mobility pricing INDEPENDENT COMMISSION

IT'S TIME

METRO VANCOUVER MOBILITY PRICING STUDY

FULL REPORT ON THE FINDINGS AND RECOMMENDATIONS FOR AN EFFECTIVE, FARSIGHTED, AND FAIR MOBILITY PRICING POLICY

Prepared by: the Mobility Pricing Independent Commission

MAY 2018

May 2018

LETTER FROM THE CHAIR

I am pleased to present the results of the work carried out by the Mobility Pricing Independent Commission over the past ten months.

The Mayors' Council and TransLink Board asked the Commission to study how (not if) a mobility pricing system could be implemented in Metro Vancouver that would:

- manage congestion
- promote fairness, and
- support investment.

The growth of our region represents an opportunity and a challenge. It is happening at a time when many sectors, including transportation, are undergoing rapid change and innovation. Efficient, affordable and sustainable mobility will be key to ensuring good outcomes for the people of Metro Vancouver. Mobility pricing offers a way to ensure this happens in a way that is farsighted, fair and flexible.

Our comprehensive investigation has found that a coordinated mobility pricing policy, that includes a decongestion charge, has the potential to address the threat of growing gridlock in a way that produces substantial benefits for quality of life and the region's economy. We have heard many concerns about fairness in relation to affordability, equity, access to transit options, privacy and the need for accountable and transparent governance. But we have found that there are ways to address these concerns through the way a mobility pricing policy is designed and implemented.

It is easy to characterize a decongestion charge as a "money grab" or "just another tax." The paradox is that the less you charge, the more it would be just that. The charge needs to be set at a level sufficient to unlock the considerable benefits of reduced congestion and more efficient mobility. That will also raise sufficient revenue to both invest in more affordable transportation options, reduce other costs of driving and offset costs for people on low incomes, just as we do for many other priced goods like housing and power.

Indeed, if you are only looking for a way to raise revenues for investment then a mobility pricing system that includes a decongestion charge is not the best solution. But if you are willing to take on the complex discussions it will require, then a decongestion charge could be transformative as part of a strategy to support efficient, affordable, and sustainable mobility in Metro Vancouver.

Continued...

To guide you in those difficult discussions we offer a series of principles which we believe should be followed in developing a policy for mobility pricing, along with recommended next steps.

Finally, I would like to acknowledge the hard work and commitment of my Vice-chair, Joy MacPhail, and the other members of the Commission in tackling this difficult subject in a spirit of curiosity, openness, cooperation and a healthy skepticism. My thanks also to the team of staff and consultants who supported our work.

It's Time to continue this conversation so our region and its residents can keep thriving!

Yours faithfully,

Allan Seckel

With support from all members of the Mobility Pricing Independent Commission:

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IT'S TIME

EXECUTIVE SUMMARY

Efficient, affordable transportation is crucial to Metro Vancouver's future.

Metro Vancouver is growing, bringing more opportunities to the people who live here – and to those who are coming here. That growth brings challenges, but the impacts of a falling population or a stalling economy would be a far bigger threat to everyone's quality of life.

One of the things we need to do to ensure everyone can benefit from the opportunities of growth is to provide an efficient, affordable, and sustainable transportation system for people and goods to get around.

Traffic congestion is getting in the way of that. It impacts our quality of life, health, safety, and regional economy. Building our way out of our traffic woes is increasingly expensive and doesn't support our region's goal to reduce greenhouse gas emissions. And the ways we currently pay for mobility could be better integrated and structured to help us meet our region's vision for livability and sustainability.

Innovations in mobility through electrification, automation and vehicle sharing are bringing new possibilities, but will also require new forms of coordination to achieve mobility goals. The mobility sector is going to change, and the way public authorities manage mobility to ensure equitable, sustainable outcomes will need to change along with it.

The Mobility Pricing Independent Commission was set up by the Metro Vancouver Mayors' Council on Regional Transportation and the TransLink Board of Directors to investigate how a more coordinated way of paying for mobility – *mobility pricing* – could help to address these challenges. The Commission was specifically asked to look at how paying for road use – *decongestion charging* – could play a role in such a strategy.

This report summarizes the findings and recommendations for how a comprehensive mobility pricing policy, that includes a decongestion charge, could support our region's growth.

How different forms of transportation and mobility are priced sends a signal which can have an impact on people's behaviour in the long term (where we choose to work and live) and short term (what time we make a trip or by what mode). Getting those signals right can lead to positive outcomes for everyone. Getting them wrong will cause multiple problems.

These recommendations on how to get the mobility pricing signals right stem from an intensive eight-month research and public engagement project called *It's Time*, launched in October 2017 by the Mobility Pricing Independent Commission. In this period, we established baseline research, analyzed policy and lessons learned from other jurisdictions, conducted multiple rounds of modelling and evaluation, completed two rounds of education and engagement with public, stakeholders, and government officials, and explored pathways to implementation.

We have found different and effective ways for a decongestion charge to make an impact in Metro Vancouver, as part of a coordinated mobility pricing policy.

Our research has shown that a decongestion charge has worked to reduce congestion in cities around the world and we looked at how it could work in our region. From our analysis, we have identified two illustrative concepts that, if implemented as part of a coordinated package, could reduce our region's congestion and support transportation investment in a fair way:

Regional congestion point charges that would cost the average paying household $5-8 per day could reduce congestion by 20-25% and raise $1-1.5 billion net per year

Multi-zone distance-based charges that would cost the average paying household $3-5 per day could reduce congestion by 20-25% and raise $1-1.6 billion net per year

These numbers are based on preliminary analysis and more work will be needed to refine concepts, costs, and benefits.

We have heard residents' and stakeholders' top concerns and have put together principles to address them.

From our research of experiences in other cities, we know public support is low before implementing a decongestion charge. Throughout our engagement, we heard from over 17,350 residents and over 300 stakeholders and government officials. Their top concerns were about affordability, availability and accessibility of transportation options, equity, and the accountable management of revenues.

These concerns are understandable and they can be addressed. We know from our analysis that it is possible to design a decongestion charge aligned with transit access and which respects privacy. A design is also possible that does not disadvantage those travelling longer distances, people with disabilities, seniors, or people with lower incomes.

We propose a set of principles to guide the design of a mobility pricing policy, covering:

- **Congestion**, including the need to deliver meaningful reductions in congestion, ensure everyone pays a fair share, and that all the ways we pay for mobility are coordinated to deliver on regional goals
- **Fairness**, meaning that differences in the way we pay for mobility should be consistent and explainable, that a mobility pricing policy should support equity, and that a decongestion charge should be aligned with access to transit
- **Supporting investment** while at the same time ensuring accountability in the way revenues are used and affirming that revenue should not be the primary aim of mobility pricing
- **Other matters**, such as the need to deliver positive economic benefits, protect individual privacy, provide stability, and support regional growth targets. We also confirm the need for continued public dialogue

We cannot leave our region at a stand-still. This is a visionary opportunity for us to move forward.

Changing the way people pay will be politically difficult, and the issues raised by a decongestion charge are many and complex. But the possibilities to support regional goals for quality of life, environment, and the economy are significant.

This report provides guidance on formulating an efficient, farsighted, and fair mobility pricing policy for Metro Vancouver. This will need to be developed and incorporated into regional policy.

This report can be considered the first phase of a feasibility study. It suggests principles that should be followed in formulating a mobility pricing policy and describes some high level decongestion charging concepts that show interesting results. More work will be needed to develop them into something that can be implemented. That is estimated to take around six to twelve months, and should include:

- Further iterations and development of the illustrative concepts
- A thorough assessment of affordability and equity impacts as well as impacts for business
- A first assessment of available technology for distance-based charging

Without visionary mobility pricing policy, our population and economy are projected to soon outgrow our transportation network.

Our region is at a critical juncture. It's time to move us forward.

ABOUT THIS REPORT

This report fulfills the Commission's mandate defined in the Terms of Reference to summarize its work and recommendations for the consideration of the Mayors' Council on Regional Transportation and the TransLink Board of Directors.

Part 1 describes why and how the project was undertaken, as well as describing how a comprehensive mobility pricing policy that includes a decongestion charge fits into the regional transportation policy.

Part 2 reviews the Commission's findings from research and engagement with the public and stakeholders. **Part 3** uses the findings to propose a set of principles to be followed in designing a mobility pricing policy. **Part 4** contains some illustrative concepts to show how a decongestion charge could be implemented in a way that meets the principles.

Part 5 contains recommendations for next steps.

The research, evaluation, communications, and engagement used to develop the findings and recommendations is contained in the appendices.

This report builds on work carried out in Phase 1 during fall 2017. The Phase 1 full and summary project update reports can be found on the *It's Time* website.

GLOSSARY

Term	Definition
Congestion point charge	A decongestion charge in which vehicles are charged for travelling past a given location or series of locations on the road network.
Decongestion charge	Decongestion charging is a tool used to combat congestion. It is a form of mobility pricing and refers to a range of fees that could be applied for the use of transportation services.
Distance-based charge	A decongestion charge in which vehicles are charged by distance travelled on all or parts of the road network.
Fuel Tax	A fee added to the purchase price of motor vehicle fuel. In Metro Vancouver, drivers pay $0.17 fuel tax per litre to support the regional transportation system.
Mobility pricing	Mobility pricing refers to a range of fees that could be applied for the use of transportation services. Examples that we already pay include car insurance, bike sharing fees, parking fees, fuel taxes and transit fares.
User Cost principle	A concept in which users are charged in proportion to how much they contribute to congestion in busy locations during busy times of the day.
User Pay principle	A concept in which users pay in proportion to how much they use the road network. In this report, road use is measured in terms of kilometres travelled.

PART 1. CONTEXT

Why we did this

PART 1. CONTEXT

What's our opportunity?

Metro Vancouver is growing, bringing lots of new opportunities.

By 2040 there are expected to be around a million more residents and half a million new jobs. The regional growth strategy *Metro 2040*, and the Regional Transportation Strategy define the pivotal role of an efficient, affordable, and sustainable transportation system in giving everyone access to the opportunities growth will bring.

The strategy will see continued development of

1) diverse and dense neighbourhoods

2) ... that are walkable

3) ... connected by high-frequency transit

4) ... and where demand for car use is managed.

Density brings many advantages. Being closer makes it easier and faster to get together, increasing opportunities for trade and innovation and increases our quality of life. A region that is more spread out means longer trips to get together and more time spent in traffic.

But our rising population and its demand for goods and services will bring more vehicles and a need to manage traffic growth. This will keep denser urban areas as attractive places to live and work. The regional growth and transportation strategies include a plan to explore demand management strategies, such as road usage charging. This is why the Mayors' Council on Regional Transportation and the Board of TransLink established the Mobility Pricing Independent Commission ('the Commission').

Traffic congestion is a growing threat to those opportunities.

Imagine if those million new residents bring with them as many cars as Metro Vancouverites own today. There could be more than 600,000 new vehicles trying to find space on our already crowded streets. Congestion is already having an impact on our quality of life, our health and our safety, and our region's economy. Estimates of the economic cost of congestion to our region range from $500 million to $1.4 billion every year[1]. That means the costs of congestion are one of many things contributing to our region's challenges with affordability.

Polling conducted in September 2017 shows what our residents think about congestion:

89% are frustrated with traffic delays caused by high volumes.

80% are frustrated with the unpredictability of travel times.

81% say transportation delays cause them lost time every week.

[1] C.D. Howe Institute,' Tackling Traffic: The Economic Cost of Congestion in Metro Vancouver.' 2015 and Canada's Ecofiscal Commission 2015

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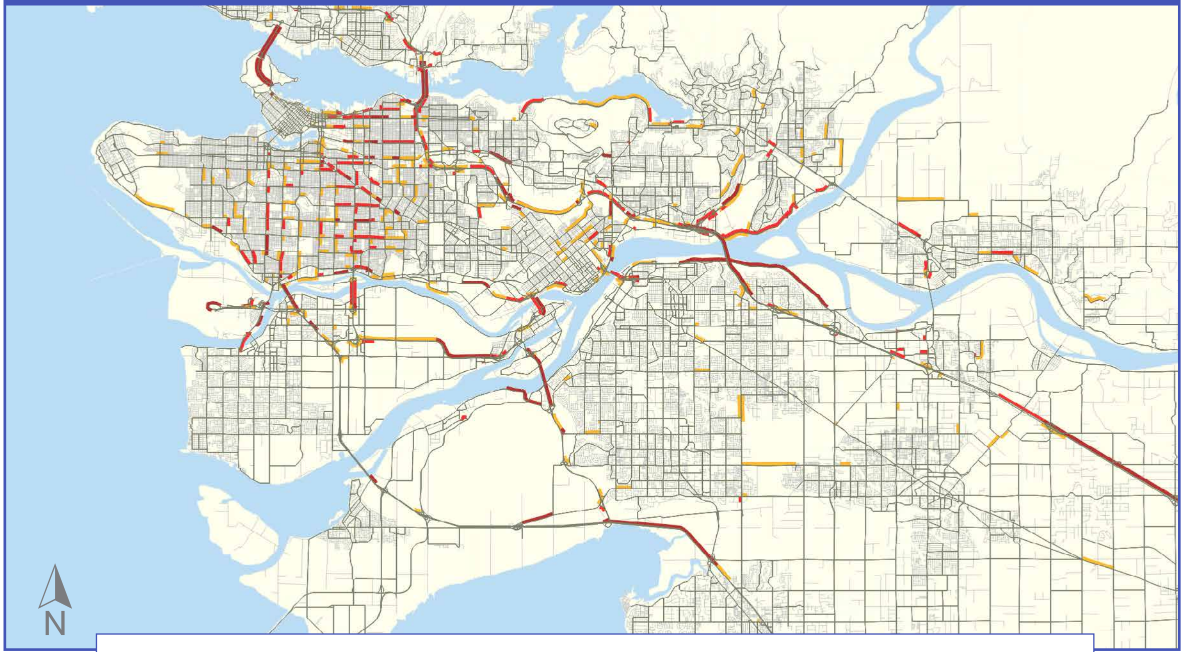
Analysis shows that congestion will continue to rise, increasing by about 40% by 2030. We will spend more of the day stuck in traffic. Unless we do something, we will all be wasting nearly 15 million minutes every day stuck in traffic – that's the equivalent of more than 28 years.

Estimated travel time delays in 2030 at AM peak period



The map above shows the projected level of vehicle delay during a morning rush hour in 2030. Vehicle delay is calculated in hours where:

10-30 hours 30-60 hours over 60 hours.

It is calculated as hours of delay over and above the Level of Service D (LOS D)[2] performance level multiplied by the vehicle volume on the road network.

The region needs more transit and better roads – and fairer ways to pay for them

The Mayors' 10-Year Vision, currently being implemented, will make a big contribution to expanding our transportation system and enabling affordable, efficient, and sustainable mobility as the population and employment grow.

Building new roads and transit can slow the rate of growth in traffic congestion, but they won't fix the problem. As long as the population is growing and the economy is doing well, traffic growth will quickly fill up any new road or transit capacity. Soon, more will be needed and that will have significant costs.

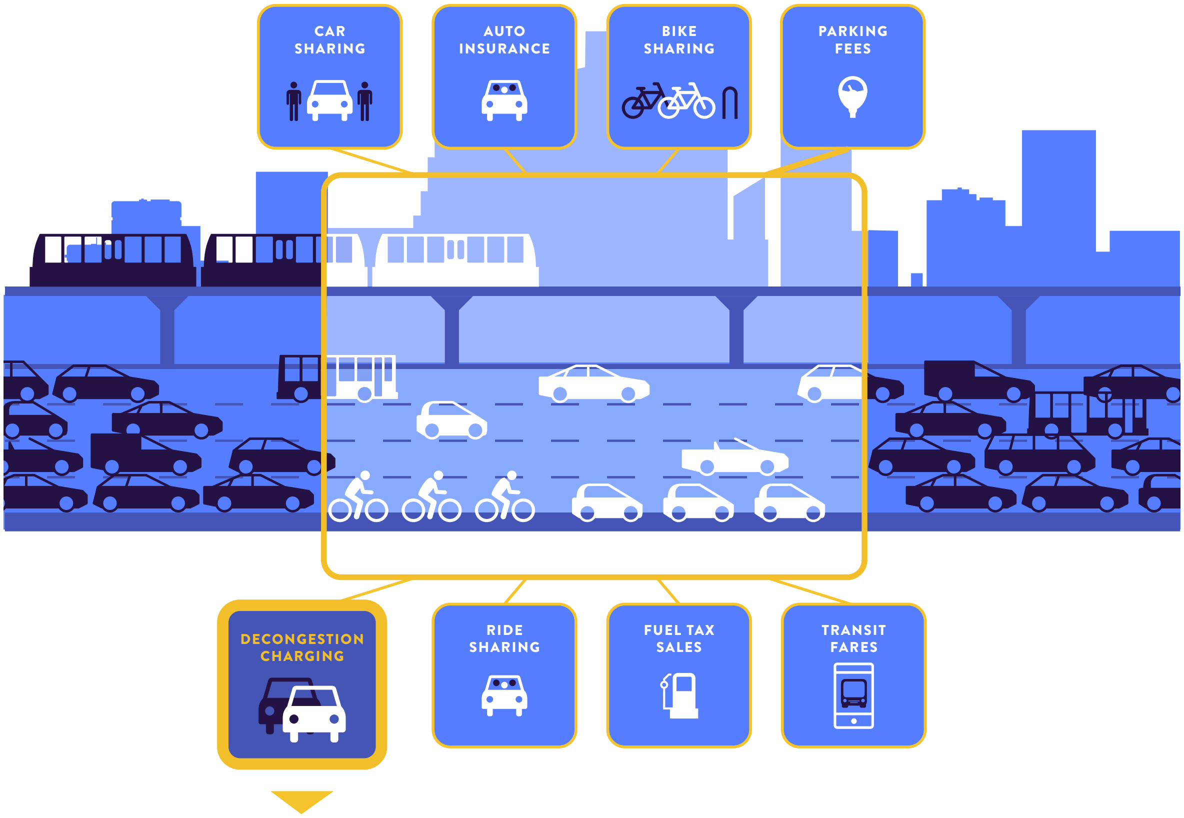
The region's previous approach to paying for some new bridges using tolls caused diversion onto less suitable routes and was unfair – as recognized by the provincial government when they ended toll collection in September 2017. Another major source of funding, the fuel tax, will not be sustainable in the long term as vehicles become more fuel efficient and electric cars become more commonplace.

[2] Level of service (LOS) is a measure used to describe traffic flow. LOS D represents an efficient use of the road network in peak traffic, but is not the same as free-flow. See Appendix B2 for a more detailed description.

What is mobility pricing and how could it help?

In our region, we pay to get around in all kinds of ways: transit fares, parking charges and taxes, insurance, fuel taxes and costs for things like taxis, bike and car share. Prices are used for different reasons.

Mobility pricing means coordinating some of the ways we pay and paying differently to make it easier for everyone to get around. This is done by using price signals in a way that can manage congestion and encourage the use of different modes of transportation. If done in the right way, it can be fairer and can raise money for investment in the transportation system.



What is decongestion charging?

Decongestion charging, also referred to as road usage charging, is a mobility pricing tool that manages demand for road space.

Every road has a limit on its capacity. A road that can carry 1,500 cars per hour will work well when 1,400 cars are using it. But when that number climbs to 1,600, traffic will slow to a crawl for that period of time. The congestion doesn't only affect the 200 cars that just joined, it affects the 1,400 that were already there and no one goes anywhere. In severe congestion, as more vehicles are trying to move past a given point, fewer vehicles are actually getting through.

Decongestion charging addresses this by charging more to drive at busy times of the day or in heavily congested areas. The charge is set so that it motivates just the right number of people to change their travel habits, by using another route, carpooling, taking alternate modes of transportation (transit, walking, cycling or motorcycle), or simply avoiding travelling during peak periods.

The relationship between travel demand and travel time is non-linear, meaning that if a few people change their behaviour, and there are a few less cars on the road, there will be substantial improvements in travel times. Most people will continue to drive and will benefit from faster, more reliable journey times.

HOW EXACTLY DOES DECONGESTION CHARGING WORK IN THEORY?

