Congested and Nowhere to Go: Congestion, Road Infrastructure, and Road Pricing in Metro Vancouver

by
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Transportation continues to be a top-of-mind concern for policy makers, business leaders and communities in the lower mainland. How best to manage and use the region's scarce transportation capacity is a complex and often contentious question.

In this paper, Jonathan Arnold, who recently completed a co-op term at the Business Council of British Columbia as part of his SFU graduate public policy degree program, explores a number of issues related to transportation demand management, including road pricing, in the Greater Vancouver context.

The contents, conclusions and recommendations advanced in this paper are the author's and do not necessarily reflect the views of the Business Council of British Columbia or its members.

EXECUTIVE SUMMARY

Road congestion is a problem that affects everyone in Metro Vancouver. Almost everything bought and sold, whether travelling from another country or from the other side of the region, relies on the network of roads, bridges, and highways. Furthermore, everyone depends on the transportation system to get to work and to carry out their social lives. For businesses, congestion means higher transport costs, lost productivity, and reduced competitiveness; for consumers, congestion means higher prices; for citizens, it means more air and noise pollution, wasted time sitting in traffic, less flexibility and more greenhouse gases.

Looking at trends of congestion and transportation infrastructure in Metro Vancouver, it is clear that the current trajectory is not sustainable. The road transportation infrastructure network is ageing and, in many areas, operating above capacity. At the same time, the region is growing at a steady pace, with limited space to accommodate projected increases in passenger and freight traffic. The region is expected to welcome an additional 1.4 million residents by 2041 which, by 2011 estimates, could result in 700,000 more vehicles vying for road space.

Transportation is a responsibility that is shared between all levels of government and, at each level, funding is below historical averages. Simply put, governments do not have the financial resources to meet the infrastructure demands of population growth, and the scope to increase the supply of road infrastructure is limited by geography and land-use. It is also clear that the current instruments for funding transportation improvements, such as fuel, parking, and property taxes, are insufficient to meet the transportation needs of the region. This makes it critical to find sustainable funding sources, and to make the most efficient use of existing road space.

Recent stimulus and Olympic spending, along with concerted investment in Pacific Gateway infrastructure and public transit, have helped accommodate some of this growth; however, long-term trends suggest that these improvements will be inadequate to meet the mobility needs of the region.

Like most big Canadian cities, congestion in Metro Vancouver is a result of having a road network that is underpriced and overused. Motor vehicles (both passenger and freight) represent the bulk of traffic in the region, and produce significant external costs that are not paid by drivers. Motorists pay directly for travel time, gas, insurance, and maintenance, but it is estimated that, on average, these direct costs represent only two-thirds of the total cost of driving a passenger vehicle.[1] Air pollution, greenhouse gases, noise pollution, adverse health impacts, and systemic congestion are all costs that are unpaid by motorists. This has made driving "artificially cheap in terms of money, and artificially expensive in terms of time."[2] As a result, the main road arteries in the region become heavily congested during peak periods of the day, which is predicted to get worse as the region grows.

Road pricing – also called congestion pricing – can take many forms, ranging from comprehensive GPS distance-based schemes, flat fees for unlimited travel, to expanding the tolling scheme on the region's bridges and tunnels. Ultimately, it puts a direct price on using road infrastructure, and it endogenizes the full economic, social, and environmental costs of driving motor vehicles, whereby road users pay according to the time and/or frequency of road

use. Road pricing encourages people to consider other forms of transportation, drive less, and/or travel at non-peak travel times. On the whole, road pricing is one of the most effective and attractive demand-management tools, as it is more cost-efficient than building new road space and it is particularly effective in reducing congestion.[3]

At a high level, 'road pricing' is one of many policy tools to address transportation problems. It fits within the much broader idea of 'mobility-management,' which is an umbrella term encompassing how governments prioritize and facilitate the movement of people, goods, and services. Every decision affecting transportation policy is, in some form, a representation of how we value mobility. Road pricing is simply a different way of valuing and conceptualizing mobility, looking specifically at the space and time of using the road network.

Road pricing is not a panacea for all of Metro Vancouver's transportation problems. Addressing the region's transportation problems will likely require a holistic and coordinated approach, involving the integration of several mobility-management tools and policies. However, based on its effectiveness in cities and regions around the world, road pricing can play a valuable role in making Metro Vancouver's transportation system more efficient, reliable, and sustainable.

Implementing road pricing is complex and raises significant challenges, involving issues of equity and fairness, political constraints, considerations for business and industry, and public acceptability. As with any policy which increases the price of an essential good, road pricing generates vocal opposition. But as demonstrated in other regions and cities around the world, these challenges are surmountable over time, with clear and concerted leadership.

Based on the research and successful implementation in other jurisdictions, pricing road infrastructure in Metro Vancouver is a viable option. Metro Vancouver and TransLink have already conducted substantial research and consultation on road pricing and plan on commencing several studies and engagement sessions in the coming years to start building a region-wide dialogue.

As a contribution to this important policy conversation, this paper explores the concept of road pricing as a method for reducing congestion, generating revenue, more efficiently managing the demand for road use, and abating environmental damage in Metro Vancouver. Overall, in order to develop a more sustainable vision of transportation, a shift in how we value and view mobility is required. Although it is an uncomfortable concept for many, road pricing represents a shift in thinking that could significantly alleviate the region's gridlock, improve transportation infrastructure, and make the region a more prosperous and cleaner place to live.

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INTRODUCTION

Metro Vancouver is at a crossroads with its transportation system. The region's ageing transportation infrastructure, expanding economy, and steadily growing population are leading to worsening congestion and systemic infrastructure stress. In the coming decades, these trends will have a strong effect on municipal and provincial agendas—involving discussions of economic growth, livability, sustainability, and intra-regional fairness. Embedded within these higher order issues are critical conversations that need to be had in relation to the region's future: maximizing the economic benefits of the Pacific Gateway Initiative; improving provincial competitiveness; providing adequate/sustainable funding for public transit; addressing housing affordability; meeting provincial environmental objectives; and, more generally, how to create a more prosperous province while maintaining the standard of living for all citizens.

Metro Vancouver is not alone in confronting these challenges. Most big cities in Canada and the United States are grappling with ageing and overburdened physical infrastructure, and many have growing populations that constrain the movement of people, goods, and services. By conservative estimates, the national shortfall in transportation infrastructure investment is over $120 billion,[4] which includes the investments needed for upgrades, repairs, and new infrastructure. Although the transportation network in Metro Vancouver is relatively 'young' compared to cities in Eastern Canada, many of the roads, bridges, and highways are nearing replacement age and/or operate above designed capacity.[5]

Transportation is a responsibility that is shared between all levels of government and, at each level, funding is below historical averages (despite temporary Olympic and stimulus spending). As the transportation infrastructure gap widens, and prioritizing spending becomes even more challenging, it is clear the current funding model for new and existing infrastructure in Metro Vancouver is inadequate.

The federal government has recently announced $53 billion over 10 years for infrastructure projects; however, this amount falls short of the investment needed to meet the demand associated with expected levels of growth. In addition, fuel taxes, one of the primary sources of revenue for transportation projects, are becoming less reliable because of continued improvements in fuel efficiency, leakages of fuel sales to neighbouring jurisdictions, and increased sales of hybrid and electric vehicles.[6] Based on present and projected shortfalls in government revenues, it will be more difficult to meet the transportation needs of Metro Vancouver going forward.

Congestion in Metro Vancouver is closely related to the infrastructure gap and the region's growing population. The construction and maintenance of infrastructure and the provision of public transit has failed to keep pace with demand in strategic locations, resulting in longer commute times, delayed deliveries, less time spent with family and friends, and adverse environmental impacts. These costs of congestion are far-reaching and impact individual motorists, businesses, public transit users, government, and society as a whole. Transport Canada conservatively estimates the total cost of congestion in the lower mainland at $1.5 billion annually.[7]

One notable economic impact of congestion relates directly to the Pacific Gateway Initiative and the movement of goods and provision of services. British Columbia is a strategic economic hub for Canada's international trade, and road infrastructure plays a vital role in connecting the Gateway's network of ports, rails, and airports. Consequently, congestion in Metro Vancouver, increases transportation costs and makes it harder to capture the full benefits of domestic, interprovincial, and international trade. For consumers, congestion means higher prices; for producers, it means higher transport costs, lost productivity, and reduced competitiveness; for citizens, it means more air and noise pollution, less flexibility and more greenhouse gases.

Taken together, the infrastructure gap, worsening congestion, and insufficient public transit services have significant short- and long-term impacts on the region's competitiveness, productivity, and overall quality of life.

This is not to say there have not been major improvements to the transportation network in Metro Vancouver in recent years. Nor is congestion a new issue. Indeed, the public and private sectors have devoted billions of dollars to improving the region's transport network, and have invested heavily in the Pacific Gateway Initiative, the Major Road Network, and public transit. But based on current and projected levels of traffic volumes, infrastructure improvement cannot by itself solve the problem of worsening mobility.

Central to Metro Vancouver's congestion and infrastructure problem is inadequate price signals. At present, people pay indirectly for using the roads, bridges, and highways in Metro Vancouver (with the exception of the Golden Ears and Port Mann bridges). This means the full costs of congestion (i.e. time delays, environmental damage, health care costs) tend not to enter our calculus when making transportation choices. Instead, infrastructure is generally viewed as a 'public good', financed from a variety of more indirect sources, such as property, fuel, parking, sales taxes, and in some cases funds provided by senior levels of government.[i] Some of these sources are related to road use, such as fuel taxes, but they do not capture the full costs of using a motor vehicle and do little to manage or reduce demand for road space.

While there is much debate on how to best endogenize the full costs and benefits of transportation infrastructure so that they are taken into account by users, there is a general view that the market is not operating well. Drivers pay directly for travel time, gas, insurance, and maintenance, but it is estimated that, on average, these direct costs represent only two-thirds of the total cost of driving a passenger vehicle.[8] Road users, therefore, have a limited connection to the external costs they impose on other drivers and the region's infrastructure and environment.[9] As a result of underpriced roads, and because people cannot be excluded from using the roads, the main road arteries in the region become heavily congested during peak periods of the day, and this problem is predicted to get worse as the region grows.

Looking ahead, coordinated and more systemic solutions will be needed to address these challenges. In order to keep pace with the region's growth, a new long-term plan is required for

[i] While fuel and property taxes act as partial gauge for driving and using road infrastructure, neither fuel or property taxes provide an adequate pricing signal to reduce congestion. Moreover, due to increasing fuel efficiency standards and a gradual shift away from fossil fuels, fuel tax revenues are expected to decline in the long-run.

managing congestion and funding transportation improvements. As part of this ongoing debate, the BC Government promises to hold a referendum in 2014 on how to fund public transit in Metro Vancouver. While this referendum is expected to touch on the future of TransLink and the public transit network, a broader conversation about how to finance infrastructure improvements, reduce congestion, and achieve greater sustainability is necessary.

As a contribution to this important policy conversation, this paper explores the concept of **road pricing** as a method for reducing congestion, generating revenue, more efficiently managing the demand for road use, and abating environmental damage in Metro Vancouver.

Presented in three parts, Section 1 of this paper sets the context and provides an overview of congestion and the infrastructure gap in Metro Vancouver. Section 2 discusses how road pricing can be used to address both of these problems, and also comments on the formidable challenges around implementation. Section 3 discusses what types of road pricing might work best in Metro Vancouver and offers a few concluding remarks. Prior to these sections, it is first appropriate to contextualize congestion and transportation infrastructure with a brief explanation of road pricing. A more robust discussion of the economic, political, environmental, and social implications of road pricing is explored in Sections 2 and 3.

What is Road Pricing?

Road pricing – also called congestion pricing – can take many forms, ranging from comprehensive GPS distance-based schemes, flat fees for unlimited travel, to expanding the tolling scheme on the region's bridges and tunnels. Ultimately, it puts a direct price on using road infrastructure, and it endogenizes the full economic, social, and environmental costs of driving motor vehicles, whereby road users pay according to the time and/or frequency of road use. Road pricing encourages people to consider other forms of transportation, drive less, and/or travel at non-peak travel times.

Many cities around the world, including Stockholm, London, Oslo, Melbourne, and Singapore, use road pricing not only as a congestion management tool, but also to raise revenue for transit projects, reduce air pollution and greenhouse gas emissions (GHGs), and create more livable cities. While the price-setting method is different in each city – depending on the city's goals and geographic features – the revenue collected is used to improve road infrastructure and public transit. Many jurisdictions have also developed ways to offset inequities caused by road pricing, in order to take into account the needs of individuals and businesses who cannot afford to pay.

