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Metro Vancouver Road Pricing Research Study

TransLink

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Table of contents

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1. Introduction

1.1 Objective and Scope of Study

The Provincial government, Metro Vancouver and TransLink share similar policy directions to ensure that the Metro Vancouver region (the "region") has an effective transportation system to move people and goods efficiently and to manage the use of motor vehicles so that negative impacts such as congestion, greenhouse gas (GHG) and air contaminant emissions do not cause the region to suffer economically, socially or environmentally. Central to achieving these policy directions is the strategic investment in transit and road capacity, and using innovative approaches to reduce vehicle use and make alternative travel choices more attractive to residents of the region. Collectively, these are intended to reduce congestion, shape land use and tackle the large proportion of the region's GHG production that comes from transportation. Both the Province's 2008 Transit Plan and TransLink's long term transportation strategy, Transport 2040, reflect these overall directions. However, the needed investments in transit and other infrastructure will be expensive and cannot be funded from TransLink's current sources.

As a consequence, TransLink is presently exploring the options surrounding the current and future funding requirements to sustain and improve the region's transportation network and infrastructure. It has a wide range of existing revenue sources but many of these sources cannot be relied on to meet growing needs for a number of reasons, which are discussed in more detail in the body of the report. As such, TransLink is considering a wide range of new sources, which like many other urban regions worldwide, includes examination of forms of road pricing. Road pricing is not only seen as a potential new funding source but also provides benefits related to more efficient and sustainable utilization of the transportation system.

TransLink is at the exploratory stages of determining how road pricing could benefit the region. No decision will be made on whether or not, or how to proceed with a road pricing scheme at this stage. Moreover, as is evident from this report, any decision to proceed will require TransLink to achieve an explicit alignment of policy direction with the Province and for both to proceed in tandem. To explore the overall potential of various forms of road pricing, TransLink has commissioned Deloitte to undertake this study which:

- Provides an explanation of the concept of road pricing, its various forms and lessons learned from other jurisdictions;
- Provides a planning level evaluation framework which can be applied to examine different road pricing concepts for Metro Vancouver; and
- Using illustrative road pricing schemes as a tool, examines a number of dimensions of road pricing which are relevant to Metro Vancouver including revenue generation and demand management, the trade-off between costs and benefits, tolling methods, etc.

This report does not, nor is it intended to, propose a definitive road pricing solution for the region at this stage. Rather, it is intended to form the basis for further assessment of road pricing against TransLink's goals and objectives and for considering additional and more detailed analysis of potential schemes.

2. Background on Road Pricing

2.1 What is Road Pricing?

Road pricing involves the charging for the use of a road or bridge, which would otherwise have been free to the user. The asset could be newly constructed or already in existence. The basis for the charge, or toll, can be a function of time, distance, load, type of facility, or other parameters such as congestion, emissions and mode.

Road pricing may be used to recover some or all of the cost of externalities from driving, such as delays in the network, increases in road accidents, and increases in vehicle emissions, all with an aim to encourage the motorist to consider the total cost that their journey involves and as a result make changes to the journey that benefit the driver and society. The changes could include making the journey at a different time, combining or shortening journeys, taking different routes, switching mode away from the car or not taking the journey at all. Road pricing may also be used to recover the direct costs of providing the transportation network, such as capital and operating costs.

2.2 Typical Road Pricing Objectives

There is a range of potential objectives for a road pricing scheme.

Congestion Reduction
Peak pricing can have the effect of encouraging motorists to switch their journey times to off-peak, thereby attenuating peak traffic flows. Pricing in general may prompt motorists to avoid the journey all together or to combine it with other journeys. Assuming that alternatives are in place, motorists may be encouraged to shift mode to transit or walking/cycling to avoid the cost or inconvenience of using a car. Trucks and other delivery vehicles may be encouraged to travel at times of low demand or take greater loads and therefore make fewer trips to reduce their costs. Road pricing is therefore a form of demand management, influencing the demand for road capacity through price signals to road users.

Financial (Revenue Generation)
Road pricing may be viewed as an alternative way for governments and other public entities to raise funds, assuming that the revenue at least covers the cost of implementing and operating the pricing system. This revenue can then be used directly to fund road infrastructure as well as other parts of the transportation system, including transit.

Additionally, road pricing may be viewed as a more appropriate and logical form of paying for transportation than some other forms of revenue, because road charges are directly related to the use of the roads. Tolling is used in many cases to recover the cost of building, operating and maintaining a new road or bridge.

Environmental
Congestion is both an environmental problem and an economic problem. Vehicle trips generate harmful emissions and the amount is increased where vehicles are stuck in stop-and-go traffic. To the extent that road pricing contributes to congestion reduction, a shift to more efficient vehicles and more sustainable transportation mode, it can reduce the environmental impacts of the transportation network and address climate change and local air quality objectives.

The majority of road pricing schemes in existence today achieve one or more of these objectives, although congestion reduction is the most common.

2.3 Summary of Lessons Learned from International Experiences

Road pricing has been applied globally to a varying degree of complexity and scale. However, despite the differences in the application of road pricing, there are some common themes with regards to the reasons for their successes and failures. The table below summarizes the lessons learned from the international application of road pricing in other jurisdictions.

Key Lessons for Implementing Road Pricing	
Have a clear objective.	Establish research to provide solid building blocks for design and evaluation.
Have a committed political champion and establish clear governance.	Define appropriate procurement strategy and structure contracts accordingly.
Establish business case and adequate approved budget.	Use proven technology – IT is an enabler.
Extensive public consultation and focused stakeholder engagement before, during and after implementation.	Focus on customer relationship management.
Secure co-operation from third parties.	Ensure a successful debut and plan adequate contingencies.
Ensure adequate public transport alternatives are provided.	Provide a strong project, contract management and support team.

3. Metro Vancouver Context

3.1 Basic Facts – Population, Vehicle Fleet, Travel Demand

The Metro Vancouver region comprises twenty-two member municipalities and one electoral area and encompasses 2,820 sq. km.

Today the region's population is estimated at 2.3 million and is expected to continue to grow by over 35,000 residents per year[1], adding 1.1 million people for a total of 3.4 million in 2041[2]. In addition, adjacent areas with influence on traffic within and through Metro Vancouver (i.e. Sea to Sky Corridor, Fraser Valley) are expected to grow at an even faster rate than the region itself[3].

In 2009, there were 1.4 million vehicles[4] registered in the region, a number that has been growing at an average rate of approximately 30,000 vehicles per year for the last decade. The vehicle fleet will grow as the region's population increases, leading to greater demands on the road network.

On an average day, roughly seven million trips are made in the region (by residents, excluding commercial trips) and about three quarters of these trips are made in private vehicles as either auto drivers or passengers and the rest is by transit, walking and cycling. Annual transit system passenger trips have increased from 110 million in 1989 to 188 million in 2009, a 71% increase.

3.2 Transportation Network

The transportation system within Metro Vancouver consists of the Major Road Network, municipal roads, provincial highways, heavy rail, ocean ports, a multi-modal public transit system, and the international airport. Public transit encompasses commuter rail (West Coast Express), the rapid transit network, Seabus and bus service, all of which are the responsibility of TransLink. Compared to many other major urban areas, Metro Vancouver's road network is characterized by relatively few controlled-access highways. Some additions and improvements to the road network are expected in the next several years, including the Province's Port Mann/Highway 1 and the North Fraser Perimeter Road East and South Fraser Perimeter Road projects and TransLink's proposed Pattullo Bridge replacement and North Fraser Perimeter Road West projects.

Overall there is a multi-jurisdictional responsibility for the road network, but it operates as a coherent system and the road users are relatively indifferent to multi-agency control.[5]

3.3 Travel Patterns

The travel challenges in Metro Vancouver are strongly influenced by geography, topography and urban form. The traditional Central Business District (CBD, i.e. Downtown Vancouver) is in the northwest quadrant of the region. The region overall is constrained by the ocean to the west and the mountains to the north. As a result, growth has been skewed to the south and east portions of the region, and the

[1] Metro Vancouver 2040, Shaping Our Future, Regional Growth Strategy, Draft – November 2009
[2] Metro Vancouver 2040 – Backgrounder: Metro 2040 Residential Growth Projections
[3] BC Stats, British Columbia Population Projections, PEOPLE Projection 29, Figure 12
[4] Includes passenger vehicles, commercial vehicles, motorcycles, trailers, motor homes, and commercial trailers with active insurance.
[5] Transport 2040, "Major Roads Highways and Gateways Map", TransLink, 2008

Fraser Valley. Numerous water bodies (e.g. Burrard Inlet, Fraser River) have led to the creation of a road network that is defined and constrained by a relatively small number of major bridge crossings.

The travel pattern in the region is increasingly becoming characterized by a 'many-to-many' pattern as more origins and destinations are dispersed among the region's many municipalities and subregions. This type of pattern of travel is challenging to efficiently serve by transit and roads, as fewer and fewer trips have common origins and destinations.

3.4 Congestion in the Region

Many trips in the AM or PM peaks experience poor operating conditions for at least one segment of the journey – especially due to the reliance on a relatively small number of major bridges and highways that are sensitive to traffic incidents. While the majority of travel occurs in the peak periods, off-peak travel has continued to increase.

It is worth noting that impacts of congestion are not universal across the network. The constraints of major water crossings in several cases have led to a situation where traffic is, in effect, metered by the congestion at these facilities, resulting in some of the worst congestion being distant from the CBD.

3.5 Provincial Transit Plan

Recognition of the need to expand travel options is not confined to Metro Vancouver or TransLink plans. Many of the same themes and broad policy directions are reflected in Provincial documents. Two examples are the Provincial Transit Plan as well as the Ministry of Transportation and Infrastructure's (MoTI) 2009/10 – 2011/12 Service Plan Update.