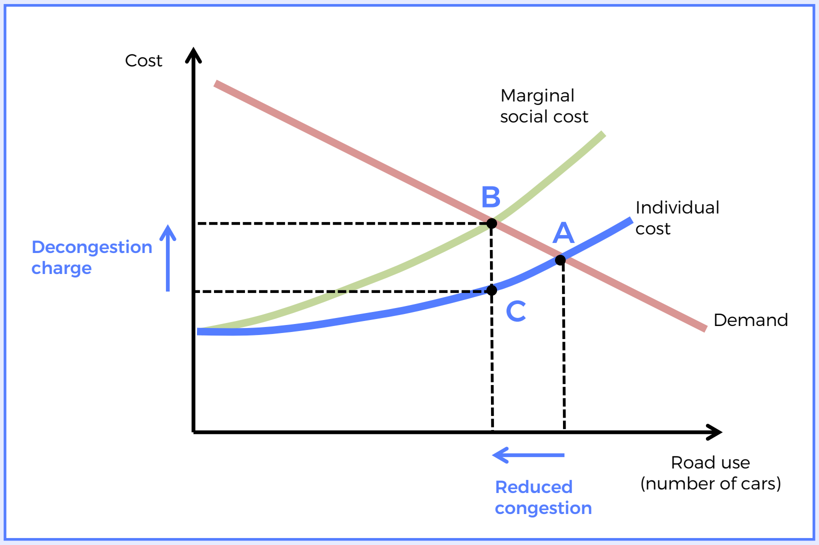
Traffic congestion is a cost for us as individuals like our time, stress, what we pay for fuel, insurance, and vehicle wear and tear etc.

But when we drive on congested roads, we also impose a cost on everyone else (their time, stress and costs) and on the rest of society (like pollution, road crashes, noise, and road wear and tear).

A decongestion charge is based on the economic theory that if we charge the full cost of using the roads when they're congested, that will cause just enough people to choose to travel in another way or at a different time that congestion will be reduced. The cost we charge is called the *marginal social cost*.

The figure below shows these relationships graphically. The horizontal axis represents the demand for car travel and the vertical axis represents the travel costs. Demand (the red line) decreases as the costs of driving increase. The blue line represents the individual cost each traveller experiences.

Costs increase as congestion increases. At point A, we see where the demand curve and the individual cost curve meet, and the level of congestion without charging. We also see that the marginal social costs are much higher.



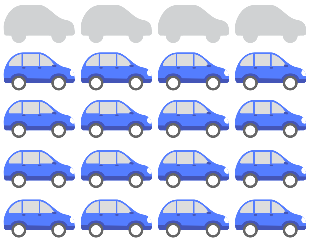
The green line represents the marginal social cost. Costs to society also increase with higher demand for car travel, but a faster rate. At point B, we see where the marginal social cost curve intersects with the demand curve where demand is lower and the price is higher.

The difference in trip costs between point C and point B is the "economically optimal" congestion charging level, assuming the goal of the charge is to recover no more and no less than the sum of all social costs associated with driving.

The marginal social cost may represent a higher cost for drivers than we are prepared to charge in reality. That was the case in this project and so the concepts presented in Part 4 represent charges set at between 50% and 75% of the marginal social cost. That is, we are choosing to accept some congestion in order to reduce the out-of-pocket costs for individuals.

How and where has decongestion charging been implemented?

Other cities around the world have implemented decongestion charging to combat their congestion, including London, Stockholm, Milan, and Singapore. Pilot projects and studies are underway in many North American jurisdictions including Oregon, Los Angeles, and Seattle.



Several lessons have emerged from examining these international examples of decongestion charging and road usage charging:

- Well-designed decongestion charging systems have reduced traffic by 15-20% and cut congestion by around one third
- Most people continue to drive and enjoy decreased travel times and increased travel time reliability
- Many of those that adapt the way they travel shift the time they travel, combine trips, car share or switch to other forms of individual transport like bicycle or motorcycle. Some people will shift to transit, and these can be accommodated with targeted increases in transit services
- All the systems studied have produced revenues that can be reinvested in the transportation system or used to reduce other costs of driving
- There are other co-benefits, like better air quality, improved public health, improved safety and a reduction in crashes.
- Although people are often skeptical of decongestion charging before it is introduced, in most cases acceptance increases once the positive effects of the charges are demonstrated, and the adaptations are not as negative as people anticipated

More information about other jurisdictions that have implemented decongestion charging and what lessons we can learn are found in Appendix B of the Phase 1 report found on the *It's Time* website.

How could a decongestion charge work as part of a mobility pricing policy for Metro Vancouver?

Growing congestion is threatening our region's opportunities. The region needs new and improved infrastructure. Decongestion charging appears to offer a partial solution to these challenges, but how could it work here? And will people really be willing to pay differently in return for shorter and more reliable journey times? These are the questions the Commission was asked to explore.

The Commission's mandate, as defined in its Terms of Reference, includes:

- An evaluation of the viability and acceptability of potential regional road usage charging alternatives for motor vehicles (including both automobiles and trucking-based goods movement) in Metro Vancouver and, based on this evaluation, recommendations on how the region should proceed with developing and implementing a more coordinated regional road usage charging policy and system
- An assessment of the implications of introducing coordinated regional road usage charging in Metro Vancouver in terms of consistency, compatibility, and coordination with pricing for other types of transportation and mobility
- Conducting and leading the work in an objective, transparent, and credible manner

Refer to Appendix A of the full report for more information on the Commission's mandate, its members, and all meeting summaries.

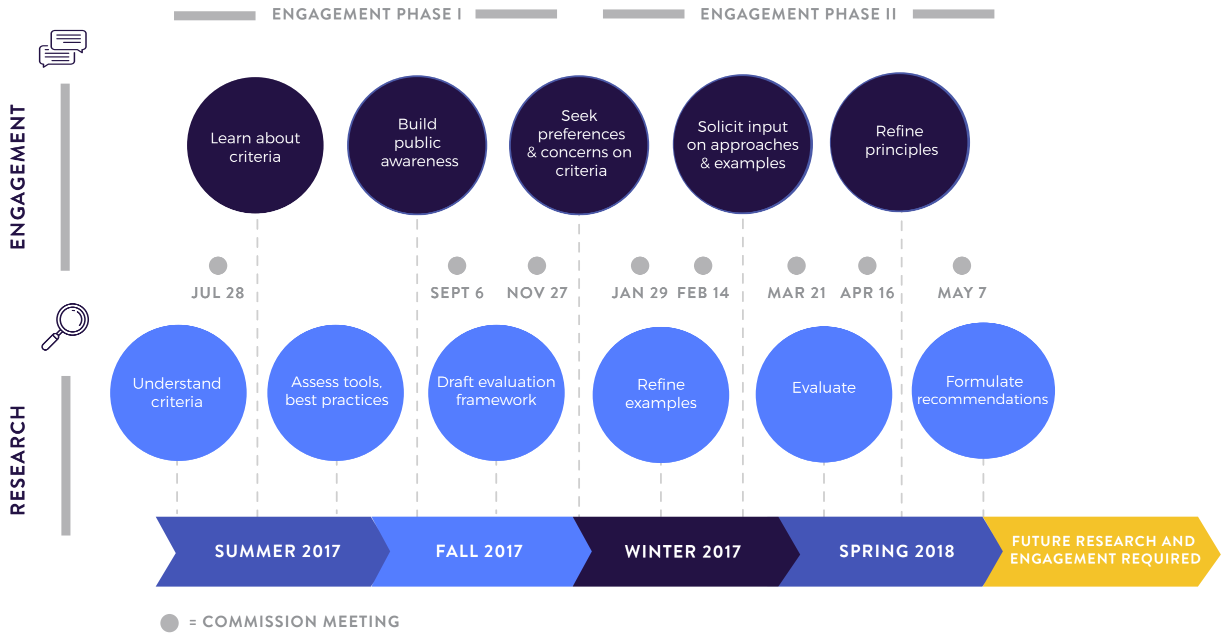
In October 2017, the Commission launched the *It's Time* project, a research and public engagement initiative to explore a mobility pricing policy and a decongestion charge. The *It's Time* project was governed by the Commission's three objectives:

Reduce traffic congestion on roads and bridges across the Metro Vancouver region so people and goods can keep moving, and businesses can thrive

Promote fairness to address concerns around the previous approach to tolling some roads and bridges but not others, as well as providing affordable transportation choices

Support transportation investment to improve the current transportation system in Metro Vancouver for all users

The timeline below illustrates how the project was carried out:



How did we evaluate mobility pricing and decongestion charging for the region?

It was not within the Commission's mandate to make decisions about if and when a decongestion charge should be introduced. Rather, the mandate was to explore and recommend *how* a decongestion charge could be introduced as part of a broader mobility pricing policy, including understanding the views of the public and stakeholders.

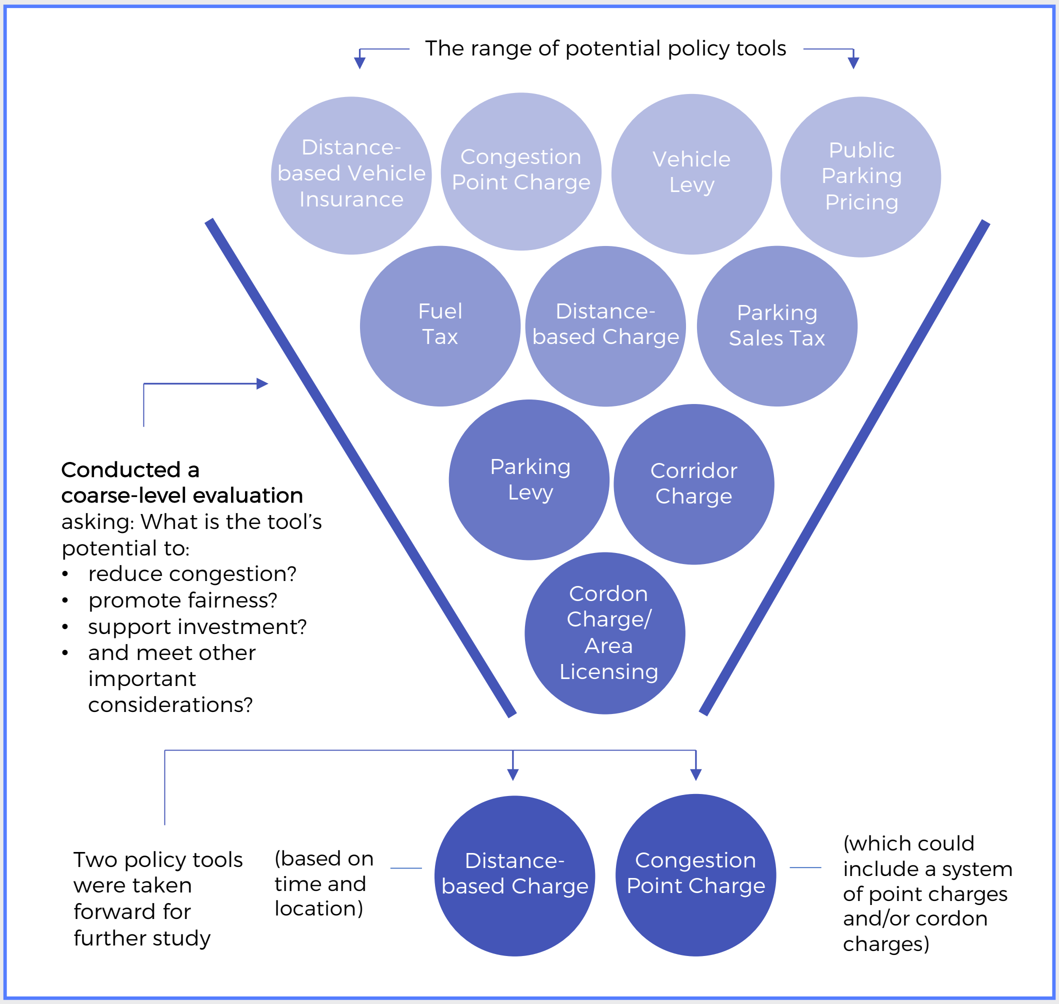
The Commission completed the following structured evaluation process to develop its recommendations:

1

Identified a list of policy tools with some potential to address congestion and raise revenue. This was based on the range of tools that have previously been contemplated in this region or are commonly considered in other jurisdictions.

2

Conducted a coarse-level evaluation of the potential of each policy tool to address the Commission's three core objectives of reducing congestion, promoting fairness, and supporting investment in transportation, as well as high-level implementation considerations.



On the basis of this evaluation, a number of policy tools were set aside. Some, like charges only on highways, were rejected because they don't adequately address any of the core objectives. Others, like a vehicle levy or fuel taxes, were set aside because although they could raise money, they would likely have limited impacts on congestion. These and other policy tools not recommended for detailed study in this project may be explored in the future for other purposes. The Commission also recommended that limited further work be carried out on parking pricing.

3

Created an evaluation framework for more detailed analysis of decongestion charging systems based on research and input from public and stakeholder engagement. The framework covers issues and values the Commission feels are important, including metrics around:

- Congestion
- Fairness
- Investment
- Local effects
- Ease of implementation
- Privacy
- Environment and health
- Consistency with the Regional Growth Strategy and Regional Transportation Strategy
- Future-proofing

4

Developed and evaluated decongestion charging systems through four rounds using the evaluation framework. The purpose was to support the Commission's learning rather than reaching a conclusion about a preferred decongestion charging system.

5

Formed recommendations resulting from this evaluation process that consist of:

- **Principles** (found in Part 3) to direct and shape the design of a mobility pricing policy including a decongestion charge in Metro Vancouver to reduce congestion, promote fairness, support transportation investment, and support other priorities emerging from this investigation phase.

  The principles have been developed over the course of the project based on engagement and research findings and Commission discussions.
- **Illustrative concepts** (found in Part 4) showing how a decongestion charge could be applied in Metro Vancouver in a way that meets the principles.

Refer to Appendix B for the research and evaluation report.

PART 2. THE COMMISSION'S FINDINGS

What we learned

PART 2. THE COMMISSION'S FINDINGS

This section summarizes the Commission's findings from the evaluation, research, and engagement activities that have informed the development of the principles.

What we did

KEY RESEARCH ACTIVITIES:

- Established a baseline for regional congestion challenges by studying existing data
- Researched evidence and lessons learned from other jurisdictions around the world that have introduced mobility pricing policies or decongestion charging
- Developed scenarios of how a decongestion charge could be implemented in Metro Vancouver to form the basis for traffic modelling and analysis, and to gather stakeholder and public input
- Modelled the forecasted impacts of decongestion charging concepts, with input variables including time, cost, directionality and location, and outputs including transportation impacts, costs and revenues, and the effects for numerous indicators of fairness
- Estimated cost and revenue implications of different charge rates by modelling and analyzing TransLink's Regional Trip Diary data in combination with the Regional Transportation Model
- Researched some technical and governance considerations for implementing a decongestion charge in Metro Vancouver

Refer to Appendix B for the research and evaluation report.

KEY COMMUNICATIONS AND ENGAGEMENT ACTIVITIES:

- Conducted **2** rounds of public opinion polling in September 2017 and March 2018 with **2,000** residents across the region
- Launched **2** multilingual public education campaigns on the Commission's work and mobility pricing in the region in **16** local distribution and **11** non-English newspapers and reaching **898,099** residents on Facebook and **65,752** website page-views
- Conducted online public engagement and in-person workshops to inform the principles, hearing from **6,078** residents and **176** stakeholders and government officials in Phase 1 and hearing from **11,474** residents and **130** stakeholders in Phase 2
- Increased accessibility by translating the online platforms into Traditional Chinese, Simplified Chinese, and Punjabi (the region's largest non-dominant languages), receiving **310** completed paper surveys from over **16** regional community offices, and conducting outreach with social service organizations
- Convened a citizen-based User Advisory Panel of **15** members representative of Metro Vancouver (selected through an external recruitment firm) to advise and provide input at key stages of the project

Refer to Appendix C for the communications and engagement report.

What we learned

The graphic below pieces together our findings to show how they tell a story and form the foundation of our recommended principles in the next section.

FINDINGS

1. Congestion is a problem with many dimensions.

2. Travel patterns are complex – good transit is key.

3. The transportation sector is in a period of rapid change and innovation.

4. Prices influence travel behaviour and affect crowding and reduce congestion...

   ....but people are very concerned about the costs and the impacts for equity.

5. A decongestion charge with a meaningful impact on congestion could have significant out-of-pocket costs for some households...

   ...but that means there are revenues available to offset some of the concerns about equity and affordability.

6. Public support for decongestion charging is low, but many are undecided. There are several measures that can increase acceptance.

This section dives into each of these findings.

Congestion is a problem with many dimensions.

Congestion remains the biggest frustration of moving around in Metro Vancouver. From our March 2018 polling results, 85% of residents are frustrated with traffic delays caused by high volumes, with 82% of residents saying transportation delays cause them lost time every week. Crowding on transit came in fourth place at 71% and the cost of transit in fifth at 70%.

It is a challenge to adequately understand and represent the issue of traffic congestion through maps and numbers.

One congestion metric does not tell the whole story – we need a few metrics…
There are many ways to define and measure congestion, and sometimes these different ways will tell different stories about congestion. It's important that a few metrics are used in order to get the complete picture.

…and in order to generate these metrics, we need access to accurate and reliable data…
Access to solid data sources is essential to measuring and forecasting congestion. This includes travel times, traffic volumes, vehicle kilometres travelled (VKT), and origins and destinations of trips at fine levels of detail.

…and there will still be many nuances to defining, measuring, and explaining the congestion story.
For example, AM and PM peak times vary by location throughout the region, so a map revealing a snapshot of peak congestion doesn't always tell the whole story.

Refer to our Moving around Metro Vancouver report in Appendix A of our Phase 1 report for our baseline research on rising congestion in the region.

The unreliability of travel times is an important impact of traffic congestion, with 74% of people polled saying they are frustrated with the unpredictability. Urban areas will always experience a certain level of congestion. Many people may accept some delay as long as they know how long the delay is likely to be. The problem occurs when the actual delay is longer than our expectations and arrival times become difficult to predict. Reducing the variance of travel times can have the effect of improving average journey times, with only small reductions in total journey times.

Travel patterns are complex – good transit is key.

Around one-third of all the trips in Metro Vancouver are to and from work. The rest are for other purposes like leisure, shopping, and visiting family and friends. Even in the morning peak period, only around half the trips are commuting to and from work, and only around one-third of trips in the afternoon are commuting[3].

The majority of trips are local; more than half of trips at all times of day are within the same municipality. The highest number of internal trips are made within Vancouver (75%), Surrey (71%), and Maple Ridge (70%).

Transit services vary across the region, sometimes as a result of history and geography. Often it relates to the density of housing and employment. Providing transit in higher density areas maximizes the number of riders and minimizes the cost per rider, helping to keep transit affordable.

[3] TransLink Trip Diary 2011

A clear message from engagement is that many people think it would be unfair to charge for the use of roads where access to transit is not as good. More than 1,400 comments or around a quarter of all the comments received related to the availability and accessibility of transit options across the region.

Experience from other cities – as well as the analysis carried out in this project – suggests that if a decongestion charge were to be introduced, most people would pay and keep driving. Only a small number of people need to change the way they travel for there to be a meaningful reduction in congestion, and most people who change behaviour would not switch to transit. They would change destinations, share cars more, plan their trips more efficiently, and reduce their distances driven. So, while good transit is important in a growing region, the fact that some areas have poorer access to transit is not necessarily a reason to delay the introduction of a decongestion charge.

The transportation sector is in a period of rapid change and innovation.

Adding to the existing complexity of the region's transportation system, there are many unknowns and uncertainties around emerging mobility trends and technologies. The likely introduction of Transportation Network Companies – ride-hailing companies – in Metro Vancouver and new developments in electric, connected, and autonomous vehicles will open up more choices for getting around the region.

The combined impact of these innovations is likely to be a reduction in the cost of mobility. This is positive, but it will not necessarily happen in a way that is equitable or sustainable. In particular, cheaper travel by personal vehicle could lead to an increase in traffic volumes.

Increased vehicle efficiency, and particularly electrification of the vehicle fleet, while it has many environmental benefits, will lead to a reduction in revenues from fuel tax.