Road pricing fits within the much broader idea of 'mobility-management,' which is an umbrella term encompassing how governments prioritize and facilitate the movement of people, goods, and services. Every decision affecting transportation policy is, in some form, a representation of how we value mobility. Public transit fares, building rapid transit, fuel taxes, bridge tolls, and providing cycling lanes and sidewalks, all involve implicit valuations of mobility. Road pricing is simply a different way of valuing and conceptualizing mobility, looking specifically at the space and use of the road network.

BACKGROUND

The Costs of Congestion

Congestion is a problem for every major city. During peak travel periods, it can bring the movement of people, goods, and services to a grinding halt, with significant and multifaceted impacts on society and economic activity. Due to our increasingly urban social structure, congestion is a well-studied topic, which began in the 1950s. A general point of agreement in the literature is that congestion results from having road space that is both underpriced and overused, causing unwanted economic, social, and environmental impacts.[10]

Like any commodity, road space is a scarce resource. In each city, road networks have a limited amount of space, which determines the density and speed of traffic. Once a roadway reaches capacity and traffic flow falls below a certain speed, congestion is the result. As a technical definition, there are three thresholds for defining congestion: when traffic flow is 50 percent, 60 percent, or 70 percent below the posted speed limit.[11] Transport Canada uses all three thresholds when estimating the costs of congestion.

Some costs of congestion can be monetized, such as the value of time spent, changes in fuel used, costs and frequency of accidents, and costs of repair to road infrastructure. Some of the social and environmental costs are more difficult to monetize since they are more abstract, including losses in worker productivity, costs linked to greenhouse gas emissions, noise pollution, and other health related impacts.

Recurrent Vs. Non-Recurrent Congestion

Congestion is distinguished by two types: **recurrent** and **non-recurrent.** The former refers to congestion that occurs on a daily basis from the roadways exceeding capacity. Non-recurrent congestion refers to delays caused by unexpected events, such as accidents, construction, and inclement weather. While they are not mutually exclusive, Transport Canada estimates that there is roughly a 50/50 split between the costs of the two forms of congestion. This distinction is important when designing policy solutions, as recurrent congestion is much easier to address than non-recurrent.

Due to the difficulties of measuring impacts of congestion, there is no agreed-upon value for the costs of congestion in Metro Vancouver—or other Canadian cities for that matter. A widely cited estimate is from a 2006 Transport Canada study, which concluded the total cost of congestion in Canada's 11 biggest cities were between $4.4 and $6.7 billion (in 2000 dollars)[12] or between $6.0 and $9 billion today (in 2013 dollars). These estimates include the additional time costs from congestion, the costs of fuel, and greenhouse gas emissions, but do not consider the costs associated with local air pollution.

As a result, the costs of congestion are much greater than Transport Canada's estimates. As noted by Transport Canada itself, many negative impacts of congestion do not have a market price, making it challenging to come up with accurate estimates. The following section provides a brief overview of some of these less-quantifiable, but important, cost implications.

Economic Costs

Congestion has significant impacts on productivity and competitiveness. While the value of time is a partial proxy for these impacts, the full effects of congestion on the entire economy are deeper. Congestion slows the movement of goods and services, and increases the direct transportation costs incurred by firms. Eventually, this results in higher prices for consumers.[13] For non-transport sector firms, congestion decreases the productivity of "employees who must travel for meetings, appointments or between work sites."[14] For exporters, congestion costs can eat into profit margins. While some of these costs may be monetized in terms of profit or time loss, the wider effects on business productivity and competitiveness are largely understudied in congestion analyses in Canada and were not included in Transport Canada's estimates noted above.

The effects of congestion on the trucking industry help illustrate these economic costs. Due to Metro Vancouver's strategic location, trucking is a critical facilitator of interprovincial and international trade. At the same time, the trucking industry contributes to and suffers from congestion. According to the BC Trucking Association, the "time per trip for trucks in the Lower Mainland has increased by 30 percent in the last 10 years (from 2007)," which has a total economic cost of over $750 million annually.[15] These costs are expected to rise in the coming years, as the growth of the Pacific Gateway is expected to result in 0.8 – 1.3 million more container truck trips by 2030 (based on 2005 projections), placing additional strain on the entire network.[16] When coupled with increasing passenger vehicle traffic, "congestion is reducing truck productivity, requiring more trucks, consuming more fuel, and generating more emissions to handle the same amount of freight."[17]

Show me the Goods!
Roughly 90 percent of all consumer goods and foodstuffs are delivered by trucks in BC.
Source: BC Trucking Association and Metro Vancouver.

Another significant economic impact of congestion is discussed in a recent study by the C.D. Howe Institute. The study, entitled "Cars, Congestion, and Costs," notes significant 'agglomeration' benefits associated with urban living and density, such as the ability of workers to access better jobs, the sharing of knowledge face-to-face, and creating demand for more business services. Some of these benefits are lost when heavy congestion pushes people further away from urban cores.[18]

For urban regions, the benefits of agglomeration hinge on maximizing economies of scale and positive spinoffs from the social relationships enabled by urban living. In terms of foregone benefits due to congestion, the C.D. Howe Institute authors estimate the costs imposed on the Greater Toronto and Hamilton Area are between $1.5 and $5 billion per year.[19] This suggests that other major urban regions, such as Metro Vancouver, also suffer significant agglomeration losses due to congestion. These findings are supported by a similar study by Hymel, who concludes that reducing congestion in heavily congested cities by 10 percent leads to a four percent increase in long-term employment.[20]

Environmental & Social Costs

Many of the environmental, health and social costs of congestion are linked. Congestion is a major source of local air pollutants, such as sulfur dioxide, ozone, particulate matter, carbon

monoxide, and nitrogen dioxide.[21] All of these air pollutants reduce air quality and result in higher rates of respiratory diseases. In total, the costs of air pollutants from the transport sector, calculated using Health Canada's Air Quality Benefit Assessment Tool, are between $4 and $7 billion annually across the country (2000 dollars).[22] Congestion is responsible for a small, albeit unknown, portion of this total cost.[ii]

Air pollutants are a localized and noticeable environmental effect from traffic congestion. Greenhouse gas emissions, by comparison, are more difficult to detect and are global in scope. Although Transport Canada includes GHGs in its estimates for congestion, it is important to note the large contribution to climate change from motor vehicles. Canada-wide, the transportation sector is the single largest consumer of energy and accounts for roughly one-quarter of national GHG emissions.[23] When added together, the energy use and GHG emissions of passenger vehicles and freight dominate the picture for the entire transportation sector, accounting for 96 percent of the sector's energy use and 82 percent of its GHG emissions.[24] As the BC and Canadian governments look to reduce GHG emissions and air pollution, the wasted fuel and energy from congestion is an obvious target for abatement.

Other important health-related impacts of congestion stem from extra time wasted sitting in traffic and the increased risk of accidents. Consequently, congestion results in higher rates of injuries and deaths, as well as higher insurance premiums and productivity losses, all of which place a bigger burden on healthcare and insurance systems. Also, sitting idle in traffic has impacts on our personal wellbeing and health, increasing the likelihood of obesity, stress, and aggression.[25]

Congestion in Metro Vancouver

Whether using a quantitative or qualitative lens or drawing on personal experience from daily commutes, congestion is a serious problem in Metro Vancouver. Residents consistently rank traffic and public transit as "one of the biggest urban challenges" of the region.[26] In 2006, Transport Canada estimated the annual costs of congestion (recurrent and non-recurrent) in Metro Vancouver at between $0.7 and $1 billion, which includes the value of time lost, fuel wasted, and GHGs emitted. When adjusted for inflation, the range increases to $0.9–$1.5 billion today.

Reality Check: Commuting Our Lives Away

The average person in Metro Vancouver spends 74 minutes commuting each day (StatsCan). Assuming the average person commutes 5 days per week, 49 weeks of the year, for 40 years: **We spend 6 hours per week, 13 days per year, and 1.4 years of our life commuting.**

For these reasons, the total cost of congestion in Metro Vancouver is higher once other direct and indirect costs are considered. For example, if the costs of congestion on the trucking industry are included in the Transport Canada total – estimated at $750 million annually – the total costs of congestion in Metro rises to $2 billion per year or more.[27] This is a conservative estimate since the full environmental, health, and economic impacts are not accounted for, including the loss of

[iiii] The transportation sector is a major contributor to harmful air pollutants. Although air quality in Metro Vancouver has improved in recent decades, it could be significantly better if congestion was further abated. For more information on air quality in Metro Vancouver, see: Caring for the Air and BCBC's Air Quality Regulation: Canadian and BC Developments

agglomeration economic benefits, increased obesity, stress, or air pollution. These remaining indirect impacts are difficult to measure and are often omitted from costing estimations.

The most recent evaluation of congestion in Metro Vancouver was the 2003 Travel Time Study commissioned by TransLink (see Bibliography for link). Using GPS devices on 20 vehicles, the study looked at 14 major road arteries during four periods (peak AM, mid-day, peak PM, and mid-Saturday). Overall, the study found a high variability of trip travel time and average speed. For example:

> The average travel speed between Surrey Town Centre to New Westminster in the AM peak period was calculated to be 27 km/hr with a variability of 62% (17 km/hr interval), or a range from 32 to 58 km/hr. However, from Richmond Town Centre to Abbotsford, the average travel speed was found to be 63 km/hr with a variability of 3% (2 km/hr interval), or a range of 42 to 57 km/hr.[28]

Although the TransLink study is now dated, it has several important conclusions that are still relevant today. Most notably, afternoon travel moving Southbound and Eastbound were the most congested periods of the day, and also featured the slowest average speed (44km/hour). During afternoon rush hour(s), approximately 27 percent of the "road network surveyed operated at average speeds 60 percent below the respective posted speed limits" (see figure 1).[29] These findings come as no surprise to regular commuters.

Figure 1 – Statistics by Time Period for all Roads Surveyed

Time Period	Total Distance (km)	Total Hours	Average Speeds (km/hr)	Actual / Posted Speed Ratio[7]		
				0 – 0.6	0.6 - 0.8	>0.8
AM	30,815	647	**47.6**	17%	15%	68%
Midday	30,027	577	**52.0**	14%	14%	72%
PM	31,501	721	**43.7**	25%	16%	59%
SAT	8,639	184	**46.9**	10%	9%	81.5%
Total:	***100,982***	***2,130***	***47.4***			

Source: TransLink (2003).

The second noteworthy finding from this study is that the region's bridges experience the greatest levels of congestion. Bridges are an integral part of the transportation system, but they form natural choke points for congestion. Of all the main Fraser River crossings, the George Massey Tunnel, the Alex Fraser and Pattullo bridges have the worst congestion.[30] During peak travel times, these crossings "experience average travel speeds between 0 and 60 percent of the posted speed limits."[31] The new Golden Ears and Port Mann Bridges have helped reduce congestion somewhat; however, the remaining corridors are still heavily congested at peak periods of the day.

Another significant finding of the 2003 TransLink study is that mid-day travel on some major arterial roads is slower than during peak morning hours. These roads include arterial roads in the North Shore, Vancouver, Maple Ridge, Pitt Meadows, Langley, and Richmond.[32] TransLink speculates that reduced parking fees during off-peak periods are the main factor for mid-day congestion in these areas. Mid-day congestion also suggests these areas have limited capacity to absorb excess congestion from regular peak periods, and some areas of the road network are reaching a saturation point.[33]

For a clearer picture of how Metro Vancouver's congestion has changed since the TransLink study, it is helpful to look at a few other indicators. First, there are more people living in Metro

Vancouver, with more cars on the road. From 1999 to 2011, the population of Metro Vancouver grew by 14 percent, and it is expected to reach 3.4 million by 2041. The number of licensed passenger vehicles jumped by 23 percent from 1999 to 2011; the number of licensed commercial vehicles increased by 19 percent.[34] Holding the ratio of car ownership in Metro Vancouver constant (from 2011 levels), this will mean an additional 700,000 vehicles on the roads by 2041.[iii] The increase population and vehicle ownership is expected to result in a 39 percent increase in rush-hour traffic by 2021, and a 120 percent increase in the proportion of "severely congested roads."[35]

The Infrastructure Gap

Underinvestment in transportation infrastructure is a major issue in Canada which has undoubtedly helped to fuel the congestion problem. In cities across the country there is a current or looming infrastructure gap, where public investment in infrastructure is failing to keep pace with maintenance needs and growing demand. The result is an ageing and overburdened infrastructure network, constricting the movement of people, goods, and services. Considering the infrastructure gap is a nation-wide problem, it is important to briefly review the national picture before looking specifically at BC and Metro Vancouver.