The Provincial Transit Plan[6], which was released in January 2008, *"is British Columbia's new strategy for expanding fast, reliable, green transit"* and observes that it is *"a major element of our climate action efforts, helping achieve our greenhouse gas reduction goals by significantly increasing transit ridership, reducing automobile use, and providing a foundation of transportation infrastructure to support the development of healthier communities in the future"*.

MoTI's 2009/10 – 2011/12 Service Plan Update[7] defines a number of provincial goals that consider all modes. Of particular note is Objective 3.1: *"Increase use of transit, cycling and other alternative modes of personal transportation".* This objective aligns well with Transport 2040's goal to have most trips being made by transit, walking and cycling.

Collectively, it is clear that many of the objectives of the region and those of the Province are well-aligned. However, how to fund the planned initiatives and provide incentives to change travel behaviour remains to be determined.

3.6 Regional Transportation Strategy and Plans

It is TransLink's responsibility to implement plans to meet the transportation needs of the Metro Vancouver region. "Transport 2040" is TransLink's long term transportation strategy, and is a key determinant of the success of the new Regional Growth Strategy being developed by Metro Vancouver.

Beyond the road projects mentioned earlier, future transportation capacity expansion in the region is expected to be largely focused on transit. Planned transit expansion includes the Evergreen Line, SkyTrain fleet and service expansion, rapid transit corridor development, and bus service expansion. Current funding streams are not sufficient to support these improvements and expansion.

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[6] http://www.th.gov.bc.ca/Transit_Plan/Provincial_Transit_Plan_LR.pdf
[7] http://www.bcbudget.gov.bc.ca/2009_Sept_Update/sp/pdf/ministry/tran.pdf

3.7 TransLink Revenue

The “Funding Stabilization” 2010 10-Year Plan adopted by TransLink essentially maintains the status quo transit service levels overall, and anticipates some transit service realignment to achieve efficiency improvements. Expansion of the transit and road networks is not included in the plan, beyond existing commitments. It requires utilizing reserves and increasing fares, fuel tax and the parking sales tax. TransLink’s three largest revenue sources are fuel tax, transit fares and property tax. The first two sources are transportation related; property tax is not (although property values are linked to accessibility of the property, which is a factor of transit service, road connections and congestion in the area). Fuel tax is increasingly being viewed as being an unstable revenue source that is demonstrating a downward trend, and therefore a replacement or supplementary revenue source will be necessary in the mid to long term. TransLink can increase transit fares but there are limits to what is practical and reasonable. Most other existing sources are relatively small in comparison.

3.8 Tolling

The Golden Ears Bridge is currently the only tolled road segment in the region. The new Port Mann Bridge under construction will be tolled by the Province, and it is anticipated that TransLink will toll the future replacement Pattullo Bridge, which is in the planning stages. Revenues from these tolls are or will be dedicated to recovering the capital and operating cost of the respective new facilities.

The *South Coast British Columbia Transportation Authority Act* under which TransLink operates allows tolls to be charged to recover all or part of the cost to provide “designated projects”, “major crossings”, or “improvements to the major road network”. The *Act* does not support tolling for general revenue purposes; tolls must be asset-specific. The Province has a set of tolling principles which essentially stipulate that only major projects that increase capacity may be tolled and a reasonable ‘free’ alternative must be available.

3.9 Why Consider Road Pricing Now?

Road pricing has been contemplated in regional transportation plans for many years, both as a source of revenue and as a demand management tool.

The region is facing funding issues in the short to medium term and may experience a continuing reduction of revenues earned from fuel taxes, as more efficient vehicles reduce the consumption of fuel. This revenue source will need to be replaced or at least augmented in the future and road pricing offers one possible solution to this problem as well as the opportunity to address the inherent limits of other existing sources. Transport 2040’s Goal 6 states that *“Funding for TransLink is stable, sufficient, appropriate, and influences transportation choices”*.

The road network currently experiences significant local-area congestion in key locations throughout the region, a condition which will only get worse as the population increases without significant action in the near term. Managing demand through road pricing could be a key technique for improving the level of service of the road network (especially since there are no plans to comprehensively increase road capacity across the region).

There is heightened public and political concern over environmental issues and road pricing provides an opportunity through demand management to reduce emissions from transport and provide funding for enhanced alternatives to the private vehicle, such as transit expansion.

The concept of paying for the use of the roads network is already in the public consciousness and has received media coverage recently, which provides an opportunity to build on discussions which have already started. Road pricing is in fact being introduced incrementally to Metro Vancouver through bridge tolls; however, there is no coordinated and coherent strategy which defines a desired ‘end-state’ for the application of road pricing in the region.

4. Illustrative Road Pricing Scenarios for Metro Vancouver

4.1 Illustrative Schemes

Five potential schemes have been developed for the purposes of illustrating the range of possibilities and issues for considering road pricing in the Metro Vancouver region. They have not been developed to solve specific transportation, environmental or financial concerns. While they are suitable as a planning tool for the purposes of this initial research, further development and refinement will be required should they be considered beyond this study.

There are only two broad ways to measure the road use of a vehicle: either detect it as it passes a specific location, or continuously track and record movements by location, distance, and time. Taking these methods into account, there are four techniques for measuring vehicle use, as reflected in the illustrative schemes:

- Toll Points, where the movement of a vehicle past a single point on a road or bridge is recorded (example: Golden Ears Bridge);
- Toll Road, where the entry of a vehicle onto the road, and its exit from the road, are recorded (example: 407 ETR, Ontario);
- Screenlines, a geographical divide over which vehicle crossings are detected, requiring a network of dense toll points on every road that crosses the screenline (example: Stockholm); and
- Spatial, where the location, distance and time of vehicle travel is tracked by GPS (example: truck toll in Germany).

Table 1 summarizes the illustrative road pricing schemes which are described in more detail in the following pages. An evaluation of the impacts of each scheme is provided in Chapter 5 of this report.

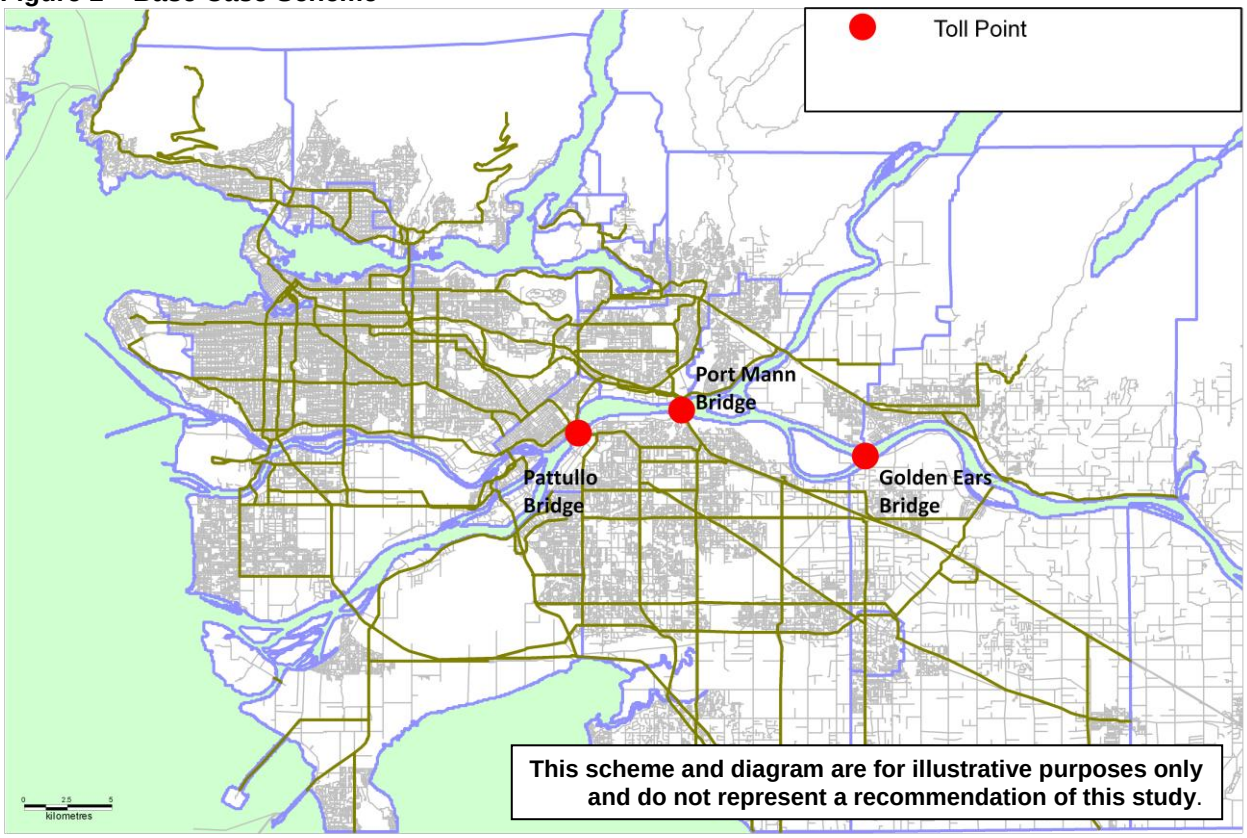
Table 1 - Summary of Illustrative Road Pricing Schemes