There are many uncertainties in how quickly this disruption will happen. The only certainty is that things will change and the way public authorities manage mobility to ensure equitable, sustainable and affordable mobility outcomes will need to change along with it.

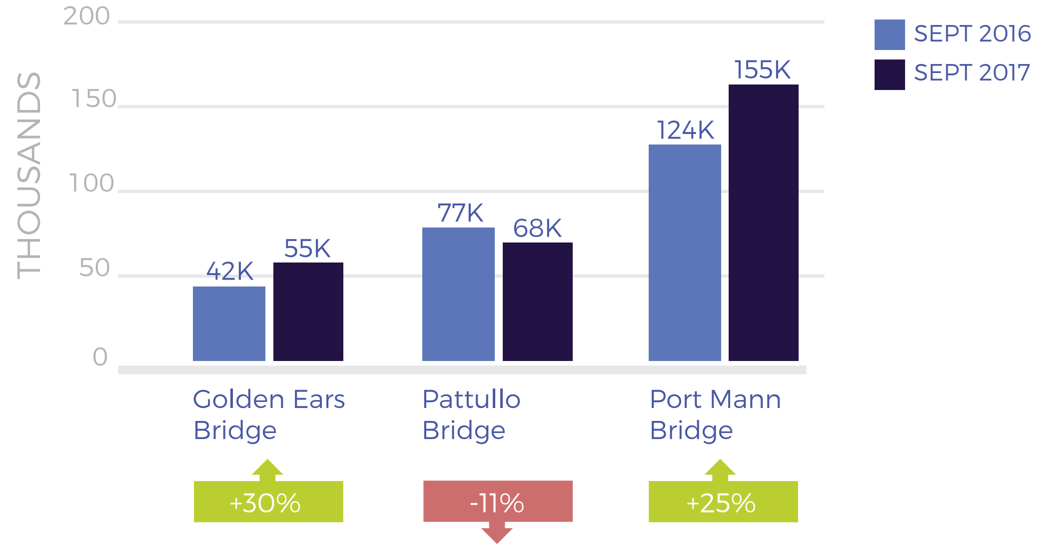
Prices influence travel behaviour and affect crowding and reduce congestion.

People sometimes talk about transportation "needs," but this is not strictly accurate. Where, when and how much we travel, and what mode we choose to take, will always be a function of what it costs us in time and money to make our trips. How different forms of transportation and mobility are priced sends a signal which can have an impact on people's behaviour in the long term (where we choose to work and live) and short term (what time we make a trip or by what mode). Getting those signals right can lead to positive outcomes for everyone. Getting them wrong will cause multiple problems.

Traffic congestion is a signal that the right price is not being charged for roads. A decongestion charge, when properly designed and introduced as part of a package, is one of the few measures that has proven effective in reducing urban congestion and encouraging the use of other modes. Cities with decongestion charging have seen sustained reductions in traffic volumes of 10-20%, resulting in an improvement in travel times of around a third. They have also seen co-benefits for reduced greenhouse gas emissions, improvements in air quality and traffic safety, and net revenues for reinvestment in the transportation system.

The tolls on the Port Mann and Golden Ears bridges showed the negative impacts if charges are applied in a way that is not coordinated. The removal of the tolls in September 2017 showed the impacts charges can have on travel behaviour in this region. Traffic volumes across the Pattullo Bridge have been reduced as drivers have chosen the other bridges which are now free, but total traffic volumes have increased.

Weekday traffic counts



Based on analysis carried out by TransLink

A coordinated mobility pricing policy that includes a decongestion charge could have a role in achieving regional objectives for land use management, environment, health, and safety. As with any transportation policy, it is important to ensure that mobility pricing generates societal benefit and desirable outcomes for the region. In particular, these outcomes should contribute to, and not detract from, the achievement of goals of the Regional Transportation Strategy, and Metro Vancouver's Metro 2040 regional growth strategy and Integrated Air Quality and Greenhouse Gas Management Plan. Decisions around land use and transportation are connected and have impacts on air quality and greenhouse gas emissions. The decongestion charging concepts illustrated in Part 4 contribute to achieving the goals set out in regional policies, through encouraging mode shifts to transit and reducing both vehicle travel and greenhouse gas emissions.

There are several decongestion charging concepts that can reduce congestion and generate revenues in a fair way in Metro Vancouver. The two most promising illustrative concepts are a regional system of congestion point charges and a multi-zone distance-based charge concept. Some minimum thresholds for charge rates that need to be applied in order to have meaningful regional congestion reduction benefits have been identified. This will be presented in Part 4.

… but people are very concerned about the costs and the impacts for equity.

We heard thousands of comments expressing anxiety and opposition to a decongestion charge. Concerns revolved around affordability and included frustration and distrust about the way revenues from existing transportation-related costs are being used and managed.

The online engagement received 3,490 suggestions to inform system design and implementation. The figures on the following page display the themes categorized by the Commission's objectives and ordered by most common comments.

Fairness themes from public comments

# of public comments for **distance-based charging**	Theme	# of public comments for **congestion point charging**
1170	Recognize **affordability concerns** and feeling of being penalized	658
784	**Improve transit and other mode infrastructure and services** to provide available and accessible options before potential implementation	652
292	Find **equitable ways to mitigate impacts** on people who are senior, lower-income, and/or differently-abled	131
56	Provide **affordable transit** fares to support fairness concerns and incentivize mode shift	16

Congestion themes from public comments

# of public comments for **distance-based charging**	Theme	# of public comments for **congestion point charging**
430	**Avoid 'double-dipping'** by reducing other taxes and costs people already pay for transportation	417
200	Study **other ways to reduce congestion other than charging**, like more efficient road use	286
58	**Apply charges only where and when congestion is a problem**, like at hot spots and/or peak hours	170

Revenue themes from public comments

# of public comments for **distance-based charging**	Theme	# of public comments for **congestion point charging**
161	Recognize that there is **distrust in how revenues have been managed by TransLink and governments**	240
120	Ensure **accountable and transparent use of decongestion charging revenues**	204
87	Distribute decongestion charging **revenues and benefits equitably across region**	181

Stakeholder and government acceptability of a decongestion charge will depend on addressing concerns about affordability and equity. Given the opportunity for in-person dialogue, some nuanced suggestions emerged to mitigate these concerns, including:

- To support social equity, offer caps, discounts, and exemptions for certain groups, including seniors, persons with disabilities and lower-income residents, truckers, businesses, non-profit meal delivery services, taxis
- To mitigate affordability concerns, offer transit options, align charge rates to the availability of transit, make transit free, and reduce or eliminate the fuel tax

There was concern regarding when and where charges would be applied, highlighting access to health care, schools, child care, and business services. There is an emphasis on integrating the system design with regional and land use planning processes.

How to measure equity remains subjective, with questions on who and how much to charge: *How could we charge higher in areas with greater transit accessibility if those residents already pay higher property taxes to fund transit? What about charging tourists and visitors? How can you charge at crossings when there are no other alternatives to get across? How is it fair if only half the population is paying?*

The question on how to equitably charge goes hand in hand with how to equitably distribute the revenues across the region for transit and transportation investment.

Driving is expensive, so people with lower incomes tend to drive less than people with higher incomes. This means that people with higher incomes are likely to pay more for a decongestion charge than people with lower incomes. However, as with many other transportation costs like transit fares, people with lower incomes will likely pay a higher proportion of their income in decongestion charges.

A decongestion charge with a meaningful impact on congestion could have significant out-of-pocket costs for some households...

There is a higher level of public support for charging that targets congestion (user cost) than for charging by use (user pay). By a two-to-one margin in the public polling, residents expressed a preference for user cost charging (49%) over user pay charging (25%). This sentiment matches the online engagement (44% vs 32%) and User Advisory Panel results.

There is lower stakeholder support for applications that do not meaningfully reduce region-wide congestion. Reasons include impacts of traffic diversions, limited behaviour shifts to other transport modes, being over-simplistic (like charging only at peak periods), and only targeting certain areas (like downtown Vancouver). There is higher support for targeted approaches, although understanding that they could be expensive, complex, and unpredictable for drivers (like multi-zone distance-based charging or charging at hot spots).

Analysis shows that the economic benefits of decongestion charging are derived from the ability to reduce congestion, and that the charges needed to achieve such a reduction are likely to be understood by many as high. Lower charges that might be considered more affordable can generate revenues but produce little or no congestion benefits. **The paradox is that the lower the charge, the more it can be described as a "tax grab" – only at relatively higher charges do the congestion benefits start to appear.**

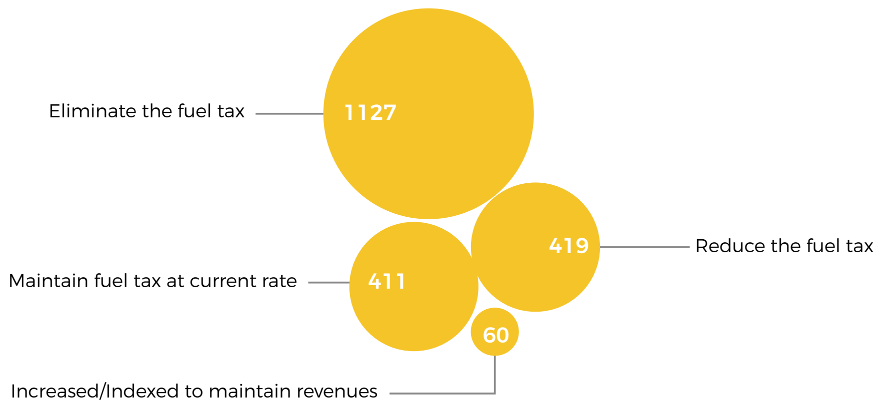
It is possible to design a decongestion charge that only raises revenues without any meaningful impacts on congestion. But the costs of raising those revenues will be significant. With little or no decongestion benefits, the overall economic case for such a decongestion charge is hard to justify.

...but that means there are revenues available to offset some of the concerns about equity and affordability.

The decongestion charging concepts that have been explored have the potential to raise net revenue. How these revenues are used will be a very significant factor in how equitable the charge is. Examples could include returning revenues through balancing against other mobility pricing fees, removing other taxes or offering targeted rebates to people on low incomes.

There was consensus among the public from polling and engagement to reduce existing taxes if a decongestion charge is implemented. 1,566 comments that expressed a preference through the online engagement platform are displayed in the graphic below:

Public preferences on managing the fuel tax if a decongestion charge is implemented



55% of polled residents gave 'reducing driving costs (i.e. insurance, parking fees, fuel taxes)' as their top priority to use decongestion charging revenues. 35% supported using revenues to reduce transit fares.

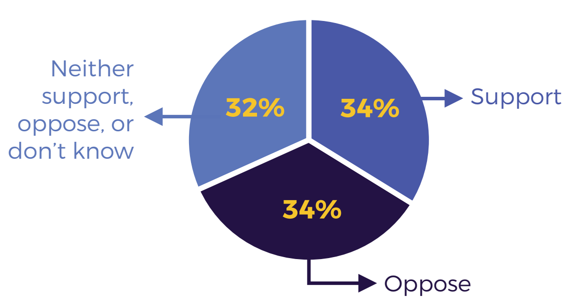
Public support for decongestion charging is low, but many are undecided. There are several measures that can increase acceptance.

Skepticism and low support for a decongestion charge were heard throughout the project with comments including '*it will not work*,' '*this is another tax grab*,' '*this is unaffordable*,' and '*it is penalizing*.'

Residents tend to be more willing to support a decongestion charge if it supports transportation investment or makes paying for transportation more fair. Comments in support of a decongestion charge spoke to benefits from reduced traffic and commute times, behavioural shifts to other modes of transport, and environmental benefits from reduced vehicle use.

Polling shows that public opinion on decongestion charging is evenly split.

March 2018 polling results:
Level of public support for decongestion charging



Results are based on an Ipsos poll conducted with 1,000 residents across Metro Vancouver.

With so much of the population still undecided, time and education will be important. Polling in March 2018 shows that awareness levels are still low for mobility pricing (30%), decongestion charging (14%), congestion point charging (13%), and distance-based charging (31%). The *It's Time* project may have been the first time many people heard about decongestion charging or considered its impacts. Polling also showed that 70% of residents are interested in staying informed on mobility pricing, and 68% think it is worthwhile to study ways to make transportation pricing more efficient and fair. This is an increase from the September 2017 poll.

The level of support in Metro Vancouver is comparable with that found in other jurisdictions which have considered a decongestion charge. As policy designs are communicated to the public, there is often a negative reaction, leading to low levels of support. Around 39% of people in London and 21% of people in Stockholm were in favour before those systems were implemented. Concerns are often driven by expectations of high costs, a perceived lack of viable transportation options, as well as a lack of confidence in the benefits of congestion reduction. Acceptance typically increases after implementation, which can be attributed to these factors:

- Travel times improve more than people expected (benefits are realized)
- Negative consequences, like paying the charges or shifting travel habits, prove less problematic than anticipated
- People adapt and accept a new status quo, no longer evaluating the policy as a “change”

Public support for a comprehensive mobility pricing policy that includes a decongestion charge will depend on addressing public concerns on:

- Affordability
- Transit options
- Equity
- Accountability in managing revenues

There are unique considerations for First Nations that need to be included in future research and engagement.

The Commission chair and vice-chair met with the Union of BC Indian Chiefs and a few representatives from local First Nations to share information and begin understanding unique concerns about decongestion charging from an Indigenous lens. Transportation, health, and cultural services are not available on reserve and in rural communities, and a decongestion charge will impact the communities' ability to access these resources. There are also limited transit and HandyDart options, and car sharing options do not service certain reserves and communities.

Key flags to consider are whether and how it would be appropriate to apply a decongestion charging system as the road network is situated on unceded Indigenous land, and how First Nations would pay into and receive the benefits. Additionally, existing engagement with First Nations on transportation has not met expectations and more dedicated and meaningful effort is required.

PART 3. PRINCIPLES FOR A MOBILITY PRICING POLICY

What we recommend

PART 1
Context

PART 2
Findings

**PART 3
Principles**

PART 4
Illustrative
Concepts

PART 5
Next Steps

PART 6
Conclusion

APPENDIX A

APPENDIX B

APPENDIX C

PART 3. PRINCIPLES FOR A MOBILITY PRICING POLICY

Based on the findings in Part 2, the Commission has put together the following set of principles to guide the development of a coordinated regional mobility pricing policy for Metro Vancouver. The principles are interdependent and are not offered in any order of priority or relative importance.

Note: Some of these principles have been used to narrow down the range of potential decongestion charging concepts to those illustrated in the following section. This process is described in the boxes under the relevant principles.

An effective, farsighted, and fair regional mobility pricing policy for Metro Vancouver should:

Congestion

A. Deliver meaningful reductions in traffic congestion

B. Ensure everyone pays a fair share

C. Coordinate all the ways we pay for mobility, including new and emerging services

Fairness

A. Be consistent and explainable

B. Support equity

C. Align prices for road use with access to transit

Support investment

A. Ensure accountability in the way revenues are used

B. Not have raising revenue as its primary aim

Other considerations

A. Deliver positive economic benefits

B. Protect individual privacy

C. Be predictable, but adaptable

D. Support goals for regional growth, climate change, and the environment

E. Continue to be explored with the public and stakeholders

Congestion

Traffic congestion is a real and growing concern in Metro Vancouver. There are many measures that need to be taken to counter the threat of growing congestion, and a coordinated mobility pricing policy that includes a decongestion charge should be an integral part of any such strategy. But it is unclear who holds overall responsibility for coordinating action on reducing congestion.

Mobility pricing is only part of the solution, and it will need to be considered in a broader context with other tools and measures and against other policy objectives for a socially, economically, and environmentally sustainable region. There are many bodies at the municipal, regional, provincial, and federal levels involved in operating our transportation network, and it is not always clear how responsibility for addressing traffic congestion is coordinated. Clarifying this responsibility will be an important part of making a decongestion charge work to address growing congestion.

The Commission recommends that the following principles be applied when considering congestion:

PRINCIPLE A

A decongestion charge should deliver a meaningful and region-wide impact on traffic congestion. This must be guided by appropriate congestion reduction targets for Metro Vancouver.

Congestion is an issue across the region, and so a mobility pricing policy should seek to have regional benefits. If reducing congestion is an important motivation, the reduction must be visible to drivers and other road users in the form of reduced travel time delays and increased reliability. That means a decongestion charge will need to be set at a level to achieve behaviour change. Many people will experience those charges as high, so there needs to be a careful balance between this and the other objectives of fairness and supporting investment.

The design of a decongestion charge should seek to minimize rerouting that could cause new congestion hot spots and adversely affect local air quality and safety.

The region does not currently have an agreed definition of congestion or any targets for reduction. This means the Commission has not been given any guidance on what a meaningful reduction of congestion might be, which is important for understanding what a decongestion charge might look like.

The Commission proposes that a target be set based on three metrics:

- Total regional congested time savings
- Visible congested time savings – the proportion of households experiencing a large reduction in congestion time
- Positive net economic benefits, which take into account the household costs and also the inconvenience to people changing behaviour

Region-wide, meaningful congestion reduction can be used to eliminate some decongestion charging concepts:

- In order to achieve region-wide congestion reduction, point charges need to be located at strategic points across the network. This excludes charges with only local scope, such as charges at just certain bridges, or at or around urban centres
- Region-wide congestion reduction is achievable in all the distance-based charge systems we studied, but it is difficult to achieve meaningful reductions using flat-rate all-day charges

PRINCIPLE B

Everyone who uses the transportation system should pay something for it. It should cost more if using the road causes congestion. It is important to find the right balance between paying for use and paying for congestion.

One aspect of fairness is that that everyone should be contributing something to the transportation system – so-called "user pay." We already do this with fuel taxes, transit fares and through property and income taxes. Another aspect of fairness is that those trips contributing more to traffic congestion, by travelling in congested locations at congested times in a way that takes up more space per person, should pay more – "user cost." While the justification for a decongestion charge does not rest on the experience of individual drivers, an important dimension of fairness could also be that people who pay should benefit from time savings.

Achieving a balance between paying for use and paying for congestion can be used to eliminate some decongestion charging concepts:

- User Cost is a priority, and charges should be higher in locations and at times where congestion is greater
- Flat-rate all-day charges do not align well with user-cost; charges that vary by time and location align better
- Distance-based charges allow for a more targeted balance between user pay and user cost when charge rates are varied across multiple zones
- A User Pay component can be achieved by additions of fuel/energy taxes to a congestion point charge

PRINCIPLE C

A decongestion charge should be coordinated with all the other ways we pay for mobility in Metro Vancouver – including new and emerging mobility services – to achieve regional mobility goals.

As discussed in Part 2, the way people pay for transportation has an impact how, where, when, how often, and how much they travel. Coordinating the price signals sent by a decongestion charge with transit fares, parking fees, and fees for existing and emerging transportation services could be a powerful way to achieve goals for efficient, affordable, and sustainable mobility. More work is required to fully understand how this should be done.

The public and stakeholders have suggested that reducing transit fares might contribute to relieving traffic congestion. Some very preliminary analysis suggests there could be synergies between a coordinated introduction of a decongestion charge and the reduction of some transit fares. There is also potential to use parking pricing to influence congestion in parts of the region that has not yet been fully explored.

An integrated mobility payment system, covering transit fares, parking, decongestion charging, and even bike and car share, taxis, and services offered by transportation network companies could introduce new possibilities for people to track their spending on transportation and could overcome some of the inflexibility of monthly transit passes. It also offers interesting potential for financial incentives to be offered in addition to charges.

Fairness

Fairness needs to be considered across many different dimensions. Consideration of fairness should apply to everyone, irrespective of how they choose to travel.

The Commission has heard many different concerns about fairness, including those regarding geographic differences across the region, the different needs of groups within society like seniors, people with disabilities, children, students, tradespeople, people providing social services, commercial drivers, as well as people with different incomes.

Many of these concerns about new ways to pay for using roads are valid, but many of them could equally be applied to the ways we already pay to use transit. A discussion about the fairness of paying for mobility needs to apply consistently across all modes of transportation.

The Commission recommends that the following principles be applied when considering fairness:

PRINCIPLE A

Differences in mobility pricing charges across users must be consistent and explainable.

