheppard LRT, building the extensions of our other lines... These are all things we need to continue doing... and in continuing to do that, we will be able to address all these problems as we grow. Because in order to grow you need to also provide the infrastructure for that.” (Planner6, 2015)

Discussions with local participants indicated a “build it and they will come” attitude towards transit construction and usage. Comments indicated that with such a dearth in past transit expansion, the various transit projects proposed in the Big Move would immediately be used by residents, and help take cars off the road.

### 5.3 The “do nothing” approach

No review of alternatives to a problem would be complete without starting at a baseline of zero – the do nothing approach. Unanimously, *all* local participants of this study – with varying degrees of expertise on transportation related topics – stated that congestion has been trending worse in recent years, and will continue to get worse if no action is taken.

“... the Ontario Growth Secretariat was involved a decade or so ago - I saw some of the first maps where they did the 2031 projections and said here's red meaning this is severe congestion and then by 2031 they had this map that was almost all red in some of the major corridors, so that was the trend with no changes to transit expansion and behaviours and stuff like that.”  
(Advocate8, 2015)

“...the number of kilometers of road, the road space that we have isn't going to increase by any significant or meaningful amount, so that means if we have more people moving to the region, using the same amount of road space, under current trends it's going to be catastrophic.”  
(Planner10, 2015)

The impact of course is non-linear, as some people will opt to stop making certain trips as congestion levels continue to rise:

“If you put more people in, then the network which was built for a number of less than that is only going to get worse. That's not going to be a linear increase, because what we know about congestion is as things get worse marginal trips disappear. So people will start, despite themselves, not taking some trips, or they'll combine other trips, or they'll shift their travel to off-peak times. I already am doing that myself as I suggested earlier, when I don't go on the 401 unless it's late at night. Other people will by necessity, if they can get rid of marginal trips, they'll do so. But, many people are taking trips that aren't marginal, they can't... you know, they have to get to work during a peak period, and they don't live... There are certain municipalities that I won't name that haven't done a very good job for planning for transit, but they're still piling in new subdivisions. Those people who live in those places won't have a choice about... They won't be able to take transit because it's just not an option for them. So they'll drive. And so those people are going to be on the roads during peak periods, so peak period congestion is going to continue to worsen. I think it's inevitable” (Gov3, 2015).

The average daily commute time in the region is expected to grow from 82 minutes to 109 minutes by 2031 with no action, whereas Metrolinx estimates that this time could actually be *reduced* to 77 minutes with full implementation of the Big Move (2008c).

In the short span of five years the region will receive 500,000 new inhabitants through international immigration alone – a population roughly the current size of the Region of Waterloo (Statistics Canada). Adding people without also adding additional travel capacity will inevitably exacerbate the congestion problem – worsening the economic, health, and environmental benefits discussed previously. It is clear that a “do nothing” approach is neither desirable nor expected of leaders in this region.



## 5.4 Short-term solutions

During local expert interviews, participants were asked to discuss solutions that they believe could help mitigate traffic congestion by encouraging a shift from driving to more efficient modes – for at least a portion of trips.

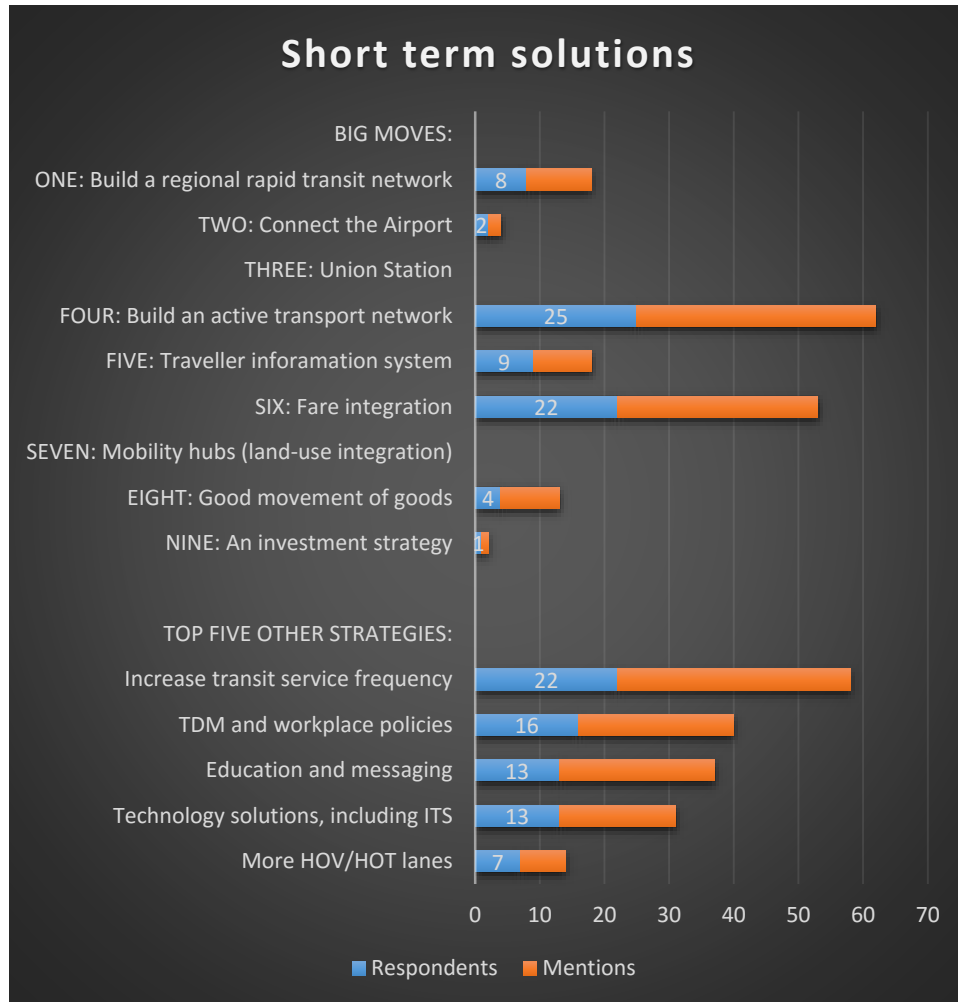


Figure 19 below charts responses showing the number of unique respondents who commented on each strategy, and the total volume of mentions for each.

As discussed previously Metrolinx included “Nine Big Moves” in their regional transportation plan dubbed *The Big Move*. These nine Big Moves are what they identify as priority actions that will have the greatest transformational impact on the GTHA’s transportation system (2008c). These Big Moves were used as part of the baseline coding scheme for participant comments – snippets of discussion were coded to a Big Move where they directly related, and coded to descriptions of new strategies if they did not belong to an existing Big Move. The top three short-term strategies discussed were: expanding the

active transport network (Big Move Four), increasing transit frequency (not explicitly listed in the Big Move), and fare integration (Big Move Six). Increasing transit frequency may be *related* to Big Move One (building a regional transit network), but the strategy that participants discussed is specifically about enhancing service frequency on the existing network, particularly in the suburban municipalities. This section will summarize the top solutions or strategies discussed in local interviews.

There are two distinct groups of commuters which need to be addressed through different types of strategies. Interview participant Evan Weinberg, of the Toronto Financial District BIA described these differences:

“...what we are seeing is greater amounts of people living in the downtown core who have very different commutes than the people who are coming from around the region. And so we have two different commuting groups that we are looking to accommodate: one is the regional commuters and the other is the very hyper localized commuters, and how we accommodate them is very different. So we focus on transit and connecting the last mile for one, and cycling and walking, and transit connections for the other.”

The following results will speak to solutions for both of these groups – fare integration and increased service to encourage transit ridership by suburban commuters, and active transportation options for those that live near work in the downtown Toronto.

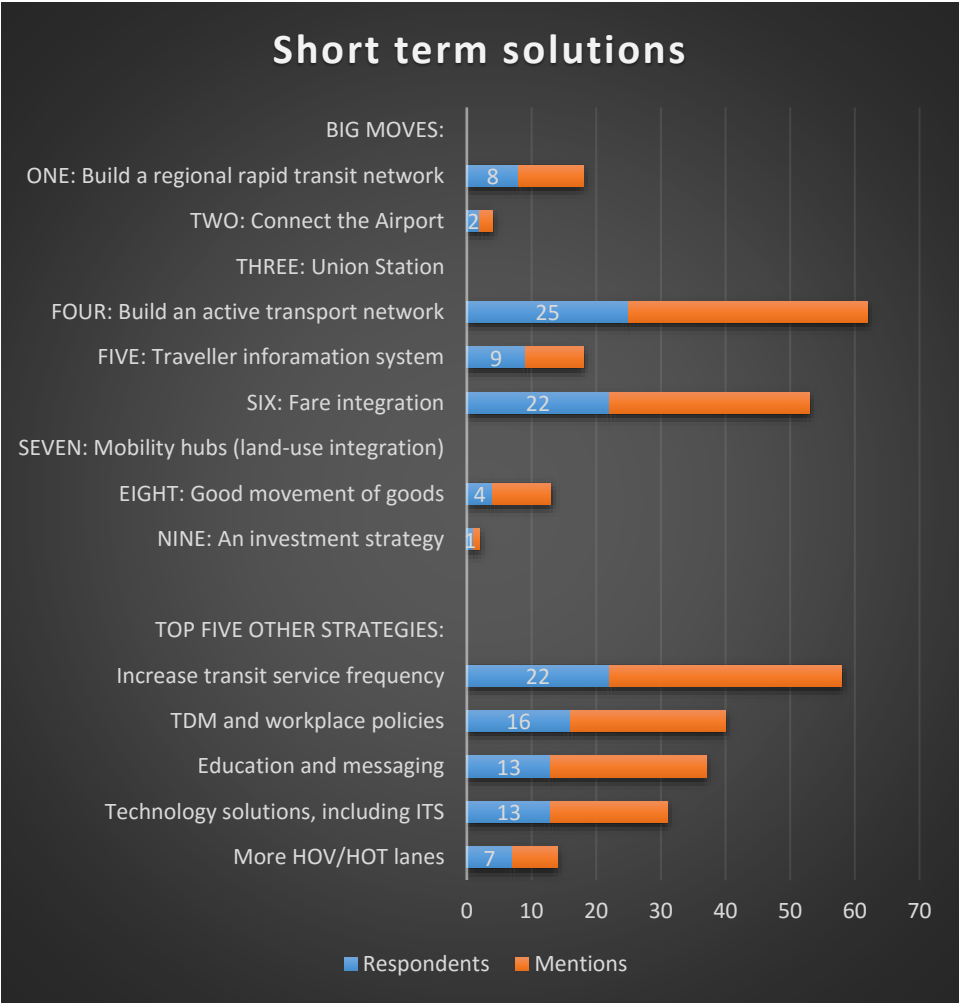


Figure 19 Short term solutions recommended by interview participants

#### 5.4.1 Big Move 6: Fare integration

*I've long been an advocate for what I see as the... there's one policy, you want low hanging fruit, it's simple, it's easy to implement, it would take very little time to implement, and it would have greater improvements to the use of the network than any other thing that I can think of. And in a word, or two words it's: fare integration. (Gov3, 2015)*

Travel behaviour and traffic congestion do not respect municipal boundaries. There are many commuters who live in one part of the city-region and work in another. A typical example is a highly skilled worker who works in downtown Toronto and chooses to live in a suburban home in the City of Mississauga or Brampton for housing affordability, living space, or other considerations. Such a

commuter may already be taking transit for a portion of their journey – perhaps driving to a GO station, parking and taking the GO train into Toronto. However, they may still be contributing to traffic congestion on their drive to the station, and taking up valuable land space with their need for parking. It has been highlighted that a major reason many of these travellers opt to avoid local transit for the first part of their trip is because of a cumbersome process and added expense of paying multiple fares.

“If I got on a Mississauga Transit bus, took it to Islington Subway, took the Islington Subway to downtown, I'd have to pay two fares. And because of that, the research shows that multiple fares loom larger than you would think... people aren't rational. And so, one of the ways that we're predictably irrational (to use the fashionable phrase) is multiple fares make us less likely to take transit, multiple transfers... we always think that a transfer is going to add huge amounts of time to our trip, so even one transfer makes a trip seem 'no, you know what, I'll just take my car.' “ (Gov3, 2015)

Big Move Number Six is to create a “region-wide integrated transit fare system” (Metrolinx, 2008c). Sharaby and Shiftan’s study (2012) recommended that fare integration should be the first step in any transit improvement plan – a conclusion that is mirrored in this investigation, as many participants suggested that the most impactful short-term policy initiative would be fare integration. It was viewed that this would encourage a shift in modal split – especially in the surrounding suburban municipalities, enabling users to pay one fare to access multiple transit agencies in the same trip.

“So, if we had real fare integration that would remove the stumbling block. People would be willing to take transit from the 905 into the 416 and vice versa, at a greater rate than they do now. They'd be more willing to take Mississauga Transit to their GO train station in the morning if that trip was free. Even if the trip is only discounted now, instead of costing you \$3 it will cost \$0.75, it still is a barrier. And if it was free, people would do it that much more. And think about what that would do. More people would use the system, fewer cars on the roads, fewer cars in the parking lots at GO stations. It would be transformational.” (Gov3, 2015)

Integrated fares have been shown to increase transit ridership by up to 25% in Germany and Switzerland, with smaller gains in Madrid and Finland (Sharaby & Shiftan, 2012).

“Fare integration to better link... Fare integration, and smarter pricing can actually make much better use of the current infrastructure that we have, or the infrastructure that we'll have in five years...” (Planner8, 2015)

A related fare policy currently under investigation at the TTC is distance-based fares, where passengers would pay a different fare based on how many zones they crossed in the city – common place in other regions around the world. GO Transit already utilizes distance based fares, where users pay a different fare depending on the distance between their origin and destination stations. A study conducted in Utah found that distance based fares tend to benefit low-income, elderly, and non-white populations, however the effect may be negative for those who live on the urban fringe (Farber, Bartholomew, Li, Páez, & Nurul Habib, 2014). As Toronto has large clusters of lower-income and recent immigrant populations living in the suburbs of Etobicoke and Scarborough at the edges of the city (Kassiedass, 2013), distance based fares may prove to be socially inequitable at this time.

#### *5.4.1.1 Barriers to fare integration*

##### **Physical barriers**

The TTC was once world-renowned for its subway and feeder bus system that allowed for seamless connections in most cases – a transit rider could get on a local bus and then enter the station without having to pay an additional fare, show a transfer, or encounter any other barrier. This seamless connection does not exist between the various transit agencies in the region. Several participants stated that having to stop and pay a fare multiple times for the same journey poses a psychological and convenience barrier for transit riders. Some users chose to drive for a portion of their trip or avoid transit altogether because of this barrier. Improving fare integration will need to go beyond a one-card payment system, over time it will need to involve improvements in the design of transit connections between modes and agencies.

“You have to make it convenient for them to use one pass, one system and able to hop on and hop off the different types of systems without having to have a separate fare or separate entry point. ...the opportunity is to create a more fluid system where there's not so many transfers going on. ...from the user's point of view it should be one system.” (Gov1, 2015)

##### **Multiple agencies**

The most significant barrier to achieving fare integration appears to be the large number of agencies involved. Go Transit, and each of the nine separately governed local transit agencies has its own fare structure, and needs to recoup its own costs for providing a service. Metrolinx acknowledges this as a barrier in the Big Move (2008c). A transit rider could potentially use three transit services on the same

journey – for example a local Mississauga Transit bus, the GO train, and the TTC subway. Splitting a reduced fare fairly between multiple agencies can become complicated.

## **Funding**

To re-state the goal: fare integration does not simply mean giving transit users the ability to pay two or more fares to different transit agencies using one fare medium; this means paying once and paying a reduced overall fare than would be paid to each agency separately – among other requirements (Schabas, 2013). In many cases this would mean that at least one transit agency is receiving a reduced fare, and would need to be compensated financially for this loss (Gov3, 2015). While municipalities and transit agencies are constantly clamouring for provincial and federal funds to build infrastructure, this is an area that has received less attention. It appears that Metrolinx would be best positioned as a regional agency to distribute funds to agencies that receive reduced fares. Of course this begs the question: where will the money come from?

### *5.4.1.2 Participant recommendations to achieve fare integration*

Three recommendations offered by interview participants involved making it easier to pay fares to encourage choice riders to take transit, using time based fares to encourage spreading out the peak ridership, and an interesting suggestion to encourage suburban drivers to switch to transit through subsidization.

#### **Enable payment with *any* card**

The PRESTO card aims to address many issues with fare integration, however several participants have asked: ‘does one really need *another* card in their pocket?’ As one interview participant put it:

“... quite honestly, the card is itself arcane and it isn't even implemented because other jurisdictions are phasing out their cards - their Oyster Cards and whatever - in favour of newer payment systems using credit cards, or cards you already have in your pocket rather than a separate card. So that you get to tap virtually any card you have, and it works like your PRESTO card. That means everyone has a PRESTO card instantly, who has a credit card. That's where you'd want to go.” (Politician1, 2015)

This recommendation has obvious cost and technology considerations to explore, however it would remove a major barrier to transit use, and would enable anyone with a credit or debit card to board a transit vehicle in the region without worrying about whether or not they had the correct change.

## **Time based fares**

Several authors have shown that short-distance and off-peak transit riders cross-subsidize longer-distance and peak period riders (Blais, 2010; Cervero, 1981; Luhrsen & Taylor, 1997). One suggestion to improve equity in fare structures, encourage transit use for shorter distance trips and a shift in choice transit trips to off-peak times is to enable zone-based and time-based fares – both of which have been suggested by interview participants:

“Same thing about getting fare pricing correct - why shouldn't we be able to move the fare system in a direction that is more efficient that encourages, introduces things like peak and off peak pricing on certain routes. We've got PRESTO. PRESTO's going to be rolled out across the TTC in the next year or two. That enables all kinds of interesting, intelligent things that we can do. And it doesn't mean again swinging the pendulum on pricing, but it means making small shifts that adjust people's decisions just enough to make a pretty big impact.” (Planner8, 2015)

Zone based fares, as discussed above are already under investigation at some local transit agencies. Additional research by Cervero (1990) however, has shown limited responses to changes in fares and suggests that people respond better to service improvements than fare discounts.

## **One payment – further subsidize connecting fares**

One suggestion for improving service and combining transit fare discounts was offered by an interview participant to overcome a psychological barrier for paying twice:

“What people want is to say I should have the right to transfer onto any other system from the network that I'm on. So from a Mississauga point of view, if I pay my \$3 to MiWay - and I go to Islington, I can just get on the subway without having to pay any more. So under the scheme, Toronto would have to be paid for the user that's getting on. You'd have to negotiate how much they would get paid, because you'd expect a certain volume discount. ...you'd expect the province to want to take that on, because it's very much in the province's interest to have people taking these long-distance trips not by private automobile, because it will reduce traffic on the roads, and reduce congestion. Like I said, it would be expensive, but I think if it's going to work I think it has to be that you pay one regular fare, and that's it.” (Gov3, 2015)

As this participant suggests, implementation of this solution also relies on solving a funding barrier discussed earlier.

#### 5.4.1.3 *Summary of findings on fare integration*

The strategy most frequently recommended by local interview participants to mitigate traffic congestion in the suburban regions of the GTHA was fare integration: Big Move 6. The literature would recommend that this be the first step in a transit improvement plan. Participants shared the following local insights for such a policy:

- There are existing transit riders who are contributing to congestion in the suburban region – by driving to rail stations
- Paying multiple transit fares (multiple payments, and fares for separate trip segments) is a barrier to transit-use
- Disconnected transit systems that force complicated transfers and multiple fare payments are a barrier to transit use
- Achieving fare integration is complicated by the involvement of multiple agencies
- Funding is a barrier to achieving a fare integration strategy that provides a discounted overall fare to multi-agency transit riders
- An opportunity exists to encourage suburban drivers to switch to local transit through fare integration and frequent transit service (to be discussed in 5.4.3)



#### 5.4.2 Big Move 4: Build an active transportation network

Through the literature review, several authors introduced the concepts of adding safe cycling infrastructure, awareness campaigns, and compact mixed-use development to encourage a shift to cycling and walking (Gössling, 2013; Pucher, Buehler, & Seinen, 2011; Pucher et al., 2010; Sallis et al., 2004). Metrolinx's Big Move 4 is defined as a priority action to build "complete walking and cycling networks with bike-sharing programs", and aligns with these concepts. The priority action supports the implementation of two major strategies of the Big Move (2008c):

- Strategy Number 2 "enhance and expand active transportation", and
- Strategy Number 7 "build communities that are pedestrian, cycling and transit-supportive"

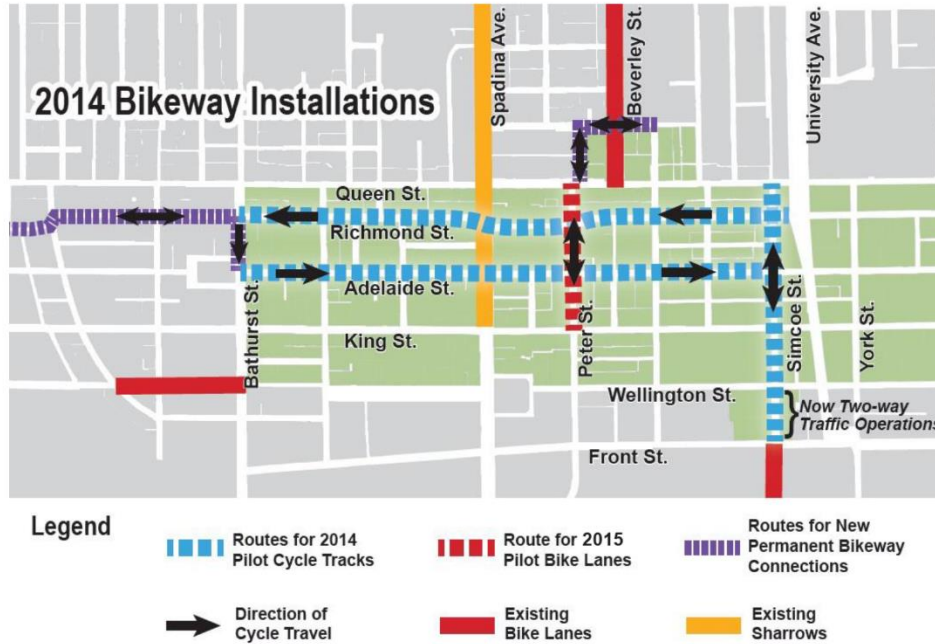
To the extent that automotive trips are converted to active modes through these actions, the building of walking and cycling networks assists with mitigating congestion. Nearly half of local interview participants discussed building an active transportation network as a short-term action that should be pursued. The results however, were particularly skewed towards downtown Toronto and Hamilton participants where the built form and densities are more conducive to cycling and walking. Most of this discussion centred around cycling facilities, with several mentions of the need to add sidewalks to both sides of the street, and improvements to the urban realm to make walking more attractive. The cycling examples discussed included the Richmond and Adelaide cycle track downtown Toronto, bike share, and land use development.

#### **Richmond-Adelaide Cycle Track**

Many interview participants discussed a recent increase in the volume of cycling in downtown Toronto, and attributed this to the increase in cycle lanes in recent years. Cycle tracks along Richmond and Adelaide streets were specifically mentioned by most participants who discussed cycling in the downtown core – see Map 7 below.

"We are seeing an increase in cycling – people are recognizing that it might actually be faster to get around using their own two legs or their own bike to get from point A to point B, and there's been an increase in cycling activity across the city. Mostly in the downtown area, which is great because our land-use lends itself very well to that. Especially since we have a really strong cycling team in our Transportation Services section, they're going through a pretty rigorous assessment, building new cycling facilities for the City. Wellesley Street, Richmond and Adelaide being a few of the ones that they've added in the last year." (Planner6, 2015)

This cycle track that participants mentioned was initiated as a pilot project in 2014, and will now be turned into a permanent facility and extended. An evaluation report produced by the City of Toronto quantifies some of the success factors that interview participants observed.