Title	Description	Objectives
Base Case – Three Fraser River Bridges Tolled	Uncoordinated tolls at toll points on the Golden Ears Bridge, Port Mann Bridge and Pattullo Bridge from 2014 (study assumption).	To recover initial investment and ongoing operating and maintenance costs of each bridge.
Scheme 1 – Base Case Coordinated with Modified Tolling	Coordinated tolls at toll points on the Golden Ears Bridge, Port Mann Bridge and Pattullo Bridge from 2014 (study assumption).	To recover investment and ongoing operating and maintenance costs of each bridge, plus possibly generate revenue for investment in transportation and reduce congestion on the bridges.
Scheme 2 – Tolled Major Water Crossings	A cordon created around the Burrard Peninsula through toll points on all of the associated bridges crossing the Fraser river and Burrard Inlet.	To generate revenue and reduce congestion into and out of the Burrard Peninsula with most of the revenues being used to enhance and improve transit and other non-auto travel options.
Scheme 2a – North Road Variant	Variant of Scheme 2, with a screenline placed along North Road.	In addition to the objectives for Scheme 2, to capture some portion of travel within the Burrard Peninsula for increased revenue generation and to encourage mode shift to the planned Evergreen Line with revenue being used to enhance and improve transit and other non-auto travel options.
Scheme 3 – Local Area Cordons	Charging to enter and travel within certain localized areas by implementing 360 degree screenlines around the areas of concern. The sample areas include the Central Business District, New Westminster, Surrey City Centre, and Port Moody/Coquitlam.	To reduce congestion within the areas, particularly related to traffic passing through each area.
Scheme 4 – Controlled Access Highways as Toll Roads	Distance based charging by converting the controlled access highways (Highway 1, 91 and 99) to Toll Roads.	To generate revenue, to reduce long distance commuter travel in the region, to reduce congestion on the highways, and to provide a revenue stream to enhance and improve transit and other non-auto travel options.
Scheme 4a – All Major Highways as Toll Roads	Distance based charging by converting all the major highways in the region to Toll Roads.	Same as scheme 4, with greater coverage.
Scheme 5 – Full Network Charging	Spatial tracking of all vehicles to charge for all travel within the Metro Vancouver region by distance, time of day and area travelled.	To reduce congestion in the region and localized areas and to generate revenue to enhance and improve transit and other non-auto travel options, to encourage mode shift, and to reduce long distance commuter travel.

4.2 Base Case – Three Fraser River Bridges Tolled

The Base Case situation is expected to occur in the region regardless of whether or not a decision is made on regional road pricing. Tolls are currently charged on the newly opened Golden Ears Bridge (GEB) and tolls are planned for the new Port Mann Bridge (PMB) and anticipated for the Pattullo Bridge (PB) once they are replaced and re-opened. The new PMB is planned to open in late 2012. It is not certain yet when the new PB will be in place; however, for the purposes of this study it is assumed to be January 2014. Therefore, the Base Case commences from January 2014.

Figure 1 – Base Case Scheme



The tolls on these bridges are/will be set at levels to recover the capital investment of building the bridges and also to fund their maintenance and operating costs. Although the tolls are planned to be set at similar levels, they are uncoordinated and attempt only to meet a cost recovery objective for each bridge. Toll rates are known for the GEB and have been publicly announced for car trips on PMB. Other vehicle rates on the PMB are not publicly available at the time of this study and rates have not been established for the PB. Therefore for the purposes of this study, it is assumed that PB will have the same rates as the GEB and that PMB rates for different categories of users will be in proportion to the GEB rates.

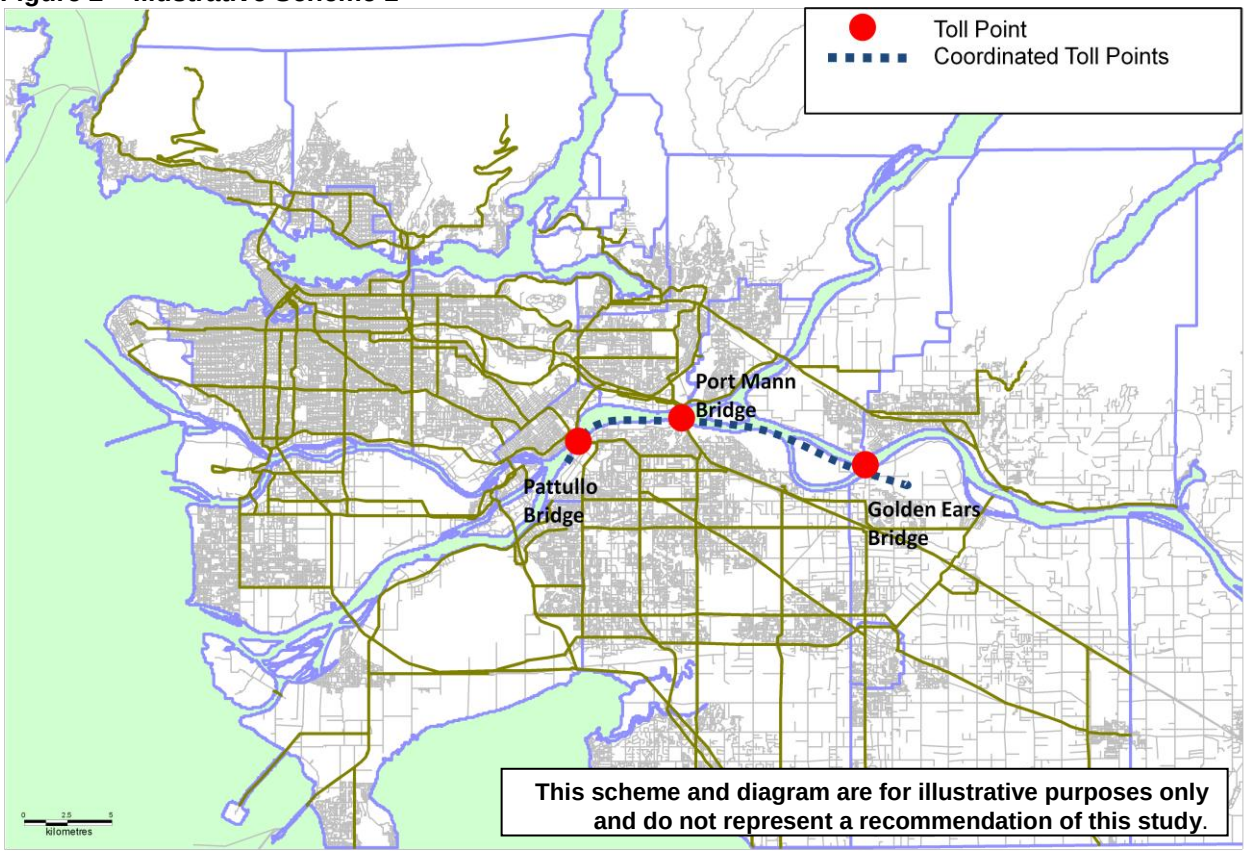
All three bridges will add capacity to the regional road network and are likely to alleviate some congestion at those river crossing points and the associated feeder routes at least in the near term. In addition, the PMB project will enable the implementation of a rapid bus service which will cross the bridge.

For the GEB, tolling is operated through a combination of antennae, which sense and identify transponder units in vehicles using Dedicated Short Range Communication (DSRC) technology, and cameras, which read and record the license plates of vehicles using Automatic Number Plate Recognition (ANPR) technology. The equipment is mounted on gantries over the roadway at either end of the bridge deck, with two gantries for each direction of traffic to allow capture of both front and rear vehicle license plate numbers. As GEB is the first bridge in the region with tolling technology, it is assumed that it will set the precedent for other bridges and roads to use the same or compatible technology and motorists will be able to use one transponder for all tolling points in all schemes, and would receive a single consolidated road charge bill issued by a central authority.

4.3 Illustrative Scheme 1 – Base Case Coordinated with Modified Tolling

Scheme 1 is a variant on the Base Case. It includes the same bridges which are included in the Base Case and assumes that a coordinated tolling regime can be operated between the bridges. The scheme will therefore not require any significant additional capital investment. Revenues will be used in priority for the repayment of the initial capital investment and operating and maintenance costs for the bridges and associated highway expenditures.