Like estimating the costs of congestion, determining the precise scope and size of Canada's transportation infrastructure gap is challenging. One method for gauging the national infrastructure gap is by evaluating total net investment spending as a percentage of GDP (capital investment minus depreciation). Since transportation policy is shared between all levels of government, this indicator of infrastructure spending is particularly relevant.

Figure 2 – Investment Net of Depreciation, % of GDP, All levels of Gov't, 1995-2011

Source: Canadian Centre for Policy Alternatives

As demonstrated by Figure 2, net investment from all levels of government peaked in the early 1960s, and has fallen gradually over time. Most noteworthy is the *negative investment rate* during the 1990s. Although Figure 2 illustrates total infrastructure spending (including water treatment plants, water supply systems, waste treatment facilities, and communication infrastructure), transportation infrastructure comprises roughly 60 percent of all public infrastructure assets, and therefore represents a majority of infrastructure investment.[36]

[iii] This was calculated by using the ratio of population to car ownership, calculated by dividing the population of Metro Vancouver in 2011 (2,313,328) by the number of registered cars in the same year (1,482,031). To estimate the number of cars in 2041, the 2011 ratio was used for the projected population in 2041 (3.4 million).

From 2004–2010, federal and provincial governments helped to narrow the gap through a renewed commitment to infrastructure spending, supported by the large-scale stimulus spending during the 2008 recession and the Building Canada Plan (illustrated by the upswing in the investment curve in Figure 2).[37] Much of this new investment spending was concentrated on improving the Canada's network of roads, bridges, subways, and commuter rail systems.[38] Despite the revived focus on infrastructure spending, however, the infrastructure gap is still significant according to recent estimates.

For a fuller understanding of the infrastructure gap, the following are three different estimates which use slightly different methodologies:

- The Institute for Research on Public Policy (IRPP) estimates the national transportation infrastructure gap is roughly $120 billion (2008), based on measuring historical spending rates as percentages of GDP.[39] This dollar figure includes investments for repairs and upgrades, as well as for new infrastructure projects.
- Using a similar methodology to the IRPP study, the Canadian Centre for Policy Alternatives concludes the shortfall in capital investment from 1980–2011 is roughly $145 billion (this total includes all infrastructure, not just transportation).
- The Federation of Canadian Municipalities (FCM), using survey results from 85 local governments, estimates the transportation deficit for (only) municipalities is $51 billion, which includes $29 billion for new infrastructure and $22 billion for upgrades.[40]

Canada's ageing and stressed infrastructure, and the rising cost of making necessary improvements, is important for a few reasons. It demonstrates the need for a national dialogue on the way the three levels of government (four in Metro Vancouver's case) fund transportation infrastructure. The Federation of Canadian Municipalities has advocated for a modernized, coordinated, and long-term national framework for years; however, getting cooperation and buy-in from the provinces and the federal government has been difficult.[41] Given the shared interests in improving transportation and the movement of people, goods, and services in Canada, a renewed debate at the national level would be a good first step.

Getting Old: The Age of Canada's Infrastructure
28% is between 80-100 years old
31% is between 40-80 years old
41% is between 0-40 years old
Source: Saeed Mirza and Cristian Sipos

The national infrastructure gap also illustrates that many major cities in Canada face similar problems.[iv] In fact, many urban centres in the U.S. and Europe are also dealing with questions of how to sustainably finance and manage transportation infrastructure. To address these problems, better coordination, communication, and information sharing between regions and cities are increasingly important. The opportunity to learn and build from successful and creative ideas developed and tried elsewhere is greater than ever.

Metro Vancouver's Infrastructure Gap

The responsibility for transportation in Metro Vancouver is shared between four levels of government, each with different responsibilities and interests: the Federal Government, the BC

[iv] Canadian cities that are not experiencing high population growth, such as Windsor and Quebec City, do not have the same pressures as high-growth cities like Vancouver, Calgary, Edmonton, Montreal, and Toronto.

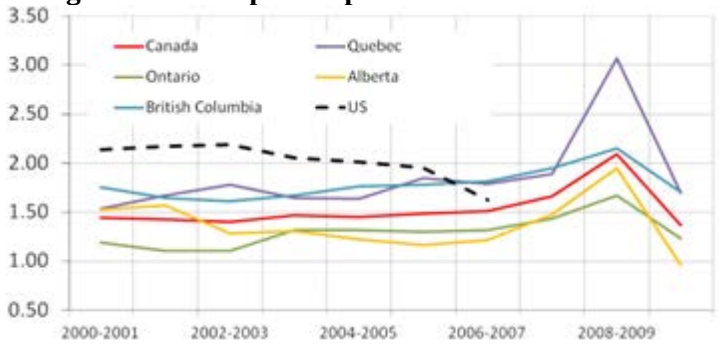
Government (which includes TransLink), Metro Vancouver, and each of the 23 municipalities. In order to estimate the size of the total infrastructure gap, it is necessary to understand the funding responsibilities of each level of government, and the estimated funding shortfall at each level. Overlap, intergovernmental transfer payments, and inconsistent reporting practices make this a cumbersome process. It is therefore unsurprising that no individual or organization has attempted to tally the infrastructure deficit in Metro Vancouver.

The exact dollar figure of the transportation infrastructure gap is not the critical issue. More important is to gauge the rough magnitude of the gap, to have a clear picture of the region's trajectory, and to understand the funding capacity to pay for necessary upgrades. To address these concerns, four components are briefly considered below. To start, the recent improvements to the transportation network and the Pacific Gateway are discussed. This is followed by a summary of three major infrastructure challenges in the region, including the municipal infrastructure funding gap, the funding gap of TransLink, and the condition of bridge infrastructure in Metro Vancouver.

The Pacific Gateway and Infrastructure Improvements

Notwithstanding the problems discussed in this paper, there have been noteworthy improvements to the region's transportation network in the past decade or so. In particular, the 2010 Olympics spurred significant investments in the transportation system. As seen in Figure 3, transport spending in BC kept pace with other provincial levels until mid-2007, when Olympic spending temporarily peaked at a Canadian high of three percent of GDP.[42] This spending led to direct improvements to the region's public transit and road network, and unquestionably helped to mitigate some of the region's traffic congestion.

Figure 3 – Transport Expenditure as Share of GDP



Source: David Gillen (2012) "Building the Future of British Columbia."

Another major component of the transportation network in Metro Vancouver is the Pacific Gateway—an initiative of the provincial and federal governments. The Gateway forms the backbone supporting international trade for both BC and Canada, and it capitalizes on BC's strategic location to American and Asian markets. It consists of an integrated network of roads, bridges, ports, airports, and rail lines, connecting many of the province's towns and cities. With increasing exports to Asia in forestry products, agri-food, minerals, and coal, the strategic advantages of BC's Pacific Gateway are predicted to grow in importance. This is especially true when considering the projected growth in natural gas development and the prospect of transporting Liquefied Natural Gas to Asian markets.

Since 2005, over $22 billion has been committed to improving Gateway infrastructure from the federal and provincial governments, TransLink, and the private sector. Of this, $7 billion has been invested in road and rail improvements.[43] To reach the projected growth capacity of the Gateway, the provincial government estimates an additional $25 billion in infrastructure investment is required by 2020.[44] See the sidebar for a list of some of the major Gateway improvements to the road network.

Unfortunately, the extent to which infrastructure investments have helped renew the region's ageing infrastructure and offset congestion is unclear. Even without a precise measure, these major road and bridge improvements have undoubtedly helped ease levels of congestion and facilitate a smoother flow of goods and services, especially through the Pacific Gateway. For these reasons, the impact of recent projects should not be understated.

Major Gateway Infrastructure Projects on the Horizon

- Complete the $1.3-billion South Fraser Perimeter Road
- Complete the $3.3-billion project now underway to improve the Port Mann Bridge/Trans Canada Highway 1
- Complete Highway 1 road infrastructure investments to support safe, reliable and efficient movement of goods and people.
- Complete the new Regional Traffic Management Centre to consolidate transportation oversight operations.

Source: Pacific Gateway Transportation Strategy 2012-2020

Municipal Infrastructure

Although the level of real per capita transportation spending in Metro municipalities has increased by 34 percent since 2000, there is still a looming infrastructure gap at the municipal level.[45] The Mayor's Council on Transportation has long argued that capital contributions from senior levels of government to municipalities for the Major Road Network are insufficient and too ad hoc.[46] Unable to generate the necessary capital at the municipal level, mayors and councils are forced to lobby TransLink and the federal and provincial governments for additional resources.[47] Often, these arrangements are on a project-by-project basis and do not represent a sustainable solution to addressing the long-term infrastructure gap.

As a rough estimation of the shortfall in BC, one report puts the total municipal government infrastructure gap at $10 billion.[48] While this total includes all infrastructure and not just transportation, it provides a glimpse of the gap's magnitude. Due to the methodology used in this calculation (the national municipal infrastructure gap divided by BC's share of the national population), it is a conservative estimate of the aggregate infrastructure shortfall in BC. The estimate is based on data from 2003 and 2006, and does not include the subsequent increases in the infrastructure shortfall or the rise in construction costs over the past decade.[49] Moreover, because Metro Vancouver is home to over half the province's population, and a significant portion of BC's commercial transportation routes, much of this infrastructure gap is likely concentrated within the Metro region.

TransLink

TransLink plays a vital role in moving people, goods, and services in Metro Vancouver. It is the primary provider of public transit in the region, and it is also responsible for the region's Major Road Network (MRN). The MRN is owned and operated by individual municipalities, but

TransLink "provides funding for the operations, maintenance and rehabilitation of the MRN, and shares in the cost of eligible capital improvements."[50] TransLink also owns the Knight Street Bridge, Pattullo Bridge and the Westham Island Bridge.

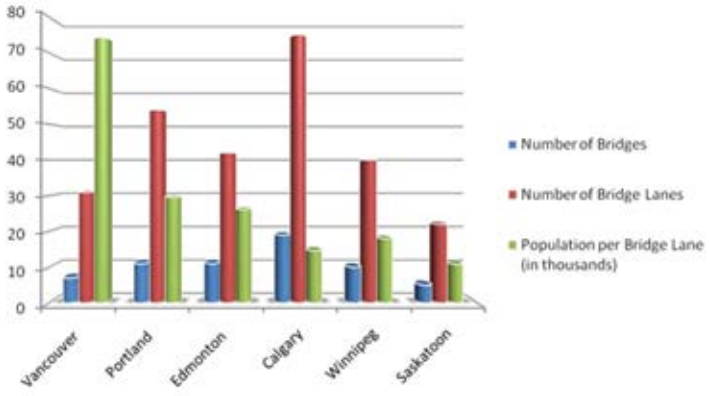
Similar to the situation in BC municipalities, TransLink lacks a sustainable long-term funding model, and is unable to meet current and future demand based on existing revenue sources. In the 2013 Base Plan, for example, TransLink scrapped plans for: over 300,000 annual service hours to accommodate population growth and overcrowding; the Highway 1 Rapid Bus Project; rapid transit between King George Blvd and White Rock; the expansion of the north shore Seabus schedule; upgrades to Lonsdale Quay; and desired funding for the MRN and cycling infrastructure.[51]

In total, TransLink estimates an overall or cumulative funding shortfall of $23 billion.[52] Five billion is required to keep its transportation network in a state of good repair, and roughly $18 billion is needed to expand the network to meet growing demand over the next few decades. Aware of the shortfall in revenue and service provision, TransLink is researching ways to secure revenues to make its financial position more sustainable in the long-run. These options are discussed in Section 2.

Bridge Infrastructure in Metro Vancouver

A comprehensive study by *Get Moving BC*, comparing bridge infrastructure in Portland, Calgary, Edmonton, Winnipeg, Saskatoon, and Metro Vancouver, found that Greater Vancouver ranks last in terms of adequate bridge infrastructure.[53] Of the 20 busiest bridges in all six cities, bridges in Metro Vancouver accounted for half. At the time of the study, the Port Mann Bridge, Knight Street Bridge, and the George Massey Tunnel had the highest traffic volumes and were more congested than other Western cities examined in the study. The Port Mann Bridge has now been replaced with a new 10 lane bridge and would probably no longer make the list, for now.

Figure 4 – Bridge Infrastructure Statistics



Source: Get Moving BC (2008).