Map 7 City of Toronto 2014 Bikeway installations on Richmond and Adelaide streets

Source: City of Toronto (2015b, p. 3)

The City (2015b) took counts of cyclists before and after installation of the pilot lanes, and showed a near quadrupling of cyclists travelling eastbound on Adelaide Street (Figure 20). Westbound results were similar. This confirms what interview participants observed visually. The growth over time aligns with results of other studies that indicate cycling growth increases in a non-linear fashion, as the network expands (Pucher et al., 2011).

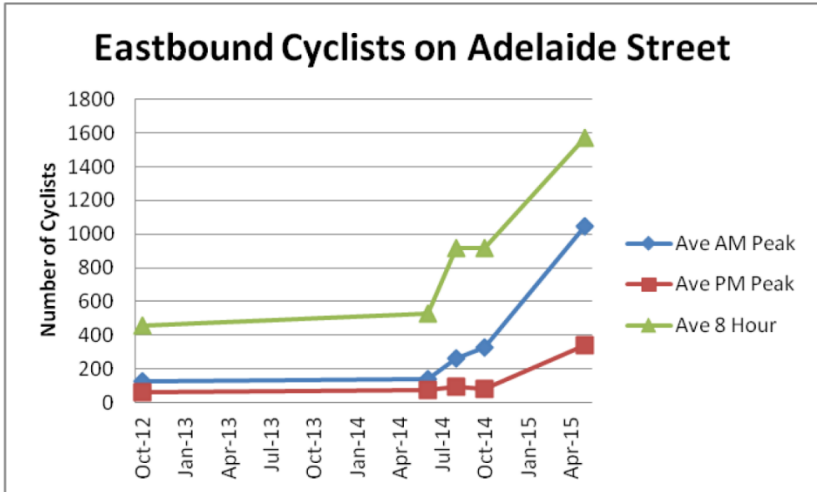


Figure 20 Average weekday 8-hr cycling volumes on Adelaide St., west of Peter St.

Source: City of Toronto (2015b, p. 9)

Interview participants discussed how the introduction of dedicated cycle lanes have encouraged a shift in modes. One participant described how the surrounding area has increased in density, yet traffic in the corridor remained stable and decreased slightly (Planner6, 2015). This was confirmed in pilot evaluation report produced by the City. The pilots reduced automotive lane capacity by one lane in each of these corridors (previously three lanes on one-way streets), yet a comparison of travel times pre-pilot and during the pilot show a *reduction* in travel time of 6.2 percent in the morning, and 7.8 percent in the afternoon peak periods, eastbound on Richmond Street between York and Bathurst (2015b, p. 13).

**Bike Share**

Bike share systems have been noted in the literature as a method to help reduce congestion, provide flexible mobility options and other benefits such as enabling more physical activity and reducing emissions (Fishman, Washington, & Haworth, 2013). Locally, several interview participants discussed the recent success of Hamilton’s bike share program:

“The other one... it's across the short term / long term, is an interconnected system of bike share serving every GO node, and the major centres. The short term is getting some bike share systems along these corridors, the long term is using that as a really important first-last mile piece.” (Planner16, 2015)

“I think a very successful example is the bike share program in Hamilton. ...with the exception of yesterday because it was very hot, you'll see people riding them everywhere. And I mean even Toronto too, but Hamilton in particular you'll look at the numbers - the usage is very, very high. And I mean, Bixi essentially stands for Bike Taxi. So it's another mode of public transportation essentially. So in a way it's teaching people - there are people who are speaking about it like 'I never used to ride a bike before,' and now they do because it's really accessible. And now they're like 'well, I ride a bike, maybe I'll take the bus, maybe I'll put the bike on the bus.' It's all relative, and a huge part of it is behaviour change. And understanding your pattern as a person, where you want to go, and how you can get there in the most convenient way possible, and also most enjoyable. Riding a bike makes you feel like a kid again, and if you can get around by riding a bike instead of having to get in a car, and walking which may take too long, I think those are the kinds of low-hanging fruit examples that we're seeing that are actually really working.” (Planner14, 2015)

These comments show that offering and expanding bike share programs help provide first and/or last mile connections for transit rides in a sustainable manner. This aligns with the literature that shows bike share users are often substituting from another form of sustainable transport, rather than switching from the car (Fishman et al., 2013). However, as a component of an overall system it is a method to introduce users to other mobility options and encourage behaviour change. The participant comment above about riding a bike ‘making you feel like a kid again,’ provides an insight to how this service could be marketed in future.

#### *5.4.2.1 Barriers to building an active transport network*

##### **Safety**

Improving the cycling network could start with the most basic, low-cost action of painting chevrons on streets to indicate to motorists that they need to share the road with cyclists. A fear of safety however has been highlighted in the literature as a major barrier to riding on roads in mixed traffic (Pucher et al., 2010). This concern was raised by numerous interview participants:

“I think with cycling, frankly people just need to feel safer. I think that's really the only impediment, because Toronto drivers are aggressive compared to the rest of the country, barring probably Montreal. And there isn't enough protective infrastructure, so I don't know

how you feel, but it's not necessarily relaxing to bike every day to and from work..." (Planner12, 2015)

"... people are reluctant to cycle because they don't feel safe. But there's this cohort that really wants to, and if there was this cycling network that was implemented in Toronto they would completely get out of their cars, get on their bikes and go to work. That's a way to move people, and a way to remove a car from the road, to free up congestion. So, if you had a comprehensive cycling network, and the funding behind it, look at what you can do." (Politician1, 2015)

Participants discussed the importance of safety for pedestrians as well:

"If there's comfortable sidewalks and large sidewalks where people can interact fairly comfortably, people will use those sidewalks. If they're narrow or unsafe or alongside fast moving traffic, I mean that's not where pedestrians are going to want to walk." (Planner5, 2015)

## **Funding**

Providing a level of safety through dedicated, and preferably separated bike lanes comes at a cost. To minimize costs, municipalities typically bundle active transport projects with larger road projects, this in turn means that the active transport network is built out as the road network nears its life cycle or as upgrades are made to roads to address congestion or vehicle capacity (Hess & Lea, 2014).

In their report written for the Toronto Centre for Active Transportation (TCAT), Hess and Lea (2014) discussed another issue with funding being that expansion of the active transport network is generally not currently accounted for in the budget of most GTHA municipalities – therefore new funds must be found outside of the state of good repair budget. TCAT has also criticized Metrolinx for a lack of plans for spending on active transportation in the remaining \$34 billion "Next Wave" projects (2013).

However, there is some assistance that municipalities can receive from the provincial government following the release of #CycleOn – Ontario's Cycling Strategy in 2014, the province announced a \$10 million fund that would match up to 50% of a municipality's contribution to an active transportation project (Government of Ontario, 2014, 2015).

## **Policy support**

While Metrolinx may have in its directive aims to improve the active transportation network throughout the region, most of the work to add safe bike lanes, cycle paths, and amenities rests in the jurisdiction of individual municipalities – as shown by the City of Toronto example on Richmond and Adelaide. Hess

and Lea's study found that Official Plans and Transportation Master Plans were critical to implementing active transportation, and these local plans lack funding as discussed above (2014).

#### *5.4.2.2 Participant recommendations for achieving an active transport network*

Interview and Charrette participants offered a number of solutions to overcome some of the barriers discussed above. These include: paint-in timelines to inform potential cyclists of future improvements in the network, reducing lane widths to accommodate a cycle lane, integrating bike sharing with transit provision, corporate sponsorships, and improvements in land-use planning.

##### **Paint in timelines**

It has been discussed that a disconnected active transport network discourages potential cyclists from cycling. A major problem however is that a municipality may need to wait for repairs to be needed to a road before it can be upgraded to include a dedicated and protected cycling lane. To connect the network until further upgrades can be made, the municipality may be able to paint in cycle lanes or chevrons on the road connecting two cycle paths *and* paint in the month or year that the road is slated to be upgraded. This would show commitment to the mode on behalf of the municipality, and encourage potential cyclists to consider the mode.

##### **Land-use improvements to incorporate active transportation**

Along some of the GTHA's busy streets it is often thought that there is just no room to add a cycle lane. This view however, is based on outdated regulations for vehicle lane widths. As streets are reconstructed in the GTHA there is an opportunity to use narrower vehicle lanes to make way for cycle lanes and other amenities. This idea was discussed by interview participant Dewan Karim, who is a senior transportation planner with the City of Toronto. He shared several intriguing facts included in a paper he wrote on the topic (2015), such as the data point that a 3m wide lane can carry 18% *more* traffic volume than a 3.5m lane because the narrower lane forces drivers to drive at a consistent speed closer to the speed limit. In relation to driver and pedestrian safety, his study found the safest lane widths are between 2.8m to 3.3m, which is less than the average 3.5m width that has commonly been used over the past few decades – particularly in the suburbs. The practice of building very wide arterial streets has also often resulted in low connectivity. As options arise to build new neighbourhoods and new roads throughout the region, increasing connectivity will increase resilience of the transportation system which assists in mitigating congestion and enables more options for access and service of emergency vehicles. As new communities are built out and as roads are re-built in the GTHA, lanes

should be narrowed, the connectivity of streets should be improved, and space allocated for an increased volume of protected bicycle paths. These land-use policy decisions have a clear impact on congestion, as every cyclist accommodated on new cycle paths represents one less car that might have been on the road. The City of Toronto has begun progress in this direction with their new vehicle travel lane guidelines (2015d).

For new developments, interview participant Antonio De Franco, a planner with Urban Strategies provided an example of the Meadowvale GO station in Mississauga to demonstrate how active transportation can be utilized in a suburban municipality. His firm is working on the station area master plan for that station, and sees it evolving from a commuter parking lot to a place with office development – supported by future RER (regional express rail). One thing they are recommending in the short term is to provide pedestrian and cycling linkages to the nearby community so that the community can get to the station without having to drive, and can start to change their habits in advance of new development taking place on and around the station. In time, expanding the active transportation network across the region can help reduce automobile traffic – by solving the first and last mile problem.

### **Integrate bike share with transit service provision**

The literature highlights that cycling provides excellent first and/or last-mile connections to complete transit service, and recommends the addition of bike parking and other infrastructure to complete the system (Pucher et al., 2010). Building on this suggestion, one interview participant recommended that bike share programs should be part of the transportation services that transit providers offer in the region:

“I think it was a shame, a disappointment that the TTC didn't take on Toronto Bike Share or Bixi Bikes when that folded. The ownership fell to Toronto Parking Authority. And if in the future, we want to further increase the modal split on things like transit and cycling, those two need to be thought of as one system together. The kind of customer base that will tap into transit or tap into cycling usually end up being the same type of person. So if you could make those two services integrated better you would be more likely to attract more users to those systems.”  
(Planner10, 2015)

Beyond the provision of the bike share program itself, another participant recommended integrating payment systems and apps related to the service (Planner16, 2015). They discussed the benefits of

Hamilton's bike share app, but the problem is that it only works with that bike share system. They suggested that one app should work bike for share access across the region, and travellers should be able to pay using their PRESTO card.

### Corporate sponsorships

During the Policy Design Charrette, participant groups were challenged to create a solution that would encourage a shift in modal split. One of the groups chose to focus on active transportation, and pitched a creative idea which involved a public-private-partnership with a sportswear company such as Nike – see a portion of their output in *Figure 21* below. Their idea involved obtaining corporate sponsorships to create an interactive education campaign educating residents on the additional benefits of active transportation. Their idea would also enable capturing user data in terms of where volumes of cyclists are travelling, to inform the building of future cycle paths.

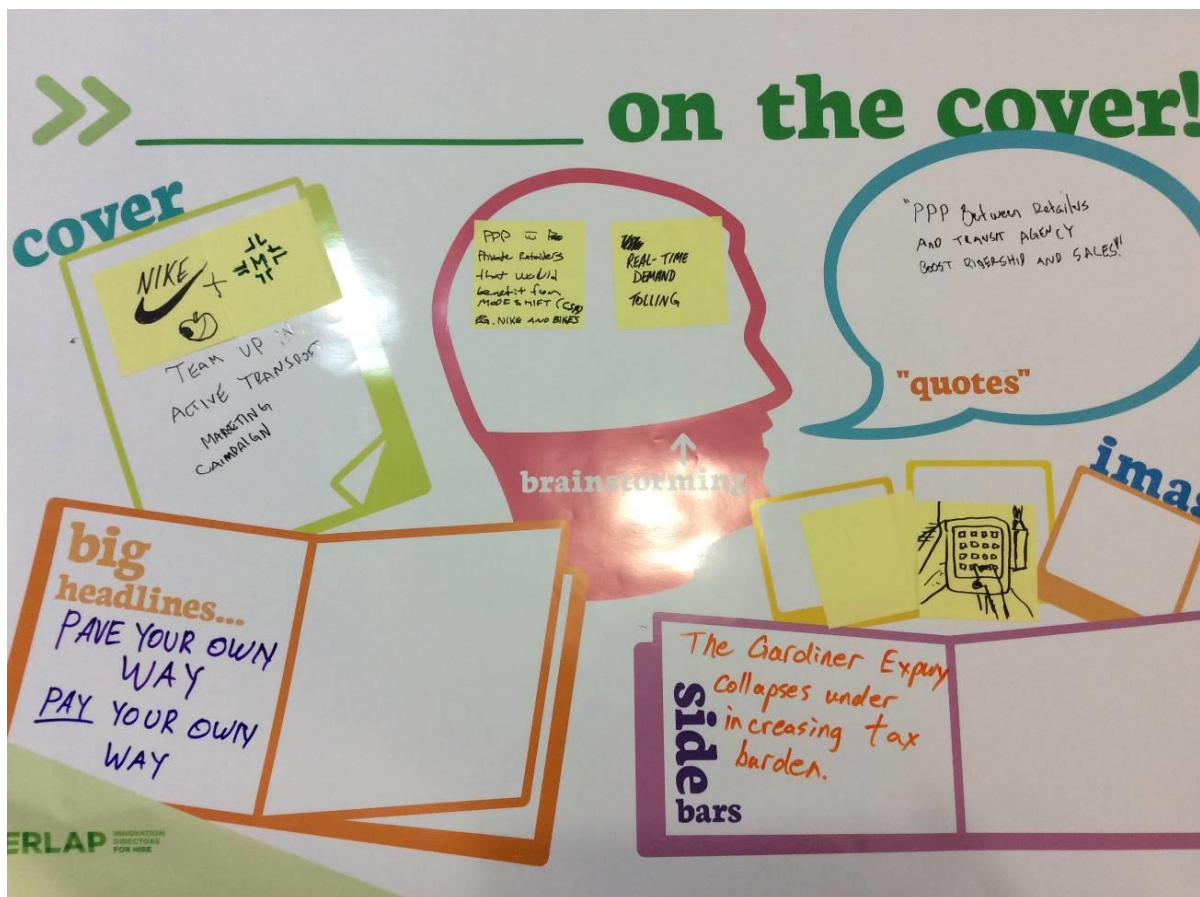


Figure 21 On the Cover Activity: Active transportation corporate sponsorship idea



#### 5.4.2.3 *Summary findings on active transportation*

Metrolinx's Big Move 4 is to provide "complete walking and cycling networks with bike-sharing programs." This is a priority action that is supported by the literature and local transportation experts. The examples provided by participants would provide the following insights:

- Pilot projects (such as the Adelaide-Richmond Cycle Path) can help build acceptance
- Funding is a problem for the expansion of the active transportation network, which could come from higher orders of government
- Implementation of active transportation infrastructure occurs at a local level
- While bike cycling is feasible in compact environments with a mix of uses, suburban residents can utilize bike share programs to participate in this mode and complete the last-mile of a transit journey

Looking to the future, as densities increase in various corridors around the GTHA, incorporation of active transportation measures will be an important part of a congestion mitigation strategy.

### 5.4.3 Increase transit operations

Interview participants who lived in the suburbs almost unanimously agreed on one common strategy to mitigate traffic congestion in the short term: increase frequency of transit service to attract ridership.

This need is introduced by interview participant Brian Crombie – a business/community leader and advocate for transit:

“I think the reason why the Toronto subway, up until recently has been thought world-wide as a very good subway system is because we actually have really good feeder buses that feed a lot of traffic onto the subway. And so I don't think we need to have LRT's necessarily. I do think we need to have good bus services that service the subways and the GO, and I don't think we have great bus services that service the GO's. We've got reasonable bus service serving the subways, but we don't have reasonable bus service serving the GO's. And one of the reasons why, and I experienced it frankly last week: one of the Mississauga buses was behind a car my son was driving, my son stopped at a stop sign, the bus was beeping and beeping -- the reason why is that the GO train was in the station. And if that bus missed the connection, the people would have to wait an hour. And guess what? The bus missed the connection. So you know, when you've got schedules that are so infrequent, the connection has to be perfect between the bus and the GO train. When you've got subways every 5 or so minutes it's not as critically important.”

The Delphi panel gave this strategy an average rating of 4.29 out of 5 in terms of its impact on mitigating traffic congestion, meaning a moderate to high impact. One panelist commented:

“Reducing the time penalty for missing a transit connection can substantially enhance the attractiveness of transit as a mobility option.” (Panelist18, 2015)

Interview participant Joanne Phoenix, of Oakville Transit shares this perspective:

“Surveys in Oakville always have to do with increasing service frequency, as one of the big things. And when you ask users or non-users you get the same answer. So users say they want more frequent, non-users say they want more frequent, in order to use it. And then across the GTHA that's the theme as well. Give us more frequent service. Frequency and reliability.”

These comments were echoed by other planners in the region:

“...and increasing the frequency so that it is a realistic option for people to get off the roads.”  
(Advocate6, 2015)

“You know, I actually don't think it's the fares that are prohibitive in preventing people from taking transit. I think it's the amount of time a trip takes, and the frequency.” (Planner12, 2015)

“I think what everyone's sort of looking for is frequent headways, routine service that you can count on. You're not walking out waiting for a bus so much as you know you're going to walk out and one's gonna be there within 5 minutes, usually is kind of what people would like to know. And ensure that it is coming right away.” (Planner2, 2015)

“...But the most meaningful way to do it is to have more people use public transit. And how do you get more people to use public transit? Well there's a whole spectrum of literature on that, and we at \*\*\*\*\* know that to get people to use transit, how you encourage more transit use is to make it convenient, make it easy for people to use, make it reliable for people to use. That people know well ok, if I can hop on a bus that comes at a predictable time, and get me to my destination at a predictable time then I will use transit.” (Planner10, 2015)

The view that most participants shared is that the frequency of bus service in the suburbs does not meet the needs of users, and so a high proportion of them drive. Even commuters who drive to a GO train station and commute to work by train are contributing to congestion for the portion of their trip that they are driving. The best way to encourage these travellers to use the local bus service would be to increase service frequency to a level that could be considered “walk out and wait.” The demand for transit service increases significantly when frequency is increased to this point – one interview participant describes the demand curve known as the “S Curve” or logistic curve:

“... what the S curve says is as supply increases, demand doesn't increase as much, but at some point in time you get to the tipping point, and as supply increases demand increases dramatically. And that's typically described by transit engineers to me as when you no longer have to look at a schedule before you go to the station - because you know something's coming soon enough that you're willing to wait.” (Advocate4)

#### 5.4.3.1 *Barriers to increasing transit operations*

The two most commonly cited barriers to increasing transit frequency were politics and funding:

##### **Politics: No ribbon cutting for operations**

A phrase that was heard repeatedly in participant interviews was that ‘there is no ribbon cutting for transit operations.’ What gets all the media and political attention are the mega transit projects and associated debates. Politicians want to be known for major transit projects that they have initiated – from former mayor David Miller and his Transit City initiative, to current mayor John Tory who was elected on a platform that included his plan for Smart Track. Even former mayor Rob Ford wasn’t necessarily against transit – he was just against anything that got in the way of the car – his mantra was “subways, subways, subways.” With all the attention focused on major infrastructure projects, there is little room for politicians to consider funding of increased transit operations – despite the fact that this is one policy that has potential to have significant impact in the near term.

##### **Funding**

The largest barrier to increasing local transit operations is a lack of available funds – especially in the suburbs. This barrier has three facets to it: 1) previous operational funding from the province has been cut, 2) political support is almost entirely focussed on infrastructure, as mentioned above, and 3) competing priorities.

Several interview participants (Politician3, Politician4) took issue with the cuts to funding of transit operations by the provincial government in the 1995 to 1998 time frame, which have not been restored since. Prior to those cuts, the provincial government contributed 50% of the operating budget for municipal transit agencies (Politician3). This creates a funding problem for the existing baseline of transit service.

“When Mike Harris was the leader of the Conservative party and the premier of Ontario in 1995 he cut ALL operating funding to the Toronto Transit Commission - the TTC. Since then, we have not had a penny of operating money. So, we're the only city in the world that operates its public transit system on the backs of municipal home owners, through the property tax base. It's unsustainable.” (Politician3)

“...the federal government, provincial government downloaded... and we're the last guy on the totem pole. They can delegate it, but we've got no place to delegate it to.” (Politician4)

The second issue related to funding increased transit operations is that support from higher levels of government is entirely focused on infrastructure expansion – which is closely related to political motivations as discussed previously. This problem starts to compound over time, because local transit agencies will continue to be responsible for operating transit service on new infrastructure that is built for them and the increased fare box revenue does not fill the gap in costs (Planner4).

The last issue related to funding is that a request to fund transit operations is in competition with every other program and service that is being offered by the municipality (Planner4). Justifying the additional spend can become difficult if there is not the current ridership level to support it – planners are faced with a chicken-and-egg scenario where they need additional riders to support transit expansion, but the riders don't yet exist in volume because the current frequency of service doesn't meet their needs.

#### *5.4.3.2 Participant recommendations for achieving an increase in transit operations*

##### **Provincial funding**

The most obvious recommendation for increasing transit operations is to provide funding for it – funding which participants felt should come from a higher level of government:

“Funding the operating. At least, let me be more specific... before Harris we were given operating money for 50% of our operating costs, and three quarters of the capital costs of any project. We want those figures restored. We want that partnership restored with the provincial government. And we want the feds to come in and help.” (Politician3, 2015)

“Somebody could dedicate funding from another level of government. Because the whole burden is right now on the local level. Again, I'm speaking within an \*\*\*\*\* context, right? We're not, we don't have regional transit service out here. We're all, \*\*\*\*\*'s responsible, we're responsible. So, the burden is falling 100% on the municipal budget. So even for us there's another level of government before we even get to the provincial or the federal government, right?” (Planner4, 2015)

The problem with this, as discussed in the literature review is that with a shift in fiscal policy towards neoliberalism, and competing government priorities, the money simply does not exist to restore this level of funding. New funding sources are required to support an increase in transit operations.

## **Explore on-demand transit as an alternative**

Two interview participants suggested that the frequency of service problem could be addressed in alternative means – through an on-demand service that is subsidized:

“...creating more walkable suburban neighbourhoods that are more transit connected is a policy moving forward - but that's not going to deal with suburbs that we have. So perhaps looking at other more innovative infrastructure pieces, like different on-demand forms of transit in the suburbs, and making the choice to subsidize them because they're usually based on having enough density to make money. So we have to make another decision that if we're going to start to supply suburbs with more transit and more on-demand transit and more bike share or whatever, that's going to come at a cost, because it's going to need to be subsidized much more heavily than we do today...” (Planner16, 2015)

Metrolinx is presently running a trial of such a service in Milton (Kalinowski, 2015). The program allows registered users to request a ride via a smartphone app, and at a cost not much more than a transit fare they get picked up in a taxi and taken to the GO train station. The service is coordinated by Waterloo startup RideCo, and provides a number of pickup options for customers – they can walk to a nearby street corner or bus stop to receive a reduced fare, or get picked up at home. They can watch the arrival of their car on the app. While users may need to share a ride, it saves them from having to park at the GO station. As a new form of carpooling, the option does contribute to congestion mitigation by removing some cars off the road. It remains to be seen how much funding or subsidization is required to sustain the service in comparison to local transit options.

## 5.5 Long-term solutions

Local interview participants were asked about long-term solutions to mitigate congestion in the GTHA, ten to twenty years out. With wide margins above any other strategies, participants talked about two key strategies: expanding transit infrastructure in the region, and better integration of land-use and transportation planning. Smaller numbers of participants also mentioned the need for a long-term investment strategy to fund the transit expansion, and road pricing and related tools (such as HOT lanes) to help manage travel demand.