Figure 2 – Illustrative Scheme 1



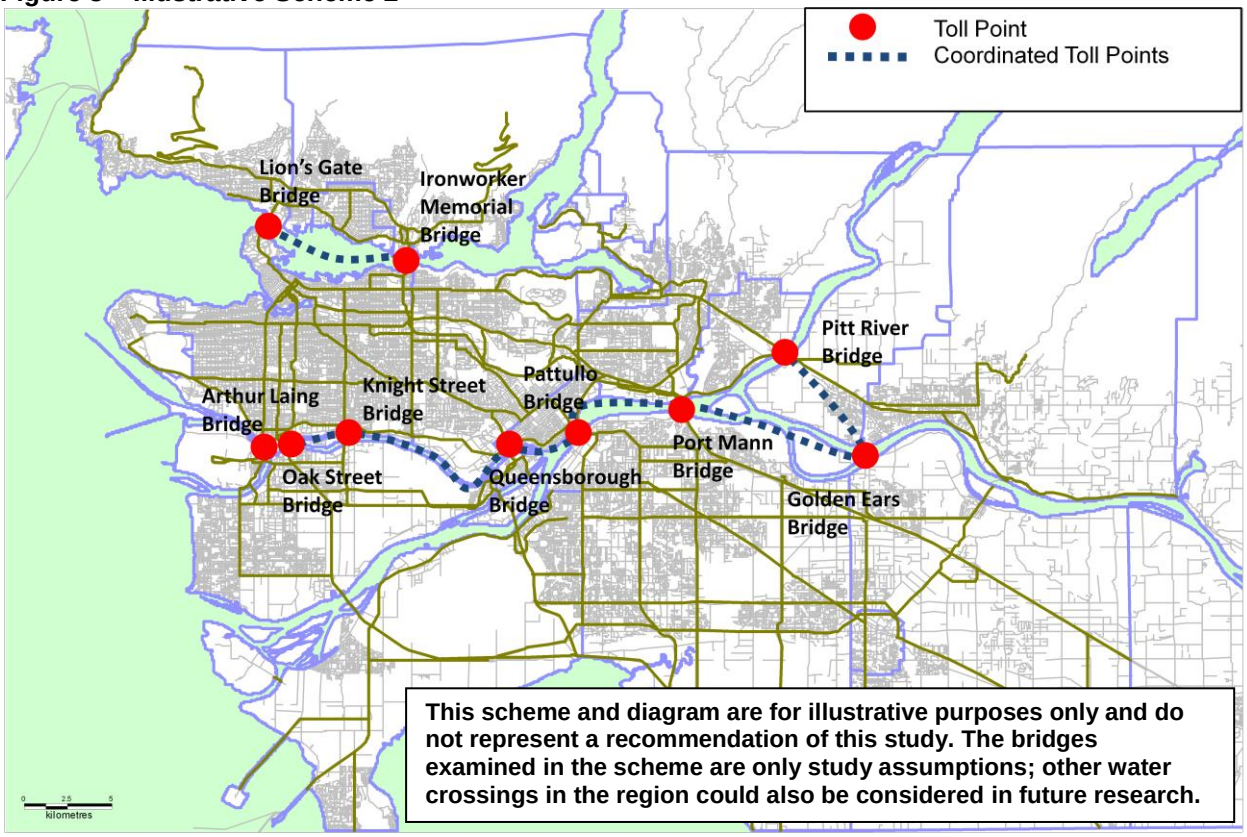
The toll rates would be set with peak/off-peak time period variations to encourage a change in trip decision-making by motorists and resultant traffic pattern. It is assumed that peak rates will be 50% higher than existing GEB rates and off-peak rates will be 50% lower than existing GEB rates. These assumptions have been made to create peak pricing in the scheme, whilst still aiming to maintain revenues necessary to recover the capital investment of building the bridges. The rates are assumed to be the same for all three bridges for analytical purposes; however, rates could vary by bridge if traffic diversion to a particular bridge is desired.

This scheme has been developed for its simplicity to implement, as it is merely an operational change to the Base Case. The purpose of this scheme is to achieve some road pricing objectives at a minimal cost and effort. Peak pricing will encourage some shift in time-of-day travel and will give motorists more travel time options than the Base Case. However, it captures only a small section of the region, will not tackle congestion in most areas and would generate less revenue than the Base Case based on the toll rate assumptions made in this study.

4.4 Illustrative Scheme 2 – Tolled Major Regional Water Crossings

Scheme 2 places toll points on all the major water crossings surrounding the Burrard Peninsula in an attempt to create a regional scale coordinated tolling regime. This scheme takes advantage of the natural choke points created by these crossings, enabling the scheme to capture large volumes of traffic and enabling demand management on these crossings, which currently experience significant congestion. This scheme also takes advantage of the fact that significant transit alternatives exist for travel into and out of the Burrard Peninsula. The bridges examined in this scheme are only study assumptions; other water crossings in the region could also be considered in future research.

Figure 3 – Illustrative Scheme 2



The toll rates would be coordinated and set with peak/off-peak variations to encourage drivers to avoid the peak hours and travel in the off-peak hours instead. It is assumed that peak rates will equal GEB and off-peak rates will be 50% lower than GEB. Higher peak rate assumptions could generate a significant mode shift that would require a higher level of investment in transit alternatives.

This scheme builds on the precedent already being set of tolling bridge facilities (e.g. Base Case), which may make it more acceptable to the public than the other schemes. The scheme is relatively simple to implement as bridge crossings are easy to toll.

The revenue generated by the scheme could be dedicated to improve transit throughout the region. As the crossings are already at or are starting to reach capacity for much of the day, there is good opportunity for mode shift if adequate transit is provided as an alternative. In addition to bus service, higher capacity transit alternatives to road travel exist for many of the crossings, although increased capacity in established services, or wholly new services, may be required to maintain mobility and support the intended mode shifts.

4.4.1 Illustrative Scheme 2a – North Road Variant

Scheme 2a removes the toll point at the Pitt River Bridge and adds a screenline along North Road to take advantage of the fact that the planned rapid transit line (Evergreen Line) will offer a high quality transit alternative for travel in the eastern part of the Burrard Peninsula, and to capture a portion of the traffic movement across the Burrard Peninsula between Coquitlam/Port Moody and Burnaby that would not be captured by the major water crossing toll points. Toll rates remain the same as in Scheme 2.

Setting a screenline along a road that traverses a densely developed area with a grid-pattern road network having many intersections and opportunities for toll avoidance, requires a large number of gantries and inspection points to minimize leakage. While the technology remains the same as in the Base Case, it will be more complex to put in place to ensure enforcement given the potential number of screenline crossing points, and the potential need to make the gantries and other equipment fit the character of the neighbourhoods.

This variant was chosen to demonstrate the effect of utilizing a toll screenline in the region. North Road may not be the best location for a screenline; however, it is useful to show the merits and difficulties of creating an artificial boundary line. The location of the screenline could be adjusted to take advantage of natural geographic barriers, such as Burnaby Mountain, to reduce complexity and cost, but many of the inherent challenges would remain.

4.5 Illustrative Scheme 3 – Local Area Cordons

This scheme comprises a number of different screenlines surrounding specific areas in the region. The local areas selected are those experiencing high traffic volumes and related congestion problems, especially congestion that is caused by 'through' traffic that does not have an origin or destination within the area. Each area could have its own specific toll regime that could have pricing which varies by time of day or varies by entry points to the area.

The local areas used for illustrative purposes in the scheme are New Westminster, Surrey City Centre, Downtown Vancouver and the Port Moody/Coquitlam area, as discussed below. For the purpose of analysis, it is assumed that the Base Case continues to exist in addition to this scheme. The discussion under Scheme 2a regarding the complexity of configuring screenlines in densely developed areas also applies to the cordons in this scheme.

The primary objective of this scheme is to tackle specific areas of congestion. There may be some secondary outcomes from the scheme including revenue generation and localized reductions in vehicle emissions. Toll revenues would be used to provide better transportation alternatives in the areas to encourage mode shift.

4.5.1 New Westminster Local Area

The cordon around New Westminster in particular would primarily aim to encourage commercial vehicles to either avoid passing through the area or avoid peak travel times. Revenues could be dedicated to pay for maintenance costs incurred in the area impacted by the pass-through of trucks.

All vehicles are charged for entering the area only. It is assumed that vehicles that enter the area will exit again and will not be charged twice during this journey. Vehicles originating in the area, e.g. those belonging to residents, are captured when they re-enter. Peak toll rates are set at 50% lower than the current GEB rates, while off-peak rates are set at zero. PB rates would be kept at the Base Case rate. The other Base Case bridges (GEB and PMB) would also be tolled as defined in the Base Case.

4.5.2 Downtown Vancouver

Traffic congestion is not as pronounced in Downtown Vancouver as it is in many other major cities, but rather it seems to exist in pockets scattered around the downtown area due to local capacity restrictions and through traffic. Actually, the downtown area exhibits positive trends towards transit, pedestrian and cycling modes. The downtown area is included in the scheme for illustrative purposes only. This area is well served by rapid transit alternatives, although capacity improvements would likely be needed to create any further modal shift.

4.5.3 Surrey City Centre

Surrey City Centre is targeted as a high growth and densification area in the draft Regional Growth Strategy. It is served by rapid transit (Expo Line), and is planned to be a hub for various frequent transit network corridors. Due to significant future growth and the lack of demand management measures, congestion is expected to become more pronounced in the area unless mitigating measures are taken

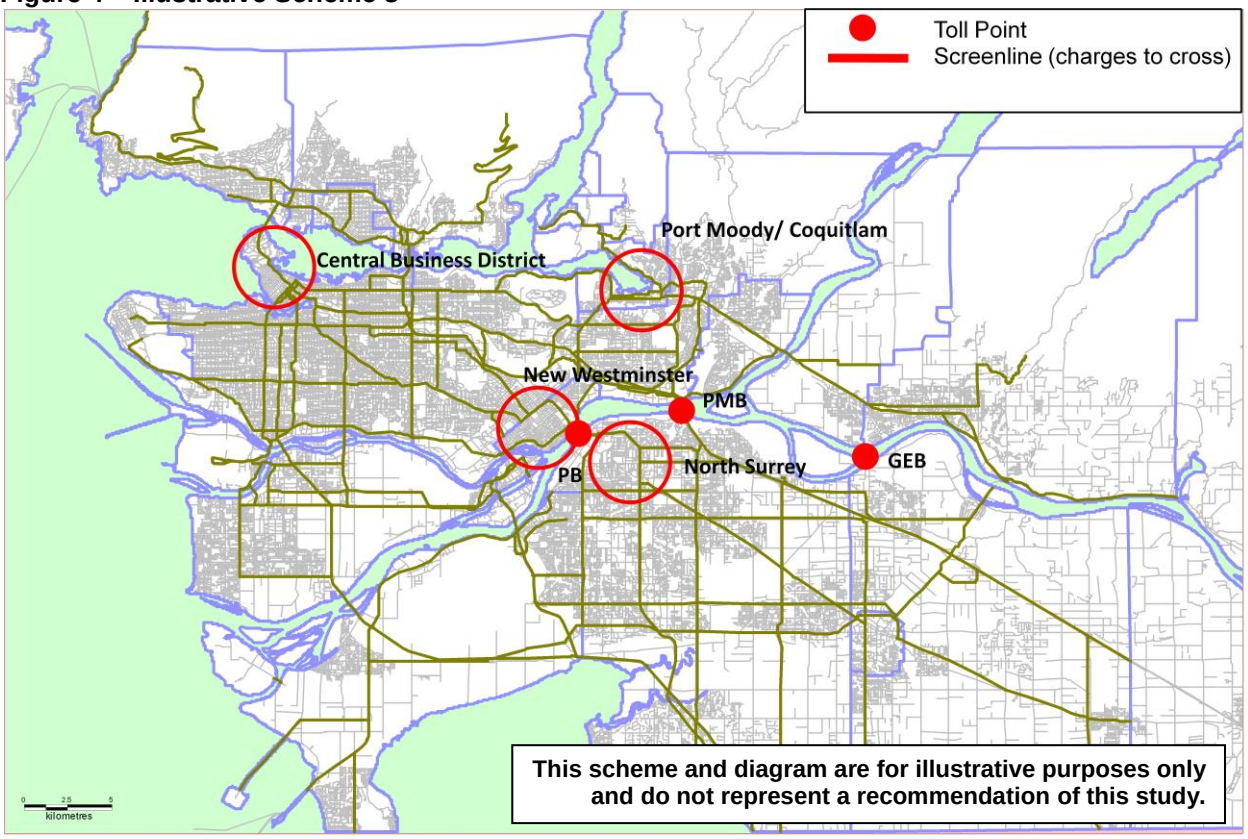
The Expo Line has a number of stations in Surrey City Centre and provides an alternative to car use for travel to and from the north side of the Fraser River. However, significant investment in transit would still be required to encourage mode shift for people travelling into and out of the area, especially from areas to the south and east of the City Centre.