The report considers several different indicators, including population per bridge lane, number of bridge lanes, and number of bridge crossings. Metro Vancouver performs poorly on all three indicators (Figure 4): it has the second lowest number of bridge crossings and bridge lanes, and the highest population per bridge lane.[54] Despite the improvements made since the study was conducted in 2010 (i.e. the Golden Ears, Pitt River, and Port Mann bridges), Greater Vancouver still lags well behind other large cities.[55]

Considering the projected population growth in the region, especially south of the Fraser River, the ageing and congested state of Metro Vancouver bridges is likely to remain a significant

concern for local and regional governments. Furthermore, the new tolls on the Golden Ears and Port Mann Bridges illustrate the high capital costs of building big projects, and the need to charge user fees to make such projects more feasible. TransLink acknowledges that major replacement or repair of its bridges/tunnels, such as the Pattullo Bridge and Massey Tunnel, can only happen with the implementation of tolls in the future.[56]

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TAKING STOCK: ROAD PRICING IN METRO VANCOUVER

This paper has highlighted two converging problems in Metro Vancouver: worsening congestion and a growing infrastructure funding gap. At the heart of both is a road system that, given the current governance framework, is underpriced and overused—creating excess demand during peak travel times, coupled with a lack of funding to properly maintain and upgrade the transportation network. Together, the costs are significant; congestion hinders the region's economic and social development, raises the cost of doing business, and makes it harder to attain the environmental goals and objectives of the province.

With the region's population growth and rising rates of vehicle ownership, these problems are not likely to go away. Governments simply do not have the funding capacity to accommodate the projected demand or to make the necessary improvements to the road network without introducing some form of demand management and/or new source of revenues. These emerging realities are acknowledged by municipal, regional, provincial, and federal government agencies, as well as by a plethora of community and business organizations. Recent infrastructure spending has helped relieve pressure on some roadways in Metro Vancouver; however, trends in congestion and infrastructure spending indicate the demand for road space continues to outweigh capacity.

It is also well-established that Metro Vancouver cannot simply build its way out of the problem. Transportation departments around the world have realized this model of "predict and provide" is both inefficient and ineffective.[57] Without pricing signals on the road network, "new road space is used up as fast as it is built and congestion remains unaffected."[58] Even if the region had the financial wherewithal to build enough roads and bridges to accommodate peak demand, it would create excess capacity during non-peak travel times and lead to an inefficient use of land and of taxpayers' money. Moreover, the growth of infrastructure in Metro Vancouver is constrained by geography: mountains, an ocean, a border, and the agricultural land reserve. While infrastructure improvements play an important role in the region's growth, the most pragmatic solution is to maximize the use of existing road space, and selectively expand and build new infrastructure as necessary.[59]

With this context in mind, the higher level question confronting Metro Vancouver is clear: how will the region's transportation network cope with growing demand for road space, and a corresponding persistent funding shortfall based on any realistic estimate of need? With this question comes the debate on how to both determine and effectively fund an optimal suite of transportation policies and new infrastructure, along with paying for necessary infrastructure maintenance and upgrades.

Figure 5 – Potential Policy Options to Address Congestion and/or Infrastructure Financing:

- Employer Payroll Tax
- Container Fee
- Parking Sales Tax
- Regional Sales Tax
- New Regional Carbon Tax
- Reallocate Current Carbon Tax
- Tax Increment Financing
- Flat Levy per Property
- Parking Levy
- Development Charges
- Vehicle Sales Tax
- Hotel Tax
- Rental Car Tax
- Vehicle Registration Fee
- Additional Property Tax
- Project Tolls on New Infrastructure
- Fuel Tax
- Benefiting Area Tax
- Increase transit fares
- **Road pricing**

Source: TransLink 2012

The stakes are high. The way government addresses these issues will shape the region's competitiveness, productivity, physical environment, quality of life and overall prosperity.

TransLink is well aware of the region's long-term transportation challenges, including the unsustainable funding gap and the region's underpriced road network. As part of its research, TransLink has considered many different options to raise new revenues and manage congestion (see Figure 5).[60] Of these options, road and mobility pricing have received consistent support. Specifically, TransLink commits to implementing mobility pricing in the coming years and building a multi-agency strategy for the future.[61] While these developments are discussed later in this paper, it is important to recognize the ongoing efforts of TransLink.

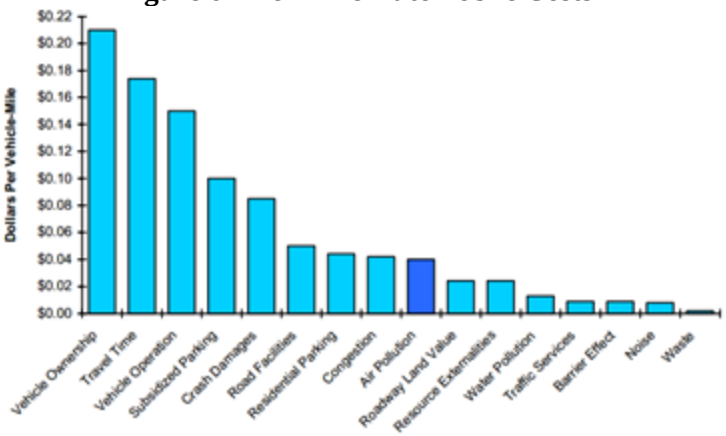
The remainder of the paper focuses on road pricing in Metro Vancouver and how it might be applied. The paper does not advocate or propose a specific form of road pricing—implementing road pricing on the ground is highly complex and requires significant engagement and consultation with business, industry, and the public. Furthermore, as the research indicates, proper travel demand analysis and modeling are needed to understand how different forms of road pricing might affect traffic patterns, business, freight, and the urban environment. Only after Metro Vancouver goes through these steps can the region start to discuss different methods of implementation. The aim here is to explore how road pricing might work in the region, examine some of the options, and highlights the many challenges of adoption.

Road pricing: A Brief Overview

Road pricing can take many forms and changes with the goals and objectives of each city, and the nuances of traffic flow. The underlying principle of road pricing, no matter the end goal, is to put a price on using road space and provide a monetary incentive for using alternative modes of travel.[62] Whether it is used to control congestion, raise revenue, or reduce environmental damage (or a mix of all three), road pricing internalizes some or all of the estimated costs that drivers impose on other drivers and non-drivers[63] (see Figure 6). This immediately sends a price signal to "link human choice and behavior to transportation choices," and provides an incentive to use other less costly and more sustainable forms of transit, such as public transit, cycling, and car-pooling."[64]

Box 1 (on the next page) provides an economic explanation of how/why road pricing works, describing the direct and indirect costs that drivers impose on the road network. These costs are important to understanding why road pricing is becoming a more attractive option to address congestion and raise revenue. Also, Box 1 illustrates the non-linear function of congestion, meaning that a small drop in the number of cars on the road, at a particular time, can make a significant change in traffic bottlenecks.

Figure 6 – Per-Mile Automobile Costs



Source: Todd Litman (2006), Victoria Transport Policy Institute

Although only a handful of cities in the world have adopted sophisticated forms of road pricing (tolled roads/bridges are very common), it is generally viewed by economists and transportation planners as one of the most effective and efficient methods to "ration road space" and raise revenue for infrastructure projects (see Appendix A for international pricing schemes).[65] This nascent consensus among economists and policy analysts – rare in public policy discourse – stems from the clear and tangible benefits and co-benefits from well-structured road pricing.

Road pricing is only one of several mobility-management tools that can reduce congestion, but it stands out for being able to achieve multiple goals simultaneously with relatively low overhead costs. Whereas other policy options can help reduce vehicle travel and raise revenues – e.g. fuel taxes, parking fees, and vehicle registration fees – none of these other options are directly connected with the time and space of using the roads.[66] Road pricing can effectively discourage vehicle use during peak periods and on heavily congested arteries, while, at the same time, raising revenue and encouraging sustainable transit.[v]

Despite the growing consensus around road pricing, its lack of serious uptake in most urban jurisdictions around the world raises important questions. The obvious reason is the unpopularity of road pricing measures among the public and (subsequently) politicians. Road pricing (for those who continue to drive) can impel road users to pay more money out of pocket. No matter how 'good' the goals or intentions may be, paying more for a service (regardless of the direct or indirect benefits) will never be an easy sell. Accordingly, business and industry are hesitant to support road pricing, even though it may help to achieve a more efficient and reliable transportation network.

[v] Tolling infrastructure, listed as a separate option by TransLink, is included within the possibilities of road pricing.

Box 1 – The Economics of Road pricing

The figure below provides a more detailed description of how road pricing works. It represents the individual costs of using the roads during peak times. To better understand the mechanics of how it works, imagine the graph depicting your daily commute and your interaction with the other drivers on the road. The private and social costs are presented on the Y axis, denoted in dollars, while the number of other drivers on the road is on the X axis. There are two non-linear cost curves. The first is the private cost curve. It includes the direct costs of using your car (i.e. gas, insurance, car depreciation) and the cost of your time.

The social cost curve is more abstract. It includes the private costs plus the costs drivers do not pay directly, such as the time costs imposed on the flow of traffic (drivers usually only consider their own time costs, but your decision to drive slows everyone down). Other social costs are more intuitive, such as environmental damage (greenhouse gases and air pollution), and the wear and tear on road infrastructure. Both cost curves are upward sloping, meaning as the number of drivers on the road increases (i.e. as traffic gets worse), the incremental private and social costs become greater. The other curve in the diagram is the downward sloping demand curve. It illustrates that as the costs of driving decrease, more and more people are willing to drive to work.

Without road pricing, traffic flow is at an equilibrium where private costs equal demand (at point A). This point represents the status quo for the untolled roadways and bridges in Metro Vancouver. The people to the right of this equilibrium are unwilling to pay the costs of sitting in traffic, and decide not to drive (as private costs are greater than their willingness to pay). When there are fewer people on the roads (to the left of point A), the private costs are lower and encourages more drivers onto the road until the equilibrium is reached. At this equilibrium, the private cost to you, as a driver, is denoted by C2. However, this is a suboptimal level of traffic, as there are significant costs not being paid (indicated by the distance from A to D). These are considered the externalities of congestion.

To alleviate the problem, road pricing is introduced. Once implemented, these external costs previously unpaid are now included in using the road. The objective is to match the total costs (private plus social) with demand (at point C). To achieve this new and more efficient equilibrium, drivers must pay a fee (the distance from C1 to C3). At the new equilibrium, some drivers now choose to take another form of transportation (public transit, car pool, or active transit) or choose another time of day to commute. Hence, the level of congestion is reduced.

While drivers now pay slightly more out of pocket (C3 instead of C2), there are several benefits gained: less traffic means shorter and more reliable commute times, less environmental damage, and less damage to the road infrastructure. These benefits are denoted by the area of the green triangle, labeled 'Efficiency Gain'.

Figure 1 – How Road Pricing Works: The Private and Social Costs of Congestion

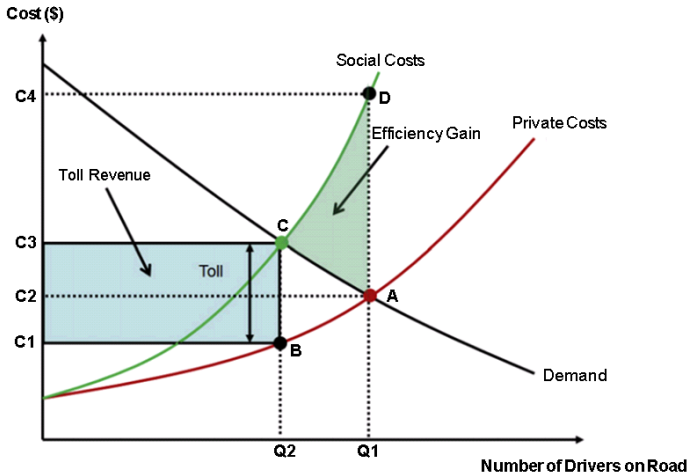


*Figure was adapted from Robin Lindsay's "Road Pricing and Investment." Economics of Transportation, Vol. 1, 2012.

Furthermore, the revenue collected from the tolls, which is the price of the toll multiplied by the number of drivers (illustrated by the blue box), can be used to fund road improvments and alternative forms of transportation (public and active transit).

Whereas road pricing unambiguously improves efficiency and reduces congestion, it also creates winners and losers. Those who cannot afford the toll (Q1 to Q2) are now worse off and must find alternative modes of transportation. Alternatively, those who pay the toll and continue to drive are better off, as less time is spent sitting in traffic. For this reason, road pricing creates a series of equity concerns which are discussed in this section.