Transit fares using the current zone structure have some relation (however imperfect) to distance travelled, that is, how much of the transit system people use. The transit fare review has looked at options including a closer relationship between the fare paid and the distance travelled and varying according to the type of transit used. The relationship between road use and how we pay for it, and in particular the differences between how we pay for road use and how we pay for transit, are not clear and explainable. Many of the concerns about the fairness of a decongestion charge, for example the impacts on people with low incomes, could equally apply to transit fares.

A decongestion charge that is designed to charge in relation to the economic costs of congestion will result in people paying different amounts. Differences in the cost of decongestion charges across users are fair to the extent that they are justified by congestion benefits, explainable by consistent application of transparent pricing principles, and that the differences favour those with least ability to pay. There may be circumstances where this could lead to excessively high charges, in which case caps, discounts, or rebates could be considered.

It will likely be reasonable that some groups – for example, people with disabilities in possession of a SPARC parking placard – could receive an exemption or discount from decongestion charges.

How charges are applied to commercial users needs to be considered very carefully. Commercial vehicle operators want to see improvements in congestion and particularly journey time reliability, but they would also value a system that allows them to allocate costs transparently and accurately to their end customers. It could be appropriate to consider special forms of charging that apply specifically to commercial users of all kinds.

PRINCIPLE B

The design of a decongestion charge should seek alignment of charges with access to transit. This can be supported by targeted transit improvements.

It is possible to design a decongestion charge that is aligned with access to transit. It would also be possible to introduce targeted improvements, for example, in the form of new direct bus services connected to park and ride facilities, to further improve this alignment.

It is important to remember that if a decongestion charge were to be introduced, most people would pay and keep driving. Only a small number of people need to change the way they travel for there to be a meaningful reduction in congestion. Most people who change behaviour will change destinations, share cars more, plan their trips more efficiently, and reduce their distances driven. So, while good transit is important in a growing region, the fact that some areas have poorer access to transit is not necessarily a reason to delay the introduction of a decongestion charge.

Systems that seek to address congestion will generally be more aligned with transit access, as urban density, congestion, and transit services are generally correlated.

PRINCIPLE C

A mobility pricing system should be designed in a way that seeks to promote equity. Any revenues from a decongestion charge above those needed for agreed transportation investments should be used to address concerns about the affordability of mobility for people on lower incomes.

Action is required on many fronts to address affordability in our region, most of which lie outside the mandate of the Commission. This should be an important theme of work in the next regional transportation strategy beginning in 2018.

Although people on higher incomes are likely to pay more under any decongestion charge concept, lower-income households will pay a larger proportion of their incomes – the same is true for existing transit fares and fuel taxes. Because people on higher incomes generally drive more at congested times of day, a system that focuses on congestion could be more equitable than one that charges the same rates irrespective of when we drive.

Systems having a meaningful impact on congestion are likely to produce more revenue than is required for current transportation investment priorities. These excess revenues could be used in various ways to address affordability concerns, and we suggest further research be carried out on:

- Reducing the fuel tax and/or other taxes that currently contribute to the regional transportation system
- Providing a tax credit to lower income households
- Reducing transit fares

Some systems could produce substantially more revenues. In this case, consideration could be given to a more comprehensive review of the ways we pay for transportation, including through transit fares, property taxes, parking taxes, the Hydro levy or even income taxes. This could address a broader picture of equity and affordability in a way that is unlikely to be achieved through targeted measures to address only the effects of a decongestion charge.

Although there is a lot of support among the public, stakeholders, and government officials for mitigating the impacts for people on low incomes, some stakeholders cautioned against measures that might reduce the impacts of a decongestion charge.

Support investment

The first use of revenues raised from a decongestion charge should be to pay for investments as part of an approved regional transportation investment plan.

The Commission's Terms of Reference set out the requirement for revenues to support transportation investment.

Revenues could also be used to increase equity or to offset other ways we pay for the transportation system, as discussed above.

The Commission recommends that the following principles be applied when considering supporting investment:

PRINCIPLE A

The entity that collects and manages revenues from a decongestion charge must ensure accountable, effective, and transparent use of those revenues.

The public and stakeholders have raised concerns about transparency and efficiency in the way revenues are used for transportation investment in the region at all levels of government. Without endorsing or refuting the legitimacy of these concerns, the Commission agrees that it will be important for whatever entity is in charge of collecting and allocating revenues to do so in a way that is accountable, effective, and transparent. This will require some level of independent scrutiny.

PRINCIPLE B

Raising revenues should not be the primary purpose of a mobility pricing policy.

While net revenues can be raised through a decongestion charge, those revenues come at a direct cost, which could be anything between 10 and 50% of the gross revenues. Costs should be kept to a minimum, but will always be more than, for example, the costs of collecting the fuel tax. In short, a decongestion charge is not an efficient way to raise revenues if that is the primary purpose. The logic of decongestion charging is that it can achieve other benefits, primarily improved journey times through meaningful reductions in congestion.

The efficiency of charge collection can be used to eliminate some decongestion charging concepts:

- Some concepts the Commission studied, for example charging a dollar per bridge, had costs that were more than half the gross revenues. The illustrative concepts presented in Part 4 have costs that are around 25% or less of gross revenues.
- The range of cost estimates for distance-based charges is larger at this time, reflecting greater uncertainty. It is anticipated that these uncertainties can be addressed with further analysis.

Other considerations

There are other aspects, beyond the three objectives of reducing congestion, promoting fairness, and supporting investment that need to be considered:

PRINCIPLE A

A decongestion charge must deliver positive total economic benefits for the region.

The total economic benefits of public policies are measured by monetizing all the effects, both positive and negative. They are a measure of how the regional economy in Metro Vancouver will benefit or be harmed by pursuing a particular policy. For decongestion charging, the major benefits include reductions in delays, improvements in travel time reliability, and emission reductions. The costs include implementation, operation, and the inconvenience to people who choose to change their behaviour. Achieving positive economic benefits is a minimum requirement for a decongestion charge. Economic benefit calculations are however blind to equity and fairness considerations and not all effects can always be monetized.

Not all of the decongestion charging systems we examined necessarily produce positive economic benefits, but it is possible to design systems that produce substantial benefits.

Total economic benefits can be used to eliminate some possibilities:

- Total economic benefits are driven by several parameters, both positive and negative. In the case of concepts that are well aligned with congestion, these benefits will depend on the level of the charge. Lower charges give lower congestion benefits, but also lower costs of adaptation for individuals. Higher charges give greater benefits, but also greater adaptation costs.

PRINCIPLE B

The design of a mobility pricing policy should support provincial and regional environmental and land use objectives, as well as considering implications for health and road safety.

Many stakeholders were interested in the potential for a more coordinated mobility pricing policy that includes a decongestion charge to make a positive contribution to objectives around greenhouse gases and criteria air contaminants. Research shows that a reduction in vehicle kilometres travelled (VKT) would support these objectives and provide further benefits for public health, noise reduction, and road safety.

The design of a mobility pricing policy also needs to support (or, at a minimum, not detract from) regional land use objectives.

PRINCIPLE C

A mobility pricing system needs to be stable and predictable but can and should evolve over time to more effectively address congestion.

Systems should also be capable of adapting over the longer term to changing patterns of congestion as a result of population growth, new infrastructure, external changes like increased automation or electrification of the vehicle fleet, or new possibilities for vehicle sharing.

Research shows that, depending on the technology deployed, decongestion charging has good potential for flexibility, and other cities like Singapore and London have evolved their systems and rates over time.

PRINCIPLE D

A mobility pricing system must recognize and respect an individual's interests and rights to privacy and use of personal information.

Research shows that it is possible to address concerns about privacy through the design and implementation of a system that meets all privacy laws, regulations, and best practices, but this will warrant close and careful attention.

PRINCIPLE E

There will need to be further communication and engagement around a mobility pricing policy, with dedicated resources and programming for inclusive outreach to Metro Vancouver's diverse residents.

There is strong demand for continued public education and engagement on mobility pricing. It is a complex topic to communicate, and it is likely to remain high-profile and controversial.

Future communication and engagement must be inclusive and designed to understand all viewpoints. Underrepresented voices can be unintentionally excluded, but those people are often impacted disproportionately. With the Commission's commitment to inclusive participation, the *It's Time* communication and engagement program had dedicated funding to reach the region's multicultural and socioeconomically diverse communities.

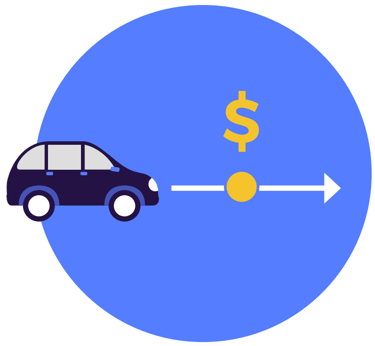
This funding set a strong precedent, and demand, for continued inclusive practices. It also showed high returns on investment on inclusive programming.

PART 4. ILLUSTRATIVE CONCEPTS FOR A DECONGESTION CHARGE

What it could look like

PART 4. ILLUSTRATIVE CONCEPTS FOR A DECONGESTION CHARGE

The Commission has analyzed a series of possible decongestion charging concepts and concludes that a system that meets the principles outlined above could be implemented in two broad ways:



A regional congestion point charge with charge points at or close to some or all of the regionally important crossings, complemented by further point charges at locations within the Burrard Peninsula

A distance-based charge with two or more zones with varying charge rates throughout Metro Vancouver

Based on analysis using outputs from the Regional Transportation Model and other sources, the two systems produce similar results in terms of congestion reduction, household costs and revenues. Distance-based charging appears to have considerable flexibility for refinement, for example, in targeting congestion and aligning with transit access and a broader mobility pricing policy. But there is some uncertainty as to the maturity of the available technology that suggests a more cautious implementation timescale would be warranted. Congestion point charging uses mature technology that could be implemented quickly with relatively little risk, but some of the flexibility and potential to integrate into a broader mobility pricing policy would be lost.

In summary, if decision-makers consider that the regional congestion problem and the need for revenues is acute, congestion point charging provides a good solution. If these issues are not acute, and more time can be taken to develop a more flexible solution, distance-based charging would be an opportunity for the region to lead the world in sustainable congestion management.

More analysis and iterations will be needed before finalizing a decongestion charge system that balances the many factors that need to be considered. The following concepts are offered as illustrations of charge levels needed to achieve meaningful reductions in congestion, and best estimates of their impacts based on traffic modelling.

SETTING CHARGE RATES WITHOUT A CONGESTION REDUCTION TARGET

In the absence of a target for congestion reduction, charge rates have been determined using a combination of two methods: marginal social cost pricing and minimum congestion reduction thresholds.

Marginal social cost pricing

Developing baseline charge rates was grounded in economic theory and the concept of marginal social cost pricing. Charges are set according to the level of congestion experienced and achieve the optimum outcome for society. That means that charge rates would vary on different parts of the road network by time of day, according to the exact level of congestion. These variable time and location charges are simplified and applied at congested points (congestion point charging) or as a per kilometre charge over a wider zone (distance-based charging).

Minimum congestion reduction threshold

Applying the theory of marginal social cost pricing will ensure that the optimal economically efficient charge rates are set for each of the congestion point charges or distance-based charging zones.

However, analysis suggests that setting the rates in this way will likely exceed the politically desired or required level of congestion reduction.

In the absence of a clear congestion reduction target, we have set a minimum threshold that would meaningfully reduce congestion. This minimum congestion reduction threshold is based on a combination of regional travel time savings, visible congested time savings, and net economic benefits.

Refer to Appendix B for the full details of how the minimum congestion reduction threshold has been developed and set.

For each decongestion charging concept, two charge rates are illustrated:

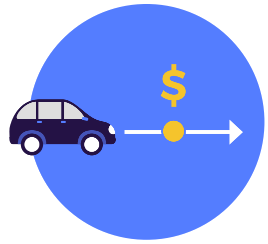
Min

Minimum: one that would achieve the minimum level of meaningful congestion reduction as described above (where the charge rates are approximately half – 50% – of the marginal social cost charge rates) and

Min+

Minimum+: one that would produce a slightly higher level of congestion reduction (where the charge rates are about three-quarters – 75% – of the marginal social cost charge rates).

Regional congestion point charges

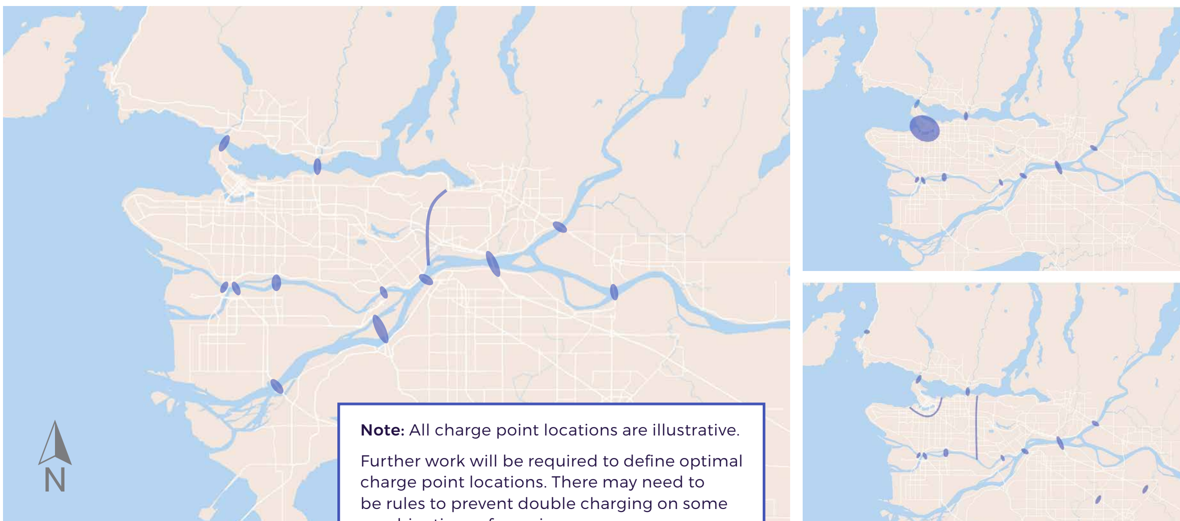


One possible approach is a congestion point charge system with charge points on or close to 12 major crossings throughout the region. Because there is congestion in areas away from bridges, particularly within the Burrard Peninsula, these points should be complemented by further points at other strategic locations.

For the purposes of this analysis, charge points have been located along North Road (the boundary between Burnaby/New Westminster and Coquitlam/Port Moody), but alternative approaches that could be worth pursuing are also illustrated below.

Further work will be required to find optimal locations for all charge points.

Illustrative regional congestion point charge concept and alternative approaches



Note: All charge point locations are illustrative.

Further work will be required to define optimal charge point locations. There may need to be rules to prevent double charging on some combinations of crossings.

Charge rates

Charge rates have been set at 50% and 75% of the marginal social cost of congestion at the given location and time, so charges vary by time of day, location, and direction of travel. Higher charges reflect higher levels of congestion. **All charge rates are preliminary and for the purposes of this illustration**. Rates are given for peak and off-peak periods. The duration of AM and PM peak periods would need to be determined. There may need to be "shoulder periods" of intermediate charge levels to avoid sudden large rate changes between peak and off-peak charges.

For both of these concepts, it is assumed that the regional fuel tax of $0.17 per litre remains in place in order to achieve a balance between paying for use and paying for congestion, as described in congestion principle B.

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Charge levels used for the illustrative regional congestion point charge concept

Charge concept	Direction of travel	Time of Day	Congestion Point Charge Location					
			Lions Gate and Iron-workers	Arthur Laing, Oak and Knight	Queens-borough, Pattullo, and Port Mann	George Massey and Alex Fraser	Pitt River and Golden Ears*	North Road
Min	Inbound (towards Downtown Vancouver)	AM Peak	$3.55	$3.59	$4.25	$2.68	$2.80	$2.60
		Off Peak	$1.06	$0.91	$0.74	$0.76	$0.54	$0.36
		PM Peak	$4.92	$3.54	$3.54	$3.05	$2.41	$1.03
	Outbound (Away from Downtown Vancouver)	AM Peak	$4.30	$2.24	$2.17	$2.18	$2.72	$0.85
		Off Peak	$0.86	$0.81	$0.65	$0.55	$0.52	$0.41
		PM Peak	$4.59	$3.92	$5.52	$3.51	$4.15	$2.27
Min+	Inbound (towards Downtown Vancouver)	AM Peak	$5.32	$5.38	$6.37	$4.03	$4.19	$3.90
		Off Peak	$1.59	$1.36	$1.11	$1.13	$0.81	$0.54
		PM Peak	$7.38	$5.30	$5.30	$4.58	$3.61	$1.54
	Outbound (Away from Downtown Vancouver)	AM Peak	$6.45	$3.36	$3.25	$3.27	$4.08	$1.27
		Off Peak	$1.29	$1.21	$0.98	$0.83	$0.78	$0.62
		PM Peak	$6.89	$5.87	$8.27	$5.27	$6.23	$3.41

*For Golden Ears bridge, southbound is inbound, northbound is outbound, relecting the higher peak flows.

Price capping should be explored as part of further research in order to address trips that cross multiple charge points in a single journey. The charge rates for some example trips using this illustrative concept can be found later in this section.

How do the regional congestion point charge concepts perform?

Depending on whether the *Minimum or Minimum+* concept is pursued, the regional congestion point charge approach has the potential to generate regional congestion reductions in the range of 20-25% and improve travel time reliability by 17-20% compared to the 2030 baseline. The estimated median weekday cost to households that pay into this system (without ever altering their behaviour) is in the range of $5.00-8.00 per day, and $1,800-2,700 per year[4].

Capital costs to establish congestion point charges are in the range $150-350 million, with annual operating costs in the range $110-200 million. Annualizing the capital costs of on-street charging infrastructure over 35 years and including revenue from the fuel tax, such a system could deliver annual net revenues in the range of $1.1-1.5 billion.

Greenhouse gas emissions from road transport would be reduced by 2-3%.

[4] Costs incurred by households that will pay the decongestion charge without ever adjusting their driving behaviour. These are an overestimate, as many households will be able to reduce costs by changing travel behaviour on some days. Annual estimates are based on an annual expansion factor of 335, which is consistent with expansion factors used elsewhere in transportation demand modelling, but a one-day travel pattern for a household may not be representative for their "average" behaviour and thus some errors are made by annualizing the daily household travel patterns. Refer to Appendix B for the full details of these metrics and methods.