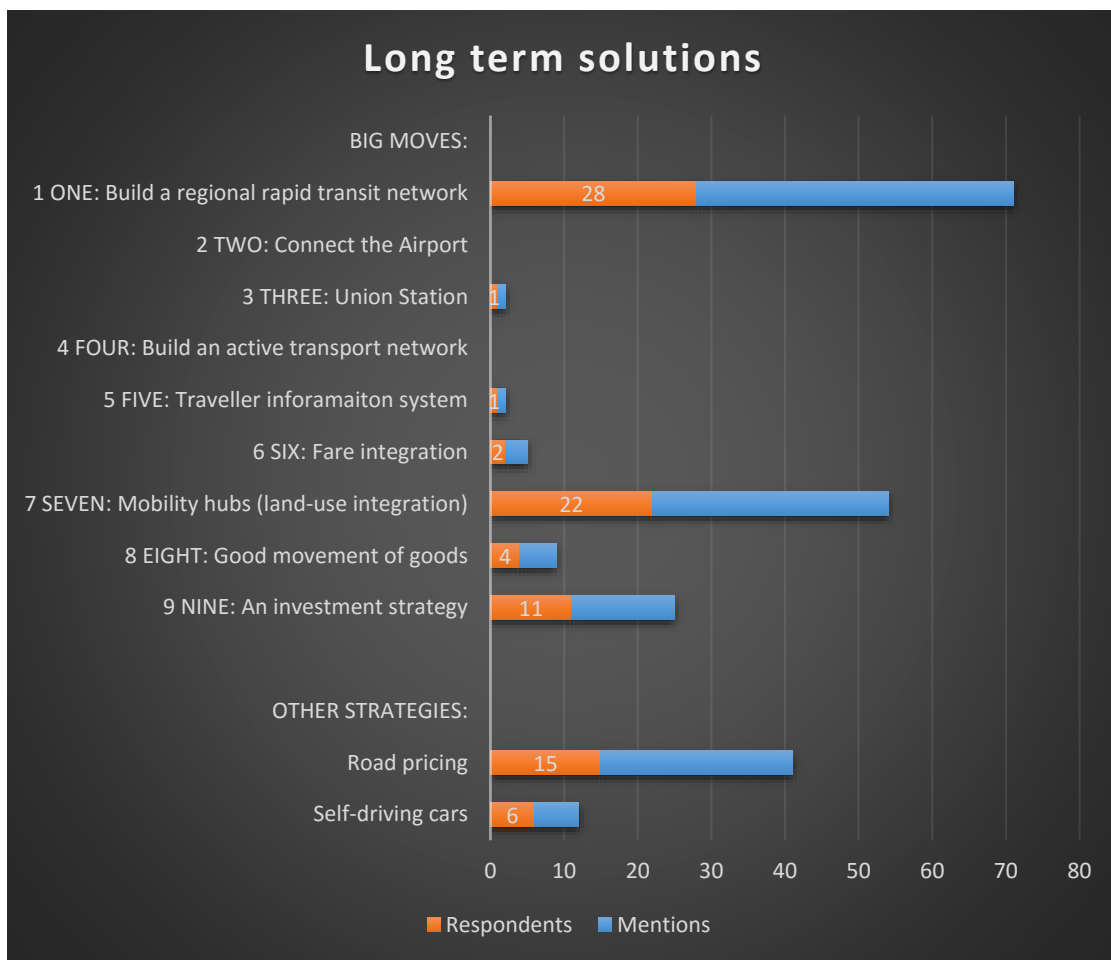


Figure 22 Long term solutions recommended by interview participants

### 5.5.1 Big Move One: Build a regional rapid transit network

Through the vision expressed in the Big Move, Metrolinx aims to move 50% more people in the region with *less* congestion than today, and achieve a modal split that includes one third of all trips to work being taken by transit, within 25 years. To accomplish this, Big Move Number One is to “build a comprehensive regional rapid transit network” that consists of an additional 1,200 kilometres of rapid transit – more than triple what exists now (Metrolinx, 2008c). This network expansion was discussed in more detail in the literature review.

Comments expressed by local interview participants aligned with and supported this strategy of transit expansion. Of course a train or a bus can carry many more people per unit of space than the equivalent of single occupant vehicles. Intuitively, if the goal is to encourage more people to shift to transit to make more efficient use of the road network, a transit service should exist that meets their needs – providing fast, frequent, and reliable service.

While some interview participants expressed concerns with some of the transit lines that are proposed in the Big Move or the priority of some of the lines, as a central strategy *all* participants agreed with the need for transit infrastructure expansion in the GTHA. This strategy was the most commonly mentioned strategy for long-term congestion relief – participants would agree that it should be the first priority of Metrolinx.

#### **LRT Projects**

When discussing long-term solutions, participants shifted their focus to rail based solutions – at the local level participants often mentioned specific LRT projects that they felt were a priority and described the benefits of putting transit in a dedicated right-of-way, for example:

“We need to have multiple light rail lines for dealing with areas that have outstripped bus and street car needs but we know are growing, we know they need to have predictable, reliable transit. So putting light rail at the surface, sometimes underground, sometimes elevated. Depending on what's going on in the area. But that will help those areas really develop because now people can get to work on time. That's a huge thing. So, Finch, Sheppard, Eglinton these are really important. I would want to have the Scarborough and Malvern LRT built. I would want to have the Scarborough Town Centre Progress Ave LRT built. If I could wave the magic wand I would do all that and I would actually keep the Bloor/Danforth extension.” Advocate7 (2015)



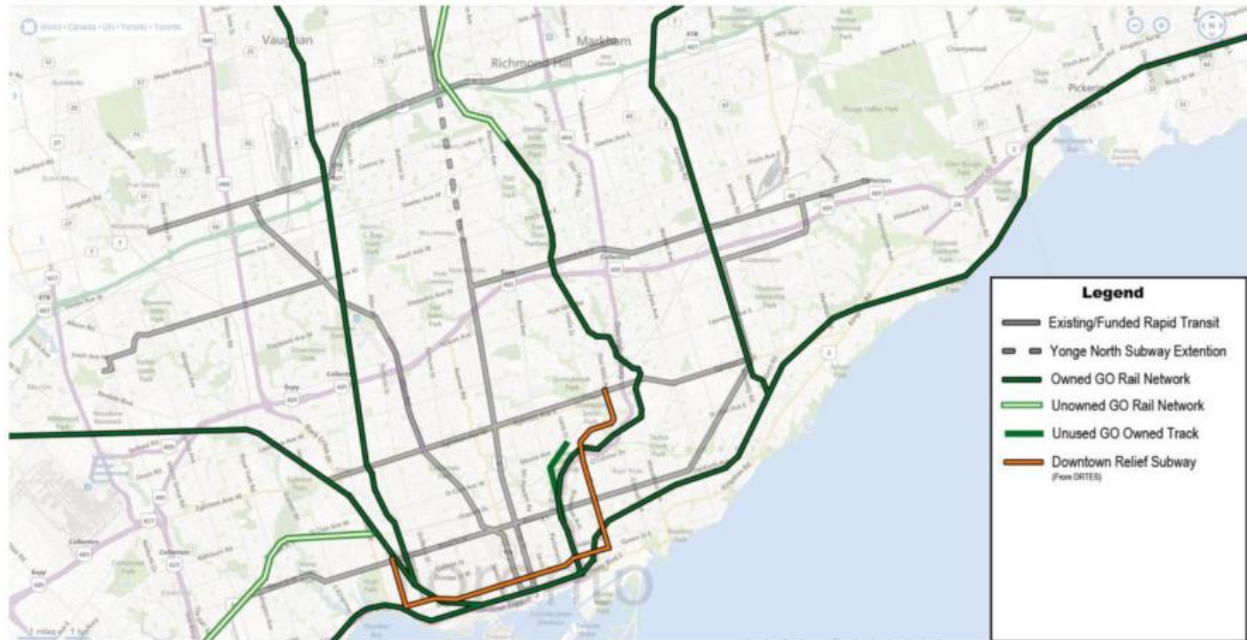
The literature would support the view that rail-based solutions are of greater assistance in supporting development and intensification, and will maintain reliability in travel times as they can absorb a higher volume of passengers and travel along their own dedicated path (Baum-Snow & Kahn, 2000; Topalovic, Carter, Topalovic, & Krantzberg, 2012b).

### **Downtown Relief Line**

The Downtown Relief Line was frequently mentioned by local interview participants. The project was only alluded to in the original Big Move, after which Metrolinx released a Benefits Case Analysis (BCA) for the project in 2012 (Map 8). As currently proposed, it is a subway project which would serve two purposes: 1) to provide an alternate high-order transit option for those coming from the east and west ends of the city and 2) to “relieve” traffic off of Line One (the Yonge line) entering the downtown core, hence the name “Relief Line” (Metrolinx, 2012). Participants discussed how the building of this line would enable further extensions of the subway system north of the city:

“So you could improve the appeal of transit only to a certain point before you actually exhaust all available options. And we’re actually at that point right now, with the Line One Subway Crowding that we have.” Planner 10 (2015)

“In the longer term? Well, Relief Line has been identified in the next wave projects. I would love to see that come to fruition sooner rather than later, just because it addresses the problem that we are currently experiencing, and being able to have that on a schedule like we have for Scarborough subway extension would be great because it just means the sooner you get that done the better we can address the problem we have on our transit system.” (Planner6, 2015)



Map 8 Downtown Relief Line  
Source: Metrolinx (2012, p. 5)

Supporters of this particular line often joke about the fact that similar rail lines have been proposed as far back as 1910, even before the TTC was created (E. J. Levy, 2015). This highlights that the political barrier to building transit in this city is not new – it has existed for over a hundred years<sup>7</sup>.

While this particular subway line would provide some peak hour relief to enable further extensions of the Line One subway line north to Richmond Hill, there have been criticisms of the project. In the review of the Big Move that Schabas (2013) wrote for the Neptis Foundation, he criticized the project for having limited potential to increase all-day transit use, and encourage higher-density development. Therefore the line may provide more comfort (less crowding) for existing transit users, but would be of limited impact in attracting new riders and therefore minimal impact on mode split. Schabas suggested an alternate scheme involving upgraded GO service and fare integration, which could provide similar benefits in a shorter timespan with reduced costs.

<sup>7</sup> For a colourful recount of the history of transit building in Toronto by Edward Levy see: <http://cityecology.net/events/lets-get-moving-ed-levy-on-rapid-transit-in-toronto/>  
[www.levyrapidtransit.ca](http://www.levyrapidtransit.ca)

## **Regional Express Rail (RER), a Crosstown, and Smart Track**

Interview participants talked about various versions of using existing freight and/or regional rail tracks to improve connectivity for the suburban municipalities surrounding Toronto.

“...well I think that the electrification of the GO lines, at least the Lakeshore line with improved headways, because right now half an hour service is not good enough. The other thing is the GO network right now is pretty Toronto centric. So starting to build better connections between the other centres...” Planner16 (2015)

“I think more 2-way, all-day express service from a regional network perspective makes more sense.” Planner 13 (2015)

“...And then in addition, I think importantly, and this is something that has been forgotten in Toronto is you'd have a Crosstown. And while we actually have OK service getting to Union Station for people that go downtown, and we may have far better with RER and all the other things we're talking about, we've got terrible service to get across the city. And London is building a Crosstown high-speed right now because what they said is while we've got reasonable ways of getting around the city, we don't have a good way to get across the city fast. Paris is doing the same thing. ...But, if you got the freight off of the CP line you could have a line that goes: Mississauga, Kipling, Dundas West, Casaloma, Summerhill, Science Centre, Scarborough. Six stations across Toronto. You could get from Kipling to Scarborough in 5 stops, in a high speed rail.” Crombie (2015)

The only concern raised by participants for these projects were the same concerns discussed for short-term infrastructure solutions: funding for increased operations of trains, and local transit feeder systems. Maintaining a high frequency of service will be critical in attracting riders (Higgins & Ferguson, 2012a; Majcherkiewicz, 2013).

### *5.5.1.1 Limitations of Big Move One*

#### **What about the first and last mile?**

During his participant interview, Moaz Ahmad, a transportation advocate with the Transit Alliance and GTA Move Network pointed out that a goal of the Big Move is to place a rapid transit stop within two kilometres of 80 per cent of GTHA residents. While this is impressive, much of the congestion occurs

because of the first and last mile problem – people choose to drive for their entire trip because transit doesn't work door-to-door for them, or they choose to drive part of the way to the train station.

### **We can't build our way out**

There is currently strong public support in the GTHA for expansion of the regional rapid transit network. Frustrations with the current level of traffic congestion fuels this support, as transit expansion has been hailed by the media and advocates as the solution to the problem. Interview participant Andrew Miller (2015), a strategic leader with the City of Mississauga discusses the issue:

“...and if you probe people on this 'why do you care about transit?' It's because they think that investing in transit will reduce gridlock and congestion. I always have to burst people's bubbles and say they're wrong about that, but that is what people think. They want to invest more in transit so that their commutes are not as grueling as they currently are.”

“We still have this belief that, I call it mis-intuition where you intuitively believe - you know, you want to get more flow so just make the pipe bigger, because that's what makes sense. And that's... your human experience would say that. But what's going to end up happening is you're also going to have more stuff flowing through now, and the problem keeps... the first few years are great, and then it keeps getting worse. We know this already, so how do we... there's an education piece that we need to do” (Planner16, 2015).

As Downs has shown, his law of triple convergence applies not only to road expansion, but to transit expansion as well (2004c). Expanding transit capacity enables more people to switch modes. However, as roadway space is made available in this process, the latent demand of travelers who were commuting at a different time or route, or opting not to travel at all, fills in the added capacity – returning congestion to the same levels experienced previously.

Ten separate interview participants acknowledged this. There are numerous benefits to expanding the transit network: the system can move more people in a more efficient manner, spurring the economy and reducing the per-capita impacts on the environment. However, expanding the transit network – even building out the entire Big Move plan – will not eliminate traffic congestion in the GTHA. The risk is that that eventually public support for transit expansion may wane if they don't see results in congestion reduction as new transit infrastructure projects are built.

### 5.5.1.2 *Barriers to building a regional rapid transit network*

#### **Politics**

The number one barrier to transit expansion discussed by interview participants was by far: politics. Often participants would use the phrase “lack of political will”, others would just say “politics” are to blame for lack of expansion. A deeper discussion with participants revealed a number of observed patterns. It’s not that our politicians don’t support transit expansion – for the most part, they *do* support this philosophically. The major problem is that politicians attach themselves to specific projects and try to use them for political gain. Specific transit projects then become pawns in a political chess game, as politicians at both the municipal and provincial level throw their support behind one project or another, introduce new projects that weren’t planned for, and cancel projects started by their predecessors.

#### **Funding**

Funding for infrastructure expansion – or lack thereof – was highlighted as a barrier by many interview participants. The literature review has shown the pattern of disinvestment in transit that resulted in an almost complete void of transit infrastructure expansion in the region over the last three decades.

Several participants believe that funding has temporarily been addressed through several announcements by both provincial and federal governments. Sustainability of the current model however, was called into question. The most contentious example highlighted was the provincial government’s plan to sell a portion of their ownership of Hydro One to finance transit expansion.

“I mean it seems that we’re good for the next 10 years and the next phase of projects but what happens after that? We’re selling off assets, public assets, to pay for that. Which is kind of a contentious issue on its own. You could make the argument that you’re selling off something that it less valuable and you’re reallocating those funds into something that’s more valuable and more forward thinking. And that’s fine, but you can’t continuously sell off your assets to pay for major infrastructure projects.” (Planner5)

One question commonly raised by participants was: “how will the province fund the next round of transit expansion after the funds from the sale of Hydro One are depleted?” Another question, tying back to the discussion earlier on short-term solutions was: “how will the municipalities fund the continued operations of the expanded transit network?”

Many of the investment tools recommended by Metrolinx and the province's own Transit Investment Advisory Panel were ignored in the last provincial budget and related announcements for transit funding. The most notable of which was the suggestion to increase the provincial portion of the HST and raise the gas tax. Participant comments on the need for a sustainable funding strategy, and the political goal which seeks fairness and equity across the province are insights that will support this reports final recommendations on implementing road pricing.

### **Poorly planned projects**

Several examples of poorly planned projects were highlighted by local interview participants. There are two risks with these projects: for one they sap limited available funds away from potentially more effective or efficient projects that could have otherwise been built or built sooner, and two a poor transit implementation can hurt public support for future expansion if a view is sustained that public money was wasted on a project.

The Scarborough subway extension was frequently held up as an example of incorrectly matching technology to use case (the low-density neighbourhoods do not support the project in terms of forecasted ridership). The UP Express, a rail link between the airport and the hub of Union Station was frequently mentioned as a project with incorrect pricing (Metrolinx prices it at a premium and has stated that the target market is business travellers who can afford the premium). And lastly, the University-Spadina and Sheppard subway extensions were discussed as examples of transit planning without land-use coordination, although there is now higher-density development occurring along the Sheppard subway line.

For any transit decision made there are multiple options to be taken into consideration. This example by one interviewee shows how a technology and implementation decision could have far reaching implications on the ongoing cost of operations, as an alternate could have saved on salaries for drivers:

“So we've got approval from the provincial government - \$1.8 billion for the Hurontario LRT. For probably \$2.5 billion, so one third more, we could build it elevated - like the sky train in Vancouver. And if it was elevated, it could run without drivers - it would be driverless. When it's on street, they won't allow it to go without drivers because supposedly drivers are going to be able to see people.” (Advocate4)

### 5.5.1.3 *Participant recommendations for building a regional rapid transit network*

#### **Leverage demonstration projects**

Several participants discussed the minimal transit that has been built over the last several decades as influencing inertia in public opinion and attitudes towards transit. Residents haven't for example, experienced a ride on an LRT because none of the GTHA's LRT projects have been built yet – so garnering support for building similar projects is difficult (Gov1, 2015; Planner1, 2015). A number of participants felt that once some of these transit projects currently under construction are complete and opened, a change in mindset will start to occur. Drivers who live near these projects will start to use them, and others will request more transit options in other parts of the city.

“I think we always have thought to sell a line to the public who have to pay for it, you have to show them the grand vision and that'll get them going, because they can see 'well that's what I'm going to get' so I'm ok paying more here, even though they're first. But I don't know if that's worked. And maybe we have to look at it the other way and yeah there's still a grand plan, but get some stuff done so people can see progress, and they can see 'aha, I get it.' I mean you'd think when Eglinton's done all of a sudden people will be saying 'I want mine on Sheppard.' That's the hope.” (Planner6, 2015)

“So I mean I think it takes iterations, and time building out, but I know our public transit guys, they have servicing agreements that they go into new sub-divisions as soon as possible, and they're not making any money but they're trying to sort of build the awareness - so that people aren't getting into the routine of using their vehicles and the options are there right away once they move in, so that they know that.” (Planner13, 2015)

Where transit expansion projects aren't already planned, some participants suggested that pilot projects and demonstration projects could be utilized to build support – such as prototyping an express bus route. Another participant gave the example of residents in Liberty Village banding together to create a transit service for themselves – small projects like that can be supported by transit agencies to try out new options.

“I think, I'm a big fan of even if they have to be small successes... You know I always joke 'well call it a pilot project then, if you can't get it in.' And show people it works. And I think maybe jaded Torontonians and Ontarians need to see that, and they need to see some of these successes... So I think we need to... if everyone could just find their lowest hanging fruit, and

identify those one or two projects and push for them to be implemented. We'd maybe get further then again the big grand vision maps that come out. And that means in one community a little express route from a college campus to a train station, a BRT somewhere else, that sort of thing..." (Politician6, 2015)

There was generally high support for pilots, trials, demonstration projects and other ways to "nudge" public opinion in favour of supporting building additional transit.



### 5.5.2 Land-use and transportation planning co-ordination

The pattern of low-density, suburban development that has occurred over the last fifty years has notoriously produced car-dependent communities (Cervero, 2002; Newman & Kenworthy, 1996). To reduce this reliance on cars, any redevelopment and all new developments must be planned to provide residents, employees, and patrons with options to take transit, cycle or walk. To achieve this, many participants identified a need for greater coordination between transportation and land-use planning in future – a goal partly addressed by Big Move #7. Several participants also provided examples showing that a trend in this direction has already begun.

#### **Big Move #7: A system of connected mobility hubs**

Metrolinx Big Move #7 is to create a system of connected mobility hubs that support high density development surrounding key intersections and stations (Metrolinx, 2008c). The strategy is to create dense concentrations of trip origins and destinations enabling an efficient and cost-effective transit system. One participant pointed out that this intensification doesn't always need to mean more people, but directing more people closer to transit stops and stations enables people to avoid using a car for more trips (Researcher1).

While this coordination of land-uses and the transportation system is important for residential uses, it is of even greater importance for future employment centres. Antoine Belaieff, the Director of Regional Planning at Metrolinx highlighted this priority in an interview:

“For people to take transit to work, it works best when workplaces are close to transit, because it's harder to provide last mile options, especially in a low-density environment. The best scenario is where the place of employment is at a transit station. So I think that continuing our efforts on focusing development at mobility hubs or stations – so that people can easily take transit to work – is critical.”

In addition to the transportation network efficiencies and the important effect of encouraging a modal shift to transit, this clustering has important economic benefits. It improves employee-employer job and skill matching within the region, allowing residents to achieve upward mobility and employers to find more qualified employees. As an example of the regional economic benefits, a doubling of access to places of employment was shown to increase productivity by up to 8% in London, England (Gill et al., 2011).

## **Things *are* changing**

In speaking with a number of transportation planners, transit planners, and land-use planning consultants through this research, it appears that there is already a trend of increased collaboration underway, between land-use and transportation planning activities.

In one participant interview, Joanne Phoenix (2015), the manager of Planning and Accessible Services for Oakville Transit points to a stack of papers on her desk and explains the shift in climate for coordination between planning groups:

“...these are site plan applications – development applications for plans for a subdivision. ...When I first started with transit....this was not happening. Things were happening out there and we (transit) were ...an after-thought. It's completely turned around. So we as a department, we review every single site plan, every single plan of subdivision. ...For the north Oakville secondary plan, again there was a whole philosophy of ‘transit first’. The last time that we did a transportation master plan in Oakville it was a multidisciplinary team of planners, engineers, transit, active transportation specialists. Whereas historically it had been lead by engineering. There was concerted focus this time on making sure that it had a multidisciplinary team and a multidisciplinary focus.”

This positive trend does not mean that this area should be ignored in future – collaboration between these groups must continue to ensure the built form in the GTHA evolves to reduce reliance on the car and support more efficient modes of transportation.

### 5.5.3 Road pricing and related tools

Road pricing involves direct user charges for accessing a particular road or the entire network. When the Delphi panel was asked to rank a series of congestion mitigation strategies, this strategy came out on top with an average rating of 4.73 out of 5 – see *Figure 23* below. A growing body of economic and transportation planning literature supports this ranking, as this strategy effectively negates the impact of induced demand – allowing other strategies that improve and expand the transportation network to keep traffic flowing (Eliasson, 2008; Hensher & Bliemer, 2014; Pridmore & Miola, 2011).