Another important reason for the slow uptake of road pricing is the lack of sufficient research on the long-term impacts. In many cases, there is an insufficient understanding of the "bigger picture," largely ignoring long-term impacts, such as the effects on the labour market, land use, value-added trade, behavioural responses to tolls, and the redistribution of social and economic welfare.[67] To address some of these important issues, TransLink has committed to conducting a "near-term study and supporting technical work to understand the impacts and implementation requirements of applying mobility pricing to the road system."[68] Before examining further the challenges and constraints of implementing road pricing, it is first necessary to explain the different structures of road pricing, including the wide range of goals, objectives, and methods.

There are three primary goals in implementing road pricing, all of which are applicable in Metro Vancouver: *managing congestion, raising revenues, and reducing environmental damage.* These goals are not mutually exclusive, as cities often pursue more than one goal, but depending on the overall objectives of a particular urban region, the road pricing scheme can change substantially. The following is a brief explanation of each goal-oriented pricing scheme:

> ***Reducing Congestion:*** these systems typically provide road users with pricing signals that reflect the time and space of an individual's road use. Congestion pricing schemes are designed for reducing peak demand, whereby the price is set according to traffic levels.[vi] During periods of high-congestion (i.e. morning and afternoon rush hours), the price of driving is higher than during other travel periods. This reduces congestion during peak periods, and creates a more reliable and efficient transportation network. Moreover, because efficiency is measured by congestion levels (rather than revenue), the price paid by drivers is typically lower than with revenue-generating schemes. Some systems provide a rebate for road users if traffic flows are below a guaranteed minimum speed.[69]
>
> ***Revenue Generation/Financing Infrastructure:*** these systems place less emphasis on time-of-day pricing to reduce congestion, and more emphasis on generating revenue. Effectiveness for this form of road pricing is measured by how well revenues repay the capital/operating costs of building infrastructure. Typically, price levels are set at a flat rate, rather than time-of-day pricing (ex. Golden Ears and Port Mann bridges). Infrastructure projects that are privately owned can use this form of road pricing to make a return on invested capital.
>
> ***Environmental:*** the primary objective of these systems is to reduce the environmental damage from congestion and idling, such as air pollutants, green-house gases, and noise pollution. Few road pricing schemes have the environment as the primary objective. Typically, reducing congestion or generating revenue is the main priority, and environmental benefits are viewed as a positive co-benefit to road pricing.

[vi] More specifically, the price for using the roads is determined through marginal-social-cost-pricing, which is an economic tool that measures the impact of adding an additional vehicle onto the roads. Hence, during peak travel times, the marginal social cost is high and is reflected by a higher price to use the road network. During non-peak travel times, the marginal social cost is lower (from having less or no congestion), and the cost for using the road network is lower (or even nil). While there is no consensus among economists on how to determine the exact marginal-social cost of congestion, a baseline pricing scheme is possible.

Based on the region's congestion and sizable infrastructure gap, along with the province's ambitious GHG targets, road pricing in Metro Vancouver would have to be based on a mixture of all three objectives. The exact weighting of each option would need to be determined through further engagement, consultation, and traffic modeling. Ultimately, these objectives need to be clearly and consistently defined.[70]

If or when Metro Vancouver achieves sufficient consensus on the overall objectives of a road pricing scheme, the more difficult task is designing the charges or tolls. With each goal-orientation of road pricing, there are multiple ways to arrange the pricing scheme. Based on a comprehensive review of road pricing schemes worldwide, author David Levinson lists at least *90 different ways* to implement road pricing.[71] In one respect, this flexibility is an advantage for policy-makers. It allows urban regions or individual cities to customize road pricing to accommodate unique needs and objectives. On the other hand, this flexibility tends to make the conversation highly technical. Detrimentally, this can lead to having too many options with varying complexity and impacts—making consensus-building difficult. This lack of clarity has strengthened public opposition to road pricing in other jurisdictions (discussed below).[72]

To avoid getting bogged down in the technical details of different pricing schemes, they can be summarized and placed into three general categories for setting charges/tolls:

1. **Distance-based charges:** road users are charged based on the amount driven, and can offer a great degree of choice and flexibility in how people pay for road use. This form of road pricing typically uses GPS technology to track the distances of road users. Alternatively, annual or semi-annual odometer inspections are another, less-intrusive, way of monitoring distance travelled. This form of pricing can be augmented by charging road users according to their vehicle's size and emissions. Distance-based charging has been implemented in Germany, the Netherlands, and Oregon.

2. **Tolling major infrastructure:** places user-fees on using strategic pieces of infrastructure, such as bridges, tunnels and highways. Tolls can either be a flat rate (i.e. if the primary goal is revenue generation) or can be priced according to traffic levels (i.e. if reducing congestion is the primary goal). The Golden Ears and Port Mann bridges are two examples from Metro Vancouver. Other examples include: the 407 highway in Toronto, the MacDonald and McKay bridges in Halifax, the I-15 highway in San Diego, California, and the major highway network in Melbourne, Australia.

3. **Area-based charges:** place a boundary around a portion of the city and charge users to enter and/or leave the cordon area. This system works best to alleviate congestion and traffic in well-defined and very dense downtown cores. The charges are typically adjusted to reflect the time of day and discourage traffic during peak travel periods. Based on its geography and traffic patterns, area-pricing has been adopted in Singapore, London, Stockholm, Bergen, and Trondheim.

Figure 7 – International Experiences with Road Pricing

City and year of implementation	Description of the system	Impacts on mobility and environment
Singapore 1975-1998 and 1998-	• Valid from 07:00 to 19:00 on weekdays. • Charge is 2 USD per crossing the cordon (up to 4 USD on expressways). • Fully electronic charging was implemented in 1998.	• Traffic reduced by 24%. • Average speed increased by 10-15 kph. • Improved pedestrian safety and reduced emissions.
London 2003	• Valid from 07:00 to 18:30 on weekdays. • Charge is 8 GBP for vehicles crossing, leaving or travelling within the charging zone. • Residents of the zone get 90% discounts.	• Number of vehicles declined by 18%. • Traffic delays cut by 25%. • Change to public transport and car share. • 7-15% decrease of NO_x, CO_2 and PM10 emissions.
Stockholm 2006	• Valid from 06:30 to 18:30 on weekdays. • Charge is 10, 15 and 20 SEK per crossings in different time periods (max 60 SEK a day). • Hybrid vehicles, taxis, buses are exempted.	• Traffic declined by 10-15%. • 14% reduction in vehicle distance in the congestion zone. • Rise in hybrid vehicles entering the zone. • 10-14% reduction of CO_2 emissions (nationwide 2-3%) and 7-9% reduction of other emissions.

Note: exchange rates (as of September 2011) for information: 1 USD = 0.73 EUR; 1 GBP = 1.14 EUR; 1 SEK = 0.11 EUR

Source: Márton Herczeg, Copenhagen Resource Institute (CRI)

Whether designed to reduce congestion, raise revenue, or mitigate pollution, road pricing – in all its forms – has been effective from an outcome perspective. While this paper does not do a comprehensive review of the structure and effectiveness of pricing schemes around the world, Figure 7 summarizes the success of road pricing schemes in Singapore, London, and Stockholm, and their effects on mobility and the environment.[73] In all three jurisdictions there was a substantial drop in traffic and air pollution, and a shift towards a more sustainable transit system.

Implications of Road Pricing in Metro Vancouver

The idea of implementing road pricing in Metro Vancouver is not new. Metro Vancouver formally endorsed road pricing as early as 1993, which was later "reaffirmed in Transport 2040 and the Regional Growth Strategy," and by the Mayors' Council in 2013.[74] Unlike other jurisdictions considering the implementation of road pricing, there is a high degree of institutional support in Metro Vancouver. Moreover, prior to 1970, many of Metro Vancouver's bridges/tunnels were tolled "as a means of financing infrastructure development."[75] Tolled infrastructure included the Pattullo Bridge, the George Massey Tunnel, the Queensborough Bridge, the Oak Street Bridge and the Lion's Gate Bridge.[76]

Metro Vancouver and TransLink have already conducted robust analysis on mobility pricing and road pricing. In its most recent iteration, TransLink conducted a detailed analysis of 20 policy options (Figure 5 above), ranking the alternatives based on the predicted effects on the transportation system, economic impact, fairness and transparency, and financial capacity. Measured against these objectives and goals, TransLink ranks road pricing highest.[77] Project tolls on new infrastructure – another type of road pricing – rank second.[78] TransLink is now moving ahead with further consultation and study to help build a multi-agency framework for road and mobility pricing. As a part of consensus building, interest in road pricing has been

voiced by several municipalities, including Delta, Surrey, Vancouver, North Vancouver, and Burnaby.[79]

With strong institutional support at the regional and municipal levels, it is perhaps curious that Metro Vancouver has not yet implemented road pricing. From a legal perspective, the unwillingness of the provincial government to endorse the idea is a primary reason. In order to adopt road pricing, the provincial government would need to amend the *South Coast BC Transportation Authority Act* to give authority to TransLink, ICBC, or some other agency to implement and administer the policy. Despite these political challenges, however, TransLink is continuing with its research and consultation on how best to implement road pricing in the region.

In addition to the political constraints at the provincial level, there are many other challenges involved with implementing road pricing, some stemming from its actual and perceived effects. It is therefore essential to understand the challenges, constraints, and sensitivities that would need to be adequately addressed.

Public Acceptability

The biggest barrier to road pricing, aside from provincial approval, is public opposition.[80] Public opposition has been so strong in some areas that road pricing is often viewed as "political suicide."[81]

For some obvious reasons, there has been widespread skepticism of how road pricing might affect the daily lives of residents. Indeed, road pricing takes something that has been viewed as 'free' (i.e. road space) and puts a price on it. This is equivalent to getting a free lunch each day, then all of sudden having to pay closer to the full price—something taxpayers are likely to view with suspicion, particularly in the absence of seeing clear benefits in return. Many motorists believe road pricing attempts to stop people from driving by penalizing motorists with higher costs. But these attitudes, while in some ways understandable, misrepresent both the intent and means of road pricing.

In its most basic form, road pricing attempts to include the total costs of driving within the price of using the roads, and internalizes these costs within our decision-making calculus. In terms of fairness, road pricing charges people based on their 'consumption' of road space: those who drive more will pay more; those who drive less will pay less. Thus, the intent is not to stop people from driving. Road pricing aims to incent people to consider other forms of transportation, drive less, and/or travel at non-peak travel times.

Depending on a person's driving habits, along with the availability of alternative forms of transportation, vehicle operators can save money by driving less. Assuming people have alternative travel options that are affordable, reliable, and convenient, the evidence suggests "consumers would choose to drive less, rely more on alternative modes, and be better off overall as a result."[82] Without question, those without good alternatives (such as people who live in large suburban communities) or who *need* to drive at peak times can be negatively impacted by higher road charges. This raises a host of fairness and equity concerns, which are discussed later in the paper. But for individuals with reasonably flexible commuting and travel options, paying

less for gas, parking, accidents, and car upkeep means that driving less can free up a substantial amount of disposable income.[83]

In the end, public acceptability is a necessary component to implementing road pricing. Public opposition has defeated road pricing in several jurisdictions, including Edinburgh, Manchester, and New York.[84] These jurisdictions had substantial institutional support, but strong public opposition outweighed support from government and business sectors, and community organizations. In Edinburgh and Manchester, where referendums were held to decide whether to adopt road pricing (without a pilot project), research suggests that voters did not fully understand the implications of road pricing and subsequently voted against it.[85]

In contrast, the pricing schemes in Norway and Sweden provide evidence that public acceptability can change once residents see how road pricing can improve traffic conditions. In 2006, Stockholm implemented a trial pricing scheme to see how it would affect congestion. Prior to the pilot project, opposition against road pricing was 62 percent; during the trial, opposition dropped to 48 percent.[86] When the city finally voted in a referendum upon the completion of the trial, residents voted 52 percent to reinstate the pricing scheme. As of 2010, support for road pricing in the city was 74 percent, and it is now a non-issue for many residents and politicians of Stockholm.[87]

The evolution of road pricing in three Norwegian cities saw a similar reversal in public sentiment. In the capital city, Oslo, road pricing was initially opposed by 70 percent of respondents, whereas by 2009 the opposition fell to 54 percent.[88] Interestingly, "when respondents were presented with projects financed by toll road funds, 74 percent were positive and only 24 percent were negative." As long as money was allocated to infrastructure, public transit, and environmental projects, three-quarters were supportive.[89]

Road pricing schemes in Bergen and Trondheim went through similar shifts in public opinion: prior to implementation, opposition rates were at 66 and 72 percent, respectively. After implementation, a majority of Bergen residents supported the pricing scheme; 72 percent of polled Trondheim residents supported it two years after it was adopted.[90]

The Scandinavian experience with road pricing offers two salient lessons. First, it demonstrates that public acceptance of road pricing can change quite dramatically once residents see how it works and that it can reduce congestion. Though expensive, implementing a pilot scheme prior to full implementation is a prudent and precautionary approach. Metro Vancouver can learn from the Scandinavian experience in this regard.