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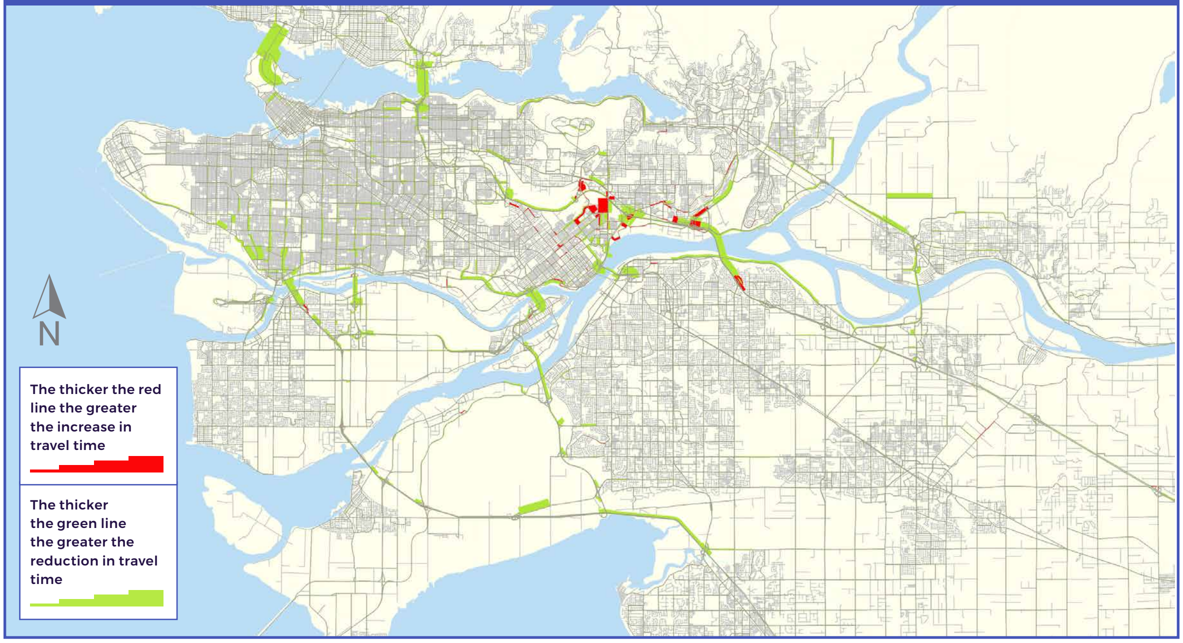
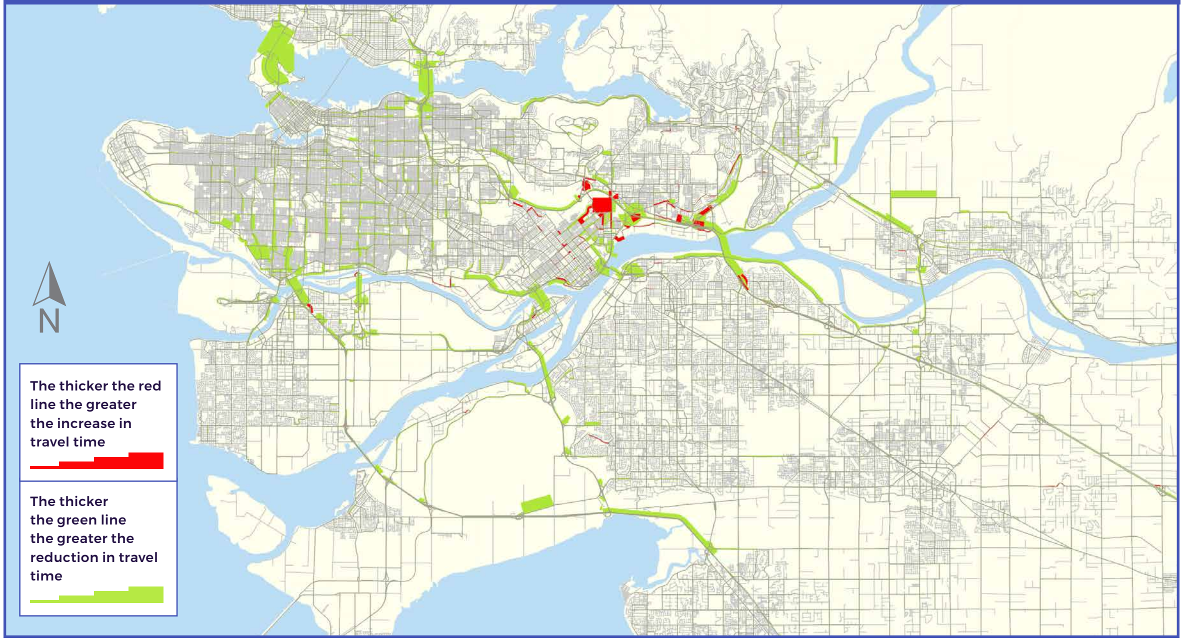
Min Travel time reductions for a regional congestion point charge compared to 2030 baseline for the AM peak period



Min+ Travel time reductions for a regional congestion point charge compared to 2030 baseline for the AM peak period



The numbers in the table on the next page are best estimates based on the modelling and analysis done to date. As concepts are further refined and updated data on Metro Vancouver travel patterns becomes available, these estimates will need to be updated.

Evaluation criteria	Units	Regional congestion point charges	
		Min	Min+
Economic benefits			
Total net economic benefits	$ million/year	$220	$290
Congestion			
Total regional congested time savings	% change from baseline in 2030	-20%	-25%
Travel time reliability	% change from baseline in 2030	17%	20%
Visible congested time savings[5]	% households that will achieve >10 mins savings per day	25%	44%
Revenue			
Total net revenue[6]	$ million/year	$1,050	$1,460
Household costs			
Median daily costs for households that pay	$/household/day	$5-6	$7-8
Median annual costs for households that pay	$/household/year	$1,800-2,000	$2,500-2,700
Median household charges as a % of annual income	Low (<$50K/yr) Med ($50K-$100K/yr) High (>$100K/yr)	5-6% 2-3% 1-2%	7-8% 3-4% 1-2%
Amount needed to correct equity imbalance[7]	$ million/year	$170	$250
Environment, health, and contribution to the regional transportation strategy and regional growth strategy			
GHG emissions (all modes)	% change from 2030 Baseline	-2%	-3%
Total VKT (all modes)	% change from Baseline in 2030	-4%	-6%
VKT/capita (private car)	% change from Baseline in 2016	-12%	-14%

High income households would on average pay more in decongestion charges than low income households, but low income households would pay a greater amount in proportion to income. The same is true of many other fees and costs. The figures under *Amount needed to correct equity imbalance* represents the amount of money that would need to be returned to medium and low income households if the goal were to create a fully equitable system in the sense that everyone would pay the same as a proportion of income.

Refer to Appendix B for the full details of the consequences and trade-offs of the congestion point charge concepts.

The following considerations for further refining the regional congestion point charge concept were identified by the Commission:

- The optimal location of charge points
- Ways to address impacts for people on low incomes, including the return of revenues
- The application of discounts and exemptions
- Price capping to mitigate high costs borne by some road users (especially for *Minimum+*)
- Ways to address vehicle trips that benefit from reduced congestion but do not pay (i.e. trips that do not cross a charge point)
- Ways to mitigate boundary effects, for example, through the application of discounts or exemptions applied to households that live in close proximity to the charge points
- Targeted transit investment and park and ride to ensure that viable alternative transportation options are available
- Options for reducing the fuel tax
- The possibility of using excess revenues to reduce transit fares
- Considerations for new and emerging transportation services like transportation network companies and automated vehicles

[5] Of the households experiencing significant daily congestion, what proportion will achieve visible congestion time savings per day.

[6] This includes revenue from the fuel tax which is included in the congestion point charge concepts.

[7] This figure represents the amount of money that would be needed to offset the income inequity.

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WHY NOT INCLUDE THE FALSE CREEK BRIDGES?

We analyzed the impact of charging on the three bridges over False Creek – Burrard, Cambie, and Granville – as part of a regional congestion point charge concept.

The result of these charges in the transportation model was traffic diversion to the already congested areas around Main Street and Quebec Street, as shown in the maps below.

The effect of this diversion was a small reduction in the overall congestion benefits of the regional congestion point charge concept. Adding a charge on the False Creek bridges does not have an impact on travel times crossing these bridges because there is little or no congestion on the bridges in the first place.

The following two maps illustrate the effects of placing decongestion charges on all bridges, including the False Creek bridges:

Min Change in traffic volume compared to 2030 baseline

Min Change in travel time compared to 2030 baseline

The thicker the green line the greater the reduction in traffic volume and travel time

The thicker the red line the greater the increase in traffic volume and travel time

Adding charges to the False Creek bridges creates some significant negative consequences. That should not rule out the exploration of alternative charge concepts in this area. A downtown cordon as part of a regional congestion point charge concept is one option worth further research.

WHY NOT CHARGE A 'BUCK-A-BRIDGE' FOR ALL BRIDGES?

During the course of the *It's Time* project, we received many comments and suggestions around the notion of charging $1 per bridge for all bridges. The rationale for this suggestion is that the rate is low, and that it's spread evenly across all bridges. An analysis of the impact of charging a dollar a bridge for the 12 bridges included in the regional congestion point charge concept drew the following conclusions:

- **There is no impact on congestion:** In order to have meaningful congestion reduction benefits, charge rates need to be high enough in the peak periods to change behaviour. Our research demonstrated that charging only a dollar per bridge is too low to have any meaningful impact on traffic levels, meaning there would be no improvements in congestion.
- **It's a very inefficient way to raise revenue:** Annual gross revenue of charging a dollar per bridge is estimated at $390 million. However, annual system costs are estimated at $210 million. Therefore the estimated annual net revenue is $180 million (only 46% of gross revenue).

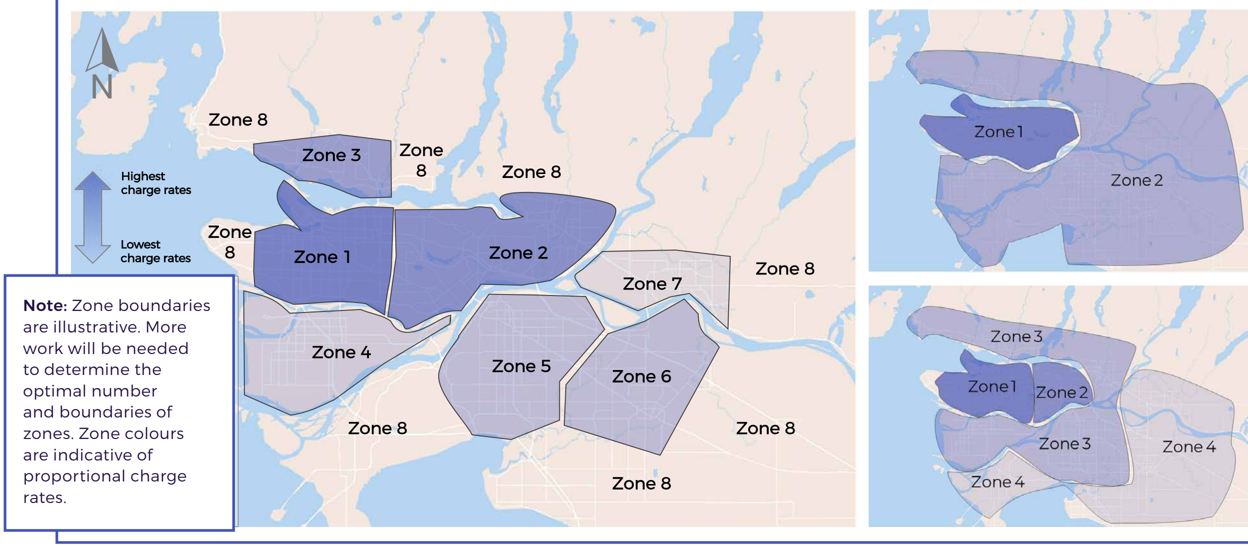
Multi-zone distance-based charges

A second approach is a multi-zone distance-based charging system, with the number and exact boundaries of zones still to be determined and refined. Charges vary by zone and time of day.

For the purpose of this analysis, eight zones with different distance-based charge rates have been developed, but alternative approaches that could be worth pursuing are also illustrated below.

Further work will be required to identify the optimal number and locations of zones.

Illustrative multi-zone distance-based charge concept and alternative approaches



Charge rates

Charge rates have been set at 50% and 75% of the marginal social cost of congestion at the given location and time, so charges vary by time of day and between zones. **All charge rates are preliminary and for the purposes of this illustration**. Rates are given for peak and off-peak periods. The duration of AM and PM peak periods would need to be determined. There may need to be "shoulder periods" of intermediate charge levels to avoid sudden large rate changes between peak and off-peak.

For both the *Minimum and Minimum+* concepts it is assumed that the regional fuel tax of $0.17 per litre (or approximately 1.8 cents/km) is eliminated.

Charge levels used for the illustrative multi-zone distance-based concepts									
Charge concept	**Time of Day**	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**	**Zone 7**	**Zone 8**
Min	AM Peak	$0.25/km	$0.20/km	$0.17/km	$0.12/km	$0.11/km	$0.14/km	$0.08/km	$0.02/km
	Off Peak	$0.07/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km
	PM Peak	$0.27/km	$0.22/km	$0.15/km	$0.11/km	$0.14/km	$0.12/km	$0.10/km	$0.03/km
Min+	AM Peak	$0.38/km	$0.30/km	$0.25/km	$0.17/km	$0.16/km	$0.20/km	$0.11/km	$0.03/km
	Off Peak	$0.11/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km
	PM Peak	$0.40/km	$0.32/km	$0.23/km	$0.17/km	$0.20/km	$0.18/km	$0.15/km	$0.04/km

Price capping should be explored as part of further research in order to address large distances driven by some users in a single day. The charge rates for some example vehicle trips under this illustrative concept can be found later in this section.

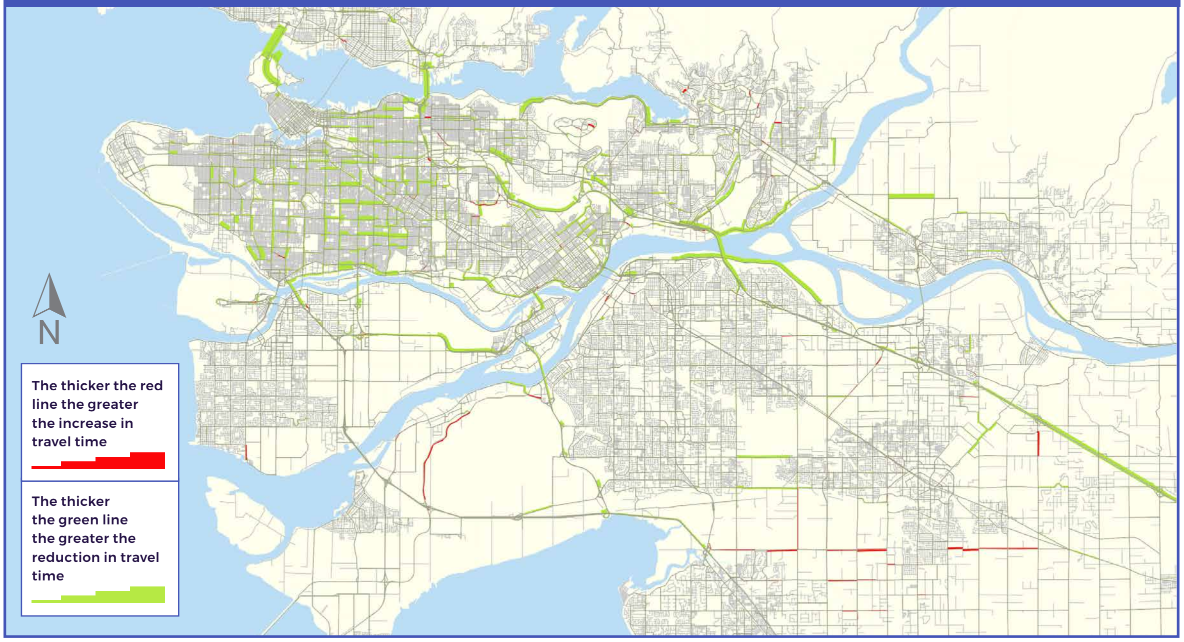
How do the multi-zone distance-based charge concepts perform?

Depending on whether the *Minimum or Minimum+* concept is pursued, the multi-zone distance-based charge has the potential to generate regional congestion reductions of 20-25% and improve travel time reliability by 18-23%. The estimated median weekday cost to households that pay into this system (without ever altering their behaviour) is in the range of $3-5 per day, and $1,000-1,700 per year[8].

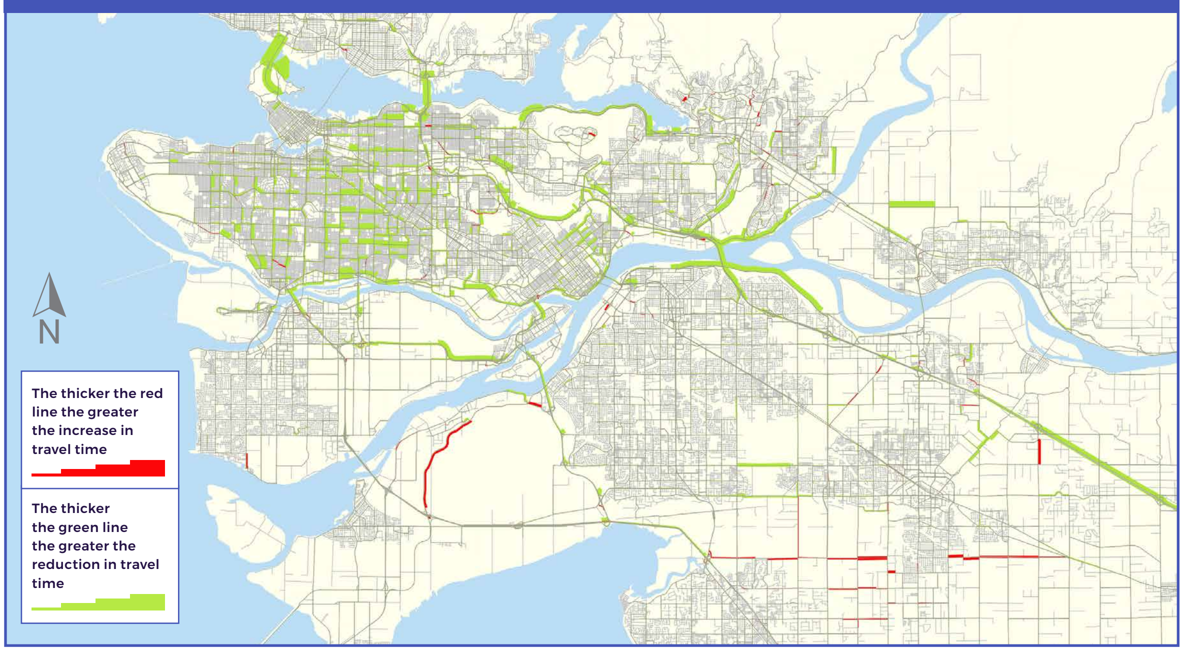
There are many uncertainties surrounding the costs of implementing and operating a distance-based charge and more work will be needed. Based on estimates from available sources that are more than ten years old, capital costs to establish distance-based charging, including on-board units in all vehicles in Metro Vancouver, are in the range of $400-700 million, with annual operating costs in the range of $300-500 million. Technology for distance-based charging is developing rapidly and it is anticipated that these costs can be reduced. Annualizing the capital costs of on-board units over 7.5 years, it is expected that such a system could deliver annual net revenues in the range of $1-1.6 billion (this includes the loss of revenue from the fuel tax, which is assumed to have been replaced).

[8] Costs incurred by households that will pay the decongestion charge without ever adjusting their driving behaviour. These are an overestimate, as many households will be able to reduce costs by changing travel behaviour on some days. Annual estimates are based on an annual expansion factor of 335, which is consistent with expansion factors used elsewhere in transportation demand modelling. Refer to Appendix B for the full details of these metrics and methods.

Min **Travel time reduction for a multi-zone distance-based charge compared to 2030 baseline for the AM peak period**



Min+ **Travel time reduction for a multi-zone distance-based charge compared to 2030 baseline for the AM peak period**



The numbers in the table on the following page are best estimates based on the modelling and analysis done to date. As concepts are further refined and updated data on Metro Vancouver travel patterns becomes available, these estimates will need to be updated.

Evaluation criteria	Units	Multi-zone distance-based charges	
		Min	Min+
Economic benefits			
Total net economic benefits	$ million/year	$180	$350
Congestion			
Total regional congested time savings	% change from baseline in 2030	-20%	-25%
Travel time reliability	% change from baseline in 2030	18%	23%
Visible congested time savings[9]	% households that will achieve >10 mins savings per day	25%	41%
Revenue			
Total net revenue[10]	$ million/year	$1,030	$1,640
Household costs			
Median daily costs for households that pay	$/household/day	$3-4	$4-5
Median annual costs for households that pay	$/household/year	$1,000-1,200	$1,500-1,700
Median household charges as a % of annual income	Low (<$50K/yr) Med ($50K-$100K/yr) High (>$100K/yr)	2-3% 1-2% 1%	3-4% 1-2% 1-2%
Amount needed to correct equity imbalance[11]	$ million/year	$230	$345
Environment, health, and contribution to the regional transportation strategy and regional growth strategy			
GHG emissions (all modes)	% change from 2030 Baseline	-3%	-4%
Total VKT (all modes)	% change from Baseline in 2030	-5%	-6%
VKT/capita (private car)	% change from Baseline in 2016	-13%	-14%

High income households would on average pay more in decongestion charges than low income households, but low income households would pay a greater amount in proportion to income. The same is true of many other fees and costs. The figures under *Amount needed to correct equity imbalance* represents the amount of money that would need to be returned to medium and low income households if the goal were to create a fully equitable system in the sense that everyone would pay the same as a proportion of income.

Refer to Appendix B for the full details of the consequences and trade-offs of the multi-zone distance-based charge concepts.