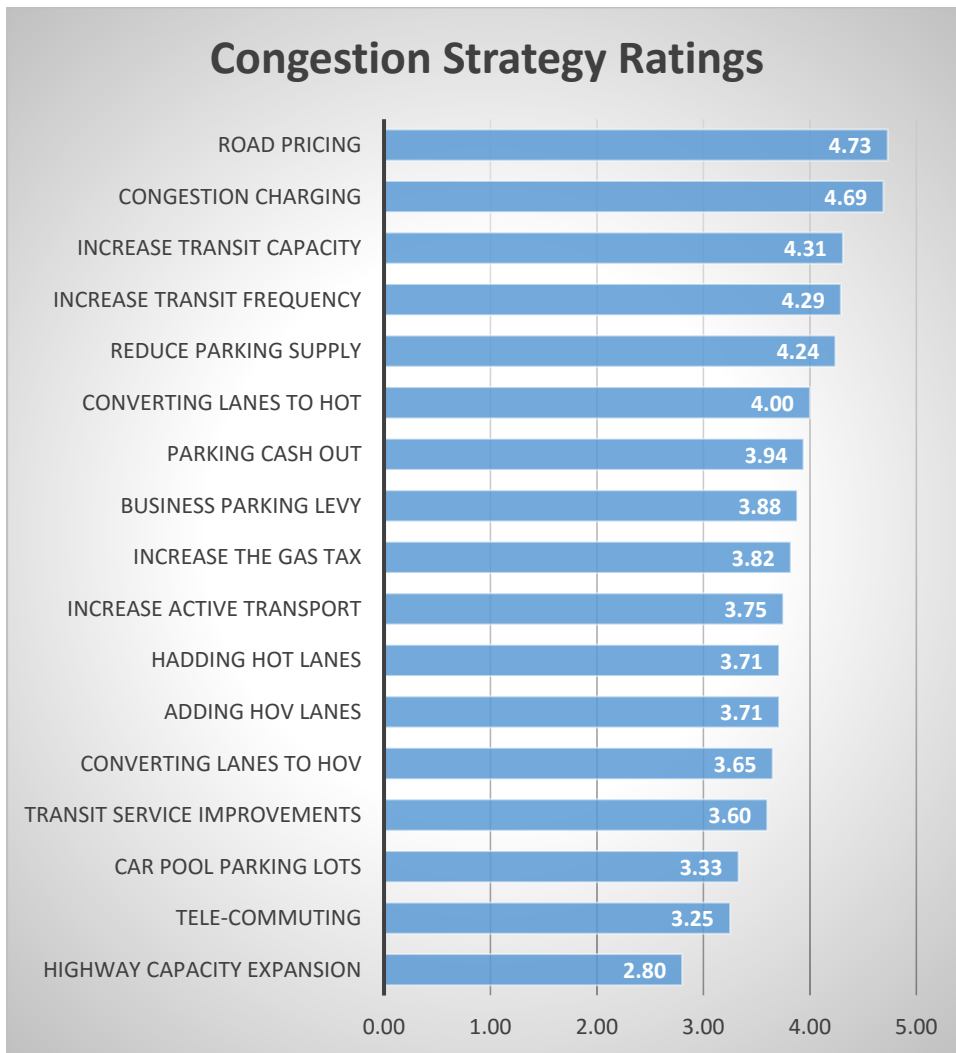


Figure 23 Delphi Panel Rankings of the Effectiveness of Congestion Mitigation Strategies

One Delphi panelist describes why we cannot rely on transit expansion alone to mitigate traffic congestion, and why road pricing is required:

“Look at the experiences with 1970s heavy rail transit investments in the US (Miami, BART, etc.). Great literature on how these systems did not live up to expectations in terms of ridership or land use change around stations. Better transit service that serves a static pattern of land use will result in little congestion reduction. TOD (transportation oriented development) can rectify this, but I doubt the benchmark of regional congestion will be reduced even with heavy TOD. Trips off the road network onto transit will likely be filled with new road trips. This is why congestion in and of itself is a good inducer for mode shift, and why road pricing is most effective as a policy tool.” (Panelist9, 2015)

#### *5.5.3.1 Gap between best practice and local opinion*

The results of the Delphi panel are representative of best practice in the field of transportation planning (related to congestion mitigation). The panelists consisted of international experts – including researchers and practitioners – and a couple local representatives who were asked to comment on the GTHA situation with a global lens. Extensive interviews with local participants provide a weather vane on the local professional opinion. Road pricing was offered as a solution by less than one third of local interviews (15 of 47), in comparison to the top ranking it received in the Delphi panel. This indicates a gap between local viewpoints and best practice.

#### *5.5.3.2 A note on congestion charging (CBD cordon)*

A congestion charging scheme involves a toll that drivers pay to access the CBD or other cordoned area during set times – as has been implemented in Stockholm and London. This strategy received the second-highest ranking by Delphi panelists in the first round survey (average score of 4.69 out of 5). As discussed previously, the GTHA is a poly-centric region with multiple employment centres. For this reason, this study would recommend road pricing over a CBD cordon or congestion charge. This recommendation was tested in the second round of the Delphi panel. Most panelists agreed with this choice, several commented on additional reasons to avoid the charge. Rick Rybeck of Just Economics LLC in Washington DC, sums up the panel’s view of this charge:

“Although I support user fees for parking and for roadway use, I generally disagree with cordon pricing. Cordon boundaries are somewhat arbitrary. As a result, people who make similar trips may be treated very differently. Also, over time, these boundaries create incentives for

residents and businesses to move away from the cordon to avoid the charge. This could be an incentive for sprawl -- which is a major cause of congestion. Mileage- and congestion-based charges are more fair and effective because they impact all trip making. Also, they encourage households and businesses to locate closer to typical trip destinations – and this leads to more compact development that is more amenable to walking, biking, transit and other forms of shared transportation.”

Referring back to local interviews, a politician and a business representative voiced concerns that a CBD cordon would negatively impact downtown businesses, and is a horizontally in-equitable solution (Business1, 2015; Politician2, 2015). For these reasons, a CBD cordon was removed from further consideration in this study.

### *5.5.3.3 Barriers for road pricing*

Hensher (2014) discussed public acceptance and political barriers as the two largest barriers facing increased adoption of road pricing. The themes explored in his paper were reproduced in the GTHA.

#### **Public acceptance**

Public acceptance for a road pricing program is expected to be low – at least initially. The primary barrier to contend with is that people do not relate the fee to time savings, and instead view it as having to pay for something which was previously “free” (Hensher & Bliemer, 2014). Local researchers agree:

“If something's free, you're going to use it. And you're going to use it as much as you want. If it's not free, you're going to think about. And the problem is that people are used to paying nothing to drive. They're used to driving for free. It's a right. And it can't be a right anymore because it's creates too many externalities. And congestion is one of them.” (Researcher1, 2015)

One interview participant offers the perspective that limited toll routes with a free alternate would receive a greater acceptance than full road pricing:

“I have heard through my office that a large segment of our membership would probably be in favour of tolling on certain routes, but I think ultimately you have to give people an option as well. If you're going to provide some sort of toll route, some express line where people can pay a little bit of money to access that road to get to where they're going a lot quicker, I think you still need to be able to offer that free option for them. So, if you want to build a toll lane on the Don Valley Parkway, you should still maintain a free portion of that road for the segment of the

population that doesn't mind sitting in congestion, or that doesn't want to pay the fee. And that's something that we've heard time and time again through our membership: if you're going to propose tolls, you still need to offer an alternative to those particular motorists as well.” (Advocate5, 2015)

Eliasson summarized a change in behaviour that results from exposure to systems: “familiarity breeds acceptance” (Eliasson, 2010, p. 9). It would stand to reason that those who have used Highway 407 (the only toll route in the region) would be more open to other forms of road pricing. There was some confirmation of this, as participants who used the 407 at least a couple times a year mentioned road pricing, HOT lanes, tolls and related fees more frequently. The province’s current plan to introduce HOT lanes may provide greater exposure to alternate forms of road pricing, and help bridge this barrier over time.

### **Politics and strong leadership**

Two out of six politicians interviewed discussed road pricing and related tools – roughly mirroring the results of the remainder of the participant group. From others, it was highlighted that it would be difficult to win over political support for road pricing. One reason was the four year election cycle discussed earlier – participants felt that politicians would be concerned about being voted out of office if such a program did not deliver immediate benefits.

“Politics, politics, politics. That's the answer. I mean, at the end of the day, we don't have leaders with the courage to stand up and say 'this is what has to be done.'” (Advocate3, 2015)

“I think the road block to that whole thing is the way our political system is currently set up... I'm not sure what circumstances are needed to be in place where a politician is going to be able to make that final decision. Even though you could talk to every road expert in the world, everything comes back to road pricing. In whatever format you want to put that in. ...the way it's set up is it's very tough for any, even our best leaders, to make that decision and still have a job. And that's the hard part of it, because most people don't like the idea of imposing new costs. And I get that. Because people, you know, dollars are scarce. ...But, when you have these four year election windows, it's very difficult. You know, politicians have jobs and careers and families too...” (Gov4, 2015)

Public acceptance and political acceptance are closely related. As indicated in the above quotes, politicians are unwilling to support road pricing initiatives because they believe them to be unfavourable by the public.

### **Lack of transit options**

From Australia, Hensher reports the most common response received from politicians regarding the introduction of a road pricing policy: ‘we will not introduce a congestion tax for motorists... due to the lacklustre standard of the state’s public transport system’ (2014, p. 228). This sentiment is the same locally in the GTHA:

“...And, we can't put pricing on roads such that we force people onto mass transit that can't accommodate them...” (Politican2, 2015)

Several other participants viewed road pricing as something that could be considered in the future, after more of the transit projects proposed by the Big Move have been implemented. With a significant backlog of transit projects, and long implementation time associated with transit projects, this barrier may continue to exist for ten years or more.

#### *5.5.3.4 Participant recommendations for implementing a road pricing program*

Delphi panelists and interview participants who discussed road pricing provided a number of recommendations to help overcome public acceptance and political barriers to implement such a scheme in the GTHA or across the province of Ontario. These recommendations included: focussing the effort, a targeted education campaign, starting with a revenue neutral program, taking an incremental approach, and dedicating funding.

### **Focus**

Delphi participants commented that public acceptance and political barriers are not unique to the GTHA, and exist worldwide. They suggested part of the problem is that leaders and stakeholders are spreading their attention across too many alternatives, and directing focus on this solution is needed.

“... consultants, academics, planners, experts ought to devote less attention to inferior alternatives [based on the belief that pricing is politically impossible]. Concentrate more on what works best, and less on what is politically feasible.” (Panelist4, 2015)

Rallying a multi-disciplinary team to focus on the effort on building a road pricing strategy will be necessary in the approach. One indication that the local conversation may be changing is shown by the

focus of a recent report by Canada's Ecofiscal Commission (2015). The report focussed solely on variations of road pricing schemes tailored for Canada's four largest cities, rather than calling for investment in transit which has been the trend of similar reports by peer agencies in recent years.

### **Education – tailor the message**

Effective and well-timed messages communicating the goals and benefits of the program were shown to be critical in the implementation of the Stockholm and London congestion charge programs (Eliasson, 2010). The education process may begin with educating politicians who would need to approve a pilot or seek support from higher levels of government to implement the project. This was a tactic taken during the Feeling Congested campaign where City of Toronto planning staff invited all councillors to a one-on-one meeting to educate them on the benefits of transit expansion. Roughly half of the councillors took planning staff up on the offer, and a number of them extended the invite further by organizing community meetings in their wards for staff to share the message (Planner6).

Next, the tailored approach should be used to communicate the benefits of a road pricing program to the public, and gathering their input. One interview participant commented:

“I think the perception is it's difficult. It's far easier to come up with one set of messaging, and communicate it to everyone. But the reality is that it's far more effective if you actually understand who you're talking to and give a compelling reason to use it, if it's specific to that audience group. And it's really no more complicated, it's just understanding what it is.”

(Media1)

During the study's charrette the need for tailoring the message was pronounced. Participants were given a task to create user personas for drivers. They then placed these persona's along a spectrum showing that some users (such as a student or retiree) would switch modes when faced with a low road pricing fee or toll, whereas others (such as professionals) would continue to pay the fee and drive – see example shown in Figure 24.



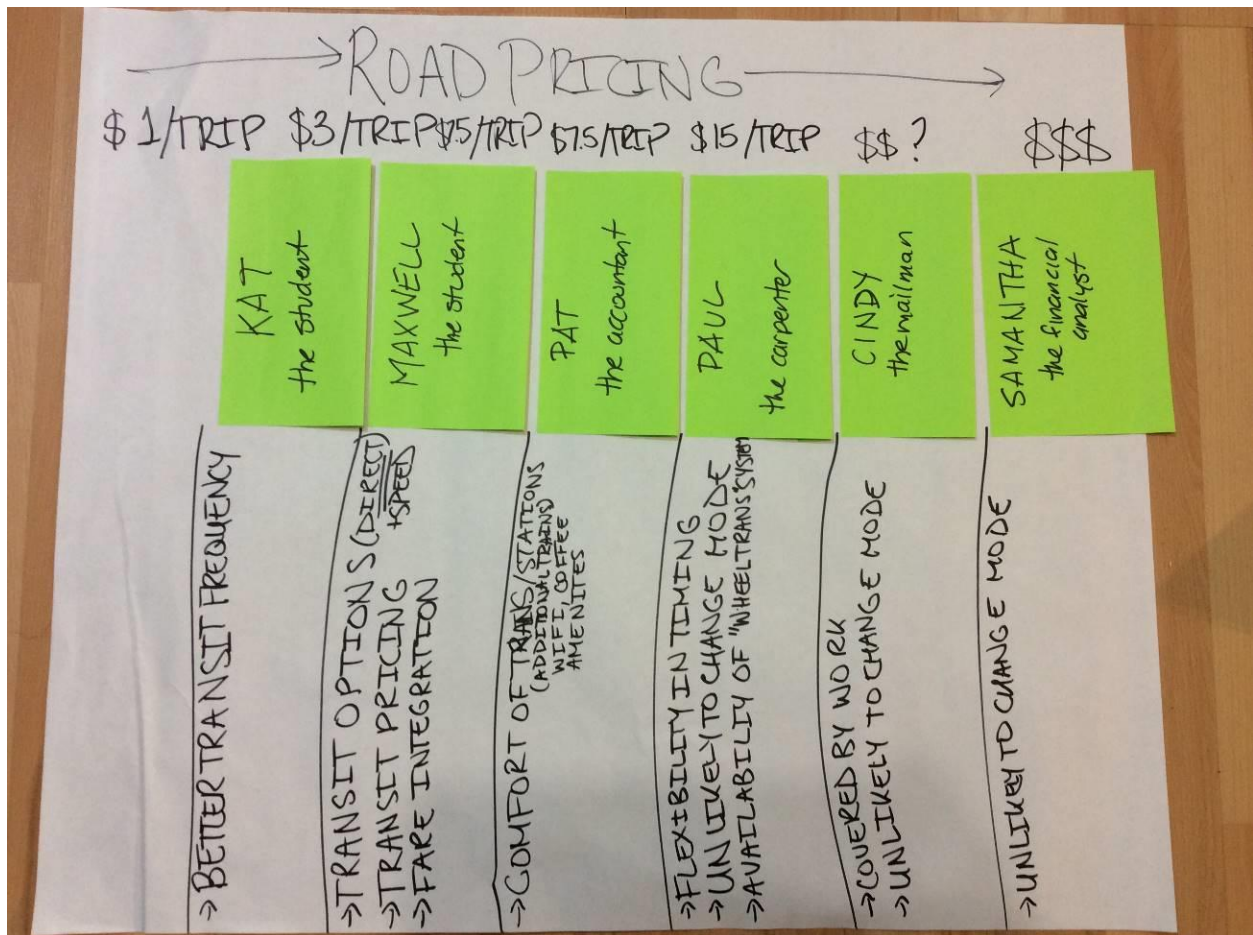


Figure 24 User personas and a road pricing scale - from the Policy Design Charrette

When asked what system changes and messages would help each of these personas to switch modes, variances in key messages emerged. For example, if the student was promised increased transit service through road pricing they would support the pricing program and switch to transit for some of their trips. On the other end of the scale, it was expected that the financial analyst (persona) would not switch modes and the message that they needed to hear was how the road pricing program would improve their travel times. This shows that there may need to be several sub-campaigns, targeting different stakeholder groups to gather public support for a road pricing program.

One message that several participants felt could cross multiple user groups was to use the example of peak-hour electricity pricing. Residents of the GTHA are accustomed to smart electricity billing where they pay different rates for peak and off peak periods. The option exists for residents to run high-electricity consuming appliances (such as clothes dryers) in the evening to save money. The transition to this pricing model faced very little opposition from the public. Participants recommended that the

message could be presented in a positive light: ‘drive off-peak to save money.’ In that way, residents could focus on the benefit of saving money on some trips rather than the negative feelings associated with paying a new fee.

### **Start revenue neutral**

One method interview participants recommended to overcome barriers for road pricing schemes is to design the program to be revenue neutral at the start. The fees could be balanced by reducing or eliminating the gas tax or another tax in proportion to the average road use fee. This sends the message to drivers that the charge is not “just another tax,” it replaces a tax with a more efficient user fee.

One politician who was supportive of tolls for the Gardiner Expressway and Don Valley Parkway (City of Toronto owned highways) was interested in tolls to support ongoing road maintenance of those roads, not as a dis-incentive for driving (Politician2). This view may be held by other City of Toronto councillors as indicated by the direction given to staff in an Executive Committee meeting to review tolling options for these roads (City of Toronto, 2015a). The current political climate would therefore likely be accepting of a revenue-neutral road pricing policy. Implementation in this manner achieves one important goal: it puts in place the tools required for a more complex road pricing strategy that could involve congestion mitigation in future.

Second round Delphi panelists were presented with the concept of revenue-neutrality for road pricing and asked about the benefits and risks associated with this implementation method. The benefits discussed included: effectiveness in linking taxation to actual travel distance, public acceptability because cost is usually the main source of complaints, and political acceptability. One panelist’s comments summarize these views:

“The point of roadway pricing is link the cost of using roads with the benefits received (or the costs imposed upon others) in order to make transportation decision making more rational and efficient. A pledge of revenue neutrality helps the public understand that roadway pricing is not a ‘money grab.’ ” (Panelist1, 2015)

One panelist did not see any risks involved with this approach. The risks discussed by others included a difficulty in estimating how much money is needed to offset other taxes, encouraging shorter trips if the perception is that driving is now “more affordable”, and bad press. One panelist stated that a low price point would yield reduced funds, and runs the risk of being ineffective at mitigating congestion which could arm the arguments of opponents (Panelist7, 2015). The general guidance from the Delphi panel

was that a pledge of revenue neutrality can be effective in winning over public acceptance, but difficult to execute.

### **Take an incremental approach – start with a pilot project**

As a general strategy for implementing various solutions, interview participants recommended an incremental approach to nudge public acceptance of solutions. Pilots have been proven as a successful way to test ideas, learn from the results, and iterate on solutions. Locally, the experience of the PanAm games was repeatedly highlighted by participants where MTO and the municipalities took the opportunity to try a few approaches to traffic management such as implementing 3+ HOV lanes. Another example was a trial of allowing off-peak deliveries and testing concerns around noise in neighbourhoods (Planner15). Internationally, the benchmark example is the Stockholm Congestion Charge program which started as a full-blown trial, followed by a referendum (Eliasson, 2008).

“...pilot projects are important because you're not hitting with a stick, you're saying we are going to test this for a period of time and we are going to learn from it and we are going to give you an opportunity to (you the public) to give your feedback prior to saying that this is going to be permanent. For something like congestion and road pricing I think a pilot of picking a few east west corridors and making a few north south corridors in Toronto and a few other cities in the region would be good to test and we can learn from them and say this worked and this didn't work, oh I actually liked this oh I didn't really like this, what do we do now. That would also be a very good suggestion in terms of how you ease people into it...” (Business1, 2015)

### **Dedicate funding**

For a road pricing scheme to gain public acceptance it is critical that funds generated from the scheme are re-invested into the transportation network, and are transparently accounted for. This is a point that was raised in participant interviews, and made very clear in the literature review on the topic (see for example: Canada’s Ecofiscal Commission, 2015; Eliasson, 2008).

#### 5.5.4 A special note on self-driving cars

At the current time, a discussion about reducing future traffic congestion would be incomplete without mentioning autonomous vehicles. Several interview respondents mentioned the potential of driverless cars to reduce the impact of traffic congestion in future – potentially replacing the need for some forms of public transit, and a significant portion of parking. Interestingly, this was generally missing from Delphi panelist responses. Participants highlighted that this technology has the potential to eliminate accidents – removing incident based congestion (although that is not the focus of this report). The vehicles could also reduce congestion through an ability to travel closer together at a consistent speed on highways. They could also have a positive impact on land-use, through a reduced requirement for parking spaces. On the negative side, one participant highlighted that if time in the car becomes useful time (one can read, or do other work) it may matter much less for someone to be stuck in a car for an hour-and-a-half every day (Planner12, 2015) which could have the detrimental effect of encouraging sprawl.

It is too early to comment on the expected effects of autonomous vehicles on traffic congestion. However, the advent of this technology may amplify the effects of policies aimed at encouraging car pooling. For example, autonomous vehicles may provide options for residents in low-density suburban areas to conveniently car pool to a regional rail station, reducing the number of vehicles on the road.

## 5.6 Major barriers

Several major barriers were reported that apply to many solutions. These include: existing land uses, housing affordability, business needs and practices, existing mindsets and behaviours, politics, funding, and time. The most significant of these were political and funding barriers.

### 5.6.1 Existing land uses

The need for land-use and transportation planning coordination was discussed above. While participants' comments would indicate a positive change in planning of our cities for greater densities, mixed-use, and improved coordination between transportation and land-use planning, the existing land-uses in much of the region pose a significant barrier to congestion mitigation strategies.

One participant who lives in a central part of Toronto explains:

“The problem is a lot of areas aren't *built* for transit - so it's virtually impossible. Where my brother lives, in Scarborough - nice neighbourhood - almost impossible to serve reasonably by transit. He could *never* enjoy this kind of transit, because it's like a three mile walk out of the subdivision. The reverse-front development against arterials with walls of fences. And the transit's running on the arterials - you can see it go by, but you can't get there. It's crazy! And that's *all over*.” (Other1)

The participant continues, with another example of a suburban area on the western side of the region:

“...they built one entire section, subdivision after subdivision where they put in these fences and they didn't allow any paths out. So they run the transit up the arterial road, and all these houses back it, and there's no paths out. How does that work? How do you serve that? You can only see it, but you can't take it - you can't get there. And they don't even allow gates in those fences, so even if those individuals *wanted* to they can't do it - they don't allow it - it's prohibited to have a gate. That's just about the most anti-transit policy I've ever heard! And so people complain, because now it's been taken over by a demographic that would use transit, and they complain that they don't have transit. It's impossible to serve, or near impossible, because you can't efficiently deliver transit through the spaghetti subdivision at the all the weird times when people are going to-and-from anything.” (Other1)

One of the many examples provided by transportation and land-use planners interviewed include a discussion of NIMBYism, media reporting, and the low-density land-use pattern that the City is trying to retrofit with improved transit:

“...there have been articles about the Scarborough subway extension where it's almost like the reporters have expressed shock that the densities in Scarborough are low... or that it's been a secret that we've tried to keep them low, so you look at the way in which they've been developed there, or Mississauga too. The way in which our suburbs have been developed means that we've got a little bit of a barrier to overcome in order to make it easier for people to get around. We've built some of those areas to be dependent on the car. So how do you increase densities to make high order transit more viable or to give people more opportunities to live and work in close proximity? Or how do you even deal with some of the ways that we've structured the road system and the networks there that are barriers to creating better urban form for things like walking and cycling and encouraging a different kind of lifestyle.”