4.5.4 Port Moody/Coquitlam

The Northeast Sector, particularly Port Moody and Coquitlam, is among the fastest growing areas in Metro Vancouver. The main east-west transportation links in the area are expected to be at or near capacity by 2021. Congestion is an issue on the Barnet/Lougheed Highway corridor, as well as a number of other roads in this general area. In an effort to address the population and traffic growth issues, the

concept of the Evergreen Line was introduced in the 1990s, and has now advanced to the detailed planning and design stage. West Coast Express currently serves this area offering an alternative to car use for commuters to downtown Vancouver. The Evergreen Line will connect to the rest of the rapid transit network providing a more attractive alternative to car use.

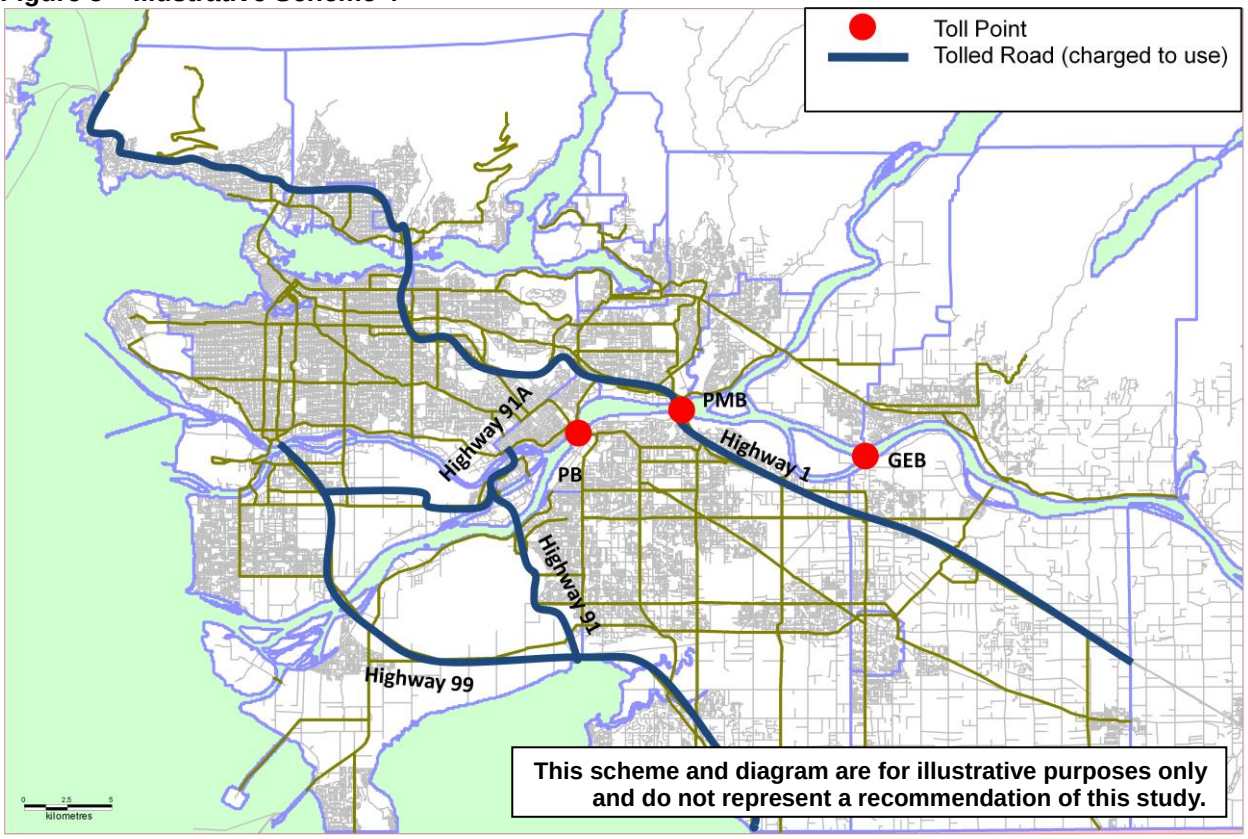
Figure 4 – Illustrative Scheme 3



4.6 Illustrative Scheme 4 – Controlled Access Highways as Toll Roads

This scheme charges for distance travelled on the major limited access highways by converting them to toll roads. The highways assumed to be tolled in the scheme are Highway 1 (through the region) and Highways 91, 91A and 99 (from Richmond to the US border).

Figure 5 – Illustrative Scheme 4



It is relatively easy to record vehicle usage of controlled access highways, either by recording all movements on and off the road at entrance/exit ramps (as done on the 407ETR in Ontario), or by installing gantries mid-way between access points. The latter approach is assumedin this illustrative scheme.

The objectives for this scheme are to generate revenue, to discourage the use of the highways for short trips during peak periods and to charge for actual distance travelled rather than for simply crossing a single toll point or screenline. Road user fees are equitably distributed to users according to usage, better reflecting their impacts on the road network.

A high toll rate will cause high diversion onto arterial roads, while a very low rate will not discourage short distance trips. Setting toll rates similar to 407ETR[8] in Ontario (the only urban-area toll highway in Canada) is unlikely to be suitable given that the 407 provides a higher service level than the highways in Metro Vancouver. Therefore, rates for this scenario are assumed to be 10c/km during peak hours and 5c/km during off-peak hours for analytical purposes only. It is assumed that the Base Case scenario will continue to exist in addition to this scheme.

[8] Toll rates for the 407ETR in Ontario: Light vehicle peak rate 19.85c/km; Light vehicle off-peak rate 18.00c/km; Heavy vehicle peak rate 39.70c/km; Heavy vehicle off-peak rate 36.00c/km

4.6.1 Illustrative Scheme 4a – All Major Highways as Toll Roads

As a variation on Scheme 4, this scheme would include all other major highways (that are not controlled-access) such as Highway 7, the South Fraser Perimeter Road (SFPR) currently under construction, the future North Fraser Perimeter Road (NFPR) and Highway 10. The reason for considering this sub-scheme is to increase toll road coverage and capture more traffic. This would require many more gantries for recording traffic, and preventing leakage may not be practical.