The following considerations for further refining the multi-zone distance-based charge approach were identified by the Commission:

- The optimal number and location of charging zones
- Ways to address impacts for people on low incomes, including the return of revenues
- The application of discounts and exemptions
- Price capping to mitigate high costs borne by some road users (especially for *Minimum+*)
- The current state of the rapidly developing technology for distance-based charging and particularly how occasional users of the system without on-board equipment would be treated
- The possibility of using excess revenues to reduce transit fares
- Targeted transit investment and park and ride to ensure that viable alternative transportation options are available
- Considerations for new and emerging transportation services like transportation network companies and automated vehicles

[9] Of the households experiencing significant daily congestion, what proportion will achieve visible travel congestion savings per day.

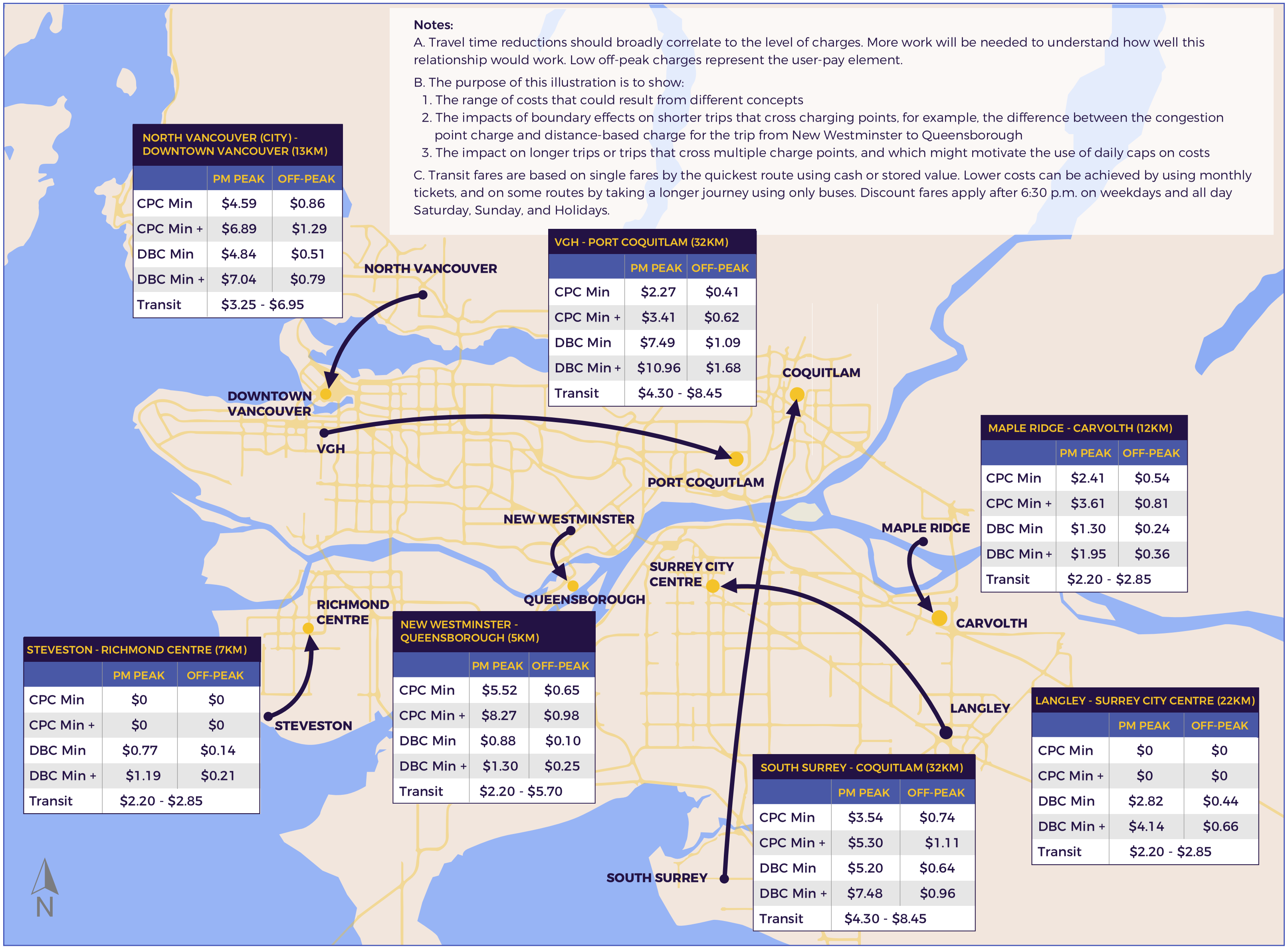
[10] Includes revenue from the fuel tax – which has been eliminated for these concepts.

[11] This figure represents the amount of money that would be needed to offset the income inequity.

Example vehicle trip charges

Most trips made in the region are relatively short and local – and this is true in both the central and more outlying parts of the region. However, some trips are much longer, and the illustrative concepts outlined above will have different cost impacts on different vehicle trips, depending on where and when they take place.

To the right are some **examples** of uncapped vehicle trip charges using the illustrative concepts, along with existing transit fare rates for comparison:



Notes:

A. Travel time reductions should broadly correlate to the level of charges. More work will be needed to understand how well this relationship would work. Low off-peak charges represent the user-pay element.

B. The purpose of this illustration is to show:
1. The range of costs that could result from different concepts
2. The impacts of boundary effects on shorter trips that cross charging points, for example, the difference between the congestion point charge and distance-based charge for the trip from New Westminster to Queensborough
3. The impact on longer trips or trips that cross multiple charge points, and which might motivate the use of daily caps on costs

C. Transit fares are based on single fares by the quickest route using cash or stored value. Lower costs can be achieved by using monthly tickets, and on some routes by taking a longer journey using only buses. Discount fares apply after 6:30 p.m. on weekdays and all day Saturday, Sunday, and Holidays.

NORTH VANCOUVER (CITY) - DOWNTOWN VANCOUVER (13KM)

	PM PEAK	OFF-PEAK
CPC Min	$4.59	$0.86
CPC Min +	$6.89	$1.29
DBC Min	$4.84	$0.51
DBC Min +	$7.04	$0.79
Transit	$3.25 - $6.95	

VGH - PORT COQUITLAM (32KM)

	PM PEAK	OFF-PEAK
CPC Min	$2.27	$0.41
CPC Min +	$3.41	$0.62
DBC Min	$7.49	$1.09
DBC Min +	$10.96	$1.68
Transit	$4.30 - $8.45	

MAPLE RIDGE - CARVOLTH (12KM)

	PM PEAK	OFF-PEAK
CPC Min	$2.41	$0.54
CPC Min +	$3.61	$0.81
DBC Min	$1.30	$0.24
DBC Min +	$1.95	$0.36
Transit	$2.20 - $2.85	

STEVESTON - RICHMOND CENTRE (7KM)

	PM PEAK	OFF-PEAK
CPC Min	$0	$0
CPC Min +	$0	$0
DBC Min	$0.77	$0.14
DBC Min +	$1.19	$0.21
Transit	$2.20 - $2.85	

NEW WESTMINSTER - QUEENSBOROUGH (5KM)

	PM PEAK	OFF-PEAK
CPC Min	$5.52	$0.65
CPC Min +	$8.27	$0.98
DBC Min	$0.88	$0.10
DBC Min +	$1.30	$0.25
Transit	$2.20 - $5.70	

SOUTH SURREY - COQUITLAM (32KM)

	PM PEAK	OFF-PEAK
CPC Min	$3.54	$0.74
CPC Min +	$5.30	$1.11
DBC Min	$5.20	$0.64
DBC Min +	$7.48	$0.96
Transit	$4.30 - $8.45	

LANGLEY - SURREY CITY CENTRE (22KM)

	PM PEAK	OFF-PEAK
CPC Min	$0	$0
CPC Min +	$0	$0
DBC Min	$2.82	$0.44
DBC Min +	$4.14	$0.66
Transit	$2.20 - $2.85	

PART 5. NEXT STEPS

What should come next

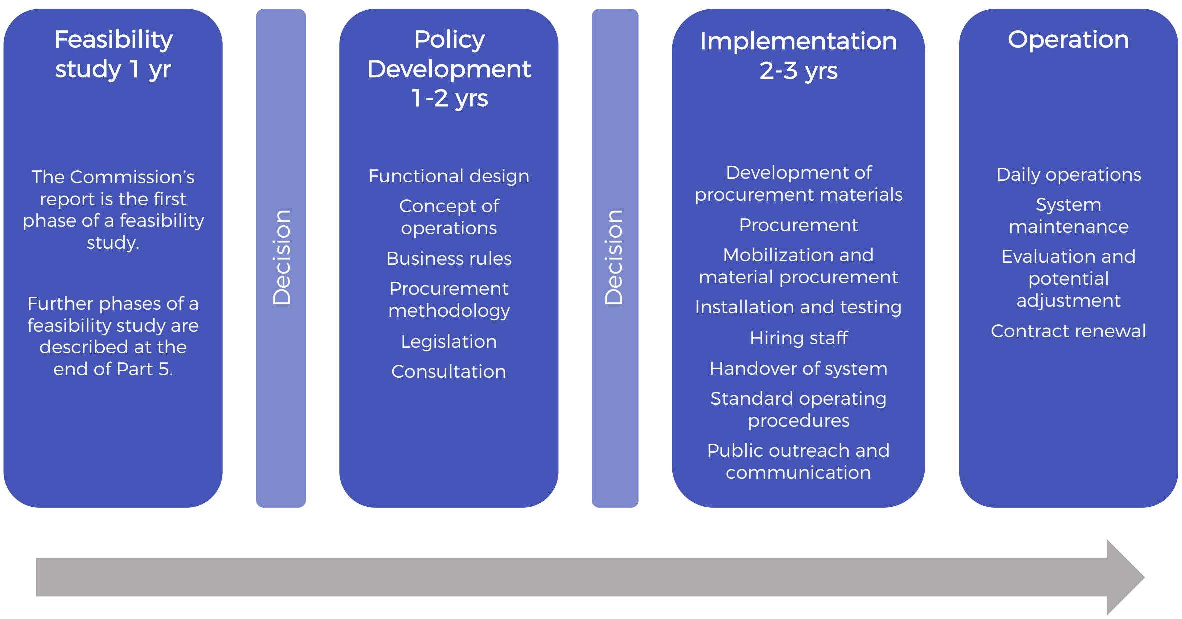
PART 5. NEXT STEPS

Pathways to implementation of a decongestion charge

This report can be considered the first phase of a feasibility study. It suggests principles that should be followed in formulating a mobility pricing policy and describes some high-level decongestion charging concepts that show interesting results. More work will be needed to develop them into something that can be implemented. That is estimated to take around six to twelve months.

After the completion of a feasibility study, there will need to be a decision on whether to proceed to a policy development phase, including the development of enabling legislation. This is estimated to take a further 1-2 years. At the end of this phase, a decision to implement will be required before proceeding to the implementation phase, which could take an estimated 2-3 years.

In all phases, there may be technical or policy reasons for pursuing a longer timeline. In particular, the greater uncertainties involved in distance-based charging suggest a longer timeline might be appropriate.



Roles and responsibilities

At appropriate points within the process, different organizations will have different roles.

The role of the region, through the Mayors' Council and TransLink, will be in the early phases to collaborate with partners to prepare a new regional transportation strategy that:

- Establishes targets for congestion reduction
- Sets out a regional policy approach to mobility pricing
- Identifies and evaluates regional transportation investments to ensure geographic alignment with a decongestion charge

At this phase, the provincial government will need to engage as owner and operator of parts of the region's transportation network.

If the Mayors' Council decides it wishes to implement a comprehensive mobility pricing policy that includes a decongestion charge, the role of the provincial government will be significant. At a minimum, it will need to set out appropriate legislation and regulations for such charges in Metro Vancouver.

A decision will need to be made about the governance of a regional system of mobility pricing and where responsibility for both policy decisions and the collection and distribution of revenues should lie.

Work outstanding to complete the feasibility study

Availability of data and the timeline of the project means that the Commission was not able to conduct some important research and analysis. The following studies should be prioritized in the second phase of a feasibility study:

- Further iterations and development of the illustrative concepts, including further study of the potential to coordinate with transit fares and other forms of mobility pricing
- A thorough assessment of affordability and equity impacts including the role of caps and discounts and the opportunities for returning or redistributing revenues
- Impacts for business, particularly transport-intensive businesses
- A first assessment of available technology for distance-based charging

Further scoping studies that could also be relevant at a later stage:

- Medium- and long-term impacts of mobility pricing on regional land use planning
- Integrated transportation payment systems (Mobility as a Service)
- Alternative governance models for the collection and distribution of mobility pricing revenues

Refer to Appendix A for more detail on next steps.

PART 6. CONCLUSION

PART 6. CONCLUSION

The Mayors' Council and TransLink Board asked the Commission to study how a comprehensive mobility pricing system could be implemented in Metro Vancouver that could:

- Manage congestion
- Promote fairness
- Support investment

If all that is desired at this stage is a way to cover costs of transportation investments, then a coordinated system of mobility pricing that includes a decongestion charge is probably not the way forward. But if the region is willing to take on some complex discussions, then mobility pricing offers a way to manage congestion and raise revenues that could be transformative as part of a strategy to support efficient, affordable and sustainable mobility for the people of Metro Vancouver.

It's time to continue this conversation so our region and its residents can continue to thrive.

APPENDIX A

Project Governance, Process, and Further Work

APPENDIX A. PROJECT GOVERNANCE, PROCESS, AND FURTHER WORK

CONTENTS

IT'S TIME

INTRODUCTION

Initiating its work in June 2017, the Mobility Pricing Independent Commission completed an extensive range of mandated activities in 11 months on a total budget of $2.31 million.

The Commission will formally dissolve upon the submission of this final report and recommendations to the Mayors' Council on Regional Transportation and TransLink Board of Directors in spring 2018. TransLink will assume the next steps in this project.

This appendix outlines how the *It's Time* project was executed and governed within the allocated timeframe and budget.

PART 1. PROJECT MANDATE

The Terms of Reference identified the expectations of the Commission regarding its mandate, responsibilities, and deliverables.

The following table is a checklist outlining how the Commission fulfilled the requirements set out in its Terms of Reference.

What was in the Terms of Reference	What we did
Section 7.1 TO INFORM THE DEVELOPMENT OF RECOMMENDATIONS:	
a. Review and consider key plans, policies and relevant work both completed and underway on regional road usage charging and mobility pricing.	The Commission reviewed relevant plans and policies, including: • *Metro Vancouver 2040: Shaping Our Future*, a regional growth strategy (2011) • Regional Transportation Strategy, Strategic Framework (2013) • *Regional Transportation Investments, A Vision for Metro Vancouver* (2014) The Commission also had access to previous studies of mobility pricing and road user charging carried out by TransLink and information regarding its ongoing Fare Review. Documents produced by third parties were also studied, including Simon Fraser University's Moving in Metro project (2013), and studies conducted in multiple international jurisdictions and by academic institutions.

b. Identify appropriate and feasible alternatives for a regional road usage charging system for motor vehicles and determine how each alternative performs against regional objectives for mobility pricing outlined in section 4 of these terms of reference.	Ten potential policy tools were identified and a broad assessment - called a coarse-level evaluation - was conducted to analyze each tool on the following criteria: • What are the tool's strengths and weaknesses? • Does the tool have the potential to be applied in a way that could reduce congestion and support transportation investment in a fair way? • How complex would it be to implement and administer the tool? Through this, the project team narrowed the list of tools to a congestion point charge and distance-based charge for further study. The Commission also recommended that limited further work be carried out on parking pricing. Policy tools not recommended for detailed study in this project may be explored in the future. Refer to the coarse-level evaluation in Appendix C of the Phase 1 full report on the *It's Time* website.
c. Conduct extensive public and stakeholder engagement and outreach to build awareness of its work, promote education and an informed and constructive dialogue on road usage charging and on mobility pricing in general, and solicit feedback on opinions, preferences, and concerns to factor into the Commission's evaluation and recommendations.	**Phase 1 engagement: Defined objectives and principles** The first phase of engagement in fall 2017 heard from 6,078 Metro Vancouver residents through the public engagement and 176 stakeholder and User Advisory Panel members through in-person workshops. This stakeholder and public input helped shape the criteria in the evaluation framework used to assess decongestion charging concepts and helped define the values and nuances within the project objectives to build a shared understanding of the overarching aims of the *It's Time* project. Refer to the Phase 1 communications and engagement report in Appendix D of the Phase 1 full report on the *It's Time* website. **Phase 2 engagement: Gathered public concerns and needs for consideration** The second phase of engagement in spring 2018 heard from 11,474 residents through public engagement and 130 stakeholders, UAP members, and elected officials from all government levels. The input included feedback on the two decongestion charging approaches being studied and identified concerns and other needs for consideration in the evaluation process. Refer to Appendix C for the communications and engagement report outlining the Phase 2 activities, participation breakdown, and findings.
Section 7.1.d TO SUPPORT AND INFORM THE EVALUATION AND RECOMMENDATIONS:	
i. Reviewing and considering approaches and impacts of different road usage charging and coordinated mobility pricing in other jurisdictions worldwide;	The *It's Time* project team collaborated with international experts to study lessons learned from other jurisdictions that have explored and implemented decongestion charging. Please refer to Appendix B of the Phase 1 full report on the *It's Time* website.

ii. Assessing the ability of the existing and planned regional transportation system in Metro Vancouver to accommodate any forecast changes in travel patterns, including changes to people's choices in travel routes, time of travel, amount of travel, and mode of travel that are likely to result from introducing comprehensive and integrated road usage charging;	Baseline research was conducted analyzing the ability of the existing regional transportation system to accommodate forecasted travel patterns and population growth. Refer to the *Moving around Metro Vancouver: Exploring New Approaches to Reducing Congestion* full research report and summary report on the *It's Time* website. Transportation modelling and analysis was conducted to forecast the impacts and results of different congestion point charge and distance-based charge concepts. Refer to Appendix B for the research and evaluation report.
iii. Estimating the potential average costs to road users of different approaches to road usage charging and how these relate to what currently exists;	Transportation modelling and analysis was conducted on congestion point charge and distance-based charge concepts at various charge rates to estimate the costs for road users. Existing costs like fuel tax and transit fares were considered for comparison. Refer to Appendix B for the research and evaluation report outlining these findings.
iv. Providing illustrative examples of the impact of changes to transportation costs for typical households at various income levels and locations;	Transportation modelling and analysis was conducted using TransLink's Regional Trip Diary data in combination with the Regional Transportation Model to estimate typical out-of-pocket costs for households at different income levels and locations. Refer to Appendix B for the research and evaluation report outlining these findings.
v. Estimating near- and long-term revenue potential of alternative road usage charging systems and identifying opportunities to optimize all regional transportation funding sources to meet future needs; and	Transportation modelling and analysis of decongestion charge concepts shows the revenue potential of these concepts. Refer to Appendix B for the research and evaluation report outlining these findings. Refer to Fairness Principle C in Part 3 of the Commission's final report and the future research needs section in Part 5 of this Appendix A for how this additional revenue could be reinvested to address equity imbalances and/or offset other funding sources.
vi. Identifying and assessing governance, regulatory, technical, administrative and related aspects of implementing and operating a comprehensive and integrated regional road usage charging system.	The Commission's final report provides preliminary recommendations on pathways to implementation based on the research conducted on implementing, operating, and integrating a road usage charging system. Refer to Appendix B-4 for the implementation report.

viii. Considering the impact and implications of alternative forms of pricing on future mobility systems in Metro Vancouver including, but not limited to, automated vehicles and shared mobility services.	Future-proofing was included as criteria in the evaluation framework, and considerations include the interaction of decongestion charging with future mobility systems. Refer to Appendix B-3 for the evaluation brief criteria briefs outlining key future-proofing considerations.
e. Identify key trade-offs and conflicts between the ability of different alternatives to meet the specified regional mobility pricing objectives and other considerations as determined by the Commission.	Through the structured evaluation process, the Commission identified and analyzed trade-offs and conflicts between the three core objectives and other identified evaluation criteria arising from different modelled concepts. Refer to Part 3 and Part 4 of the final Commission report.
Section 7.2 MEETINGS	
a. The Commission will formally convene regular meetings open to the public during its term to review work and deliberate.	Throughout its work, the Commission aimed for a high level of transparency through sharing real-time public results and comments in both rounds of online engagement, releasing a multilingual Phase 1 update report with activities and findings to date, and publishing the Commission meeting minutes on the *It's Time* website. This enabled the Commission to engage with many more people than would have been possible during public meetings. The Commission's Chair and Vice-Chair opted not to convene meetings in public due to compressed timescales and the complexity and sensitivity of the subject matter.
Section 7.3 DELIVERABLES	
a. The Commission will summarize its work and recommendations in a final report to the Sponsor Authorities.	This final report contains the summary of activities and final recommendations for the consideration of the Sponsor Authorities.
Section 7.4 COMMUNICATIONS	
The Commission will have a public website. All materials, including agendas, presentations, analyses, working papers and reports, considered at the public meetings of the Commission will be made available on the website.	A project website – www.itstimemv.ca – was launched on October 25, 2017, featuring key project information, multilingual FAQs, published research, materials and reports, and Commission meeting minutes. In Phase 1, the website reach consisted of 15,558 distinct visits to the site from 12,827 distinct users and 30,176 pageviews. In Phase 2, the website reach consisted of 16,720 distinct visits to the site from 13,566 distinct users and 26,361 pageviews.