(Planner15)

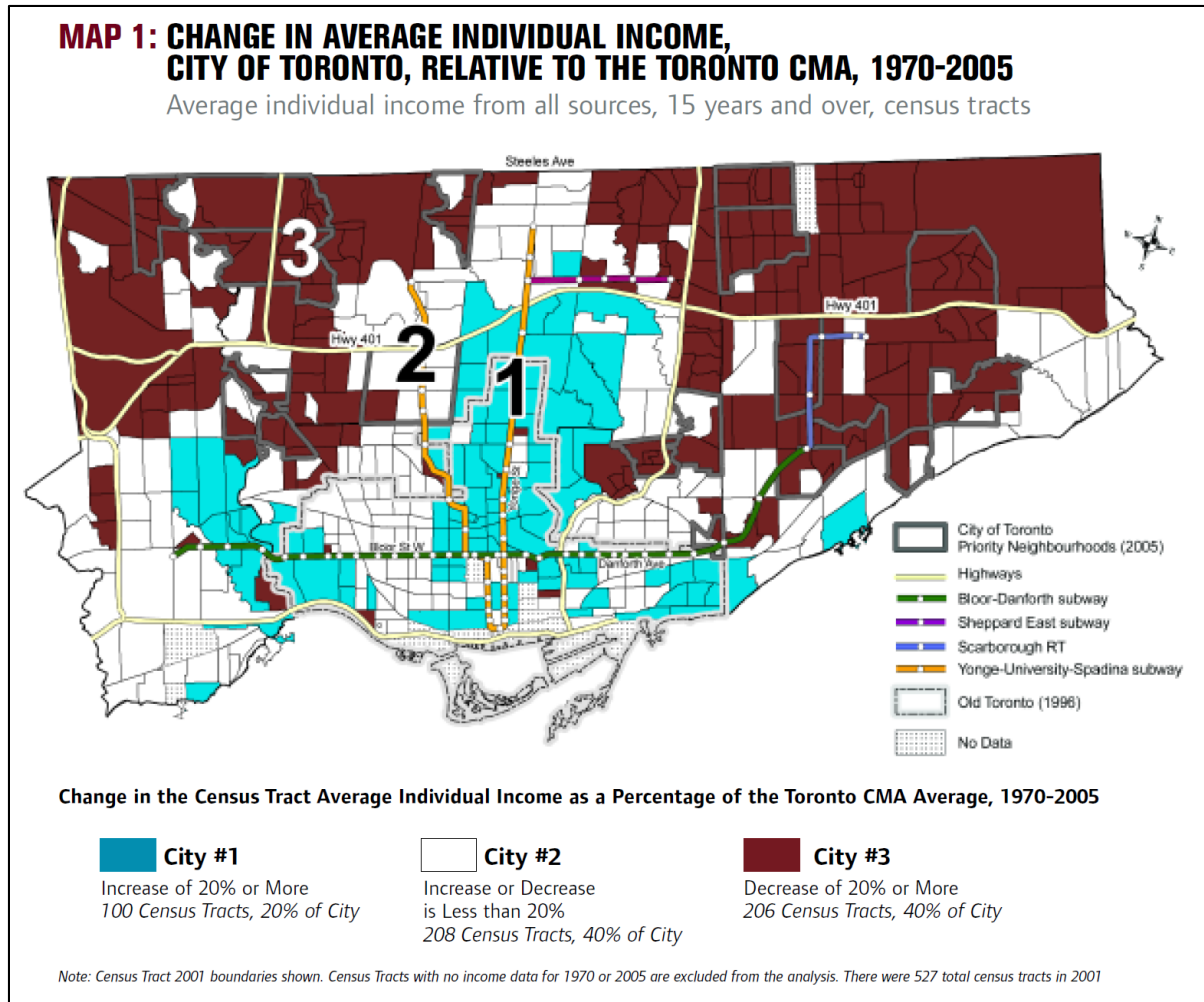
These vivid examples describe just *how* car dependent some of our suburban neighbourhoods have become in the region. Encouraging residents of these neighbourhoods to make a shift in their modal choice towards transit is a difficult task, because the design of their neighbourhoods are not conducive to transit service.

### 5.6.2 Housing affordability

A problem related to existing land-uses is a housing affordability issue that contributes to residents' choice of housing location and long commutes to work. As residents – especially those with families – seek housing that provide enough space to meet their needs, they are often forced to choose a house in a suburban community which may be far from their work location – be that in downtown Toronto, a suburban office complex, or other location. It becomes difficult to provide alternatives to the car for these residents. One participant explains:

“You choose where you work to an extent but you choose where you live. And a lot of that has been tied to housing affordability. It's not necessarily just access and travel time. A lot of it is based on ‘Hey, I can actually get a certain amount of square footage, I can get a certain amount of bedrooms, I can get a place by (I have young kids) schools, libraries, services, rec centres, this and that.’ And it's not necessarily a clean-cut thing. I sincerely feel people are choosing their commuting patterns based on the housing affordability issue, than anything else.” (Planner1)

A well-known report, often referred to as the “tale of three cities” depicts the impact of the housing affordability issue within the City of Toronto. See *Map 9* below taken from this report, which shows that the incomes of residents in closer proximity to subway lines increased 20% or more over the last twenty five years, with the exact opposite effects of those on the north-west and north-east ends of the city, which are not well served by higher order transit (Hulchanski, 2010). This indicates that the choice to live in car-dependent communities is not only a choice of the wealthy, but also a predicament for lower income earners.



Map 9 Change in Average Individual Income in the City of Toronto

Source: (Hulchanski, 2010)

Middle-income earners have consistently sought housing in the suburban municipalities surrounding Toronto – in the regions of Peel, York, and Durham – areas which have provided newer homes at a lower cost per square foot, but with limited transit service and other alternatives to the car (Kassiedass, 2013). It would appear that people are often not factoring the cost of transportation in their housing decisions.

### 5.6.3 Existing mindset and behaviours

Many interview participants described the key task of a congestion mitigation strategy as achieving a shift in philosophy, mindset and attitudes of the public. The barrier is an entrenched culture that favours driving. A portion of the population does not want to give up their car, is not interested in individual actions to mitigate congestion, and are unwilling to accept changes in their neighbourhood.

#### **Auto-dependent lifestyles**

One participant from a suburban community describes the attitude of those who live there, and the expectation that driving is the only viable form of transportation:

“Very few people walk and cycle to work. Even when I walk down to the town hall for council meetings sometimes, I get people pulling over 'oh, do you need a ride? Did your car break down?' No, I'm just walking! You look around [name of the suburban municipality] to see a person in a suit carrying something, it's like 'something's wrong with that guy.' So that's one thing that... we're so car centric in this area, and in the whole society, it's like 'you don't have a car, what's wrong with you?' So that's one thing - we've got to change that model.” (Politician4)

Other comments shared reinforced the superiority of the automobile in getting a person directly from point A to point B in a space that the driver can control, versus a negative reputation of transit as being slow, unreliable, and other peculiarities such as a desire to avoid sitting beside smelly people or those who are “man spreading” (taking up more space than their allotted seat). For many who live in suburban areas of the region the car is the number one choice, and transit is viewed to exist for those who can't afford to or are otherwise unable to drive.

#### **Individual travel choice**

As one participant put it: “congestion mitigation is something that people have to do on an individual level for a collective benefit” (Advocate2). They go on to describe a general attitude that most people support transit expansion with the hopes that *everyone else* will use it to free up road space for them to get to work faster (by driving). The discussion wraps up with a hypothetical example that depicts two common mindsets: 1) transit service must narrow the service gap to the car to attract users, and 2) commuters want to see the benefit or impacts of their individual effort in order to continue with a change in behaviour:



“...supposing I drive to work today, and you're saying 'take transit a couple of days a week as your contribution', well ok, I take transit and it's a pain-in-the-ass, and I notice on the days that I still drive things haven't really changed, and I'm even noticing that sure I got a congested road, but I'm still getting there a half an hour faster than when I took the bus. Show me where this is in my interest to take transit? Because the problem is, unless you have so big a shift that it is actually visible, people are going to say why am I doing it?” (Advocate2)

### **NIMBYism**

A major change required to make increased transit service viable, entice a shift in mode to transit and active modes, and even reduce trips is to increase the densities and mix of uses in our communities (Cervero & Kockelman, 1997; Ontario Ministry of Infrastructure, 2006). Unfortunately, the majority of the region is already settled, and many who live in low density communities have become accustomed to their way of life.

The term NIMBY (“not in my back yard”) is often used to summarize the view that local residents have against the placement of a new municipal service or a change in or near their community. NIMBYs are often not against a particular project or the principal of change entirely, they simply don't want it near where they live. The classic example is that residents may recognize the value of their municipality having a garbage dump, but for obvious reasons do not want a new one placed near their home. As for our discussion on traffic congestion, comments received show that pushback grounded in NIMBYism will make it difficult to achieve some of the land-use changes required to support greater densities, and in some cases even oppose new transit lines.

An example of the contradictory views that residents with a NIMBY attitude may hold:

“And yet those same people that are protesting any kind of medium density development to their area, they're probably also the ones that say we need to protect the Green Belt and the Oak Ridges Moraine.” (Planner15)

Several study participants pointed to the public debate of the decision on the Hurontario-Main LRT project (which was still pending at the time of their interview) as a telling example of how extreme and harmful NIMBYism can be. Sean Marshall describes the project and disappointing Brampton City Council decision in a Spacing Magazine article (2015). The proposed project, listed under the Second Wave of the Big Move included a 23.2 kilometre LRT line, the construction of which would be *fully funded* from the provincial government. The line would have connected the municipalities of Mississauga and

Brampton to the rest of the region, linking three GO (regional rail) stations, and several major bus routes along one of the GTHA's busiest corridors. Brampton City Council voted 6-5 *against* the downtown Brampton portion of the route. Once constructed, the LRT project will terminate at Steeles Ave; only three of the eight stops proposed for Brampton will be built.

Several of the factors that weighed into the negative vote included heritage concerns, potentially low ridership, and a concern about operating expenses (Marshall, 2015). The NIMBY factor, Marshall reported, included wealthy home owners on Main Street opposing the plan to run an LRT through their neighbourhood. He points out that even former Premier Bill Davis – a respected leader famous for cancelling the Spadina Expressway, and known to be pro transit – was a major opponent of this LRT project running down his own street. The comments on the article online indicated a view that Metrolinx lacks power, and should be able to build the full line as originally planned for the greater good of connectivity for the region.

#### 5.6.4 Politics

Politics were the most frequently discussed barrier across the board by interview participants – even *politicians* raised this as a barrier! The political barrier has been introduced in two dimensions above – first that there is no “ribbon cutting for operations” and therefore limited political will to support increased frequency of transit service in the suburbs, and second that politicians seeking to use major transit infrastructure announcements for political gain consistently cancel, re-open decisions on, and stall higher order transit projects. Two other dimensions of the political barrier are worth discussing here: the impacts of the four year election cycle, and a lack of experience with transit.

While there are extensive benefits to living in a free and democratic society, and the four year election cycle allows citizens to send a clear sign of approval or descent of government actions, the cycle inherently encourages short-term decision making. This is because the benefits to be reaped from long-term projects exceed the timeframe of the current election cycle, forcing politicians to prioritize the projects that can demonstrate more immediate value to voters. Politicians who initiate longer term projects may not be around to cut the ribbon on project opening. Therefore, politicians will often seek decisions which can yield results in the near term, garnering them enough public support to be re-elected.

Several participants believed that the reason many politicians favour subways and lack support for bus and LRTs is that subways are the only form of transit many of them use – people will support what they

are familiar with. Even some of the study participants who lived in suburban Toronto, and most who lived in the surrounding municipalities drove to work – part or all of the time. When these politicians do take transit it is typically on a TTC subway or GO train. Therefore the famous Scarborough subway decision was made by politicians who were biased by a mode choice they are familiar with.

It is important to note that the discussion of politics and support for transit and infrastructure is not specific to one political party. While the current Liberal provincial government is generally viewed to be pro-transit, Soberman and team note that it was a Conservative government that increased spending on municipal transportation in 1972, and twenty five years later it was also a Conservative government that removed almost all spending in this area (2006). Several interview participants echoed this view.

#### 5.6.5 Time

Time is not highlighted frequently in the transportation literature, but it was raised by about a third of interview participants as an issue to take into consideration. Large infrastructure projects take a long time to plan, design and build.

“...the issue that we have, with transit particularly, is that the planning, design, and construction times/durations are so long. Like you can't build them in election cycles. To build a rapid transit line is a 4-8 year construction process depending on the complexity, the engineering and how money is rolled out for certain things. And that's not even the design planning phase, this is like when you are actually like 'Hey, we're actually going to get shovels in the ground' “ (Planner1, 2015).

The long lead time for construction projects can impact public support:

“It's really hard to get anybody excited about having a subway line that's going to come in 20 years from now” (Planner3, 2015).

Relating this back to the political barrier, one participant highlighted that there are two or more election cycles (at all levels of government) prior to the opening of several major transit projects such as the Eglinton Crosstown or Finch West LRT. The risk is that a political leader with other priorities could get elected and cancel a project before it is opened (Advocate7, 2015).

One participant also noted that it will take time to develop the organizational capacity to deliver the transit infrastructure that has been back logged for a couple decades:

“...collectively as a region we're going from almost building no transit for a long, long time to building a lot of transit. It's not just the politicians, it's about building an organization like Metrolinx. ... in 2007, we didn't have a regional transportation agency and the TTC wasn't used to building stuff. All those people went to go work, they went to London England or Kuala Lumpur or you know Hong Kong, or Singapore, all these places building there's a group of skilled people that know how to do this stuff and they go where the work is. And it takes time to build teams, just like it's going to take time for Toronto Maple Leafs to rebuild a process, it will take them time. They're building from the ground up - same thing, we're building from the ground up, and it means all the positions and all the organizations that need to be set up to do this, there's a huge learning curve going on right now in the industry in this region, and in the institutional frameworks, and that can only move as quickly as possible as well” (Planner8, 2015).

Participant input would indicate that there is no silver bullet for the congestion problem. The mix of solutions required to mitigate it will be implemented over time, and progress should be measured over the long-term.

#### 5.6.6 Business needs and practices

Downs introduced a concentration of trips in time as a key component of the cause of congestion (Downs, 2004a). Workplace and telecommuting policies were frequently mentioned by interview participants as an option to mitigate traffic congestion – circumventing this concentration of trips. Other participants however, commented that we may already be maxing out the extent to which telecommuting will be used.

“The consumption of mobility despite the increase in virtual communication.... Like the theory that everyone could live and work anywhere because of cell phones and video conferencing and email and all this kind of stuff, and instead what's happened is it's accelerated the need for people to meet face-to-face, because the more, like I just met you today... we're having a better conversation face-to-face than we ever could have had...” (Planner8, 2015).

The use of telecommuting does not eliminate the need for in-person meetings. From other interview participant conversations it is apparent that those who have the option to work from home occasionally already pursue this option. They still commute into the office several days a week for in-person meetings. This indicates that telecommuting as a congestion mitigation strategy would play a minor role in future.

Other trends in business practices are helping to make more efficient use of office space – such as the trend for hot desking. However, this leads to an intensification of workers and travel needs:

“The other factor to take into consideration is, I call it an invisible intensification in the existing building. So what you don't necessarily see is that there are more people working within these office buildings than 10 years ago by virtue of consolidation of offices. The way we work is different so generally most people don't have their own office anymore. There is a lot more shared space. So a lot of the growth to the south of us in the new builds is consolidation spaces of existing businesses where they are consolidating all their offices from across the region where they are putting everybody into a new place where you have per person less square footage to work with. There is substantial intensification within existing buildings and that's something you don't see...” (Business1)

## 5.7 Summary of findings

This chapter has provided an overview of opportunities to mitigate traffic congestion in the GTHA, from the eyes of nearly fifty local experts in related fields. Additionally, barriers to these solutions have been explored, along with participant recommendations to overcome them. Input from the panelists of the Delphi method used in this study has helped identify a policy gap – road pricing as a required strategy to mitigate congestion, along with insights for implementation. Lastly, some insights gained from the study’s Charrette were presented – such as the need to tailor the message to the audience.

This study has found strong support at the local level for Places to Grow and the Big Move. The strategies most frequently discussed to shift modal split in the short term are: fare integration; increased frequency of transit service; and expansion of the active transportation network. For the long-term, local participants most frequently discussed the importance of transit infrastructure expansion and improved land-use and transportation planning coordination.

Findings from the study’s Policy Delphi would indicate that the missing strategy to tie together other strategies of the Big Move is road pricing – what this report calls the “tenth big move.” The participant base – both locally and internationally – would support an incremental approach to introducing road pricing, starting with a pilot project.

In addition to the findings above, the following insights gleaned from primary research will inform this study’s final recommendations:

- A trend of improvement in land-use and transportation planning has already begun in the GTHA
- Traffic congestion is perceived to be the worst along the region’s major highways
- Lack of funding for transit operations continues to be a problem – partly because there is no “ribbon cutting” for transit operations
- We can’t build our way out – auto use dis-incentives are needed in the strategy mix, and are missing from the Big Move
- Major barriers identified locally are also common around the world: public and political acceptance of new policies

The next chapter will discuss these findings and provide final recommendations.

## Chapter 6 – Discussion and Recommendations

### 6.1 Introduction

#### **The Tenth Big Move**

Through a qualitative mixed-methods approach, this study has explored the core research question: *how might we encourage a positive shift in modal split to mitigate traffic congestion in the GTHA?*

Analysis of participant input highlights an apparent gap in transportation planning policy – a lack of an effective TDM policy. The strategy best suited to fill that gap is a road pricing program. Such a strategy would pull together the other nine Big Moves of the regional transportation plan, and hence this report calls road pricing the “Tenth Big Move.” Despite significant public benefits for a road pricing program, there will undoubtedly be large public and political acceptance barriers to face. Participants of this study have suggested that these barriers can be overcome through the use of pilot projects and incremental change. Leveraging these participant insights and referring to the literature on these topics, this study offers two recommendations for GTHA transportation policy, and six key recommendations to guide implementation:

#### **Policy Recommendations**

1. Metrolinx must continue to pursue the nine Big Moves (strategic priorities) identified in the Big Move regional transportation plan.
2. The next iteration of the regional transportation plan should include a road pricing program as the *tenth* Big Move to effectively manage demand and tie together the other nine Big Moves

#### **Implementation Recommendations**

1. Tailor the message
2. Start with a pilot
3. Create a partnership organization between MTO, Metrolinx, and the municipalities
4. Design (introductory) pricing of the program to be revenue neutral
5. Dedicate funds to transportation system improvements
6. Implement through a public trial, followed by a referendum

This chapter will outline these recommendations, and describe the analysis which has helped to formulate these ideas.

## 6.2 Discussion of research questions

The core research question of this study is: *“as population growth in the GTHA continues, how might we encourage a positive shift in modal split to help mitigate traffic congestion?”* This section will discuss the study’s sub-questions, focusing on policy gaps, barriers, and solutions to overcoming barriers, as these topics were the focus of the study’s primary research.

### 6.2.1 Research question: what are the impacts of traffic congestion?

As this study’s literature review has shown, severe traffic congestion in the GTHA is a serious problem. The impacts are far reaching, and extend beyond the simple matter of wasted time by commuters. *Some* congestion is a sign of a prosperous economy, however congestion is currently limiting productivity, employment, and global competitiveness of the region – to the tune of \$11 billion a year. Further to this, congestion is impacting the health of the region’s residents, causing undue stress and reducing physical activity, leading to several more serious health conditions. Lastly, air quality suffers and even pollution of waterways is impacted by excessive congestion. The excessive reliance on the automobile further spurs a greater volume of roads to be built and widened, along with extra parking space, all of which urbanize land unnecessarily and further exacerbate the problem. A city built on serving the car fails everyone – including car drivers.

### 6.2.2 Research question: what are the causes of traffic congestion?

Downs (2004a) has shown that peak hour, recurring traffic congestion is caused by a concentration of trips in time, mode and space. A high volume of people chose to leave for work, school, or another purpose at around the same time each morning and return in the evening. Most of these people chose to drive, or are chauffeured, and a high volume will select highways as the quickest route to get to their destination. This causes traffic congestion on highways and regional roads, as demand exceeds the capacity for which these roads were designed to handle.



### 6.2.3 Research question: what opportunities (policies) exist to encourage a shift from auto use to more efficient modes?

Traffic congestion is a problem of supply-and-demand matching for road capacity. Solutions therefore, can be approached from both the supply and demand side of the equation (Table 2). Supply-side options include building more or wider roads, adding HOV/HOT lanes or toll highways; expanding transit capacity through building new bus or rail lines, or improving frequency and capacity on existing lines; and improving the active transportation network. Demand side options include methods to encourage car pooling (such as HOV lanes and car pool lots); educational programs; dis-incentives to auto-use such as increases in the gas tax, parking policies, or tolls; and incentives to use transit. The improved coordination of land-use and transportation planning is a theme that runs through both sides of the equation.

### 6.2.4 Research question: what policy gaps (if any) exist in the regional transportation plan for the GTHA?

The Big Move produced by Metrolinx is the regional transportation plan (RTP) for the GTHA. By extension, this represents the primary plan through which traffic congestion will be addressed. Analysis of the Big Move has highlighted that the largest policy gap is a missing transportation demand management (TDM) strategy with a fiscal element. Secondary to this, local participants indicated that increased local transit service coupled with fare integration are the two strategies expected to have the greatest impact on shifting the modal split to mitigate congestion at the regional level, in the short term. Increasing the frequency of transit service is not adequately addressed in the Big Move.

The nine priority actions (Big Moves) that Metrolinx has outlined as having the “largest and most transformational impact on the GTHA’s transportation system” (2008c, p. 21) align with six of the ten strategies of the Big Move. These relationships are highlighted in green in Figure 25. Two of the strategies that do not currently have priority actions assigned to them are: strategy number three related to improving the efficiency of the road network, and strategy number four to create an ambitious TDM program. A road pricing program should be a key component of achieving both of these strategies, and as such should be included as a strategic priority – see blue shaded boxes in Figure 25.



Figure 25 Metrolinx Big Move Strategies and Priority Actions - with the Tenth Big Move added

Source: chart compiled from data presented in the Metrolinx Big Move RTP (2008), plus author's recommendation of the "Tenth Big Move"

#### 6.2.4.1 Big Move Strategy Number One

Strategy Number One, the cornerstone of the RTP – “build a compressive regional rapid transit network” is heavily focussed on transit infrastructure expansion. The first three Big Moves (priority actions) are aligned with this strategy. Big Move Three speaks to an expanded Union Station, Big Move Two to improving connectivity to Pearson airport, and Big Move One is to build “a fast, frequent and expanded regional rapid transit network”. This priority action includes a listing of planned regional rapid transit projects such as LRT and BRT projects. However, achieving the component of Metrolinx’s vision to “move 50 percent more people in the region with less congestion than we have today,” will require a shift in modal split. Metrolinx needs to convince transit riders to abandon their car for the entire length of their trip (rather than driving to the nearest rail station), more often. To do this requires the cooperation and coordination with local transit providers to increase local transit service.

While acknowledging the limitations of this study (it is not an exhaustive review of the Big Move), there are two gaps in regards to transit expansion and congestion relief to highlight:

- Increased transit frequency is needed to mitigate traffic congestion in the suburban regions
- High-order east-west transit connections are planned too far in the future

#### **Increasing transit frequency**

Local participants of this study (both expert interviews, and residents who took part in the Charrette) have indicated that the most severe regional traffic congestion problems are felt along 400 series highways and regional roads serving the suburban regions. These participants have recommended that the best solution to help shift the modal split in these areas would be to increase the frequency of transit service. There are numerous plans to increase the frequency of regional rail (GO) service, however riders will continue to drive to these stations, contributing to congestion in the periphery, unless viable local transit options exist to get them there. The barrier to increased funding for the operational side of local transit service as many participants have said is that “there is no ribbon cutting for operations.” It is a political barrier. Politicians benefit from the success of implementing a new shiny infrastructure project, not from announcing more frequent service. This is unfortunate, because the short term need is in frequency of service.

## East-west connections

The Growth Plan has identified several urban growth centres in these municipalities. Future traffic mitigation (and economic prosperity) of the region is dependent on building higher order transit connections between these economic hubs, and serving it with frequent transit.

The second gap is also related to the insight that congestion is worst along regional highways connecting the suburbs. This gap was introduced by interview participant Brian Crombie:

“...people don't go from Mississauga to Scarborough anymore - it just takes too long. And if you had an easy way of getting across the city, they would be connected. At one point in time, we were talking about a train that went from Mississauga to Markham - the two fastest growing cities, the most IT oriented and pharmaceutical oriented cities in the GTA. And how do you get there? You go by the 407, you don't even go into Toronto at all, you go around the periphery of Toronto (by car). Well you know, if there was a Crosstown you would knit the city together. I worry that we're becoming... you know it's a radial system that is going to break each one of the parts of the radial away from everything else, and only connect it to the centre. And when you think about a network, a network is lots of connections, rather than all the connections going through one spot called Union Station” (2015).