As a second lesson, public acceptance is highly correlated with how the pricing scheme is designed and communicated. Supported by evidence from other cities (in addition to the examples in Scandinavia), public support has increased when revenues are clearly and transparently earmarked for transit improvements.[91] Understandably, residents want to know where their money is being spent, and that it is going towards creating a better transportation network.

Based on experiences from other cities, there are a host of other actions government can take (both before and after implementation) to better mobilize public support.

- Provide reliable and unbiased information to citizens, showing the benefits and challenges of road pricing.
- Give the public a clear rationale for why road pricing is a desirable policy option (i.e. clearly discussing the problems of congestion and infrastructure financing).
- Make the pricing system easy to understand, convenient, and flexible.
- Bolster alternative transit options to provide adequate choice.
- Payment should be easy to use with multiple options.
- Ensure the privacy of data.[92]

Inequities of the Existing Transportation Network

With any major policy involving a shift in pricing, there are equity and fairness considerations, and this is certainly true of road pricing. Some of the issues that arise are contentious and pull in different directions. This is due, in part, to the wide range of possibilities for structuring road pricing, and also because the "perception of equity is highly subjective."[93] A good place to start the discussion of equity and fairness is with the existing transportation network. There are several entrenched inequities with Metro Vancouver's current transportation system that road pricing, if structured properly, can address.

In some parts of the region, the current tolling system for the Golden Ears and Port Mann bridges is viewed as highly unfair by many residents and businesses. Of Metro Vancouver's 22 bridges, the Golden Ears and Port Mann are the only two that are tolled (although earlier bridges infrastructure did have tolls)—leaving residents around the Fraser River paying more than residents elsewhere in the region. This has been a point of contention in regional politics for years, and municipalities such as Surrey, Delta, and Maple Ridge have voiced support for a more equitable tolling system.[94]

Another significant inequity with the current transportation network is the provision of public transit. Outlying municipalities such as Surrey and Delta pay the same taxes to TransLink as other municipalities, yet receive proportionally less investment in public transit and get less service. The $2 billion Canada Line (serving Richmond and the airport), the $1.4 billion Evergreen Line (serving Burnaby, Coquitlam, and Port Moody), and the proposed UBC line, are all examples of big-ticket transit improvements which overlook the needs of several municipalities, such as Delta, Langley, and Surrey.

In many respects, road pricing can help address these inequities. If, for example, all bridges/tunnels were tolled by the same (small) amount, or if all residents in Metro Vancouver paid the same per-kilometer charge, this could make the road network more equitable. There is no reason why, in the absence of an overall framework to address inequities, only residents living in and around the two tolled bridges should pay more than residents living elsewhere in the region. The province (or TransLink) could create a transparent and fairer framework for redistributing the revenues from road pricing. This framework might include specific transit improvements to all major hubs in the region, including regions that are currently underserved by TransLink.

Other Equity Concerns

Adopting road pricing requires a shift in who pays for road use; some people will be better off, and others will be disadvantaged. People who decide to pay the price of using the roads benefit from shorter and more reliable commute times. These beneficiaries are typically people who place a higher monetary value on their time (typically, those with higher-paying jobs or higher incomes). Conversely, the people who place less value on their time or who cannot afford to pay for using the road must find alternative modes of transportation. Without any form of compensation, this latter group is forced to change their transportation choices and, as a result, can be worse off.

As a result of this shift in who can and cannot afford to pay for using the roads, one of the biggest criticisms of road pricing is that it discriminates against people with low incomes. In this light, road pricing implemented in the absence of mitigating policies is seen by some critics as regressive; a policy which serves the interests of the more affluent, who can easily afford to pay more and who also benefit from faster commute times. The level of public acceptability of road pricing (discussed above) is likely to be contingent on the actual and perceived fairness to people with relatively low incomes. Therefore, it is important that that issue receives careful consideration.

While concerns over the impact on lower income households are legitimate, many of the inequities associated with road pricing can be offset through the redistribution of revenues. Through providing rebates, tax credits, discounts, better transportation options, or eliminating other taxes/fees, many socio-economic inequities can be addressed.[95] Moreover, those who do not drive will clearly benefit from the introduction of road pricing.[96] Because low-income individuals are less likely to own and operate a car and are more likely to use public transit, road pricing can be designed so that the overall affect on low-income individuals is positive and provides a net benefit (assuming revenues are used to enhance service).[97] In light of these findings, Metro Vancouver and TransLink have recognized that improvements to public transit and other offsetting mechanisms will require careful and thorough consideration.[98]

These socio-economic equity concerns will likely become less important over time. As noted by the designer of the Stockholm road pricing scheme, Jonas Eliasson, road pricing becomes internalized into the decision-making of people and households in the long-term, whereby people "change jobs and move homes" to better accommodate the pricing system.[99] As a co-benefit, this encourages the development of more compact and sustainable communities: it encourages people to live closer to work and drive less, and it facilitates sustainable forms of transit (walking, cycling, and public transit). These are well-established goals adopted by the provincial and municipal governments through the provincial Climate Action Charter.[100]

Business and Industry Considerations

There are several ways to conceptualize the impacts that road pricing might have on business and industry. The first is to consider the economic costs of doing nothing; in other words, evaluating the costs of congestion according to current and projected levels. This was discussed in Section 1, where it was suggested that congestion costs in Metro Vancouver are in excess of $2 billion annually. These costs are both private and social in scope, impacting the region's economic competitiveness, productivity, overall health, and the urban environment. In terms of affecting

the bottom line of business and industry, congestion unambiguously causes "delays, unreliable deliveries, reduced customer service, higher fuel and other costs."[101]

In light of these costs, the reductions in congestion from road pricing stand to benefit regional businesses and the economy more generally. If well-designed, road pricing would result in less congestion during peak periods and make the transportation system more reliable and efficient. If enough traffic is taken off the roads, this could reduce transportation costs for businesses and improve the overall productivity and competitiveness of the region.[102] Additionally, if the revenues from road pricing are used to further improve the transportation network, this can create a feedback loop to benefit business and industry through having a better and more efficient transportation network. Based on these benefits, several prominent business organizations have voiced support for road pricing (in some form), including the Toronto Board of Trade, the BC Chamber of Commerce, and the BC Trucking Association.[103]

An additional benefit of road pricing, often undervalued by business and industry, is the impact on incentivizing shifts towards greater efficiency. If firms are flexible, the rational response to road pricing is to alter behaviour to minimize costs. This can include changing the time of transport to off-peak times, investing in more fuel-efficient vehicles, or maximizing the use of empty truck space. As illustrated by the pricing scheme in Germany – where all trucks are charged according to mileage, weight, and fuel efficiency through GPS devices – higher costs can spark gains in efficiency and productivity.[104] Although the size and scope of these efficiency gains are difficult to predict, they represent an important feature of how firms and the overall economy can benefit from road pricing. All of these benefits are important for the efficiency of the Pacific Gateway and for improving the movement of goods and services through Metro Vancouver's ports, rails, and roads.

Despite the wide range of economic benefits road pricing can offer, many business and industry groups are hesitant to support the idea. Opposition from business and industry, like that from residents, can be a significant force preventing the adoption of road pricing. Based on the results in other jurisdictions, firms are likely to be skeptical at first that road pricing will actually result in a net benefit. Businesses would be obligated to pay charges/fees for using road space, and some firms, like many individuals, see road pricing as an extra tax. The benefits from lower transportation costs and increased efficiency are often overlooked.

A clear reason for the skepticism of business interests is a lack of good data and analysis on how road pricing might affect the bottom line costs of doing business. This is a problem that applies to the entire field of road pricing, not just Metro Vancouver, notably because measuring the impacts of road pricing on freight and goods movement is far more complex than with passenger travel. There over 90 different ways to implement road pricing, each interacting with the "multitude of vehicle types, shipment, business structures, logistic supply chains, attributes of trade routes, and the secrecy of information due to business competition."[105] What is more, many of the impacts on business and industry are long-term in nature and interact with other economic variables (such as recessions, unemployment, inflation, wage trends etc.). All of these factors make it difficult to determine or predict the specific impacts of road pricing on firms in a region.

Given these concerns, it is helpful to evaluate the effects on business and industry in some jurisdictions that have already adopted road pricing.

> **London:** prior to implementing the London Congestion Charge, "businesses were losing an estimated £2-4 million per week due to congestion."[106] After the implementation of the charge, 71 percent of surveyed businesses (n=500) said the pricing scheme had no noticeable impact on their business.[107] Only nine percent said the scheme had a "very negative" impact, while 9 percent noted a "very positive" effect. Traffic has been reduced by 16 percent and congestion by more than 30 percent under the scheme.[108] Small businesses and convenience store owners, sensitive to minor increases in transport costs, were the most vocal opponents of road pricing.[109]
>
> **Melbourne:** the city's 22-kilometre automated tolled highway network, connecting three major freeways in metropolitan Melbourne, Australia, is estimated to save businesses in the area of roughly $225 million each year (converted to Canadian dollars, 2007); it also saves businesses "up to 25 million litres of fuel a year."[110]
>
> **Norway:** the anticipated costs to business and industry were major concerns prior to the adoption of cordon pricing in Oslo, Trondheim, and Bergen. Once the pricing schemes were well-established in each city, "the effects on the city centre were mostly positive or only slightly negative." Over time these concerns have become less of an issue.[111]

Ultimately, the effects of road pricing on the movement of goods and services requires further study in Metro Vancouver in order to properly investigate what extent businesses and industry would benefit from road pricing, and whether offsetting mechanisms (such as discounts, capped-fees, and rebates) are appropriate. Unlike most passenger vehicles, where operators in most cases are able to use alternative modes of transportation, business and freight have a "greater dependency on the roads than most regular road users."[112] It is therefore important to understand the potential effects of road pricing on business and industry. Key questions include:

- What model of pricing will be used?
- What collection and monitoring system is most appropriate for the region?
- How will road pricing affect small, medium, and large businesses, and the overall competitiveness of the region?
- Based on traffic modeling, how much time will road freight save from reduced congestion?
- Can road freight change travel patterns to avoid peak travel times?
- How will the funds from road pricing be used to improve road freight infrastructure, and what other transit projects will be built?
- Will trucks from out of the region be charged the same as local trucks? If so, how?

Geographical Constraints

In order to have an effective road pricing system in Metro Vancouver, it must also be sensitive to the region's unique geography, traffic flows, and settlement patterns. With mountains to the north, an ocean to the west, a border to the south, and an estimated 60,940 hectares of designated land for the agricultural land reserve, the room to build new infrastructure is limited. Infrastructure improvements are constrained by all of these factors, making it increasingly

important to do more with less. Accordingly, it is not appropriate to take a road pricing system from another jurisdiction and simply impose it on Metro Vancouver.[113]

Unlike Stockholm and London, congestion in Metro Vancouver is not limited to the downtown core, and traffic does not move in a singular direction. Instead, congestion patterns are heterogeneous and reflect the growing suburban areas outside the historical Vancouver/Burnaby/New Westminster core. The City of Vancouver is still the largest urban area for employment; however, "its share in the region has been decreasing" due to the rapid expansion of surrounding cities.[114]

Although road pricing can help address the existing inequities with the transportation network, one important consideration is whether road pricing would disproportionately affect those living in outer suburbs. People living in Langley and Burnaby, for example, drive roughly twice as much as those living close to the downtown core.[115] Depending on the type of road pricing chosen, residents in these outer municipalities may pay more than other residents. Indeed, this was the primary reason why road pricing was not enacted in New York. These concerns require further analysis and research.

Shifting Commuting Patterns
A small number of residents in neighbouring cities work in Vancouver: 8% in Maple Ridge, 14% in Pitt Meadows, 14% in Port Coquitlam, 10% in Surrey, and 5% in Langley.
Source: Statistics Canada. 2006

Implementation Challenges

There are several practical challenges with implementing road pricing. The first, and perhaps most important, is the overhead cost of implementing and operating the system. New and emerging technologies have made this issue less complicated than a decade ago. Through electronic monitoring and global positioning systems (GPS) the overhead costs of different types of road pricing have decreased significantly. Depending on the objective and type of pricing, overhead costs can be as low as 3-5 percent, as illustrated by the national road pricing scheme in the Netherlands, operated by using GPS.[116] Moreover, the accuracy of tolling technology has also improved. For example, Germany's tolling system for freight movement – using On-Board Units based on GPS technology – is 99 percent accurate.[117] For a range of overhead costs from international road pricing schemes, see Figure 8 below.