Section 11 ADVISORY PANELS

1. Three advisory panels will be convened to provide strategic advice to the Commission on a regular basis, with the goal of identifying key issues, opportunities, needs and considerations to help inform the Commission's approach, work and activities needed to fulfill its mandate: a. Users Advisory Panel: comprised of local residents and users of the transportation system, including auto drivers, transit riders, and others, with representation from across the region.	A User Advisory Panel (UAP) was established through a third-party recruiting firm to ensure the group was representative of Metro Vancouver's diverse population. The panel consisted of 15 representatives. Consideration was given to age, cultural and gender identity, income, geography, and mode of transportation. Three User Advisory Panel meetings were conducted to provide ongoing guidance and advice to the Commission: • UAP Meeting #1 (Nov 2017): The project team presented introductory information about decongestion charging and sought input on defining the project's objectives and principles. Refer to Appendix D in the Phase 1 full report on the *It's Time* website for the workshop summary notes. • UAP Meeting #2 (Feb 2018): The project team presented decongestion charge approaches being studied and sought input on preferences, needs, and concerns. Refer to Appendix C for the workshop summary notes. • UAP Meeting #3 (Apr 2018): Before confirming the final recommendations with the Commission, the project team presented certain draft principles for feedback and input. Refer to Appendix C for the workshop summary notes.
b. Stakeholders Advisory Panel: comprised of representatives from major regional stakeholder groups representing community and business from across the region.	Regional and local stakeholders representing organizations across key sectors (advocacy, social service, health, transportation, industry, business, environment, academic, and labour) were invited to two rounds of stakeholder engagement: Phase 1 Stakeholder Workshops (Nov 2017): The project team presented introductory information about decongestion charges and sought input on defining the project's objectives and principles. Phase 2 Stakeholder Workshops (Jan and Feb 2018): The project team presented the decongestion charging concepts being studied and sought input on preferences, needs, and concerns. The project team also hosted at-request meetings with other stakeholder organizations and city councils.
c. Peer Advisory Panel: comprised of representatives from peer agencies with experience in road usage charging and mobility pricing elsewhere and available to provide independent perspectives on the conceptual and practical aspects of proposals under consideration by the Commission.	A Peer Advisory Panel was established but, due to the compressed timeline and resources of the project, had limited opportunity to comment. The project team included several members with direct experience of implementing and studying road user charging in other jurisdictions, including the Executive Director (experience in the UK and Sweden), consultants with WSP (Ontario, Sweden, USA), and consultants with D'Artagnan (USA and UK).

PART 2. ABOUT THE COMMISSION

In 2014, the Mayors' Council approved a resolution, endorsed by the TransLink Board of Directors, to convene an independent Commission to govern and oversee research and engagement on mobility pricing in Metro Vancouver.

Commission membership

The Commission was recruited through an application and interview process with around 50 applicants, and 14 community leaders were selected. Their current professional and community leadership roles are included in the table below:

Name and position(s)		Municipality of Residence
Allan Seckel, Chair	• CEO, Doctors of BC	Vancouver
Joy MacPhail, Vice-Chair	• Chair, ICBC • Chair, Adler University	Vancouver
Commission members		
Iain Black	• President and CEO, Greater Vancouver Board of Trade	Coquitlam
Jennifer Clarke	• President, JPC Strategies	Vancouver
Harj Dhaliwal	• Associate Dean, Marketing Management at BCIT	Surrey
Paul Landry	• Principal, PRL Consulting	Langley
Lori MacDonald	• Executive Director, Emily Carr Students' Union	Vancouver
Graham McCargar	• President, MC Freight Systems	Maple Ridge
Gavin McGarrigle	• BC Area Director, Unifor	Surrey
Michael McKnight	• President and CEO, United Way of the Lower Mainland	North Vancouver
Elizabeth Model	• CEO, Downtown Surrey Business Improvement Association	Burnaby
Bruce Rozenhart	• Principal, COUNTERPOINT Communications	Richmond
Philip (Pip) Steele	• Vice-Chair, Delta Police Board • Member, Standing Advisory Committee on Finance, City of Delta	Delta
Grace Wong	• Senior Advisor International to the Provost and Vice President-Academic, UBC • Immediate Past Chair of S.U.C.C.E.S.S. Board of Directors	Vancouver

Commission meeting outcomes

The Commission met eight times at key milestones throughout the project to guide the project team's work, make decisions, and ultimately develop the final independent recommendations contained in this report.

The outcomes from these meetings are summarized in the table below:

Meeting	Outcomes
Meeting #1: July 28, 2017	• Established project governance and guidance • Reviewed the Terms of Reference • Discussed objectives and values of the project process • Agreed to a high-level work plan for research and engagement activities
Meeting #2: September 6, 2017	• Clarified project process and desired outcomes • Reviewed more detailed research and engagement work plans • Approved the structured evaluation process for decongestion charge concepts • Identified key information needed to inform final recommendations in spring 2018
Meeting #3: November 27, 2017	• Narrowed research direction for recommendations • Reviewed Phase 1 research and engagement findings • Agreed on two decongestion charging approaches for further analysis in Phase 2 • Reviewed the draft evaluation framework to guide final recommendations in spring 2018
Meeting #4: January 29, 2018	• Explored and understood emerging research • Reviewed modelled decongestion charging concepts, and considered their trade-offs and impacts on the Commission objectives
Meeting #5: February 14, 2018	• Provided feedback and direction on emerging research findings • Reviewed more modelled decongestion charging concepts • Strengthened understanding of the trade-offs and impacts of different charging variables (time, location, directionality) on the Commission objectives • Provided direction on decongestion charge priorities and preferences
Meeting #6: March 21, 2018	• Reviewed more modelled decongestion charging concepts, and continued to explore trade-offs and findings to inform the recommendations • Agreed on draft principles to inform recommendations • Provided direction for the development of illustrative concepts for a congestion point charge and distance-based charge
Meeting #7: April 16, 2018	• Reviewed Phase 2 engagement findings • Agreed on findings, principles, and illustrative concepts to inform recommendations • Reflected on lessons learned
Meeting #8: May 7, 2018	• Reviewed and approved final Commission report

Refer to Appendix A-1 for the Commission meeting summaries.

PART 3. PROJECT PROCESS

The following table offers a deeper dive into the process to develop the recommendations found in the Commission report. The project team conducted a range of research and engagement activities over two phases aimed at answering these overarching questions:

What we asked

What are the issues we are trying to address?

What we did

Research and engagement activities to understand and validate the problem statement, including:

- Established a baseline for regional congestion (refer to Appendix A in the Phase 1 full report on the *It's Time* website)
- Conducted public opinion polling to validate the challenges and costs of congestion for Metro Vancouver residents, and identify gaps in perception and understanding of decongestion charging
- Engaged stakeholders and the public to better define the objectives

What we asked

Which mobility pricing tools could we recommend to reduce congestion and support transportation investment in a fairer way?

What we did

Research and evaluation activities, including:

- Learned more about decongestion charges through studying its theory, trends in public acceptance, and lessons learned from cities around the world (refer to Appendix B in the Phase 1 full report on the *It's Time* website)
- Identified and conducted a coarse-level evaluation to narrow down the study to two decongestion charging approaches: a congestion point charge and distance-based charge (refer to Appendix C in the Commission's phase 1 report on the *It's Time* website)
- Developed examples of how both decongestion charge approaches could be implemented in Metro Vancouver to form the basis for traffic modelling and analysis and to gather stakeholder and public input
- Modelled the impacts, with input variables including time, cost, directionality and location, and outputs including transportation impacts, costs and revenues, and the effects for numerous indicators of fairness
- Researched how a coordinated mobility pricing policy including a decongestion charge could be implemented in Metro Vancouver, including governance and technical considerations
- Created an evaluation framework with criteria informed by research and stakeholder and public input
- Conducted a detailed evaluation of decongestion charging concepts to inform the final recommendations

Refer to Appendix B for the research and evaluation report with the full process and findings.

What we asked

What are important considerations for Metro Vancouver residents and stakeholders when it comes to decongestion charging?

What we did

Communications and engagement activities, including:

- Built public awareness of the Commission, mobility pricing, and decongestion charging through a project website, social media platforms, and a multilingual communications campaign
- Conducted the first round of engagement in November 2017, hearing from 6,078 participants through the online platform and parallel paper surveys, as well as 128 stakeholders and UAP members and over 49 government officials at in-person workshops which informed the evaluation framework criteria (refer to Appendix D in the Commission's phase 1 report on the *It's Time* website)
- Communicated through a public education campaign to humanize and illustrate the benefits and impacts of a congestion point charge and distance-based charge system
- Conducted the second round of engagement, hearing from 11,284 participants through the online platform and parallel paper surveys, as well as 76 stakeholders and UAP members and 55 government officials at in-person workshops and meetings to gauge public preferences
- Heard from the region's diverse residents by translating the online platforms into Traditional Chinese, Simplified Chinese, and Punjabi (the region's largest non-dominant languages), providing parallel paper surveys, and targeting outreach to social service organizations across Metro Vancouver (there were 13 participating members by the third meeting)
- Convened a 15-member User Advisory Panel and held three meetings to seek input at key stages of the project process.

Refer to Appendix C for the communications and engagement report with the full process and findings.

PART 4. THE PROJECT TEAM

The Commission was supported by a staff secretariat responsible for managing the research and engagement program design and execution, including overseeing and managing required consultant services.

The staff secretariat consisted of seconded staff from TransLink, Metro Vancouver, and the City of Vancouver. The Executive Director and two Management roles were recruited and selected by TransLink through an open competitive process. A call was put out to Metro Vancouver and the region's municipalities for further staff.

Seconded from TransLink:

- Daniel Firth, Executive Director
- Vincent Gonsalves, Manager, Communications and Engagement
- Fearghal King, Manager, Pricing Policy & Analysis

Seconded from Metro Vancouver:

- Raymond Kan, Senior Regional Planner

Seconded from the City of Vancouver:

- Lindsay Neufeld, Planning & Policy Analyst

The following consultants supported key elements of the project design and execution:

Project Stream	Consultants and TransLink staff support
Research and Modelling Program	• Planning staff at TransLink conducted much of the transportation modelling through the use of the Regional Transportation Model (RTM) • McElhanney supported the modelling and analysis • WSP supported the research and analysis, including work on collating and analyzing international experience, charging theory, and implementation
Evaluation and Structured Decision-Making Program	• Compass Resource Management supported the design and execution of the evaluation and structured decision-making processes • D'Artagnan provided strategic support to the evaluation and decision-making processes
Communications and Engagement Program	• D'Artagnan through subcontractor Context Research supported the communications, public and stakeholder engagement, and reporting programs • FleishmanHillard HighRoad supported the government and media relations programs

PART 5. DETAILED RECOMMENDATIONS FOR FUTURE RESEARCH, COMMUNICATIONS, AND ENGAGEMENT

This section identifies recommendations for future research, communications, and engagement.

- Completing the feasibility study
- Scoping studies
- Opportunities for field testing
- Project process and timeline design
- Meaningful First Nations engagement
- Inclusive and accessible communications and engagement
- Further public education
- Opportunities for in-person engagement
- Representative citizen panel or task force

FUTURE RESEARCH

The Commission's work can be considered the first part of a feasibility study. Unavailability of data and the compressed timeline of the project limited the research and engagement activities that the Commission was able to complete.

There is considerable existing academic knowledge around mobility pricing, decongestion charging, and regional transportation more broadly in our local academic institutions. Extending a call for research projects and partnerships should be considered to leverage this expertise and further build local capacity. There may also be potential to outsource some research directly to these institutions to secure the independence and transparency of the analysis.

Completing the feasibility study

The Commission recommends that the following further research is prioritized as part of a complete feasibility study:

1. Further iterations and analysis of the illustrative concepts

This study was limited by its timeframe. The project modelled and analyzed as many versions of the concepts as was possible in the time available, which allowed for four iterations in total. International experience shows that up to eight iterations may be needed to optimize the various parameters. Further work to test refined charge point/boundary locations and charge rates should be a priority.

For the regional congestion point charge concept, further analysis should be conducted on optimal locations for the charge points. For the multi-zone distance-based charge concept, analysis should be conducted on the specific locations of zone boundaries and could consider other zone configurations. Other analysis should include:

- **Regional travel time reliability**
  The reliability of travel times is a concern for residents. The analysis included a preliminary look at the impacts of decongestion charging on regional travel time reliability, and further analysis should be done to refine the methodology.

- **Weekend travel patterns**
  Engagement with stakeholders and the public has highlighted that traffic congestion on weekends can be a problem in certain parts of the region. The Regional Transportation Model used in the project is currently limited to weekday travel data and projections.

  Efforts should be made to obtain quality data on weekend travel patterns so that a fuller picture of regional congestion and the potential benefits and impacts of decongestion charging can be considered.

2. Affordability and equity impacts of mobility pricing including the role of caps and discounts and the opportunities for returning or redistributing revenues

Affordability is a difficult concept to define as it is a complex and personal equation. Further research should consider how households may be impacted in their current situations, but also how mobility pricing and decongestion charging would combine with other factors to influence future choices around housing and employment locations. Specific areas for further research include:

- **Further analyze existing household transportation expenses and evaluate how mobility pricing and decongestion charging would impact these expenses for different household types**
  This analysis estimated household-level costs for decongestion charging concepts using 2011 Regional Trip Diary data combined with results from the Regional Transportation Model. Further research should update this analysis using 2016 Census data and 2017 Regional Trip Diary results and conduct further analysis of existing transportation expenses.

- **Evaluate the distribution of costs and benefits of regional transportation investments**
  Understanding how people (individuals and society) currently pay for mobility requires a broad lens that includes both monetary and non-monetary costs, as well as the associated benefits. Further research should explore where the current inequities are regarding geography, income, and transportation modes, where and for whom transportation is being subsidized, and how this would change with the implementation of a coordinated mobility pricing system. There needs to be a way to understand and communicate how the benefits of transportation investment in one part of the region benefit accessibility in all parts of the region.

  Methods for forecasting and measuring the equity impacts of transportation investments should also be developed.

- **Consider the role of caps, discounts, exemptions, rebates, etc. and their impacts on affordability and equity**
  It was not possible to study these types of policies in detail during this project. Further research should explore the effects of each of these policies for equity, congestion reduction, and revenues, and should develop a consistent rationale for their application.
- **Explore additional possibilities for returning excess revenues over those needed for transportation investment, either directly to households or by offsetting other costs and taxes**
  Further research should build on the possibilities for the use of revenues laid out in the recommended principles in Part 3 of the Commission's final report..

3. Impacts on business, particularly transport-intensive businesses

There are many potential benefits for businesses from a coordinated mobility pricing system that includes a decongestion charge. However, there is a need for a better understanding of the impacts for transport-intensive businesses, particularly in distribution, and for people who visit multiple job sites around the region including, but not limited to, tradespeople, social service providers, and film industry workers.

There also needs to be an assessment of how costs for businesses might impact the cost of goods and consumer services.

4. An assessment of available technology for distance-based charging

The multi-zone distance-based charging concepts show some promising results, but there is still uncertainty around the availability of technology for an urban charging system that varies by distance, time, and place. Technology is developing rapidly, and a thorough assessment of the current and near-term availability and costs of technology will be required before a decision is made to proceed to policy design.

Scoping studies

The following studies could be carried out as part of a scoping exercise for future research:

1. Medium- and long-term impacts of mobility pricing on regional land use planning

While many jurisdictions are currently studying the potential for region-wide decongestion charging approaches, few examples allow us to see the medium- and long-term effects of charges on land use planning and location decisions. While analysis indicates that decongestion charging broadly supports the policies for focused urban growth set out in Metro Vancouver's regional growth strategy, further research should examine the impacts that each decongestion charging concept could have. This should include a comparison to the impacts of growing congestion under a baseline "do-nothing" scenario.

2. Integrated transportation payment systems (Mobility as a Service)

One recommendation suggested by stakeholders and emerging through research is the potential of an integrated payment system for all forms of mobility pricing, covering transit fares, parking, decongestion charging, and even bike and car share, taxis, and services offered by transportation network companies. This introduces new possibilities for people to track their spending on transportation and could overcome some of the inflexibility of monthly transit passes. It also offers interesting potential for financial incentives to be offered, in addition to charges. These types of systems are beginning to emerge in other cities around the world, and it is recommended that this concept is explored in detail for Metro Vancouver.

3. Alternative governance models for the collection and distribution of mobility pricing revenues

There are many agencies at all levels of government, as well as commercial operators, involved in the delivery of transportation services in Metro Vancouver. Many models could be employed for the implementation of mobility pricing. The advantages and disadvantages of various alternatives would need to be considered.

Opportunities for field testing

Once a decision to move forward with implementation of a decongestion charge is reached, field testing could be a viable way to collect on-the-ground information to build on the research outlined above. The purpose of a field test needs to be clear (for example, to understand possible behavioural changes, to test technology, to test business models, to collect empirical evidence of congestion impacts, to test public acceptance) as it is critical to the design and scale of the test system(s).

In the short-term, further analysis will be required to identify:

- The questions to be addressed;
- The type of test systems that could be implemented to address these questions (e.g. scale, location, user groups, real vs. test charges);
- The appropriate length of the test phase; and
- The steps that would follow the test (e.g. reassessment, full-scale implementation if it hits identified policy targets).

FUTURE COMMUNICATIONS AND ENGAGEMENT

The Commission recommends the following approach and activities for future phases of communications and engagement on mobility pricing:

Project process and timeline design

The Commission recommends a staggered project process where there is adequate research completed prior to further public and stakeholder engagement and communications. This will provide more data for public education and allow the public to validate certain research findings.

Due to the timeline provided, the research, engagement, and communications programs in this project ran concurrently. While this allowed for strong public interest and participation within a short period of time, some information sought by the public, stakeholders, and government was not yet available at the time of engagement, such as details around concept design, charge rates, and potential benefits and impacts.

Meaningful First Nations engagement

This project was a starting point for hearing unique considerations and concerns on mobility pricing from an Indigenous lens.

Dedicated time, budget, and programming is required in future phases for outreach and relationship-building with governments and community members to share information, engage meaningfully, and gather input in a respectful and appropriate way. This is particularly important given concerns raised about past engagement on transportation issues and the potential of mobility pricing policy to impact local Indigenous communities' mobility and rights.

Inclusive and accessible communications and engagement

Dedicated budget and programming in this project offered opportunities to target public education and engagement to reach and hear from Metro Vancouver's diverse residents, including multilingual and lower income communities. The Commission recommends this continue for future phases.

This approach is particularly critical when studying affordability and equity impacts. Time and resources are key enablers in reaching people who are often more underrepresented in engagement processes, which could include seniors, people with lower incomes, multicultural communities, people with disabilities, and parents with children living at home.

Further public education

The Commission recommends adequate time and resources for a communications program to keep the public informed and better equip them to participate in future engagement phases on mobility pricing, aiming to:

1. Develop public understanding of how the region could benefit from a decongestion charge

The project team found that Metro Vancouver residents had limited knowledge of the multifaceted challenges that congestion brings to the region, and there was not enough time for a thorough, inclusive, and far-reaching public education campaign.