The gap has been acknowledged by Metrolinx:

“One of the most significant gaps in the current transit network is the lack of east-west higher-order transit connections to destinations other than Union Station” (2008c, p. 61).

Metrolinx has outlined plans to improve east-west connections with higher order transit, through staged implementations over time – a sampling of these projects is highlighted in Table 13 below. There are plans for BRT and LRT projects to help serve local needs within regions and municipalities, and rail connections to connect the southern parts of municipalities to the east and west of Toronto, through Union Station within the first 15 years. However, rapid transit parallel to Highway 401 which cuts through the northern suburbs of Toronto is minimal. Lastly, direct connections between the outer ring municipalities (discussed above) will be served through bus connections for the entire time span covered by the current RTP. There is a nod towards providing an express rail service, however that is forecasted beyond the twenty five year time span.

First 15 Years	16 to 25 Years	Beyond 25 Years
<p>LRT connections providing east-west connections within Toronto:</p> <ul style="list-style-type: none"> <li>Eglinton LRT</li> <li>Finch West and Sheppard LRTs</li> </ul> <p>Bus rapid transit on 407, connecting:</p> <ul style="list-style-type: none"> <li>Halton, Peel, York, and Durham regions</li> </ul> <p>Express rail on Lakeshore line connecting:</p> <ul style="list-style-type: none"> <li>Hamilton on the west, right across the region to Oshawa on the east</li> </ul>	<p>A new subway service in Downtown Toronto, relieving:</p> <ul style="list-style-type: none"> <li>The King/Queen corridor</li> </ul> <p>Dedicated transitway along Highway 407</p> <ul style="list-style-type: none"> <li>Providing service through York Region, connecting to the airport via Highway 427</li> </ul> <p>Opportunities for upgrading BRT services to LRT will be examined</p>	<p>Additional rapid transit in a dedicated transit facility serving:</p> <ul style="list-style-type: none"> <li>East and west portions of Highway 407</li> </ul> <p>East-west Express Rail connecting:</p> <ul style="list-style-type: none"> <li>Oakville, Mississauga, Vaughn, Richmond Hill, Markham, and Pickering</li> </ul>

Table 13 Sampling of planned transit projects providing east-west connectivity in the GTHA

Source: Metrolinx (2008c, pp. 60–67)

**Limitations in ability to reduce travel time**

Mogridge’s work highlighted in this study’s literature review, and Thomson’s golden rule of urban transport, “the quality of peak-hour travel by car tends to equal that of public transport” (Mogridge, 1997, p. 7) would raise some skepticism on the effectiveness of the Big Move to achieve some of its goals in relation to traffic congestion. Metrolinx reports that the average time a person spent commuting daily in the GTHA was 82 minutes in 2008, and they forecast that figure to reduce to 77 minutes with full implementation of the Big Move in twenty five years (2008c, p. 59).

A rough example shows how Metrolinx may have arrived at this estimate. We will use the median trip length of 7.7 kilometers, for transit trips taken across the GTHA during the morning peak period in 2011, reported by the Transportation Tomorrow Survey (University of Toronto, 2011, p. 6). We multiply this by the average speed of BRT service (at the low end), and arrive at 62 minutes of in-vehicle travel time. If we then assume that transit service runs on a 15 minute frequency, and that each person may wait an average of 7.5 minutes per start of each journey, this may add an additional 15 minutes of wait time to transit journeys. We arrive at 77 minutes average daily commute time by transit.

$7.7\text{km (per direction)} * 2 * 15\text{km/h (average speed of BRT at low-end)} = 62 \text{ minutes}$

ADD:  $7.5 \text{ minutes travel time (per direction)} * 2 = 77 \text{ minutes total}$

Metrolinx calculations likely involved far more extensive calculations, however there are a number of risks in delivering this reduced travel time that the variables above highlight. The average trip length for one, would need to stay stagnant and the Transportation Tomorrow Survey (2011) shows that commute distances have grown from 6.5km to 7.2km to 7.7km in 1996, 2006, and 2011 respectively. The trend would indicate that trip lengths may continue to rise. The region's transit agencies will also need to find funding to support transit frequencies of 15 minutes or less, and as highlighted in this study funding for operations remains a political challenge. If Metrolinx is unsuccessful in building an extensive higher-order transit network that utilizes dedicated rights-of-way, and if they aren't successful at improving the frequency of transit service over time, the average commute time by this mode will increase rather than decrease. These points were emphasized in the Neptis Foundation review of the Big Move. They used one example of a future LRT trip from Malvern to downtown Toronto which was forecasted as taking 1 hour and 15 minutes – not much faster than driving in rush hour traffic. At the system level, they estimated that the current transit plans in the Big Move would deliver 800,000 *fewer* daily riders than Metrolinx predicts by 2031 (Schabas, 2013, p. 9). If that is the case, a greater number of cars will be on the road and average commute times (for all modes) will continue to rise in the region.

#### 6.2.4.2 Big Move Strategies Number Three and Four

Big Move strategies three and four are inter-related. They will be discussed together, as this is the area that the *tenth* Big Move (road pricing) can have the greatest impact.

##### **Strategy number three**

Strategy number three of the RTP “improve the efficiency of the road and highway network” includes the building of additional highway capacity in a strategic manner, methods to encourage car pooling such as HOV lanes and car pool lots, the creation of an ITS (Intelligent Transportation Systems) strategy, and investigation of HOT lanes.

These improvements are necessary to improve the efficiency of the road network, which will help move a great volume of people. Many interview participants discussed the opportunity of using innovations in ITS in particular to improve efficiency. However, as several Delphi panelists noted in their comments these initiatives will only deliver results in congestion mitigation if coupled with transportation demand management techniques. To significantly increase efficiency, a fiscal policy must exist to encourage travellers to self-select trips with highest values of time and priority to be made by car, and encourage an overall shift to other modes. A road pricing program can therefore help reinforce the effectiveness of the strategy to improve the efficiency of the road and highway network.

##### **Strategy number four**

Strategy number four – “create an ambitious transportation demand management program” relies heavily on education programs such as Smart Commute which works with employers to help shift employee commutes to efficient modes. There are no Big Moves associated with achieving this strategy, nor are fiscal policies (such as gas taxes, tolls, or road pricing) discussed in the plan. Fiscal policies have been highlighted throughout this report as a necessary component of a TDM strategy to effectively curb induced demand (see for example: Downs, 2004). Dis-incentives to auto use are required to keep traffic flowing. If these are not in place, any road capacity made available through other strategies will quickly be re-consumed by travellers who opt to change their time, route or mode of travel to driving.

### 6.2.5 Road pricing is the ideal tool

A road pricing program that charges drivers for every kilometer they drive has been proven to be *the* most effective method to manage demand for road access, achieve efficiency in the road network, and mitigate traffic congestion. As a financial dis-incentive to auto-use, this solution encourages greater use of more efficient modes of transportation, thus influences a positive shift in modal split. Numerous studies support this recommendation, including:

- This study's Delphi panel rated road pricing as the number one solution, amongst a wide range of supply-side, demand-side, fiscal and non-fiscal tools. Their average rating was 4.73 out of 5, indicating an expected high impact on mitigating traffic congestion
- Although a smaller proportion, about one third of this study's interview participants (15 of 47) also stated that this would be the most impactful solution (others may have avoided it because of concerns over public and political acceptance, or the more pressing priority of transit expansion)
- Down's (2004a) seminal work on traffic congestion indicates that such a fiscal tool would be required to overcome the effects of triple convergence
- Parry's study (2002) compared the efficiency of the gas tax, a single lane toll, a uniform congestion tax across highway lanes and a transit fare subsidy at reducing congestion, and concluded that the uniform congestion tax achieves over 90% efficiency. The other tools forego at least two-thirds of efficiency gains from an ideal congestion charge that varies across lanes.

A road pricing program would help tie together the other priority actions and strategies outlined in the Big Move. For example, a road pricing strategy would re-inforce the effectiveness of Big Move Four "complete walking and cycling networks with bike-sharing programs" by providing a dis-incentive to auto use encouraging alternate modes for shorter trips. Even trips converted to transit provides the benefit of an additional walk to and from the transit stop. One study on the effects of the Stockholm Congestion Charging program found that travelers who had access to a car and were exposed to the congestion fee showed a moderate increase in physical activity, and a reduction in time spent sitting (Bergman, Grjibovski, Hagströmer, Patterson, & Sjöström, 2010). This indicates that a road pricing program could have impacts beyond improving efficiency of the road system – positive health benefits associated with incorporating active transportation in one's lifestyle could be experienced.

Lastly, a road pricing program would provide benefits on both sides of the supply-and-demand equation. For example, this study has highlighted a need for funding of increased transit operations – on existing



and future infrastructure. A road pricing program would generate funds that can be spent on improving the overall transportation experience in the region – including spending on transit operations and active transportation.

#### 6.2.6 Research question: what are the barriers to implementing a road pricing program?

Referring back to the literature review, we have seen that road pricing is not a new strategy – it was first introduced by William Vickrey in 1959. He stated then that the reason such a program was not adopted previously was due to a technological limitation, which he believed was finally solved (1959). Since that time, technology solutions have evolved considerably, yet road pricing is still not widespread. The reason for this is that the largest barrier has not been a technology barrier. Other authors have discussed themes such as awareness and education, lack of alternatives, public acceptance, and political will (Downs, 2004a). Participants of this study confirmed the existence of these barriers, and provided colourful commentary on the extent to which they are at play locally.

##### **Awareness and education**

Goodwin described two initial phases in his model of the gestation process for road pricing (2006). At first, he states that there is no public support for road pricing because it is just an idea held by academics, policy makers and the like. He describes a second phase of increasing support for the general idea which is fuelled by recognition of congestion as a problem and a rejection of the traditional supply-side solutions. While there is clearly frustration in the GTHA with current and forecasted congestion levels, road pricing (or fiscal tools in general) are a minimal component of the local discussion among transportation professionals and stakeholders. The solution was recommended by less than a third of interview participants. The idea of road pricing is known, but it is not being pitched to the public.

##### **Lack of alternatives**

Participants believe the prime reason road pricing is not more widely discussed is that transit and other alternatives do not exist (at reasonable service levels) for a large portion of the GTHA population. Enforcing tolls, road pricing, or related initiatives to encourage travellers to switch modes would therefore be ineffective, as many have no viable alternative. The plan would only succeed in generating funds. Some participants would be in favour of tolls at low dollar values, to contribute to the maintenance of certain roads (such as the Gardiner Expressway and Don Valley Parkway), others would be in favour of road pricing only after a greater expansion of transit infrastructure is in place to provide

an alternative for travelers. Four (out of nine) of the second round Delphi panelists recommended that the region should start the communication process to educate the public prior to transit expansion, and another three recommended educating the public in parallel. Without this awareness, a road pricing proposal would not move past Goodwin's first phase of support.

### **Public acceptance**

Schuitema (2010) has shown that tolls and per kilometer fees face low public acceptance because they don't believe the plans will be effective in reducing congestion. As drivers don't expect their own car use to change with the introduction of the plan, they only foresee themselves being in a slightly worse position having to pay for a good that was previously free (road access).

### **Political will**

The four year election cycle was highlighted by interview participants as an inherent barrier for long-term progressive decision making. The concern is that politicians are so focussed on delivering visible short-term value to voters to support re-election within four years that they do so at the cost of decisions which have a longer-term payback (beyond their current term). While congestion charging schemes have been shown to produce immediate results once implemented, there is a long road to implementation and therefore politicians are unlikely to attempt to weather the storm by proposing a road pricing program that may not be implemented within their current term.

To overcome this barrier, a program should be framed in manner to deliver immediate benefits prior to implementation. For example, a leader could propose increased transit service to be paid for through future road pricing proceeds and schedule that transit service to start immediately to show value to voters. Another option is that if a reduction of another tax (such as the gas tax) are planned as part of a road pricing program, this could be implemented prior to the road pricing program to show benefits to voters.

## 6.3 Recommendations

To answer the core research question: *as population growth in the GTHA continues, how might we encourage a positive shift in modal split to mitigate traffic congestion?* This study recommends that Metrolinx continue to pursue the Nine Big Moves it has identified as priority actions, and add the pursuit of a road pricing policy as the *Tenth* Big Move. This additional strategy will ensure maximum efficiency of any new transportation infrastructure added by providing a dis-incentive to auto use and encouraging a shift to more sustainable modes. This section will outline the recommended policy elements for such a plan, and suggest a method for achieving the first step in implementation through a pilot project.

### 6.3.1 The vision

Imagine a future where you have true transportation choice in the GTHA, and absolute gridlock is a thing of the past. The year is 2026, a number of the Big Move major transit infrastructure projects are now open and running – such as the Eglinton Crosstown LRT in Toronto, RER projects such as Smart Track serving the surrounding area, and increased local transit and ride sharing options mean that you never have to wait more than ten minutes for a ride. The effects of Places to Grow have continued; your neighbourhood now has a mix of densities and uses, and you can bike to some of your destinations. The gas tax, and vehicle registration fees no longer exist. You now make your contribution to maintaining the road and transportation network through a per-kilometer road pricing fee. Similar to your use of electricity, this access fee also incorporates peak-hour pricing and discounts which encourage you to travel off-peak to save money. The fee also varies depending on where you drive and on current congestion levels – so driving downtown Toronto in the middle of rush hour is usually more expensive. Pricing is communicated to you via road signs, an app on your smartphone, a website, or visual indicator on your dash. These fees have encouraged you to change your commuting habits occasionally – at least once a week you either work from home, ride your bike, leave at an alternate time, carpool or take transit. When you do drive it is a pleasurable experience. Horrific traffic congestion has become a thing of the past, thanks to the first nine Big Moves and road pricing – the tenth Big Move.

### 6.3.2 Insights informing policy recommendations

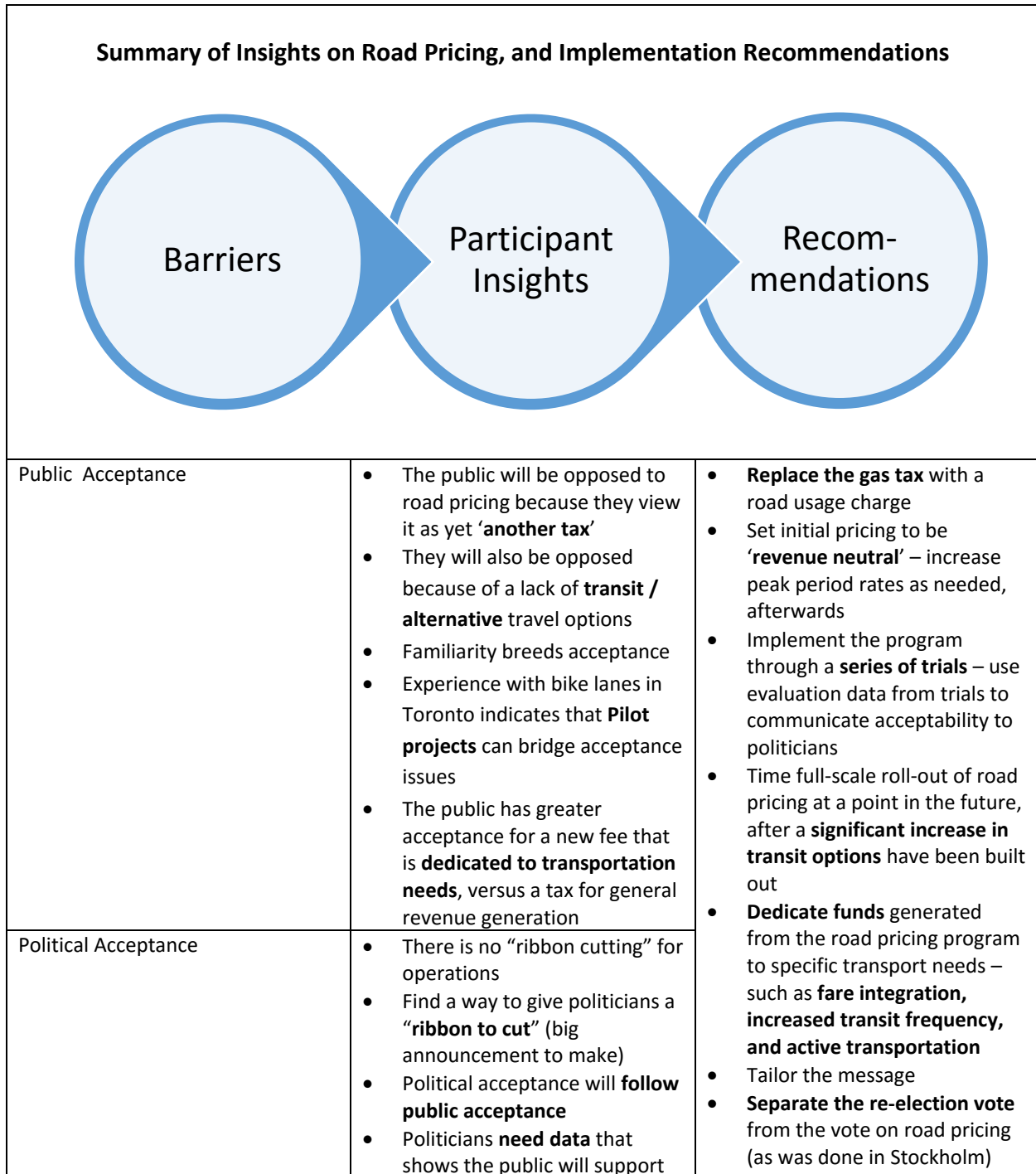


Figure 26 Insights informing recommendations

### 6.3.3 Policy elements

This section will cover high level policy elements to help the reader envision what a road pricing program may look like for the GTHA and/or province of Ontario.

#### Pricing

With a road pricing program in place, drivers will pay a per-kilometer fee for their road access, which increases their awareness of the cost of driving. This report provides the following guidance for setting pricing: the program should start at a revenue-neutral level, add premiums for driving during peak hours and along congested routes once the program is in place and understood.

The justification for starting the program revenue neutral is to demonstrate to citizens that this is not a “tax grab.” To achieve neutrality, the government must reduce some other tax at a roughly equivalent rate to the road pricing charges. The natural candidate for this is the current provincial gas tax. The gas tax has been shown to be a blunt instrument for mitigating traffic congestion, and will yield reduced revenues in future with continued improvements in the fuel efficiency of vehicles (Kitchen & Lindsey, 2013). Replacing the gas tax with a VKT fee has been shown to improve the overall network and have a positive impact for lower-income groups (Welch & Mishra, 2014). The provincial government could cancel their portion of the gas tax, in advance of implementing a road pricing program. The per-kilometer fee for road access could then be set at the average cost of the prior gas tax. For example, this fee could be set at 1.2 ¢/km with the following assumptions:

$$\begin{array}{rclcl} \text{Average fuel} & \times & \text{Prior provincial gas tax rate}^9: & / & 100\text{km} & = & \text{Per km road access fee} \\ \text{efficiency}^8: & & & & & & \\ 8.2 \text{ L}/100 \text{ km} & & \$ 0.147/\text{L} & & & & \$0.012 /\text{km} \end{array}$$

Two benchmarks would indicate that a starting fee of 1.2¢/km would be appropriate. First, the road user fee charged in the Oregon pilot program was 1.5¢/mile, based on similar calculations of what operators of 20mpg vehicles pay in Oregon fuel tax (Oregon Department of Transportation, 2013). The Oregon rate converts to 0.932¢/km (ignoring differences in currency values). Factoring currency differences, and higher fuel taxes in Ontario, it would appear that a road user fee of 1.2¢/km is roughly

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<sup>8</sup> Hypothetical example. 8.2L/km was selected as an average from a sample Energuide label for vehicles available at: <http://www.nrcan.gc.ca/energy/efficiency/transportation/cars-light-trucks/buying/7483>

<sup>9</sup> Current provincial gas tax rate is 14.7¢/litre of unleaded gasoline. See: <http://www.fin.gov.on.ca/en/tax/gt/>

on par with the rate used in Oregon. Second, Aecom and KPMG's report (2013) estimated a number of scenarios ranging from 1¢/km to 10¢/km, and proposed that a rate of 1.43¢/km would raise \$500 million annually in the GTHA.

For further comparison of the above starting rate, here are three toll rates/proposals for the GTHA. First, one can consider that the Highway 407 ETR rates are currently 34.5¢/km during peak periods. Second, Finkleman's (2011) study looking at potential HOT lanes indicated that drivers are willing to pay 20¢/km to avoid congestion and access an HOT lane. Third, Pembina Institute's recent report *Fare Driving* proposed tolls for all lanes of regional highways in the GTHA (Srivastava & Burda, 2015). Their staged approach would recommend an initial toll of 14¢/km in peak periods and 10¢/km off-peak, which would increase to 21¢/km peak, 17¢/km off peak in 2025 when additional transit options are available for residents. In all of these cases, the toll is applied only to one lane or a highway series, leaving drivers with free (albeit more congested) routes that they can take. When setting a fee for every kilometer that every driver must pay, the fee should be much lower. The Aecom and KPMG report (2013) would recommend 10¢/km as the upper bound of the range. Therefore, a rate of 1.2¢/km as a replacement for the provincial gas tax would be a reasonable starting point to evaluate impacts on traffic congestion, and policy makers would have latitude up to 10¢/km to increase rates to achieve policy goals.

A discount could be applied to electric vehicles, recognizing their reduced contribution to green house gas emissions, while still enabling a financial contribution to maintaining the road network. Similarly, a premium could be applied to high-polluting vehicles, or applied on a sliding scale based on fuel consumption/efficiency ratings of vehicles.

### **Revenue dedication**

Revenue collected through pricing of roads within the GTHA should be dedicated to the improvement of the region's transportation system – for improving roads, transit, and active transportation options. Dedicating funding to road maintenance and infrastructure improvements satisfies the user-pay principle. To the extent that increased transit service reduces congestion for motorists, redirecting some funding to transit also satisfies the directness of benefits principle (Kitchen & Lindsey, 2013).

This revenue dedication is critical for achieving public acceptance of the policy. One of the key themes that emerged from the community consultations performed by the Transit Investment Strategy Advisory Panel was described by the phrase “dedicate it or forget it” (Transit Panel, 2013b). The Panel found that

there was willingness from the public to pay additional taxes, as long as they could be assured that the funds would not be mixed with general revenues.

If the road-pricing program is implemented province-wide (as recommended), revenue can be distributed in other ways across the province. For example, road pricing revenue tracked for traffic on roads going through a small town can be given to that town to spend on its own local priorities. King, Manville and Shoup discussed a similar approach in their paper (2007), indicating such a method to attain political success through dedicating revenue to cities. In the Ontario context, smaller towns can benefit from the volume of seasonal traffic that drives through these towns to access cottages and other holiday areas. With the gas tax, these towns saw little to no proceeds of that revenue. With road pricing, they could automatically be assigned revenue commensurate with the traffic that flows through on their roads. This could overcome the horizontal equity issues indicated by the now famous statement from premier Wynne that she “would not ask residents of North Bay to pay for transit in Toronto” (Brennan, 2014).

### **Targeted subsidization**

A specific area of revenue dedication can further assist with congestion mitigation. Metrolinx or the province could utilize some proceeds from road pricing to subsidize local transit agencies in a targeted manner that helps overcome several issues with fare integration, and transit frequency. This solution would allow a transit user to get on a local transit bus or LRT in one municipality (such as Mississauga or Brampton), tap on with a PRESTO card, and tap off at their final destination in another municipality (such as downtown Toronto). They would pay one fare – the GO transit or regional express rail fare – and the cost of their local transit trip would be covered through a subsidy from Metrolinx or the province back to the local transit agency. This overcomes the psychological barrier of having to pay multiple fares, it provides an incentive to take local transit instead of driving to the GO station, and it incentivizes local transit agencies to run more frequent service as they are essentially paid to do so from a partner agency.