4.6.2 Illustrative Scheme 4b – HOT Lanes

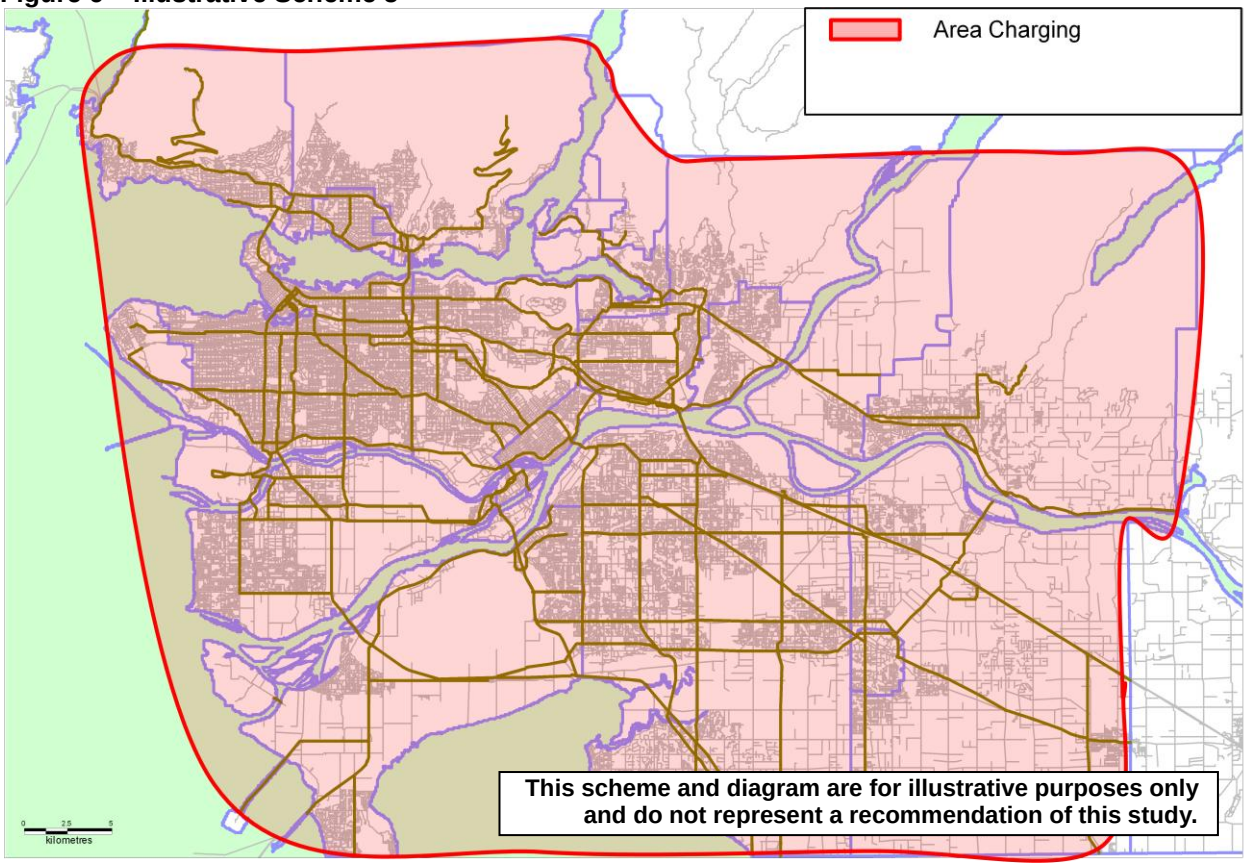
High Occupancy Tolled (HOT) lanes are physically separated lanes on limited access highways which motorists can chose to travel on for a fee. They typically provide a greater level of service (i.e. faster travel speeds, more certainty of travel times, and less congestion). They are often High Occupancy Vehicle (HOV) lanes which may have spare capacity and therefore give the option to vehicles that do not meet the high occupancy requirement to use the lane for a charge. The toll rates can be updated on a real-time basis to charge a higher fee when the lane speed differentials are higher so that the price paid is proportional to the benefit received, and/or optimized to maximize revenue to the tolling authority.

The use of HOT lanes in Metro Vancouver is likely to be impractical given the discontinuous and relatively small limited access highway network in the region. It would take considerable investment in infrastructure to either add new lanes or make existing lanes suitable for use as HOT lanes and they are unlikely to provide returns which would meet this level of investment. In addition, expanding the regional highway network is inconsistent with existing and proposed regional growth management policies. Therefore, this scheme is not examined any further in this study.

4.7 Illustrative Scheme 5 – Full Network Charging

The full network charging scheme charges for the use of all roads at all times by all vehicles within the Metro Vancouver area.

Figure 6 – Illustrative Scheme 5



The objective of this scheme is to capture all movement within the Metro Vancouver region and to charge based on distance travelled, area travelled (location), and time of day; thus potentially creating a more equitable system where all vehicle users are charged based on usage during peak and off peak periods. It would replace the Base Case scenario completely and tolls would not be charged for crossing any bridge.

Such a scheme would require road use tracking devices in each vehicle in the region to track the movement of the vehicle (time, distance, and location) by Global Positioning Satellite (GPS) receiver, record the information, and communicate road use to the tolling authority. Additionally, cameras would be needed at various locations to monitor the movement of vehicles in the region for verification purposes and fraud avoidance.

Unlike the transponder units in other schemes, tracking devices would not be optional; all vehicles subject to payment for road use would require them. There is no standard for such tracking units at this point in time. It is likely that TransLink would have to develop its own standard as well as the central billing system. Equipping the regional vehicle fleet with tracking devices would be a major undertaking, with approximately 1.5 million vehicles to equip. Ongoing repair and replacement of the units would also be a substantial undertaking. The technology for this scheme exists and has had limited applications, such as the truck tolls in Germany. There are currently no similar sized schemes in operation which would provide some practical insights into this scheme's concept. The Netherlands has been planning a country-wide scheme which would apply a charge on all vehicle movements in the country. The scheme would not be due for full implementation until the latter half of this decade and would still have to go through several stages before being rolled out. At the time of preparing this report, general elections are taking place in the Netherlands, the outcome of which could have a significant influence on the future of the scheme.

5. Evaluation of Illustrative Schemes

5.1 Evaluation Framework

A planning-level evaluation framework was developed to evaluate and qualitatively compare the illustrative schemes in the following categories:

Table 2 - Scheme Evaluation Framework

Category	Objective	Types of Consideration
Transportation	1. Maximizes positive traffic impacts	– Reduces congestion at key bottlenecks – Improves predictability of journey time – Optimizes efficiency of road network
	2. Minimizes negative impacts	– Traffic diversion onto adjacent streets – Minimizes need for mitigation measures
	3. Positive behavioural change	– Potential for mode shift away from auto driver – Reduces number of auto trips/vehicle km travelled
Social	1. Ability of scheme to support land use planning	– Supports regional growth management objectives
	2. Improves livability of adjacent communities	– Reduces noise and pollution related to traffic congestion – Safer roads
	3. Equitable and fair	– Equitable / fair allocation of costs and benefits to users – Availability of transportation choices – Provides for geographic equity
Economic	1. Positive impact on business in Metro Vancouver	– Reduces travel time and congestion leading to increased productivity, better access to retail etc. – Facilitates goods movement
	2. Capital investment avoidance	– Defers the need for additional transportation investments
	3. Greater utilization of existing transportation investments (road and transit)	
Environmental	1. Reduces overall vehicle emissions	
Financial	1. Maximizes revenue generation	– Potential for future revenue growth – Minimizes potential for revenue leakage
	2. Minimizes level of capital investment in tolling system (including mitigation measures)	
	3. Stability of cash flow / high level of confidence	

Each scheme was assessed as to how well it met the objectives when compared to the Base Case. In addition to the evaluation under the framework above, each of the schemes has been assessed in terms of implementation issues and risks associated with technical and governance matters.

Table 3 - Technical and Governance Considerations

Implementation Category	Issues & Risks to Consider
Technical	• Simplicity of scheme • Proven technology • Potential for technological obsolescence in the short-term • Flexibility of the technology to adapt to change
Governance	• Jurisdiction of assets • Legislative requirements • Level of potential public support • Level of potential political support

5.2 Description of Evaluation Process

A number of approaches were taken to evaluate each scheme according to the evaluation framework described above. A combination of qualitative and quantitative measures was used:

- Application of Deloitte Knowledge and International Experience - The Deloitte project team collectively applied the evaluation framework in advance of the assessment process by an expert panel and then refined the evaluation based on expert panel input.
- Expert Panel - A panel comprising regional transportation experts was assembled and participated in a full day workshop to assess each scheme in relation to the objectives of the evaluation framework.

5.3 Results of Scheme Evaluation

As noted earlier, each scheme is evaluated on a relative basis against the Base Case scheme. The summaries presented in the following subsections provide a discussion of the performance of each of the schemes under the identified evaluation categories.

5.3.1 Illustrative Scheme 1 – Base Case Coordinated with Modified Tolling

Transportation Implications: Overall this scheme is likely to create a better impact on traffic patterns than the Base Case, as the peak and off-peak pricing and ability to coordinate tolls between bridges should contribute to additional congestion reduction. Some traffic will still divert to other untolled bridges but it is likely to be less significant than the Base Case since there is lower off-peak pricing. There is unlikely to be a major shift to transit as there are relatively few viable transit alternatives to these bridges, and free bridges to the west (e.g. Queensborough) remain available. To encourage mode shift, significant additional transit investment and supportive demand side management measures would be required in these corridors.

Social Implications: The scheme is unlikely to have an impact on land use planning or adjacent communities that would noticeably differ from the Base Case. Compared to the Base Case, this scheme would provide more options for users to travel at a reduced cost at certain times of the day.

Economic Implications: As a result of the above outcomes, there is likely to be a positive, though minor, impact on businesses compared to the Base Case. There may be some positive impacts from more efficient goods movement as a result of reduced congestion. The transportation implications will lead to minimal capital investment avoidance and greater utilization of existing transportation investments.

Environmental Implications: The impact on vehicle emissions is likely to be minimal in comparison to the Base Case, given that the scheme is unlikely to create significant mode shift. There will be some benefit from congestion reduction on the bridges, but again this is likely to be minimal.

Financial Implications: The capital costs from the scheme are likely to vary only slightly from the Base Case. This is to allow for the additional costs involved in coordination of the three bridges, which include project procurement costs and back office co-ordination costs. The infrastructure on the bridges would remain the same as the Base Case. Revenues are likely to be lower than the Base Case as a result of the assumed toll pricing structure, which gives a reduced price for off-peak traffic, and slight diversion and mode shift. Net Revenues are likely to be the lowest amongst all of the illustrative schemes examined.

Technical and Governance Considerations: Technical implementation is relatively straightforward for this scheme as the technology will already be in place for the Base Case and will involve only coordination of the tolling system across the three bridges. This would nonetheless require Provincial and TransLink tolling governance to be agreed upon. To continue collecting tolls beyond the point of capital cost recovery on the bridges would require policy changes and political support. It is possible that there will be some increased public acceptance to this scheme because the differential charges will give users slightly more choices than the Base Case.

5.3.2 Illustrative Scheme 2 – Tolled Major Water Crossings

Transportation Implications: It is likely that this scheme will create significant positive traffic impacts through reductions in the amount of auto travel in the region. Peak pricing will encourage congestion reduction on the bridges during peak periods, benefiting traffic moving in and out of the Burrard Peninsula at all access points. The lack of free alternatives to tolled bridges will prevent diversion issues. Potential exists for considerable mode shift which would require significant investments in higher capacity transit to cross the cordon.