Figure 8 – Comparative Implementation Costs

Scheme	Running costs/ revenues	Technology	Comment
London	42%	Camera + ANPR	Operational scheme
Stockholm	21%	Camera + ANPR	Operational scheme
Germany	12%–>25%	GPS & manual declaration	Operational scheme
Austria	11%	DSRC	Operational scheme
Switzerland	6%	Tachograph & GPS & DSRC	Operational scheme
Norway	8–14%	DSRC	Operational scheme
Singapore	20–30%	DSRC	Operational scheme
Netherlands	3–5%	GPS	Vodafone estimates
US modelling	8–16%	DSRC	Spreadsheet modelling
San Francisco	20–30%	DSRC ('Fastrak')	Proposed scheme

Source: John Walker (May 2011), "The Acceptability of Road Pricing."

As a technical issue, it is also important to note that current provincial policy would need to be amended in order to adopt a comprehensive road pricing strategy. According to the provincial Guidelines for Tolling (2003), tolls can only be used to finance highway and capacity expansions, such as on the Golden Ears and Port Mann bridges. If a bridge or highway is tolled, residents must have access to a "reasonable untolled alternative."[118]

Although the provincial "Guidelines for Tolling" seem to prohibit any form of comprehensive congestion-management pricing scheme, the guidelines could, under the right circumstances, be amended by the Provincial government. The guidelines are not entrenched in legislation or regulations (which would make amendments more difficult). The bigger impediment is a lack of provincial support for road pricing generally, and an unwillingness to advance the idea in the region.

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WEIGHING THE OPTIONS: CAN ROAD PRICING WORK IN METRO VANCOUVER?

As with any major change in public policy, road pricing can be messy, contentious, and raises a host of concerns that need to be addressed to move forward. Indeed, road pricing requires a significant shift in how we perceive and use the road network. The trajectory of population growth, congestion, expanding port and freight traffic, and ageing infrastructure all put mounting pressure on the region's growth and development, and Metro Vancouver needs to confront these difficult challenges with determination and rigor.

It is also important to recognize the wider context of the region's development. This has historically been a major flaw with road pricing dialogue. It is often a highly theoretical, academic, and at times simplistic conversation—ignoring important factors, such as behavioural responses, undesirable impacts on business and industry, political dynamics, and a range of implementation issues.[119] In the Metro Vancouver context, other important issues affecting the region's growth and development include: housing affordability, economic competitiveness, and environmental sustainability. Road pricing interacts with each of these issues, and should therefore be an integral part of the discussion.

At face-value, road pricing can prompt a knee-jerk reaction: citizens, businesses, and local organizations are concerned that the shift to a user-pay model will result in higher costs. The benefits of shorter and more reliable commute times, better public transit, and improved road infrastructure are difficult to conceptualize, and are often overshadowed by the high visibility of the pricing itself. Moreover, the long-term consequences of road pricing, such as land-use, impacts to value-added trade, boundary effects, and the redistribution of social and economic welfare, are relatively understudied.[120] This is due, in part, to road pricing's status as a relatively new policy tool, but also to the methodological issues in measuring some of these long-term impacts.

In order to build greater consensus around road pricing as a viable policy tool, these concerns need to be addressed by government, the private sector, and civil society. This will undoubtedly take time and energy. As demonstrated in other regions, once the benefits of road pricing become more tangible and intuitive, and after the key challenges are addressed, road pricing can become more palatable. For these reasons, adopting a pilot program to demonstrate the potential benefits of road pricing could be a pragmatic first step. The road pricing scheme in Stockholm provides a useful learning experience for Metro Vancouver in this regard. Although the two cities have different political cultures, geography, and commuting patterns, the two metro areas are roughly the same size and both rely on an intricate network of bridges.

Moving Forward with Road Pricing

The discussion of implementing road pricing in the region is well underway. Metro Vancouver and TransLink have already conducted robust research and analysis on road pricing, and continue to build support for implementing a road pricing scheme in the near future. In its most recent planning document, the 2013 Regional Transportation Strategy, TransLink outlines how the region can benefit from road pricing, and make the transportation network fairer and more

efficient. Under these goals, TransLink commits to adopting a mobility pricing strategy, looking at how time-of-day pricing can be used for public transit, parking, and roads and further commits to:

- Making mobility more affordable for the economically vulnerable;
- Combining forms mobility pricing with new investments in the transportation network (i.e. new bridges/tunnels and/or rapid transit lines);
- Commencing a study exploring the technical details and impacts of implementing mobility pricing and its effect on the road system; and,
- Making a flexible pricing system that protects road access for people who have few or no options to change their transportation.[121]

Community support for road pricing is also growing. SFU's Centre for Dialogue is joining the road pricing conversation by convening four regional dialogues with residents and stakeholders, beginning in late October. The purpose of this community engagement initiative is to enhance the literacy and understanding of road (and mobility) pricing in Metro Vancouver, and to identify the concerns and opportunities of potential systems. For more information on these sessions, see the SFU Centre for Dialogue website.

Concurrent with the efforts of TransLink and the Centre for Dialogue, the Provincial Government has committed to holding a referendum in 2014 on how to fund transportation in the long-term, sustainably. The referendum is expected to touch on the future of TransLink and how to pay for necessary transportation improvements. Roughly one year away, the details of the planned referendum (binding vs. non-binding, the referendum date and question) are still unknown, and the public is without information outlining the referendum options. At this point, it is unclear whether the referendum will encompass road pricing, or other specific mobility-management tools.

Regardless of the referendum question, many regional and municipal officials are concerned that the short timeframe may not provide enough time for proper consultation, engagement, and discussion, especially when considering the significance of the referendum outcome.[122] In protest, the Mayors of Metro Vancouver sent a letter to the Province opposing the referendum in June, 2014. Despite these concerns, the referendum is scheduled to move ahead as planned.

Options for Metro Vancouver

Building on the context, data, and analysis presented in this paper, we conclude by digging a little deeper into what form of road pricing might work in the region. While it is ultimately up to TransLink, Metro Vancouver, and residents to determine what is 'right' for the region, certain forms of road pricing will likely work better than others.

The intent here is not to advocate a specific model of road pricing for Metro Vancouver; rather this section examines some of the alternatives that may be most appropriate. In general, there are several overarching principles that government should address, no matter what form of road pricing is considered:

> **Address socio-economic equity concerns:** the pricing scheme should be sensitive to lower-income households, and seek to offer these individuals a net benefit. Also, the

needs of other vulnerable groups, such as seniors and persons with disabilities, should be given due consideration. Rebates, exemptions, and discounts should all be on the table.

Address existing intra-regional inequities: risking oversimplification, the road pricing scheme should minimize or eliminate the existing transportation inequities in Metro Vancouver. This includes the unfair tolling of only two of the region's 22 bridges/tunnels, and the unequal provision of public transit services in some Metro area municipalities.

Bolster other transportation options: Road pricing works best when people have competitive, affordable, accessible, and reliable transit options. Choice and flexibility are critical. Metro Vancouver's transit system is ahead of other cities in terms of public and active transit; however, many communities in Metro are currently underserved by TransLink and require better public transit options. Those who are 'priced off the roads' byroad pricing (i.e. those who cannot afford to pay) require some form of compensation. Improvements to the transit network can be one form of compensation, and could be supplemented by other offsetting mechanisms such as free (or discounted) transit passes. These offsetting mechanisms need to be clearly and transparently outlined.

Recycle revenues: the revenues from road pricing should operate in a closed system, meaning that all revenues be reinvested into improving regional transportation services and infrastructure. This can include public and active forms of transit, as well as making improvements to the road network for passenger vehicles and freight. As illustrated by various international examples, acceptance of road pricing will likely increase if such projects are specific and transparent.

Pricing should offer a net gain for business and industry: proper research and analysis is currently lacking in this regard. Theory and real-world examples demonstrate a net gain for business through reduced travel time and fuel use, and increased productivity in some jurisdictions; however, more research and modeling is necessary in Metro Vancouver to determine the effects on business. This should include a breakdown of how small, medium, and large businesses are likely to be affected. The need for offsetting mechanisms should be considered within this work as well. In order to get the support of business and industry, the pricing scheme needs to be "resilient, adaptable, and flexible."[123]

With these general considerations in mind, it is important to note that TransLink and Metro Vancouver are aware of many of these issues. Both organizations have undertaken preliminary research and analysis, and TransLink in particular plans on conducting further study on wide-ranging impacts of road pricing.[124]

In terms of specific road pricing schemes, the discussion here focuses on comparing the three models listed in Section 2*: distance-based pricing, area-based pricing, or tolling major infrastructure*. For simplicity and brevity, robust analysis of road pricing schemes is left for government, business, industry, and civil society. The following is a general discussion of some of the major advantages and drawbacks of each form of road pricing. For a more detailed

analysis of the different types of road pricing and their projected impacts, see the additional resources in Appendix B (in particular, the 2010 Deloitte study commissioned by TransLink).

Area-based pricing

Based on the heterogeneous traffic flows in Metro Vancouver, and the growing suburban communities south of the Fraser River, a cordon pricing system (which creates a tolled area around the downtown core, where drivers pay to enter and/or exit) is likely an ineffective approach. Cordon pricing would discourage people from driving into the downtown core (a sticking point for business and industry), and would do little to improve traffic flows in other parts of the region. As a result of high parking prices, changing settlement/employment centres, and better public transit, traffic entering the downtown core has actually decreased from a decade ago.[125] Thus, the forms of road pricing in London and Stockholm are not applicable to the unique geography, traffic, and settlement patterns of Metro Vancouver.

Another form of area-based pricing, supported by several local governments, is to create pricing zones around each municipal boundary. This system would charge people to enter and exit each municipality, and could help manage the existing inequities associated with bridge tolling. Viewed by some as politically acceptable because it treats all municipalities equally, it would likely be relatively effective at reducing congestion. According to 2006 data, "more than 60 percent of commuters cross municipal boundaries, and most of the growth in commuting flows is occurring between suburbs and from the city of Vancouver to the suburbs."[126] Thus, much of the region's traffic would likely be captured from municipal boundary charges.

Implementing this option, however, would be extremely difficult. Municipal boundaries are not neatly defined, and drawing the pricing lines would surely be both complex and a source of political upheaval. Also, people living on or near municipal boundaries are likely to be more affected by this form of pricing than others. This raises another important implementation issue: what form of technology would be used to charge road-users under this pricing scheme? Bridges are natural tolling points and work well with some municipal boundaries (for example, the crossings between New Westminster and Surrey, and the crossing between Vancouver and Richmond). But some municipal boundaries, such as between Vancouver and Burnaby, Burnaby and Coquitlam, and Langley and Surrey, pose serious challenges for implementing municipal-boundary tolls. Would road users be charged to travel along municipal boundaries? Or only when they cross municipal boundaries? If the latter, would GPS technology be used to monitor travel patterns? These questions require further discussion and study.

Tolling Major Infrastructure

The large network of bridges in Metro Vancouver makes tolling major infrastructure an attractive option (see Figure 9). If all bridges (and the Massey and Cassiar tunnels) are tolled similar to the Golden Ears and Port Mann bridges, this could effectively reduce congestion throughout the region. Moreover, it could provide the region with significant new revenues, and eliminate the current inequity in bridge tolling. A comprehensive or region-wide tolling system for Metro Vancouver bridges is supported by the Greater Vancouver Regional District, along with the Consulting Engineers of BC.[127] It is argued that tolling the 22 bridges in the region will help maintain geographical equity, and also limit traffic redirection (it is hard to avoid bridges in

Metro Vancouver!). As an international comparison, road pricing in Stockholm generated negligible redirection of traffic onto other (non-tolled) routes.[128]

Figure 9 – Major Bridges and Tunnels in Metro Vancouver

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a. Major bridges and tunnels marked with red circles: 1 (Lions' Gate); 2 (Burrard St.); 3 (Granville St.); 4 (Cambie St.); 5 (Georgia Viaduct); 6 (Dollarton); 7 (Second Narrows); 8 (Cassiar Connector Tunnel); 9 (No. 2 Road); 10 (Dinsmore); 11 (Sea Island); 12 (Arthur Laing); 13 (Oak St.); 14 (Knight St.); 15 (George Massey Tunnel); 16 (Alex Fraser); 17 (Derwent Way); 18 (Queensborough); 19 (Pattullo); 20 (Port Mann); 21 (Pitt River); 22 (Golden Ears); Westham Island bridge is off southwest corner of map.