### **Technology**

Road pricing has been proposed by economists for several decades, however technological solutions to implement such a program have historically been limited. For example, William Vickrey presented options in 1959 which included an electronic and a photographic method of identifying vehicles as they passed a checkpoint (Vickrey, 1959). Now, with advances in in-vehicle telematics, GPS technology,

wireless machine-to-machine (M2M) communications, and the proliferation of smart phones there are numerous options to implement a road pricing program. These options mean that consumers have choice in how their road use is tracked, and how they pay for it. The Oregon trial provides a number of viable options including using an On Board Unit (a “dongle”) installed in a vehicle, reporting mileage through a smartphone app, and logging odometer miles (Oregon Department of Transportation, 2013). A dongle is a small computing device that can track and report vehicle information such as mileage and location. It is plugged into a vehicle’s on-board diagnostics (OBD) port, which has been a standard port on nearly all vehicles manufactured since 1996 (the port was designed for mechanics to run diagnostics for emissions monitoring and maintenance). Installation is easy – this study’s author has installed a similar device from insurance provider Belair Direct to track driving behaviour and qualify for an insurance discount. Figure 27 depicts a user installing the dongle to an OBD port in the Oregon trial. A smartphone app could provide a low-cost alternative to dongle deployment and offers users the benefit of only paying for their own road use (in the case of shared vehicles). The downside is that users must remember to open the app before they drive. Lastly, auto manufacturers can embed tracking technology in vehicles to track usage and report back to the billing infrastructure for road usage. Figure 28 below shows the billing process used during the Oregon trial.



Figure 27 User installing an On Board Unit (a "dongle")  
Source: Oregon Department of Transportation (2013, p. 19)



FIGURE 3-3 Oregon's Road Usage Charge Program

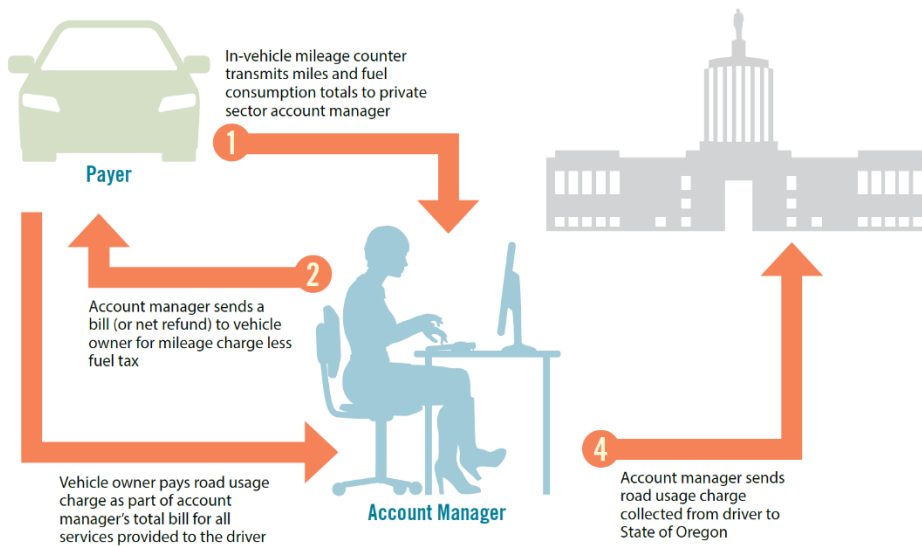


Figure 28 Oregon's Road Usage Billing Process

Source: Oregon Department of Transportation (2013, p. 15)

### Co-existence with HOT lanes

High Occupancy Toll (HOT) lanes were identified in the Big Move as an option to investigate for implementing the strategy of improving the efficiency of the road and highway network. More recently, the provincial government has renewed commitment to investigate this option and announced a pilot trial to begin in the summer of 2016 (Ministry of Transportation, 2015). The introduction of HOT lanes could help increase public acceptance for the use of tolls and eventually full road pricing. HOT lanes and road pricing are not mutually exclusive, nor should HOT lanes necessarily cease to exist once road pricing is in place. At lower road pricing rates, there could still be some volume of congestion during peak periods and HOT lanes ensure that those with the highest value of time – especially emergency vehicles and priority transit vehicles – have a clear path. Road pricing and HOT lanes can be complementary programs – therefore the same technology should be used to enable both, whether that is a transponder, dongle, or other method.

## **Addressing privacy**

The Oregon trial revealed that a portion of users have privacy concerns related to the government knowing where and when they drive. This can be addressed through several methods. First, the technology could be set up such that actual GPS data is not reported to the government agency – only distance travelled, time, and congestion zones (if price is varied by location). Second, the Oregon policy to destroy location and metered use records within 30 days after payment/dispute (2013), can be adopted in Ontario. Third, drivers can be provided the option to report odometer readings only, and pay based on total kilometers travelled. This could be done in a similar method to how residents used to report their municipal water usage. If a tiered pricing program is in place, such users would have to pay the higher rate for *all* usage, rather than receiving a discount during off-peak periods as there is no way to verify where or when they have driven with this last method.

### 6.3.4 Implementation recommendations

#### Getting from here to there: pilots, trials and referendums

The vast majority of transportation experts and economists would agree that a road pricing program needs to be in place to make the most efficient use of any major city's road network, the trick is in the implementation. The two largest barriers facing any pricing program are public and political acceptance. The lessons learned from reviewing the Stockholm congestion charging scheme would indicate that a trial is helpful; once implemented the public would see the benefits and the political challenge would be solved. However, as King, Manville and Shoup wrote in their paper *The political calculus of congestion pricing*, "implementation will not solve the political problem, because implementation *is* the political problem" (2007, p. 111). For this reason, this study offers a pilot as a precursor to a trial as a path to overcoming public acceptance and political barriers. There are too many questions that are difficult or impossible to answer at this point, for MTO, Metrolinx or another regional authority to design a road pricing program for the province of Ontario or the GTHA. Some of the questions that a pilot could help answer are:

- How should this program be marketed and messaged? What key messages resonate best with road users? Should the message be:
  - Cost savings: "we will remove the gas tax" or "you can save money by driving off-peak"
  - Time savings: "you will be able to get to your destination \_\_\_ faster"
  - Other benefits: "get home in time to see your kids"
  - Some other message?
- What rate should prices be set at initially?
  - The equivalent of the gas tax (as suggested here, to gain public acceptance)?
  - A higher rate (to produce greater initial results in traffic reduction)?
- How will this program impact the modal split? What volume of additional transit service will be needed to accommodate the increase in that mode?
- What portion of the population is concerned with security issues? How will we address these concerns?

## The Pilot

Jonas Eliasson (2010) who was responsible for the design of the Stockholm charging system advises that designing a charging system is a very difficult and iterative task. For this reason, this report recommends that a pilot project be conducted prior to a trial of the road pricing program. The pilot would be limited to a specific number of users, specific regions, or other focus group to experiment with and provide feedback. This sampling of the population can be provided with the experience of living in a future state where road pricing has been implemented, and their reactions to different price points and messages can be tested. For example, the following scenario/hypothesis could be tested:

*If the following is implemented:*

- *The provincial gas tax is scrapped*
- *Drivers pay a per-kilometer fee to for accessing all roads. This fee is roughly equivalent to the old provincial gas tax, with a small premium for accessing high demand (congested) roads during peak periods – such as a dollar a trip.*
- *Drivers are made aware of the cost of their road access – either through an in-vehicle display, mobile app, or website*
- *Transit service is increased to ten minute (or more frequent) service*

*At least twenty percent<sup>10</sup> of peak period trips would be diverted to a different time or mode (such as transit or cycling), made on a less congested route, or cancelled altogether, resulting in free movement on the roadways between 50-80 km/h during peak hours<sup>11</sup>.*

A pilot project could provide data indicating the mode choice decisions typical drivers would make in this future scenario where drivers pay directly for their road access, and have improved transit service as an alternate. The output of such a pilot study could provide data for transportation planners to calculate the impacts on the road network with the implementation of road pricing at certain rates. More importantly, the rich experiences of participants in such a trial can help inform political decision making. Politicians would be able to hear from real people who have experienced the pilot. The

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<sup>10</sup> Stockholm's congestion charge resulted in a traffic reduction of 22% (Schuitema et al., 2010, p. 587), and in the Oregon pilot, drivers who faced a higher per-mile charge during peak time also reduced their driving at those times by 22% (Canada's Ecofiscal Commission, 2015, p. 4)

<sup>11</sup> The range of 50-80 km/h was recommended as the target speed to keep peak hour traffic moving on regional highways in Pembina's report (Srivastava & Burda, 2015, p. 3). They cited Natural Resources Canada, cautioning that speeds above this rate result in higher fuel consumption:  
<http://www.nrcan.gc.ca/energy/efficiency/transportation/cars-light-trucks/fuel-efficient-driving-techniques/7513>

participants who chose to switch modes or time of travel for some of their trips can describe that experience, and participants who chose to continue driving for all trips can attest to the benefits of improved road access outweighing the cost of road pricing.

Element of the “future state”	Experience in the pilot
<b>Drivers pay a per-kilometer fee for their road access</b>	Participants provided with an on board unit to install in their vehicle. They log in to a mobile app and/or website to view their usage and make payments.
<b>The gas tax no longer exists</b>	Participants are provided with a gas discount card that gives them a discount equivalent to the provincial gas tax rate.
<b>Drivers usually experience free-flowing traffic, very few congestion delays during peak periods</b>	<p>Participants are allowed to use HOV lanes on regional roads and highways (even as a SOV driver), but must pay a higher peak-period access fee. Alternately, they can access new HOT lanes at the set road pricing fee.</p> <p>This simulates a future where the roads have been de-congested through the implementation of road pricing.</p>
<b>Local transit service frequency has been improved to 10 minute (or less) service, through funding from road pricing</b>	Local transit services can either increase bus operations along routes near participants’ homes, for the period of the pilot. Or, participants can be provided with a ridesharing service that mocks this frequency of service.

Table 14 Road Pricing Pilot Program Experience

### Tailoring the message

Musselwhite (2009) demonstrated that there is a heterogeneity of attitudes and acceptability when it comes to road pricing, and recommended a targeted approach with messaging. His work showed that some people warm up to road pricing as their understanding of the issues improves, and others remain opposed. Beirão and Sarsfield Cabra (2007) recommended that marketing campaigns created to educate the public should use a targeted approach with different messages for different groups. This recommendation was echoed in input obtained through all primary research methods used in this study. Interview participants involved in media work recommended that agencies segment the market and

tailor the message, and charrette participants laid out a spectrum of users who would react differently to different price points.

Further research would be needed to identify specific segments and messages. However, as an example students who would be more likely to switch to transit as a result of a road pricing fee could be pitched a message about funding for increased transit service. To appeal to retirees and other groups concerned about cost, the message could be that road pricing would save them money if they drive off peak (similar to electricity pricing). Finally, for groups that are unlikely to switch to an alternate mode or time, the program could be referred to as 'Smart Pricing' and they can be pitched the benefit of improved travel times on the road.

### **Selecting pilot participants**

Selecting a representative mix of pilot participants is required not only for validity of the study data, but more importantly for political reasons. Politicians and other decision makers need to be reassured that the results being presented are representative of the average voter, in order to garner political acceptance. Influential participants can also be selected for inclusion in the participant mix, which serves a dual purpose of providing input to the pilot, and communication of the benefits to a wider audience. For example, Oregon's pilot program included eight state legislators, and a representative of AAA in the participant pool (Oregon Department of Transportation, 2013).

When the pilot progresses to a full-blown trial, one recommendation to increase public acceptance is to introduce road pricing in stages, starting in an area with a high degree of congestion so that reduction in congestion can be visibly demonstrated. This would help convince others that the policy would meet its objectives (Schuitema et al., 2010).

### **Learning from the pilot**

An evaluation should be conducted after each pilot. In Oregon's case, their initial pilot studied behavioural factors, without involving actual payment (Oregon Department of Transportation, 2013). Their second pilot involved participants making actual payment for their road use, and receiving credit for the gas tax that they paid. After each pilot run, the program was evaluated and changes were made based on participant input. There is a large body of literature discussing program evaluation – specifics are out of scope of this project. The recommendation is that a formal evaluation be scheduled after each pilot phase is run, documenting behaviour change, public acceptance, and other key factors to be reported to politicians and decision makers.

## Timing

Judging from the pace of the Oregon road pricing pilot program (Oregon Department of Transportation, 2013), implementing such a program may be a ten year process. Oregon’s first pilot project was run in 2007, enabling legislation passed in 2013, and the second pilot project began this past summer in July of 2015. In the GTHA, a series of 2-3 pilot projects could be aligned with the opening of select high-order transit lines, such as the York University Spadina subway extension in 2016, the Eglinton Crosstown in 2020, and the Finch West and Sheppard East LRT’s in 2021.

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Local trans.	York University Spadina subway extension					Eglinton Crosstown		Finch West + Sheppard East LRT									
																	Yonge subway extension
Regional							Smart Track			Electrification of GO lines							
HOT	HOT Pilot						HOT permanent lanes										RER
Road Pricing	Road Pricing pilot planning																
		Pilot 1	Evaluation														
				Pilot 2	Evaluation				Pilot 3 (if needed)								
										Public trial of full road pricing program							

Figure 29 Possible timeline for Road Pricing Pilot Projects

Sources: Transit dates: Srivastava and Burda (2015, p. 33), HOT Lane dates: Ministry of Transportation (2015)

## The trial and referendum

Insights from participant interviews and the Delphi panel indicate that the four year election cycle is a major barrier to implementation of contentious programs such as road pricing – politicians focus on decisions that can deliver near-term results to help them get re-elected. The timing of the pilots, trial, and referendum can align with election cycles to turn this barrier into a benefit (Figure 30). Input from participants indicates that major political decisions often occur within the second and third terms of a politician’s office – they spend the first year familiarizing themselves with issues, and in the last year they are hesitant to make major decisions that risk re-election. Therefore, politicians should be approached to run the first road pricing pilot projects in their second or third term of office. There is low-risk for a politician to support a pilot, as there is no commitment for full implementation. In the second election cycle (years five to eight), additional pilots can continue, however the timing of the trial should be held towards the end of the term around year seven. Lastly, the referendum should be held as early as possible in the third term of office. As demonstrated in the Stockholm congestion charging trial, politicians were willing to support a trial and referendum separated across two terms of office as it

allowed them to separate themselves from any negative publicity of the program. In this order, voters can re-elect the current governing politicians, but chose to separately vote against the road pricing program. Of course, the expectation is that the public will see the benefit of the program, and vote to keep it. However, this separation of the program from a particular politician or party is critical in gaining political support.

<b>Election cycle:</b>	One (year 2-3)	Two (year 5-7)	Three (year 9)
<b>Road pricing activity:</b>	Pilots	Pilots, Trial (year 7)	Referendum

Figure 30 Political timeline of proposed road pricing pilots, trial, and referendum

### 6.3.5 Summary of recommendations for implementation

International experience and local insights have been used to recommend an implementation approach to overcome expected barriers. This study recommends initiating a road pricing program through a series of pilots. The first few pilot tests would be limited to a specific number of users and geographic locations. The results of these pilots would be used to inform plans for further rollout. New messaging would be tailored based on input from participants, and presentations to politicians would include data from the pilot to indicate the level of public acceptance for the program.

In the election cycle following the initial pilot, additional pilots can occur as needed, leading up to a full public trial towards the end of the election cycle. To ease concerns about the project, the public would be assured that they will be given the option to vote to keep the project or scrap it, and the plan presented to politicians would show that the referendum is scheduled in the following election cycle, separating them from the project.

Early in the third election cycle, a referendum should be held to allow the public to decide upon keeping the road pricing program. If the program is designed well and delivers results in congestion reduction and improved travel time, it is expected that the public will vote to keep the program.

Other recommended elements to improve public acceptance (and effectiveness) of the program include: replacing the gas tax with this program, dedicating revenue generated to transportation investments, and improving frequency of transit service in parallel to the trial.



## 6.4 Conclusions

Traffic congestion is a wicked problem. There is no single solution to solve this urban ill. This study has however, shown how the introduction of a *tenth* Big Move can assist in weaving together the other nine Big Moves in the GTHA's regional transportation plan to effectively mitigate traffic congestion.

Over the last fifty years we have done a horrible job of coordinating land-use and transportation planning, centering plans around use of the car which failed everyone – including the car drivers. This research has found that is changing in the GTHA, with greater levels of coordination between these two planning disciplines and stakeholders. Over the past thirty years, we have also failed at delivering transit infrastructure to keep pace with population growth in the GTHA. Many have commented that this is due to a lack of “political will” to spend money in this area. This is also changing – with more than \$16 billion committed to transit investment over the next two decades. Now that we have policies in place addressing land-use and hard infrastructure, the last major policy lever left to pull is one of soft infrastructure and fiscal policy. We will need a method to increase transit operations (service frequency) on current and future infrastructure that is being built, and we need a method to encourage a shift in demand and mode split towards sustainable modes. The ideal strategy to fill this gap is a road pricing policy.

This research has shown that the greatest barrier to implementing a road pricing policy at a local level is public and political acceptance. Building ‘political will’ involves being empathetic to the operating constraints of political decisions. Public acceptance can be increased by tailoring the message to specific audiences, providing additional benefits such as replacing the gas tax and improved transit service. Political acceptance can be improved through the use of pilots that build confidence in public acceptance, and careful timing of pilots, trials and a referendum.

This study suggests that the Big Move is missing a critical strategy – that of road pricing to encourage more efficient use of the network. Inclusion of such a strategy in future strategic plans for the region would significantly improve the effectiveness of the Big Move in meeting its goals.

Many grad students would offer you their two cents on a topic. I offer you 1.2 per kilometer (sometimes less, sometimes more) and improved frequency of transit service to help mitigate this wicked problem we call traffic congestion.

### 6.4.1 Study contributions and opportunities for future research

#### **Contributions**

This study offers several contributions to the academy and field of planning. First, it provides a narrative and temperature check on current views of transportation and land-use planning in relation to congestion mitigation in the GTHA.

Second, the study contributes to the body of literature on traffic congestion tactics, and demonstrates how the lessons learned from strategies tried elsewhere in the world can be applied to a local problem. The findings and recommendations show how revenue dedication of road pricing can be further used to mitigate traffic congestion through targeted spending on a local need: increased transit frequency in the suburban area. This finding may be transferable to other regions looking to implement road pricing and dedicate funding to their transportation system.

Third, the recommended approach to implement road pricing through a pilot and a trial is backed with evidence that shows trials have worked internationally for congestion charging, and locally for smaller projects in active transportation. The political climate that has warmed to the introduction of HOT lanes pilot projects further supports this recommendation. Other regions around the world can also look for evidence of local pilots that have worked, and leverage this trend for their introduction of new policies.

#### **Opportunities for future research**

This study performed high-level strategic policy analysis for the GTHA as a region. There are a number of opportunities for future research related to this study:

1. While this study revealed broad differences in needs between suburban and downtown residents, a follow-up study could compare needs in individual municipalities of the GTHA
2. This study relied on a qualitative mixed-methods approach. A follow-on study which investigates perceptions and attitudes with a quantitative approach could further inform policy makers on the potential efficacy of recommendations
3. If a road pricing pilot project is pursued, an evaluation study of the pilot would be valuable to researchers and practitioners alike

## 6.4.2 In reflection

Granted, this thesis has been written in third-person, I am purposely switching to first-person for this reflection. Many a master student enter grad school with the view that they will change the world with their thesis – I was no different. There were a number of lessons I learned about the research process through this journey. I wish to share three of them with future students.

First, for some perspective: I was a part-time student for the majority of this pursuit. My background is not related to planning: I have an undergraduate degree in business and IT, and my work experience includes being a product manager at RIM/BlackBerry, working for a small strategy consulting firm, and other non-planning roles. I have thoroughly enjoyed the course work, and interactive elements of the degree. I managed the research elements and writing without any problems. However, I struggled with my literature review for a long time – perhaps because I came at it from a professional/non-academic perspective, perhaps for other reasons.

### LESSON ONE: YES, THE LITERATURE CAN BE YOUR FRIEND

Coming from the tech industry, we have a term we call the “pivot,” which refers to the decision to make a change in business direction after learning something new about the market or your product. I’ve often said that I made two pivots during the course of my thesis work. My first pivot, which I really consider just a half-pivot, occurred around September 2014 after I had invested significant effort in reading and documenting what would be considered “gray literature.” I was advised that I needed to bolster my literature review with more peer-reviewed academic sources. After doing so, I found a number of theorists who have helped me to understand the root of the congestion issue. The advice I would give another student stumbling with their literature review is to undertake the “Five Why’s” exercise (Google it). Essentially, you respond to your initial research question with a number of responses, and re-phrase the best response as a new question to be answered. You repeat this up to five times until you get to the root of the issue. If you source the work of one or two authors for each of those steps, you will be on your way to building your literature review.

### LESSON TWO: TIME WAITS FOR NO ONE

My major pivot came in the Spring of 2015, when the provincial Liberal government announced significant funding for building rapid transit in the GTHA (and other areas in the province). Until then, my research topic was looking at a sustainable investment strategy for transit. Traffic congestion was a topic of interest, and my review of the gray literature pointed to transit infrastructure as the solution,

for which a lack of funding was the largest barrier – it was the barrier for which I was determined to find a solution. One can say I have an interest in big problems. Of course, while I was philosophising away, the real world went ahead and solved its own problem. I am thankful for the government’s decision to fund transit, despite the monkey wrench it threw into my work.

I changed my research focus to a related topic, attacking the problem of congestion at another layer. My recommendation to a fellow student would be to bite off a smaller component of a problem that you can manage on a fixed timeline.

### LESSON THREE: AN ITERATIVE PROCESS WORKS BEST

Despite being a strong proponent of an iterative process, my research largely followed a “waterfall” method of project management where my local interviews informed the Policy Delphi, and the Delphi informed the Charrette. If I were to do this again, I would perform a smaller number of initial interviews, run a round of the Delphi, seek out additional interviews, and proceed in a multi-round fashion allowing my multiple research methods to interact with each other. Another alternative could have been to use local experts as Delphi panelists, and interview international experts (via telephone or video conference). The Charrette was a useful exercise, however the time restraints did pose a problem. In future, I would recommend running a multi-evening Charrette, allowing the output of one evening to inform the next.

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## Appendix A Discussion of Metrolinx Investment Strategy Tools

The Big Move laid the groundwork for an investment strategy to come, by outlining projected funding requirements, high level timing of capital expenditures, and a three phased approach (2008c). Phase one was to be a series of “quick win” transit investments within five years. Phase two was to utilize the MoveOntario 2020 seed funding of \$11.5 billion and federal funding requests to focus on 15 priority transit projects between 2009 and 2015. Phase three was to identify new and innovative ways of funding the regional transportation system in an investment strategy to cover the balance of the 25 year plan out to 2033.

Metrolinx released their Investment Strategy in May, 2013. This section will discuss the four investment tools that Metrolinx proposed in their Investment Strategy:

- A 1% increase to the HST
- A \$0.05/L increase in the Gas Tax
- A business parking levy, and
- Development Charge amendments

For each tool, this summary will cover: effectiveness in raising funds, efficiency in administering the tool, fairness and equity, and the tool’s ability to contribute to the policy objective of encouraging a shift in modal split. Similarities and differences to the Transit Panel’s recommendations will also be discussed.

### **An increase to the HST (Harmonized Sales Tax)**

A regional sales tax is a tool that has been commonly leveraged to support transit expansion in many major cities around North America including: New York City, LA, Chicago, Houston, Minneapolis, Denver, Dallas, Phoenix, and Charlotte (Higgins & Ferguson, 2012b; Metrolinx, 2013a). Metrolinx recommended a one percentage point increase to the HST, in their Investment Strategy. According to their estimates this could generate \$1.3 billion per year in 2014 dollars, after reductions for the proposed Mobility Tax Credit (Metrolinx, 2013a). This would account for 65% of the \$2 billion per year funding estimate to implement Next Wave projects. Ideally, this would be implemented as a regional tax increase in the GTHA only. However due to the methods in which the tax is administered at federal and provincial levels, the province may need to administer the increase province-wide and redirect funds collected outside of the GTHA elsewhere.