Social Implications: Because of the cordoning effect of the toll points, the scheme may be perceived as an attempt to restrict access to the Burrard Peninsula. This is not the intent of the scheme, but a byproduct of the geography. This could reinforce the real or perceived social and economic divide between the areas north and south of the Fraser. To offset concerns such as these, it may be necessary to earmark a significant portion of the revenues to transportation investment in the high growth South of the Fraser area.

This scheme tolls all the bridge traffic but not any of the sub-regional travel within the areas on either sides of the cordon. This may be seen as inequitable. On the other hand, this scheme tolls the majority of the bridges in the region as opposed to some bridges in one part of the region, which could be viewed as more equitable. The scheme may benefit land use planning as it will reduce long distance commuting across the region and encourage travel around Town/City Centres. At the same time, the scheme may prompt a reduction in short, discretionary trips across the bridges, which could have both positive and negative impacts, depending on the measure.

Economic Implications: There is likely to be a benefit to the business community from reduced general traffic and goods movements travel times at the water crossings. As noted above, the divide between the areas north and south of the Fraser River may become more pronounced and business travel is likely to become more locally focused in those regions as their catchment areas become smaller due to some customers choosing not to cross the bridges to avoid paying the tolls.

Environmental Implications: The impact on vehicle emissions is likely to be more significant than the Base Case, given that the scheme is likely to cause mode shifts, reduce total VKT, and reduce bridge congestion, assuming adequate investments in transit and other alternatives are made.

Financial Implications: The scheme is likely to generate significantly more total and net revenue than the Base Case as a result of the large increase in captured traffic volumes. While operating costs also increase, the revenues should more than cover these costs each year and the capital costs are likely to be repaid early in the project life.

Technical and Governance Considerations: Technical implementation would also be relatively simple with this approach. As noted earlier, the technology will already be in place for the Base Case bridges and it is assumed that this technology can easily be applied to the rest of the bridges. Also, many motorists will already be familiar with bridge tolling and many will likely have transponder units for use on the Base Case bridges. As with Scheme 1, governance between the different asset owners would need to be addressed, including who bears the costs, how the revenue is collected, and who would receive it and in what proportion. In fact, similar governance issues are apparent with all the schemes.

5.3.3 Illustrative Scheme 2a – North Road Variant

Transportation Implications: This variant is likely going to encourage mode shift to the Evergreen Line but would have negative traffic impacts on local areas around the screenline.

Social Implications: The North Road screenline is likely to be viewed as unfair and inequitable to those residents living close to the line. It may be viewed as arbitrary in its placement by comparison to tolling on a water crossing because there is no obvious geographic border. Additionally, the area east of the North Road has been targeted as an area of high growth, and running a screenline through the peninsula in this area could hamper regional growth management objectives and bisect contiguous neighbourhoods.

Economic Implications: The scheme is likely to create negative economic impacts in the area near the screenline, as it is likely to cause a reduction in short trips made by local residents which would impact negatively on retail and other businesses. Local businesses would incur additional operating costs.

Environmental Implications: The impact to vehicle emissions is unlikely to be significantly better than Scheme 2 given that the impact to traffic will be small.

Financial Implications: As with Scheme 2, this scheme is likely to generate significant net revenue and will repay the tolling system capital costs early. There will be an increase in capital costs as a result of the additional gantries put in place to create the screenline. Back office and procurement costs would remain largely the same.

Technical and Governance Considerations: From a technical implementation perspective, the creation of a screenline along a road is significantly more difficult than the tolling of water crossings alone. A large number of toll points on many roads is required to create the screenline and prevent motorists from avoiding detection. The only alternative would be to close or re-route cross streets, which is likely impractical and undesirable at this scale.

As compared to the major water crossings (owned by TransLink, the Province, or the Federal Government), screenlines such as the North Road example would require endorsement of the affected municipalities (who own the roads), in addition to the active participation of the residents and businesses in these same municipalities who would be affected in the planning for any regional road pricing scheme.

Public acceptance of placing toll points on local roads is generally considered to be lower than for the tolling of water crossings. There is however some precedent for North Road being designated a screenline, as sections of it serve a similar purpose in separating existing transit fare zones.

5.3.4 Illustrative Scheme 3 – Local Area Cordons

Transportation Implications: It is unlikely that this scheme will have significant positive traffic impacts, and it may actually increase overall VKT and associated negative impacts since there are many opportunities to divert around cordons when they contain relatively small areas. There is limited potential for incremental mode shift as the public transit which passes through those areas is already reaching capacity levels, although additional investment in transit service in these areas, if feasible, could support positive mode shifts.

Social Implications: The scheme presents very negative impacts on land use planning which alone may be significant enough to prevent it (or variants) from being considered much further. Creation of a scheme which discourages travel to City/Town Centres is contrary to planning for the region which aims to link high density centres and concentrate employment growth into centres rather than out to office parks.

Economic Implications: Location of retail is important to the concept of a town centre, but cordons will cause the capture area of businesses within the local areas to diminish, potentially negatively impacting business performance. On the other hand, there may be some positive impact from improved goods movement.

Environmental Implications: The impact on vehicle emissions in the areas alone could be better than the Base Case, depending on how much diversion occurs. However, higher VKT in the region overall would increase emissions in the region. Determining the net environmental impacts would require further analysis.

Financial Implications: It is assumed that the Base Case would exist alongside this scheme, so each local area cordon represents incremental revenue generation for the region. When considering only one cordon at a time, revenue in the first year of operations would not be significantly more than the Base Case despite the increase in volumes captured by the scheme and the fact that diversion is not expected for trucks. This is because the volume of traffic captured is limited and toll rates are low (50% of the peak rate, nil for off peak). It is assumed that operating costs are incurred only during the peak period because no tolls are charged during off peak. This scheme is likely to produce relatively low net annual revenue, amongst the lowest of all of the illustrative schemes examined.

Technical and Governance Considerations: From an implementation perspective, as with the North Road screenline, the scheme would be significantly more complex to put in place than tolling the Base Case. It would require significant investment to prevent leakage given the number of entry and exit points on the cordon lines. Public support is likely to be relatively low; as residents of the areas may view that they are being charged to travel from their homes as a result of a problem caused largely by through traffic and traffic coming from outside the area. The business community may not support this approach due to the negative impacts explained earlier.

5.3.5 Illustrative Scheme 4 – Controlled Access Highways as Toll Roads

Transportation Implications: This scheme will likely discourage the use of the controlled-access highways for short trips, and increase speeds and reliability on the highways through reduced congestion. However, this presents significant diversion issues for the rest of the region as the highways are currently being used for short 'hop-on, hop-off' journeys, particularly where they pass through parts of the region such as Coquitlam, Burnaby and the North Shore. Therefore the benefit to discouraging short trips may not outweigh the costs created by congestion pushed to other areas.

Social Implications: This scheme charges traffic for distance travelled, rather than for crossing over a single point, so that road charges are equitably distributed to users according to the distance driven, better reflecting their impacts on the tolled road. Since only a small portion of overall travel would be tolled, the scheme may be viewed as unfair by some.

The scheme would lend some support to land use planning objectives as it would potentially discourage longer distance commuting and make living in town centres close to employment locations more appealing.

Economic Implications: The scheme could potentially have a positive impact on businesses as it would increase goods movement speeds through reduced congestion. However, the overall transportation network would be negatively impacted as the local roads which would have to absorb diverted traffic could be pushed to capacity, which would affect local businesses.

Environmental Implications: The scheme may have a negative impact on vehicle emissions as it is unlikely to reduce traffic volumes in the region overall and as a result of diversion, congestion may be worse in other areas. Additionally, mode shift will not occur as the transit alternatives along these routes are not plentiful.

Financial Implications: It is assumed that the Base Case would exist alongside this scheme, so it represents incremental revenue generation for the region.The capital costs incurred are likely to be significantly higher in this case than in the previous schemes. This reflects the large number of toll points and equipment which would be required for the scheme. However, the scheme can potentially generate positive net revenues, which would repay these costs early in the project life. The level of operating costs are a function of the number of transactions, which cannot be determined with accuracy at this stage as information is unavailable on the average trip distance. Given the inherent uncertainties, net revenues may be either positive or negative.

Technical and Governance Considerations: From a technology perspective, the scheme would be relatively simple to implement. The technology used would be the same as with the bridges of the Base Case.

The highways selected under this scheme are owned and controlled by the Province. Therefore, it will not be possible to implement the scheme if the Province does not support it. A revenue-sharing agreement would be needed, or TransLink would need to be allowed to operate the tolling system and collect the revenues.

Finally, it may be difficult to gather public support for the scheme as the resulting congestion relief may not be significant and congestion due to diversion may negatively impact adjoining communities. As such, this scheme may be viewed primarily as a revenue generating mechanism, notwithstanding the fact that revenues are assumed to be earmarked for transportation investment.

5.3.6 Illustrative Scheme 4a – All Major Highways as Toll Roads

Scheme 4a, which looks at tolling all of the highways, would be very difficult and costly to implement. It would either require a far greater number of gantries than Scheme 4 to capture all access points, or would require that some of the access points be closed to prevent leakage in the system and traffic diversion. It would however, capture a larger volume of traffic and cover a greater network of the region than Scheme 4. It is deemed to be an impractical option to implement in this region and is unlikely to provide benefits that outweigh the costs.

5.3.7 Illustrative Scheme 5 – Full Network Charging Scheme

Transportation Implications: This scheme is viewed as providing the greatest positive benefits and the least negative effects in terms of transportation impacts of any scheme relative to the Base Case, as it captures all road travel by all persons in the region. Significant investment in transit service throughout the region would be required to provide the necessary levels of access and mobility. This scheme has the highest potential for modal shift.