Source: Cited in Robin Lindsey (2013), "Prospects for Urban Road Pricing in Canada Prospects for Urban Road Pricing in Canada."

Technology for this form of road pricing is well-developed and accurate. Tolling major infrastructure, however, requires significant upfront capital to outfit some portion of the remaining 20 bridges with sensors, in addition to the overhead to operate the tolling technology. Sensory technology (either Automatic Number Plate Recognition or Dedicated Short Range Communication) is used in many jurisdictions, such as Singapore, Stockholm, London, the U.S., Norway, and Austria. Based on these international examples, capital/operating costs can be as low as 8 percent of revenues (Norway) or as high as 42 percent (London). A comprehensive costing exercise for this form of road pricing would be required.

As an additional equity issue, tolling the bridges and tunnels may be viewed as unfair to areas with higher concentrations of bridges and tunnels. Surrey and Richmond, for example, are connected to almost half of the region's bridges. In addition, if only bridges and tunnels are tolled, this may not reduce congestion in all areas. More study of the issue is required, but it may be appropriate to also toll other major pieces of infrastructure, such as the Sea-to-Sky highway or portions of Highway 1.

Distance-Based Pricing

On the surface, distance-based pricing is the most comprehensive and flexible form of road pricing.[129] It can offer an equal incentive for people to drive less and, depending on how it is implemented, encourage people to drive less during peak times of the day. It can also be designed to charge people based on vehicle type (i.e. the weight of the vehicle and its subsequent damage to the road network) and vehicle emissions. Perhaps most importantly, advancements in technology facilitate a high degree of choice with distance-based pricing. The pilot program in Oregon, for example, gives road users five different options for how participants pay for road use, ranging from a basic flat fee (with unlimited travel) to using travel information from smartphones and GPS devices (to pay on a per km basis).

Although distance-based pricing operates on a fundamental principle of fairness (i.e. the more kilometers driven, the higher the price), the effects in Metro Vancouver could be highly inequitable. Simply put, people in neighbouring communities often drive greater distances than people living close to Vancouver's downtown core.[130] This effectively penalizes residents of suburban municipalities and rewards high-density areas where people are less dependent on cars. While this may be beneficial in the long-run – encouraging the development of more sustainable and compact communities, less dependent on cars – it will likely create substantial backlash from outlying municipalities and be seen as unfair by suburban residents. In a similar vein, distance-based pricing may disproportionately affect people with lower incomes, who, because of high housing prices in the downtown core, are pushed to live further away. These equity concerns are important and require further analysis.

Generally, there are two ways to implement distance-based pricing. The first is to conduct regularly scheduled audits of vehicle odometers. Doing this via a single provincially regulated insurance company (the Insurance Company of BC) would be simpler and more straightforward than having to rely on multiple insurers (as in other jurisdictions), as audits could be coordinated with vehicle and insurance renewal. The downside of conducting odometer audits is that road users cannot be charged based on the time of travel, only total distance travelled. There are also questions of how vehicle owners would react to a requirement to report mileage in this way.

The second method for distance-based pricing uses GPS technology, similar to the systems in Oregon, the Netherlands, and Germany. Motor vehicles could have a GPS device installed, with the capability of tracking the total distance traveled and time of day. Compared to other options, this offers an effective and flexible way to reduce congestion—especially when considering that road users could have multiple options in choosing their own pricing/payment method, and type of technology.

The costs of GPS technology have come down significantly over the past decade, which makes distance-based pricing more viable than before. The GPS systems in the Netherlands, Germany, and Switzerland have some of the lowest operational costs compared with other road pricing schemes (see Figure 9 above). But as with any technologically advanced system, there are privacy concerns with distance-based pricing. The biggest concern is that GPS devices would track personal travel behaviour. This Orwellian style of monitoring may prompt objections from many, and would require safeguards to ease concerns. Ideally, the data would only track

kilometers driven and the time of day. Collecting data on specific travel behaviour (while possible) needs further discussion and research.

All Options on the Table

Looking at the different forms of road pricing, the foregoing discussion offers a glimpse into the wide range of trade-offs associated with area-based, infrastructure-based, and distance-based pricing. Realistically, each of these options is viable in Metro Vancouver, and each would have distinctive impacts on residents, businesses, land-use, and the transportation network. Moving forward, it is important that all options are carefully debated and studied—both within the context of the transportation network and other 'bigger picture' realities of the region.

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CONCLUSION

This paper has discussed worsening congestion and infrastructure financing as two interrelated problems facing the region. In a larger frame, congestion and insufficient transportation infrastructure interact with several other important demographic, economic, political, and social issues. The costs of these trends are far-reaching and systemic—slowing the movement of people, goods, and the provision of services. Like the common cold, congestion is a nuisance which interferes with our everyday lives and is something that everyone wishes would just go away.

The current trajectory in Metro Vancouver is unsustainable in many respects, and the challenges the region faces are formidable. The region is growing at a steady pace, with limited space to accommodate projected increases in passenger and freight traffic. In many areas of the region, the scope to increase the supply of road infrastructure is limited by both money and space, and as discussed above, key elements of the regional transportation network – municipalities, TransLink, and bridge infrastructure – are dealing with the legacy effects of significant underinvestment. Current instruments for funding transportation improvements, such as fuel, parking, and property taxes, are insufficient to meet the transportation needs of the region, which makes it critical to find sustainable funding sources.

From an economic lens, worsening congestion and the shortfall in infrastructure investment will continue to have a detrimental impact on the region's development, growth, and international competitiveness. Almost everything we buy travels by truck; and, to varying degrees, we all depend on the road network to get to work or school and to carry out our social lives. Having efficient and reliable transportation is therefore intrinsically linked to transportation costs and our overall well-being as both consumers and citizens. Without question, improving mobility in the region holds great potential for maintaining and advancing economic growth and prosperity.

From an environmental perspective, Metro Vancouver and the Provincial government have made ambitious commitments to reduce greenhouse gases and other sources of pollution. The transportation sector – both passenger and freight – has a big influence on these sources of environmental damage, and reducing congestion can be a major source of abatement and a way to make our environment cleaner. Furthermore, the move to create more compact and sustainable communities is an overarching goal of both local and provincial governments. Reducing dependence on motor vehicles can help realize all of these goals.

The opportunity to reduce vehicle demand and ensure more efficient use of the road network is therefore is increasingly attractive to many policy-makers. As discussed throughout this paper, road pricing is one demand-side management tool which can help address the region's transportation problems. By charging road-users based on the actual costs imposed on the road network, pricing the roads is one of the most direct and effective ways to reduce congestion, raise revenue, and abate environmental damage. As noted by the BC Chamber of Commerce, "jurisdictions around the world are recognizing that to be sustainable, funding mechanisms need to combine sustainability with the principle of user pay while managing traffic demand; a well designed road pricing system meets all of these criteria."[131]

In many senses of the term, road pricing is not a new concept in Metro Vancouver. Before 1970, many of the bridges in the region were tolled; and the idea of implementing some form of road pricing for motorists has formally been on the agendas of TransLink and the Greater Vancouver Regional District since 1993. TransLink, based on its 2013 Regional Transportation Strategy, is now actively pursuing the implementation of road pricing and initiating further research, consultation, and engagement.

Given these developments, road pricing may not be as great of a shift as people think—fundamentally, it requires looking at our values of mobility in a different light. To date, roads have been underpriced and overused, making "travelling by car artificially cheap in terms of money, and artificially expensive in terms of time."[132] Putting a price on using the roads is simply a different way of viewing and using road infrastructure.

Without question, implementing road pricing is complex and raises significant challenges, involving issues of equity and fairness, political constraints, considerations for business and industry, and public acceptability. As with any policy which increases the price of an essential good, road pricing generates vocal opposition. But as demonstrated in other regions and cities around the world, these challenges are surmountable over time, with clear and concerted leadership. Based on the experiences of cities and regions that have successfully implemented road pricing, it is important to focus on the broader goals of improving the reliability, efficiency, and sustainability of the transportation system, rather than get bogged down in technicalities. At a minimum, road pricing in Metro Vancouver would need to be flexible, transparent, and give people choice.

Although this paper has focused on the impact of passenger vehicles and freight movement, the dialogue around road pricing is wider in scope. It reflects how we all move around the region and it interacts with issues such as housing affordability, economic competitiveness, and environmental sustainability. Going forward, it is important that all road users are included in the conversation—viewing the transportation system not just in terms of cars and trucks but as enhancing the mobility for all road users.

The dialogue around road pricing is expected to intensify in the coming years in Metro Vancouver, especially with the anticipated referendum in 2014 on how to sustainably fund transportation in the region. While it is uncertain whether the referendum will encompass road pricing or other specific mobility-management tools, the topic is likely to receive increased attention from local governments, Metro Vancouver, and TransLink. At the same time, it offers an opportunity to move the conversation forward and address the higher-level issues outlined throughout this paper.

Overall, in order to develop a more sustainable vision of transportation, a shift in how we value and view mobility is required. Although it is an uncomfortable concept for many, road pricing represents a shift in thinking that could significantly alleviate the region's gridlock, improve transportation infrastructure, and make the region a more prosperous and cleaner place to live.

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Appendix A – Overview of International Road Pricing Schemes

(http://www.tac-atc.ca/english/resourcecentre/readingroom/pdf/roadpricing-brief.pdf)

Location	Year of Introduction	Primary Objective	Secondary Objective	Type	Charges	Technology
Singapore	1975 (Original)	Reduce congestion in CBD	Encourage use of transit	Cordon based CBD access plus expressways and outer ring roads	Variable: • fee periodically changed depending on travel speeds • by vehicle type	• OBU with inserted debit card • DSRC with gantries • ANPR for enforcement
www.lta.gov.sg						
Oslo, Norway	1990	Revenue - dedicated for transport investment in Oslo		Cordon based central area access	Flat fee depending on vehicle weight	• In vehicle transponders • Toll booths for manual payment • ANPR for enforcement
San Diego, California (I-15)	1996	Originally to achieve more effective use use of prior HOV lanes and therefore to relieve congestion on main route	Revenue generation	High Occupancy Toll (HOT) lanes. With recent expansion, now called Managed Lanes	Dynamic Variable Pricing for single occupant vehicles – price per mile varies with congestion.	• In vehicle transponder using DSRC
www.sandag.org		www.fastrak.511sd.com				
Toronto, Canada 407 ETR	1997	Provide additional expressway system capacity	Revenue generation for expanding and extending the highway.	Toll "closed" facility – per kilometer toll fee	Variable by: • Time of day • Vehicle type	• In vehicle transponder using DSRC • ANPR for payment without transponder • Gantries at entry and exit ramps
www.407etr.com						
Melbourne, Australia	2000	Reduce congestion in CBD	Improve access for freight associated with port	• Toll facility • Two routes: City Link (22 km) Eastlink (39 km)	Fee for toll zones	• In vehicle transponder using DSRC ANPR for enforcement
www.vicroads.vic.gov.au						
London, UK	2003	Reduce congestion in central area	• Encourage use of transit • Revenue dedicated for transport investment	Cordon based central area access	Pre-or post-paid flat fee	ANPR (for charging and enforcement)
www.cclondon.com						
Santiago, Chile	2004	Reduce air pollution by alleviating severe queuing / congestion	Provide new infrastructure through private concessions	Tolled urban roads network	Variable by time of day	• In vehicle transponder using DSRC • ANPR for enforcement
Germany	2005	Revenue for maintenance and road system improvements	Allocate costs to HGVs which cause disproportionate share of road wear	HGV distance charges on national autobahn system	Variable charges for HGV>12 tonnes based on: - class of vehicle - number of axles	• OBU – GPS for charging • ANPR for enforcement
www.toll-collect.de		www.bmvbs.de/en				
Stockholm, Sweden	2007	Reduce congestion	• Improve environment • Encourage transit use • Revenue dedicated for transport investment	Cordon based central area access	Variable by time of day. Vehicle owners invoiced monthly.	ANPR (for charging)
www.vv.se/templates/page3__1715.aspx						

CBD = Central Business District
OBU = On-board unit
HGV = Heavy Goods Vehicle
DSRC = Dedicated Short Range Communication
ANPR = Automatic Number Plate Reading

Appendix B – Selected Resources on Road Pricing

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