Individual consumers will pay for this cost increase. Metrolinx estimates that the impact on individuals will be approximately \$158 per year or \$3 a week (Metrolinx, 2013a). While this does not sound like a significant amount of money, fairness between regions and social equity impacts need to be considered. Premier Wynne has been quoted as saying that she “won’t ask someone in North Bay to pay for transit in Toronto” (Brennan, 2014) – there are tensions elsewhere in Ontario for an increase in tax that may not benefit them. A retail sales tax also has a disproportionate impact on lower-income households, because spending on consumables makes up a greater portion of lower-income household income (Mackenzie, 2013). To counter this impact, Metrolinx recommends a Mobility Tax Credit to offset the additional cost for low-income earners (Metrolinx, 2013a).

While an HST increase would have been a very effective and reliable means to raise a considerable amount of funds and it could be administered efficiently, the major drawback to the tool is that it does not incent any change in behaviour and therefore would have no impact on the modal split in the region.

### **A regional increase to the fuel and gasoline tax**

The second investment tool Metrolinx recommended was an increase of \$0.05 per litre to gasoline and fuel tax in the GTHA, to support transit investment. In comparison, the Greater Montreal Area and Metro Vancouver both have regional taxes more than three times as high as what was proposed for the GTHA (Metrolinx, 2013a). The Transit Panel provided a similar recommendation with one of their proposals – but asked that the increase be phased in, starting with \$0.03 per litre, increasing one cent per litre per year until an increase of \$0.10 was reached (Transit Panel, 2013c).

Metrolinx estimates that a 5 cent per litre increase in the gas tax will result in \$330 million per year of revenue by 2021 in 2014 dollars (Metrolinx, 2013a). There is some variance however, between the Metrolinx estimate and the Transit Panel, who believes that \$140 million per year could be generated from each once cent per litre increase to the gas tax.

Travellers and businesses who transport goods or pay for employee travel (for example for service and repair persons) would be impacted by this cost increase, however businesses may be able to recoup the increase through the price of goods and services sold. Gas station owners near the inner borders of the GTHA may also lose out to patrons who drive just outside of the borders to save money, however this loss is expected to be minimal as drivers would be burning fuel on their search for a small discount.

Metrolinx estimates that a \$0.05 per litre increase would cost individuals approximate \$21 per year or 40 cents per week (Metrolinx, 2013a).

This tool serves a dual-purpose: both raising funds for transportation infrastructure investments, and as a dis-incentive to auto use. In Vancouver for example, with a gas tax increase fuel consumption and vehicle kilometers driven have been declining on average of 1.5 percent per year since 2007 (Metrolinx, 2013a).

Instead of an increase to the gas tax, the province has opted to redirect a portion of the gas tax. This has also been done in Calgary, where the province of Alberta is allocating \$0.05 per litre from fuel purchased in that city towards future transit development (Higgins & Ferguson, 2012b).

### **A business parking levy**

Metrolinx recommended a business parking levy on off-street, non-residential parking spaces across the GTHA. It is recommended that the levy vary based on current value assessment of the parking spaces – which will vary across the region, but the average charge would be \$0.25 per space per day. Metrolinx estimates that business parking levies can generate \$350 million per year, in 2014 dollars (2013a).

Similar parking levies have been used in Montreal, Sydney, Nottingham, and in Amsterdam (Metrolinx, 2013a; Ubbels & Nijkamp, 2002). While businesses will be charged the levy, the cost will likely be passed along to consumers where there is a competitive market for parking (where they currently pay a fee to park). In areas where consumers currently receive free parking (such as strip malls, and suburban malls), it is likely that the business will absorb the additional cost.

Two of the best methods to encourage a move to transit in city centres are to increase the price and reduce the availability of parking – parking policies for example have played a significant role in the success of the C-Train in Calgary (Higgins & Ferguson, 2012b). This also has impacts to built form – businesses would be encouraged to provide a reduced number of parking spots to meet their needs (Metrolinx, 2013a).

### **Development Charge Amendments**

Development charges are commonly used to fund infrastructure development worldwide – including Vancouver and London, UK (Metrolinx, 2013a). Development charges specifically ear marked for public

transit have been used in San Francisco, Washington, and Portland (Ubbels & Nijkamp, 2002). Metrolinx has recommended that the Development Charges Act be amended to assist in funding transit expansion. They are also recommending a 15% increase in development charges across the GTHA. Metrolinx estimates that this increase could generate \$100 million per year by 2021, in 2014 dollars (2013a).

While developers will be required to pay these additional fees, they would ultimately be passing them on to the end consumer purchasing property. A development charge increase by itself would not have a direct impact on modal splits. However, developers may choose to build with greater target densities to assist in recouping the additional charges by spreading the cost over more units. Increased densities, with the right neighbourhood design can be beneficial to encouraging increased use of transit, walking and cycling.

## Appendix B Invitation letter – for key informant interviewees

Sanathan Kassiedass  
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o. 416-238-1085 // m. 647-628-2583

[Date]

[Participant]  
[Address 1]  
[Address 2]

Dear [participant name],

Would you agree that the Greater Toronto and Hamilton Area is currently experiencing a crippling traffic congestion problem? Do you believe that the Big Move, backed by recent funding commitments from the federal and provincial government will solve the problem? In either case, I want to hear from you.

I am a student pursuing an MES (Planning) at the University of Waterloo. I am conducting a study seeking to understand what additional policy components (if any) could be included in an effective strategy to mitigate traffic congestion in the region in future. As a stakeholder, I would like to invite you to participate in this research through a half-hour interview – in person, or via telephone, at a location and time convenient to your schedule. The only requirement for participation is that you must have some knowledge of the Metrolinx Big Move, and an informed opinion on traffic related issues.

I have included in the attached a sample list of questions, an FAQ summarizing the details of participation, and a consent form to be signed prior to participation. This study has been reviewed by and received ethics clearance from a University of Waterloo Research Ethics Committee.

Please review the attached brief material, and advise if you are willing to participate. I would certainly look forward to engaging you in this study.

Sincerely,



Sanathan Kassiedass

### Sample Questions:

1. How would you envision our transportation network in 25 years?
2. Are you aware of the “Big Move”? If fully implemented, how effective do you believe the Big Move will be in meeting its goals related to:
  - Traffic congestion
  - The economy
  - Health and quality of life
  - The environment
3. In addition to, or in place of, transit expansion, what do you believe can be done to mitigate traffic congestion in the:
  - short term (within the next 5 years)?
  - long term (10 – 20 years)?
4. What is preventing some of these solutions from being implemented?
5. How do you think we can do to overcome the barriers you have mentioned?

Note: these are there sample questions, additional/alternate questions may be asked. The interview will follow a semi-structured format – all participants will be asked a series of base questions, with additional dialogue evolving based on individual conversations.

### Contact Information:

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519-888-4567 x35922

This project has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. Participants who have concerns or questions about their involvement in the project may contact the Chief Ethics Officer, Office of Research Ethics at [519-888-4567](tel:519-888-4567), Ext. 36005 or [maureen.nummelin@uwaterloo.ca](mailto:maureen.nummelin@uwaterloo.ca)

## FAQ

### **What is the time commitment?**

I am requesting a half-hour interview. You are welcome to speak for longer.

### **When do you need to meet?**

I am performing three rounds of interviews over the summer. I would appreciate an appointment at your earliest convenience. Day time and evening timeslots are available.

### **Where will this be held?**

The interview will be held at a location of your choice – your office, a local coffee shop, or other spot.

### **Do I need to prepare anything prior to the interview?**

No. I have provided sample questions for your consideration, but no preparation is required.

### **Do I need to answer all questions?**

No. You can choose to decline any question asked.

### **How will my input be captured?**

All responses collected are strictly confidential. I am requesting permission to audio record our interview. This will enable transcription and aid in accuracy of data capture. Audio recordings and transcriptions will be saved in an encrypted folder on my hard drive until two years after successful defense of my thesis (expected January 2016). Transcribed data will first be anonymized, then analyzed with key insights noted and clustered.

### **What if I change my mind?**

You would have the right to withdraw consent or contributions at any point in the study process. Please contact me by email to do so.

### **What further contact can I expect?**

At the conclusion of our interview, I will ask if you would like to be contacted further for the following:

- To participate in a design charrette related to the study (in October)
- To receive a draft summary of findings, prior to study conclusion
- To receive a final copy of the report and/or an executive summary

### **How does my participation help?**

Study findings (which include summary insights, but not attributable comments) will be shared with participants and additional persons or agencies recommended by the participant pool. The study can therefore assist in informing policy makers with options and methods to form policy with a positive impacts on society.

### **Will compensation be provided?**

Sorry, no remuneration will be provided.



## INTERVIEW CONSENT FORM

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By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

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I have read the information presented in the information letter about a study being conducted by Sanathan Kassiedass of the School of Planning within the Faculty of Environment at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses.

I am also aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through a University of Waterloo Research Ethics Committee. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at 519-888-4567 ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

YES  NO

I agree to have my interview audio recorded.

YES  NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

YES  NO

<b>PARTICIPANT:</b>	<b>WITNESS:</b>
_____ Name	_____ Name
_____ Signature	_____ Signature
_____ Date	_____ Date

**INTRODUCTION:**

As population growth in the Greater Toronto and Hamilton Area (GTHA) continues, how might we encourage a shift towards the optimal modal split to mitigate traffic congestion? That is the core research question that this study seeks to address.

**Note:** for background information, please refer to the Case Context document which was shared via email.

In total, this study employs three research stages:

- **One-on-one interviews:** with key stakeholders including transportation and land-use planners, related civil servants, politicians, business leaders, the media, and transportation advocates. Interviewees are asked about opportunities to mitigate congestion, barriers, and recommendations to overcome those barriers.
- **This Policy Delphi (survey):** you will be presented with some of the key themes from the first stage of interviews and asked for recommendations based on international experience to address these concerns.
- **A Policy Design Charrette:** after the findings from the first two methods are compiled, local participants will be invited to take part in a workshop where methods rooted in design thinking will be used to unpack the problem and identify creative solutions.

This initial survey will identify specific areas to explore in a latter round, and ask your advice on initial themes that have arisen in the research to date. It is expected to take 15-20 minutes to complete, depending on the volume of commentary you wish to provide. Thank you again for your time, participation, and most of all, advice!

Sanathan

**QUESTION 1:**

The literature and local interviews reveal a list of solutions which have been employed world-wide to mitigate traffic congestion. To help focus our discussion on a short-list of key strategies, please rank the following tools and tactics on their effectiveness in reducing traffic congestion.

**Notes:**

I am asking for your general expertise in how effective these tools may be for an urban region *such as* the Greater Toronto and Hamilton Area – ie. your answer may be less-specific to this particular city, and more about an assessment of the overall technique.

Many of these tools have several complementary impacts – such as increasing mobility of lower-income segments, reducing GHG emissions, improving the impacts of agglomeration economies, and improving goods movement. **If, however, the prime goal is to reduce traffic congestion through a positive shift in modal split, how effective would each of these solutions be (within a suite of tools)?**

Please use a scale of 1-5 where:

- 1 = Negative impact
- 2 = Moderately negative impact
- 3 = Little or no impact
- 4 = Moderate impact
- 5 = High impact

N/A = Don't know, or unsure

Tactic	Further details	Rating				
Tele-commuting	An educational program to encourage working-from-home one day a week.	1	2	3	4	5
				N/A		
Increase active transport options	Expansion of the cycling network to improve safety and convenience for cyclists. Improving the pedestrian environment.	1	2	3	4	5
				N/A		
Car pool parking lots	Adding car pool parking lots along major expressways.	1	2	3	4	5
				N/A		
<i>Converting</i> existing lanes to HOV lanes	The GTHA currently has 85 km of HOV (2+) lanes on regional expressways. This can be expanded to up to 235km as was trialled during the recent PanAm Games.	1	2	3	4	5
				N/A		
<i>Converting</i> existing lanes to HOT lanes	An option may exist to convert the temporary HOV lanes added during the PanAm games to High Occupancy <i>Toll</i> lanes. In this situation, single-occupant drivers may pay a toll to access the HOV lane.	1	2	3	4	5
				N/A		

Tactic	Further details	Rating				
		1	2	3	4	5
Highway capacity expansion	Adding a general-use lane to regional expressways (where there is room to do so).					
				N/A		
Adding HOV lanes	The province has plans to increase the HOV network to 450 km of HOV lanes by 2031 – a significant portion of which would be in the GTHA.	1	2	3	4	5
				N/A		
Adding HOT lanes	Rather than adding a lane only for HOV use, the added lane can also be accessed by single occupant drivers paying a toll.	1	2	3	4	5
				N/A		
Transit service improvements	Improvements that enhance service without improving capacity – such as WiFi on busses, newer vehicles, or nicer seats.	1	2	3	4	5
				N/A		
Increase transit frequency	Increase transit frequency – to 15 minute or better service on regional lines, and levels which equate to “walk out” service in local areas.	1	2	3	4	5
				N/A		
Increase transit capacity	Build out the 1,525km of high-capacity transit identified by the Big Move Regional Transportation Plan (mix of regional express rail, subway, LRT, and other technologies matched to demand) across the region.	1	2	3	4	5
				N/A		
Reduce parking supply downtown, and in other key areas	Updating land-use regulations that include reduced <i>maximum</i> parking requirements, rather than <i>minimum</i> requirements.	1	2	3	4	5
				N/A		
Business parking levy	A \$0.25/day parking levy applied to all non-residential parking spaces.	1	2	3	4	5
				N/A		
Parking cash out	A program which would provide employees a free transit pass (or other perk) in lieu of a free parking spot, by their employer.	1	2	3	4	5
				N/A		
Increase the Gas Tax	In Ontario, there is currently a \$0.10/litre Federal Excise Tax, \$0.147/litre Provincial Gas Tax, and a 13% HST (retail) sales tax added to fuel sales.	1	2	3	4	5
				N/A		
	The Metrolinx Investment Strategy calls for an increase of \$0.05/litre to the gas tax – if not applied to the whole province, it could be applied within the region of the GTHA.					

Tactic	Further details	Rating				
Congestion charging scheme	A program similar to what is in place in London or Stockholm, where drivers must pay a daily fee (ex. \$5) to enter the CBD (or other cordoned area) by car.	1	2	3	4	5
				N/A		
Road pricing	A program similar to what is being trialled in Oregon, where drivers must pay a fee for every mile they drive and fees can vary by time-of-day and location.	1	2	3	4	5
				N/A		

**1 B)**

**What additional tools or policies are missing from this list?**

## **QUESTION 2:**

One general theme that has arisen through local interviews is a “build it and they will come” attitude towards transit expansion. Transit expansion has been heralded by local media as the solution to our congestion woes, and many respondents share a belief that once new higher-order transit services are in place there will be a natural shift towards using it. Is this a safe assumption?

How can we gauge whether the added transit services will simply provide improved service to those that would have used transit anyways, or whether it will entice would-be car drivers towards becoming transit riders? What experience can you share from examples of recent transit expansion projects in other parts of the world?

## **QUESTION 3**

In discussing barriers with local respondents, “politics” has arisen as the most pronounced barrier. One common statement is that “there is no ribbon-cutting for operations.” The provincial government has substantially cut back funding for transit operations in recent decades. While there have been recent commitments for infrastructure expansion, there is a concern regarding ability to pay for continued operations of any new service. The political football here is that announcing a new infrastructure project is beneficial for a politician, whereas there are no big announcements to be had for increases in operational funding that could improve service frequency in places like the outer suburbs.

How might we overcome this barrier and make it attractive for politicians to support operational funding for transit?

## **QUESTION 4:**

Road pricing (charging drivers for every mile they drive) has been gaining support in the academic literature on traffic congestion. It is viewed as a method to recoup declining gas tax revenues as vehicles become more fuel efficient, and as electric vehicles gain in popularity. Additionally, it can correct inefficient charging of road use, and curb induced demand.

If the GTHA, or the entire province of Ontario were interested in pursuing this as a long-term strategy, what can be done over the coming years to help nudge the public towards supporting such a scheme?

## **QUESTION 5:**

What additional reports or examples would you wish to highlight at this point that might be applicable to the GTHA context? Do you have any final comments to share for this round?

## TENTH BIG MOVE POLICY DESIGN CHARRETTE

### GOALS

1. Build empathy and connections between various stakeholders in transportation and land-use planning in the GTHA – to improve cross-discipline collaboration.
2. Provide a capacity building experience that equips participants with new knowledge, tools and techniques to apply to shared civic challenges.
3. Identify a series of fresh new ideas to address challenges raised throughout the research – ideas which can be refined and brought forward to decision makers within the region.

### DESIRED OUTCOMES

- Apply an approach rooted in design thinking methods to a guided discussion on the topic of traffic congestion in the GTHA
- Ideate / co-create prototypes of potential solutions to mitigate traffic congestion in future

### AUDIENCE

- 24-30 participants (working in 4-5 groups of 6)
- Various roles: transportation planners, land-use planners, consultants, transportation advocates, business leaders and the public

### SETTING

- Studio in the Ryerson School of Urban and Regional Planning

### AGENDA

Time	Activity
5:00 – 5:30pm	<b>Setup</b> (30 mins)
5:30 – 6:00	<p><b>Registration and refreshments</b> (30 mins)</p> <ul style="list-style-type: none"> <li>• Meet and mingle</li> <li>• Participants are assigned a colour tag by stakeholder group – find seat at a table with associated tag</li> </ul> <p>Heat map activity (happening concurrently)</p> <ul style="list-style-type: none"> <li>• Each group/table given a street network map of the GTHA + tracing paper</li> <li>• Each participant answers this question on a sticky note: where in the city-region do you regularly avoid during the peak periods or other times?</li> <li>• Asked to highlight this area in yellow on map</li> </ul>
6:00 – 6:05	<b>Teaser Introductions</b> (5 mins)

	<ul style="list-style-type: none"> <li>• Introduce myself, and peer facilitators – Rob, Ryan, and Howard <ul style="list-style-type: none"> <li>○ Student, pursuing masters in planning at the University of Waterloo</li> <li>○ Looking into the traffic congestion issue that we’ve heard so much about</li> <li>○ Will give you a bit more information in a few mins</li> </ul> </li> <li>• Ask: why are we here tonight? What got you interested in the evening? What do you hope we might accomplish?</li> <li>• Administrivia – advise where the washrooms are, and hand signal to get the group’s attention</li> </ul>
6:05 – 6:15	<p><b>Ice breaker - Interviews (7 mins)</b></p> <ul style="list-style-type: none"> <li>• To learn / empathize with fellow participants experiences with congestion</li> <li>• Pair up, and interview for 3 mins, then switch</li> <li>• Questions to ask: <ul style="list-style-type: none"> <li>○ What mode/modes do you normally use to get to work/school?</li> <li>○ What frustrates you most about your commute, or other trips around the GTHA?</li> <li>○ How do you think your commute might change in future?</li> </ul> </li> <li>• Report back – quick roundtable intro for each person</li> </ul> <p><b>Hot zones (3 mins)</b></p> <ul style="list-style-type: none"> <li>• Ask each table to mark in red specific highways, roads, or regions where they believe congestion is the worst/most problematic <i>today</i></li> </ul>
6:15 – 6:25	<p><b>Project Intro</b></p> <ul style="list-style-type: none"> <li>• Highlight goals of the project: <ul style="list-style-type: none"> <li>○ Identify incremental changes that can help mitigate congestion over time</li> <li>○ Methods to encourage <i>more people</i> who currently drive alone to car pool, take transit, cycle, or walk <i>more often</i>.</li> </ul> </li> <li>• Commit to making good use of their time, and to take ideas forward to leaders at MTO, Metrolinx, etc</li> <li>• Acknowledge limitations – time</li> <li>• Set the tone – fast paced evening</li> </ul>
6:25 – 6:30	<p><b>Creating Persona’s</b></p> <p>PART ONE: Selecting examples</p>



<p>6:30 – 6:40</p>	<ul style="list-style-type: none"> <li>• Ask participants to think about being stuck in traffic somewhere along the red line they indicated previously</li> <li>• Solo activity: Ask participants to describe the three drivers they see on their left, right, and in their rear view mirror</li> <li>• Group activity: Each table then posts up their example people on a board, and clusters similar/identical people</li> <li>• LARGE GROUP: Ask each table to share the names/descriptions with the larger group. Post-up unique names at the front of the room.</li> </ul> <p>PART TWO: Empathy Maps</p> <ul style="list-style-type: none"> <li>• Assign a persona to each table</li> <li>• Hand out empathy maps</li> <li>• Describe the purpose of an empathy map</li> <li>• Situation: be that person, getting ready to leave in the morning</li> <li>• Ask each person to fill one out – with each person at the table starting at a different section (we may not have time for everyone to fill it out completely)</li> </ul>
<p>6:40 – 7:00</p>	<p>PART THREE: Persona creation</p> <ul style="list-style-type: none"> <li>• Introduce goal – create specific examples of average people whom we can design solutions for</li> <li>• Brainstorm exercise to describe these persona’s</li> <li>• Their needs: <ul style="list-style-type: none"> <li>○ Why does this person drive?</li> <li>○ In what scenarios would this person car pool?</li> <li>○ In what scenarios would this person take transit?</li> <li>○ In what scenarios would this person cycle?</li> <li>○ In what scenarios would this person walk?</li> </ul> </li> <li>• Cluster descriptions, and name each persona</li> <li>• Draw an image of the persona</li> </ul>
<p>7:00 – 7:15</p>	<p><b>What can we do?</b></p> <ul style="list-style-type: none"> <li>• Set the stage <ul style="list-style-type: none"> <li>○ Summarize common strategies – transit expansion, active network expansion, etc</li> <li>○ Interest in exploring equity issues, public acceptance issues, etc</li> </ul> </li> </ul> <p><b>Why we can’t build our way out</b></p> <ul style="list-style-type: none"> <li>○ Overview of induced demand</li> <li>○ State interest in understanding the local context for one less explored solution</li> </ul> <p><b>Video</b></p> <ul style="list-style-type: none"> <li>• Show TED Talk that introduces congestion pricing</li> </ul>

	<ul style="list-style-type: none"> <li>• Table discussion – what would a road pricing strategy include</li> </ul>
7:15 – 7:30	<p><b>Who Would Switch?</b> (15 mins)</p> <ul style="list-style-type: none"> <li>• Activity that asks the groups to place their persona’s along a pricing spectrum</li> </ul>
7:30 – 8:00	<p><b>On The Cover activity</b> (30 mins)</p> <ul style="list-style-type: none"> <li>• What would the next ten years look like if we pursued a road pricing strategy in collaboration with other initiatives under way?</li> <li>• How would we get over public acceptance and political barriers?</li> </ul>
8:00 – 8:20	<p><b>Group Presentations</b> (20 mins)</p> <ul style="list-style-type: none"> <li>• Each group presents to the others</li> <li>• Ask one other group to complete the Feedback Grid for the presenting group, and rotate</li> </ul>
8:20 – 8:30	<p><b>REFLECTION</b> (5 - 10 mins)</p> <p>Reflection questions:</p> <ul style="list-style-type: none"> <li>• What did we do this evening?</li> <li>• What were some of the words, ideas, or phrases that stood out for you today?</li> <li>• What was a low point for you this evening?</li> <li>• What was a high point?</li> <li>• Of the ideas you’ve heard today, what excites you the most?</li> </ul> <p>Thank yous:</p> <ul style="list-style-type: none"> <li>• Timeline <ul style="list-style-type: none"> <li>○ Will share some ideas with the panel</li> <li>○ Academic writing done Dec-Jan</li> <li>○ Brief/report out early next year</li> </ul> </li> <li>• Commitment to email report to participants</li> <li>• Commitment bring ideas forward to my participant base of leaders within Metrolinx, MTO, and the municipalities</li> <li>• Thank everyone very much for their time</li> </ul>

## Glossary

BCA	Business Case Analysis
CBD	Central Business District
GTA	Greater Toronto Area
GTHA	Greater Toronto and Hamilton Area
OP	Official Plan
ITS	Intelligent Transportation Systems
RPM	Rational Planning Model
RTP	Regional Transportation Plan
SOV	Single occupant vehicle
TOD	Transit Oriented Development
VKT	Vehicle Km's travelled
VMT	Vehicle miles travelled
VOT	Value of time