Social Implication: This scheme is determined to be the most fair and equitable of all schemes examined as it captures all vehicle travel in the region. The toll rates can be varied to charge higher rates when the cost to the region and society is higher. Because the scheme covers the entire region it can be used to influence the traffic patterns to and from different areas to support the land use strategies of the region with more effect than other schemes. Toll rates can be set to vary depending on the location of travel.

Economic Implications: As a result of the reduced travel time and congestion in the region, business will benefit from faster and more reliable goods movement, shorter commute times for employees and better access to retail.

Environmental Implications: It is also likely to have the most positive impact on emissions because of the system-wide traffic impacts. Additionally, the scheme could be designed to charge different rates for different classes of vehicles based on their efficiency and/or actual levels of emission.

Financial Implications: Unlike other schemes, this scheme would completely replace the Base Case, since road users would not be charged for the use of an individual asset. Toll rates do not need to be capped for the same reasons as they would need to be in other schemes (i.e. to prevent excessive diversion). The limit to which rates could be set would be influenced by public and political support. Therefore, a range of revenues could be generated by the scheme. By way of encouraging public acceptance for the scheme, it could initially be introduced as revenue neutral and therefore rates would be set at a level that would generate the same level of revenue as the prevailing fuel (or other existing) tax that could be replaced by this scheme. Over a number of years, revenues could then be increased if appropriate. Thereafter, it has the potential to generate the highest revenues of all of the illustrative schemes.

This scheme is by far the most expensive to implement and capital costs are likely to run into several hundreds of millions of dollars. It is difficult to provide a reasonable estimate given that there are no similar schemes in place to provide a benchmark, and given the level of innovative systems development that would be required.

Technical and Governance Considerations: This scheme would be the most technologically complex and likely to be the most difficult to implement from a governance and public acceptance point of view.

The technology required is not yet proven or reliable at this scale of application, although it is becoming increasingly so and therefore the scheme could be viewed as potentially suitable in the future. Gantry points already in place from other schemes using camera and ANPR technology could be utilized as part of the enforcement element to the scheme.

Obviously, as the scheme covers the entire region, it affects the full breadth of asset owners, government bodies and key stakeholders. Therefore, it could take considerably more effort to achieve agreement and co-operation between all parties than other schemes. It is also quite a radical change to the apparent cost of driving in the region, even though it could replace some of the existing taxes and charges that fund transportation. Regardless, gaining public acceptance would be challenging. However, it is the most equitable scheme, which may be more appealing to some members of the public.

5.4 Other Measures

Several other measures are available which could potentially achieve some of the same objectives as road pricing, with varying degrees of effectiveness. Such measures are introduced here simply to highlight that road pricing is not necessarily the only solution to the region's transportation challenges, and a portfolio of complementary measures should be implemented over time to create a comprehensive approach to addressing the service, infrastructure and funding challenges that the region faces. Evaluation of these measures is not within the study scope.

Intelligent Transportation Systems (ITS)
ITS applies technology on the road network to make it more efficient and safe. ITS is not extensively used in the region although TransLink has an active ITS function. ITS offers some promise to reduce congestion and increase the utility of the existing road network, but it will not generate revenue.

Carbon Tax and Fuel Tax
The advantage of these taxes is that they are proportional to the level of road usage, and result in a higher per-km charge to larger and heavier vehicles that have more impact on the network and environment than smaller and lighter vehicles. It is a demand management tool, but a relatively crude one because it cannot account for differences in time and location of driving and sends only an indirect pricing signal since many drivers are not conscious of their fuel consumption.

Parking Strategies
Targeting the parking of vehicles, rather than their operation, is a way to indirectly manage demand for the road network and raise revenues to support the transportation network. Demand can be managed by restricting the amount of parking allowed by municipal development bylaws, and revenue can be raised by taxes on parking spaces, areas, or charges. Taxes levied on parking charges (rather than spaces) can be varied by time of day and location, and thereby contribute to peak demand management. Paid on-street parking is used by several municipalities in Metro Vancouver in certain areas to raise municipal revenue.

Vehicle Levies
A fixed monthly or annual vehicle levy could serve to raise revenues to support the transportation network. This may curtail slightly the size of the regional fleet by increasing fixed costs of vehicle ownership and stimulate a shift to smaller and/or more efficient vehicles if the levy is structured to provide the necessary financial incentives. The levies would have no influence over use of the road network in time and space, and unless a method is devised to tie the levies to distance travelled, they would have little to offer in terms of demand management aside from their potential influence over vehicle ownership. Implementation is feasible, given the vehicle licensing and insurance infrastructure of the Insurance Corporation of British Columbia (ICBC), with which all vehicle owners in the region must interact to register and licence vehicles.

Distance-Based Insurance (Pay-as-You-Drive) / Insurance Tax
Insurance premiums could be used as a way to alter the fixed cost of driving. In particular, it could be structured to reduce the fixed costs by linking them to distance driven. Reducing the fixed costs and increasing the variable cost of each trip encourages motorists to consider the cost of each incremental trip and potentially reduce the amount of travel. The implementation of a scheme such as this is potentially easier to do in Metro Vancouver than in many other regions given the role of ICBC. While distance-based insurance is in itself a demand-management measure, it could raise revenues as well if a per-km insurance tax was levied on the variable insurance premium.

6. Key Findings

Metro Vancouver's localized concentrations of congestion dispersed across the region do not easily lend themselves to being 'solved' by a practical and reasonable road pricing scheme. Only Scheme 5, which covers the entire region, would have the ability to capture all of these areas. However, this is the most extreme form of road pricing possible and is not practical for implementation in the short to medium term. Metro Vancouver has a number of other objectives and these, more so than congestion, may be partially achieved through road pricing.

Though the analysis of the illustrative schemes is high-level and does not as yet provide a definitive solution for the region, it is possible at this stage to eliminate a number of schemes from further consideration:

- Localized Area Schemes, such as that suggested around New Westminster under Scheme 3, would likely produce results that are contrary to the land use planning goals set for the region; and
- Controlled Access Highway tolling (Scheme 4), while practical to implement, is likely to cause diversion to, and congestion on, local roads, which would merely shift the problem to areas that were not designed for large traffic volumes.

Additionally, toll screenlines through densely developed areas (as used in Scheme 3 and Scheme 2a) are likely to be problematic due to the effects they have on lands immediately adjacent to the line.

There remain a number of schemes which could potentially provide benefits to the region and therefore should be explored in more detail:

- Coordinated tolls on the Base Case bridges (Scheme 1) would be very simple to implement and could be the first step towards road pricing in the region, although it would not bring incremental revenue unless toll rates were raised above what is currently contemplated. Also inherent in the scheme is peak pricing to help encourage modal shift and trip time shifting. Coordination may also allow for regional optimization of traffic volumes on each of the bridges;
- Tolling all major water crossings that have reasonable higher order transit alternatives (Scheme 2) would be relatively straightforward to implement and would be a natural progression from the coordinated tolling of the Base Case bridges. This could bring significant incremental revenue, and would help address bridge congestion through demand management rather than road capacity expansion; and
- The full network charging scheme (Scheme 5) has the ability to contribute to all of the regional objectives and is clearly the most equitable and flexible approach to road pricing – it is a nearly ideal economic tool. However, it is costly, complex, and risky (at this point in time) to implement and is more likely to be suitable as an end goal for the region.

If modal shift is an objective for road pricing, then alternative modes must be made available. It was observed that capacity, coverage and frequency of transit are not currently sufficient to facilitate a large mode shift. Therefore, significant investment in alternative modes of transportation will be required for most of the schemes.

Road pricing is not a panacea, but offers promise in helping to meet some key regional objectives. Each of the schemes examined is better at meeting some of the objectives than others, and an effective regional road pricing plan may need to incorporate aspects of each of these schemes. To be practical, a regional road pricing plan would also likely need to evolve over time, with various interim measures being eventually replaced with something like Scheme 5.

International experience has shown that the factors which are essential in a successful road pricing scheme are:

- A clear objective which drives both the technical design and social/political acceptance;
- A political champion with both the ability and desire to have it implemented; and
- Engagement with the public with the aim of gaining its understanding and support.

International experience also suggests the following key steps to implementation, which will most likely take at least several years after a decision to proceed is made:

1. Conceptualization and Planning – engaging with key stakeholders; high level traffic modeling and costing;
2. Plan Design – deciding on a definitive road pricing scheme; and
3. Program Launch and Implementation – development and procurement of the scheme, including mitigation measures, investment in transit, establishment of necessary legislation, etc.

Based on the experience of other jurisdictions, when attempting to implement a road pricing initiative it is most likely that there will be resistance from the public and various groups and interests, at least initially.

In all of the illustrative schemes examined there are multiple stakeholders, including different owners of the assets being tolled. Each of the parties involved would need to reach agreement on the tolling of these assets and on the distribution of the revenues and responsibilities for the costs before the schemes could be implemented.

Despite its drawbacks, including the risk it presents to TransLink (and the Province) as a stable source of revenue, fuel tax is the current revenue source that most closely matches the attributes of the ultimate road pricing scheme (Scheme 5 – Full Network Charging). While it does not offer the ability to charge by time of use and location and there is opportunity for avoidance, it does capture mileage and is the revenue source that is most analogous to “user pay”.

Improved information and analytical tools are needed to better understand existing and future travel patterns and support further planning work in scoping the scale and nature of alternative transportation improvements required, and design features such as location of toll points, toll structure, etc. Better traffic information is also needed to support a traffic management system which is an integral part of a road pricing system.

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