To create greater public awareness and combat some misperceptions, the Commission recommends dedicating adequate resources for public education to highlight how mobility pricing and decongestion charging works and the results of from implementing it in other parts of the world. This fulsome education campaign should take place before engaging the public on research findings and analysis.

Furthermore, the online engagement program revealed that the public would like additional information on:

- Other means of reducing congestion rather than charging
- Trade-offs and impacts of introducing a decongestion charge as it relates to benefits to transportation investments and its impacts on greenhouse gas emissions
- Specific decongestion charging concepts that are being considered
- Exact charge rate(s) and clear breakdown of how revenues would be used
- Users that would qualify for exemptions or discounts
- Implementation and management costs and the governing body responsible for the decongestion charging approaches

2. Clarify key terminology

The use of both 'mobility pricing' and 'road usage charging/decongestion charging' terms created confusion among the public during the limited education campaign period. The Commission recommends dedicating resources to educate the public about the distinctions and nuances of each concept.

3. Address key issues that may dominate the conversation

Issues of affordability and trust in government were some of the top public concerns. These issues affected the ability to have productive conversations about how mobility pricing and decongestion charging could work in the region.

Prior to embarking on future engagement and communications programs, resources should go towards addressing these concerns.

4. Identify key influencers to help tell the story (online and in-person)

A number of mobility pricing champions emerged during engagement with stakeholders and government officials.

The Commission recommends creating more opportunities for champions to share their expertise on the benefits of decongestion charging in public. The champions should also be diverse and reflect Metro Vancouver's demographic makeup.

Opportunities for in-person engagement

During the limited number of in-person events and the User Advisor Panel meetings, residents who spoke to project team members left feeling like they had a better understanding of the topic and its complexities.

As a result, and when appropriate within the process, the Commission recommends identifying opportunities for in-person outreach that offers meaningful, accessible opportunities for project members to engage with the public, which may not necessarily be large open houses.

Future outreach efforts should meet people where they are; this could include pop-ups at community events, schools, and public gathering spaces during non-work hours.

Representative citizen panel or task force

An important lesson learned is that that a citizen panel like our User Advisory Panel can be an invaluable part of any project with wide-reaching impacts. From this, the Commission recommends the following:

1. Continue to establish and engage a citizen panel as the conversation and project on mobility pricing progress

Our representative panel gave us the opportunity to continue pulse-checking the public's stance and understanding of the *It's Time* project, process, findings, and recommendations. Members of the User Advisory Panel provided insight and feedback, distinct from other stakeholder groups. During the final panel workshops, members expressed a strong understanding of decongestion charging and had been positively championing the issue to their friends and family.

2. Equip panel members to act as community leaders to further expand the reach of the public education campaign

Due to the success of the panel, the Commission recommends an expanded User Advisory Panel in size and scope. Members of the panel could go on to champion the project and its findings to their respective communities. This will help build greater transparency and trust between the general public and the project team.

APPENDIX A-1. COMMISSION MEETING SUMMARIES

Metro Vancouver Mobility Pricing Independent Commission
Meeting 1
July 28, 2017

Minutes of the Meeting of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) held on Thursday, July 28, 2017 at 12:00 p.m. in the Doctors of BC Boardroom, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:

Allan Seckel, Chair
Joy McPhail, Vice-Chair
Jennifer Clarke
Harj Dhaliwal
Paul Landry
Gavin McGarrigle (arrived at 2:00 p.m.)
Michael McKnight
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:

Iain Black
Graham McCargar
Elizabeth Model

STAFF SECRETARIAT:

Daniel Firth
Vincent Gonsalves
Raymond Kan
Fearghal King
Lindsay Neufeld
Catherine Rockandel, Facilitator

PREPARATION OF MINUTES:

Carrie Peacock, Recording Secretary, Raincoast Ventures Ltd.

1. Chair's Welcome

Related information: "Metro Vancouver Mobility Pricing Independent Commission, Background Material"

Allan Seckel, Chair, called the meeting to order at 12:00 p.m. and acknowledged key objectives of the MPIC outlined in the "Metro Vancouver Mobility Pricing Independent Commission, Background Material". He confirmed that to support the Commission's success, MPIC meetings would remain open, respectful and welcoming of varying viewpoints and questions.

Chair Seckel led Commissioners in a round of self-introductions. Daniel Firth, Secretariat, introduced staff members in attendance.

2. Project Background

Mr. Firth referred to an overhead presentation and the report "Metro Vancouver Mobility Pricing Independent Commission, Background Material", and offered comments on:

- The Commission's mandate and direction to evaluate mobility pricing options for Metro Vancouver (MV) based on the objectives to:
  - Manage congestion
  - Promote fairness
  - Support investment
- The technical, engagement and decision-making objectives of each of the four phases of MPIC's draft Workplan and timeline, including:
  - Phase 1: Context, Problem Statement and Assessment Metrics (August to November 2017
  - Phase 2: High Level Assessment of a Long List of Options (August to December 2017)
  - Phase 3: Detailed Assessment of a Short List of Options (October 2017 to March 2018)
  - Phase 4: Recommendations (January to April 2018)
- Defining "mobility pricing" as the coordinated pricing of all transportation modes and services (i.e. transit fares, parking fees, fuel sales tax, roads, bridges, etc.)
- Complexities associated with mobility pricing, including: multiple dimensions, objectives and public interest.

During discussion, comments were offered regarding:

- The MPIC's recommendations anticipated April 2018
- Expectations outlined in the MPIC's Terms of Reference, including:
  - Intermittently scheduled "check-in" points with the political process
  - Consideration of options to reduce congestion and raise revenues
- Demographic information and other data available to assist the MPIC in its deliberations
- Evolving transportation trends, including electrified vehicles and autonomous cars
- Mono-centric transit systems in other major cities (e.g. Oslo, Norway) focused on delivering people to and from one area
- Consideration of options to raise money for transportation infrastructure, managing congestion, etc.
- Potential implications of electrified vehicles on gas tax revenues.

  Action Item: *Mr. Firth was requested to include a discussion on potential "outcomes" and "principles" on the agenda of a future MPIC meeting.*

Action Item: *Mr. Firth was requested to email the overhead presentations reviewed at the meeting to Commissioners.*

3. Understanding the Commission's Role and Function

Catherine Rockandel, Facilitator, invited Commissioners to work in pairs to discuss successes they had each personally experienced on other boards or commissions.

Based on their paired discussions, Commissioners subsequently recognized some successful approaches of effective boards and commissions, including:

- Establishing a common goal and set of values by which to function
- Having informal discussions, which increases members' willingness to be open, connected, innovative and creative
- Committing to fairly resolving issues and staying focused
- Working towards achieving consensus, while:
    - Respectfully and collaboratively sharing priorities and opinions
    - Listening to and understanding each others' perspectives
    - Ensuring all participants have an opportunity to fairly share ideas
    - Prioritizing issues and generously compromising where required.

4. High Level Workplan

Mr. Firth displayed and reviewed information regarding the MPIC's 2017-18 Budget, noting that the funding allocated to the Commission for the next nine months, was primarily for professional services and administration.

Discussion ensued on:

- The intent to retain professional consultants to assist the MPIC in its decision-making processes
- Meetings and public consultation opportunities scheduled throughout the four phases of the Workplan, including:
    - On-line consultation processes
    - Engagement meetings:
        - Commissioners should attend at least one in each phase
    - Public Meetings:
        - All Commissioners should attend
        - Closed sessions may be convened immediately afterward to review comments provided
- Providing opportunities for the public to identify concerns, opportunities and constraints, in a fair and inclusive manner
- Conveying information and seeking public feedback through organizations that:
    - Provide services to people who are unable to participate in online processes
    - Represent people of multiple languages and abilities.

Action Item: *Staff was requested to redefine the "South of the Fraser" group referenced in Workplan, given its vast geographic area.*

It was MOVED and SECONDED
That the Mobility Pricing Independent Commission approves the "Mobility Pricing Independent Commission, Draft – High Level Work Plan" dated July 19, 2017, subject to further information on the communication process, after a Communications Consultant has been retained.

CARRIED
Mr. Firth reported that:
- The Chair and Vice Chair will meet with the Mayors' Council in late September 2017
- The next meeting of the MPIC (Meeting 2) will receive the updated Workplan and may consider a resolution to send the Workplan to the Joint Steering Committee, for information and comment
- The Secretariat will send Commissioners an email (with a link to an online scheduling tool) to assist in scheduling upcoming MPIC meetings.

Recess
The meeting recessed at 2:37 p.m. and reconvened at 2:47 p.m.

Action Item: *Mr. Firth to send an email to Commissioners with:*
- *A sample invoice template (including required details) for Commissioners to use when invoicing for their participation on the MPIC; and*
- *Copies of the signed letters confirming their appointment to the MPIC.*

5. Project Values and Goals
The Facilitator welcomed Commissioners to brainstorm on project values, goals and objectives.

During a brainstorming discussion on "values", the following suggestions were considered:
- Credibility/trustworthiness
- Transparency
- Respect
- Inclusiveness
- Openness
- Efficiency.

Discussion ensued on incorporating an intermittent "check-in" with the agreed upon values in the Workplan.

During a brainstorming discussion on a potential "engagement goal", the following suggestion was considered (comments are indicated below in italics):

- "Engaging those that work, live [and play] in Metro Vancouver in a fair, unbiased, credible and transparent process, to inform the Commission's recommendations on mobility pricing":
  - *Contact a broad range of stakeholders for feedback, including: individuals, organizations, health authorities, and the economically/physically vulnerable population*
  - *Consider replacing the word "inform".*

During a brainstorming discussion on potential "engagement objectives and communications" the following suggestions were considered:

- A Communications Consultant will minimize the potential for public misperceptions
- Divide the first clause, with the first statement being "Educate and inform about the problems..." and the next statement being "Educate on how mobility pricing may be a solution to those problems…"
- Consider replacing the word "problems"
- Consider omitting the phrase "…and what the Mayors' Council and Board do with the information provided by the Commission".

6. Short Term Priorities and Next Steps

Mr. Firth acknowledged feedback offered with respect to the Commission's priorities and next steps.

7. Reflecting Back – Looking Forward

Commissioners were commended for their keen participation and perspectives shared during the meeting's earlier discussions.

During discussion on "communications", comments were offered on:

- Research which indicates how incorrect messaging can impact public opinion
- Communicating benefits of infrastructure improvements
- Supporting perceptions of equity, fairness and long term sustainability
- Challenges in addressing complex problems with multiple and varied geographies.

During a brainstorming discussion on "common objectives", the following suggestions were offered:

- Fairness
- Regional sustainability (economic, social and environmental)
- Addressing congestion (as it relates to quality of life)
- Identifying the "problem" the MPIC aspires to resolve.

During a brainstorming discussion on "common areas of tension", the following suggestions were offered:

- Complexity
- Regional representation (identifying priority areas)
- Compromises to be made versus having multiple goals
- Overlapping jurisdictions
- Funding for the 10-Year Vision of Metro Vancouver Transit and Transportation (10-Year Vision).

During a brainstorming discussion on "common communication objectives", some of the suggestions offered included:

- Communications should:
  - Establish and maintain trust, transparency and a positive (not fear-based) approach, while confirming that the mobility pricing process is not "anti-car"
  - Reach diverse audiences
  - Promote collaborative solution-building
  - Be clear, simple, relevant and use audience-appropriate language
  - Avoid the use of acronyms and jargon
  - Prevent inadvertently instigating public concerns regarding taxation
  - Present a more equitable system with more choices
  - Provide updates on the MPIC's activities
  - Recognize the uniqueness of the region
- Consider separate communications plans for public and business stakeholders
- Communicate with the corporate sector regarding mutually beneficial outcomes:
  - Engage business organizations as stakeholders
- Proactively acknowledge changes in transportation technology.

8. Other Business

The Chair and Vice Chair extended appreciation to the Facilitator, the Secretariat and Commissioners, and agreed to discuss the meeting's conversations, with the Commissioners who were unable to attend.

9. Closing Summary

The July 28, 2017 Meeting of the Mobility Pricing Independent Commission concluded at 4:45 p.m.

Certified Correct:

Allan Seckel, Chair	Carrie Peacock, Recording Secretary Raincoast Ventures Ltd.

mobility pricing Independent Commission

Metro Vancouver Mobility Pricing Independent Commission
Minutes – Meeting 2
September 6, 2017

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Wednesday, September 6, 2017 at 12:00 p.m. in the Doctors of BC Boardroom, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:

Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Iain Black
Jennifer Clarke (arrived at 12:55 p.m.)
Harj Dhaliwal
Paul Landry
Graham McCargar
Lori MacDonald
Gavin McGarrigle
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:

Elizabeth Model
Vincent Gonsalves
Michael McKnight

ALSO PRESENT:

Hilary Farson, Context Research
Daniel Firth, Mobility Pricing Independent Commission Staff Secretariat
Raymond Kan, Mobility Pricing Independent Commission Staff Secretariat
Fearghal King, Mobility Pricing Independent Commission Staff Secretariat
Michael Harstone, Compass Resource Management
Anna Lilly, FleishmanHillard
Lindsay Neufeld, Mobility Pricing Independent Commission Staff Secretariat
Sally Rudd, Compass Resource Management
Jim Whitty, D'Artagnan Consulting LLP

PREPARATION OF DETAILED NOTES:

Carrie Peacock, Recording Secretary, Raincoast Ventures Ltd.

1. Chair's Welcome

Allan Seckel, Chair, called the meeting to order and welcomed attendees.

2. Review of Previous Minutes

Action Item: *Mr. Firth agreed to send MPIC members a web link to access the MPIC meeting notes and other documents.*

It was MOVED and SECONDED
That the July 27, 2017 Mobility Pricing Independent Commission Minutes be approved as presented.

CARRIED

3. Contract Awards
Mr. Firth referred the meeting to the chart titled "Mobility Pricing Independent Commission Meeting 2 – Contract Awards for Professional Services – Division of Responsibilities", and reviewed contracts awarded for professional services.

4. Actions from the Previous Meeting
a) Objectives and Values
Mr. Firth reviewed the draft document titled "MPIC – Project Goals, Values and Objectives" and welcomed Commissioners to submit feedback.

b) High Level Project Plan
Mr. Firth reviewed the document titled "MPIC – Draft High Level Workplan", noting that some of the timeframes in the workplan, may be adjusted if needed.

5. Update on the Impacts of Bridge Toll Removal
Mr. Firth reviewed a series of overhead slides and offered comments regarding:
- The September 1, 2017 removal of bridge polls from Golden Ears Bridge and Port Mann Bridge
- A map indicating the location of five Fraser crossings (Massey Tunnel, Alex Fraser Bridge, Pattullo Bridge, Port Mann Bridge and Golden Ears Bridge)
- A chart titled "Historic Fraser Crossing Volumes", comparing past traffic volumes
- A list of "Potential Impacts of Bridge Toll Removal"
- A chart titled "Forecast Impacts 2030 – Vehicle Crossings" comparing traffic volume forecasts
- A chart titled "Forecast Impacts 2030 – Auto Travel Times" comparing auto travel time forecasts.

During discussion, the following responses were offered to questions raised:
- The impacts of charging commuters for using bridges will be studied further
- Data on the Fraser crossings referenced in the presentation have been considered; additional crossings may be studied at a future date

- Future consideration could be given to:
    - Surveying commuters on how bridge tolling impacts their travel patterns
    - Studying journey time impacts on transit routed over the Port Mann Bridge
- TransLink may report in November 2017 on the impacts of the bridge toll removal.

6. Structured Decision Making

Michael Harstone, Compass Resource Management reviewed an overhead presentation titled "Strategic Decision Support for development of MPIC Recommendations to the Mayor's Council" and offered comments regarding:

- The structure and focus of Compass, a team of research and consulting professionals
- Compass' role to support MPIC in the development of recommendations
- Engagement points connecting the public input and research / analysis processes
- Key decision areas identified in the MPIC Terms of Reference
- Key features of a structured decision making process, including striving to achieve consensus, and reconciling differences through broad exploration of options and adverse effects
- A draft format for a flexible "MPIC Consequence Table", designed to support the Commission's dialogue.

Action Item: *Mr. Harstone agreed to send a copy of the overhead presentation reviewed at the September 6, 2017 MPIC meeting to Commissioners for information.*

Health Break

The meeting recessed at 1:40 p.m. and reconvened at 2:00 p.m.

7. Stakeholder and Public Engagement

Hilary Farson, Context Research, and Anna Lilly, FleishmanHillard, jointly reviewed an overhead presentation titled "Mobility Pricing Independent Commission, Communication and Engagement Strategy". During the presentation, comments were offered regarding:

- Project objectives
- Situational analysis (i.e. political leadership change, toll removal, regional growth, public perception)
- Communication and engagement objectives, based on increased awareness, participation and ensured credibility
- Development of the following strategies:
    - Communication and Engagement Strategy
    - Government Relations Strategy
- Utilizing paid, earned, shared and owned communication channels
- Communication and engagement efforts intended to increase the campaign's reach
- Activities proposed in the "E1 (September – December 2017) Timeline".

During a brainstorm discussion on the tone of messaging for a public messaging campaign, comments were offered regarding:

- Credibility impacts of maintaining a positive and proactive messaging tone
- Initiating the public messaging campaign with a neutral messaging tone
- The previous transportation-related referendum process
- Potential opportunities to share information on mobility pricing at the September 25-29, 2017 Union of BC Municipalities (UBCM) convention in Vancouver, BC.

8. Brainstorm Discussion: What is Important When Evaluating Road Usage Charging Options for Vehicles

Sally Rudd, Compass Resource Management, reviewed a presentation titled "What is important when evaluating road usage charging alternatives for motor vehicles", and offered comments regarding a variety of alternatives.

During a brainstorm discussion on the key benefits and concerns demonstrated by the illustrative scenarios presented for consideration, comments were offered regarding:

- Impacts anticipated of some mechanisms on businesses, trucking and commerce
- Issues related to tracking vehicle usage
- Fairness and equity
- Convenience that may be associated with adding trip time and costs
- Anticipated behavioral changes
- Predictability elements of some options
- Considering infrastructure when measuring performance
- The effectiveness of reducing congestion and targeting areas, where needed
- Costs associated with implementing mechanisms
- Addressing privacy-related issues.

9. Issues Management

Ms. Lilly reviewed a presentation titled, "Issues Management, Mobility Pricing Independent Commission", and offered comments regarding:

- The scope, approach, process and coordinating with others
- The political and policy environment (i.e. affordability, perceptions of TransLink)
- Creation of an "Issues Management Matrix" to help identify and monitor issues
- Development of a communications protocol, guidelines and processes, to confirm roles and responsibilities.

During discussion on "media relations", the following comments were offered:

- Designated spokespeople (i.e. the Chair, Vice Chair, the Executive Director) could be tasked with speaking to media on behalf of the Commission
- The communications lead could provide some key messages for Commissioners to convey and/or repost on social media.

During further discussion, it was noted that confirmation of upcoming meeting dates would be conveyed to Commissioners as soon as possible. Additionally, it was noted that a representative from TransLink could be invited to an upcoming meeting to provide information on transportation-related taxes and fees currently being generated (i.e. through property taxes, gas taxes, etc.).

10. Other Business

The Chair welcomed participants to submit any additional feedback after the meeting.

11. Chair's Closing

The September 6, 2017 Meeting of the Mobility Pricing Independent Commission concluded at 5:00 p.m.

Certified Correct:

Allan Seckel, Chair

Carrie Peacock, Recording Secretary
Raincoast Ventures Ltd.

Metro Vancouver Mobility Pricing Independent Commission
Minutes - Meeting 3
November 27, 2017

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Monday, November 27, 2017 at 12:00 p.m. in the Doctors of BC Boardroom, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:

Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Iain Black
Jennifer Clarke
Harj Dhaliwal
Paul Landry
Lori MacDonald
Graham McCargar
Gavin McGarrigle
Michael McKnight
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:

Elizabeth Model

ALSO PRESENT:

Daniel Firth, Staff Secretariat
Fearghal King, Staff Secretariat
Raymond Kan, Staff Secretariat
Vincent Gonsalves, Staff Secretariat
Sabrina Lau Texier, TransLink (for Item 5)
Lindsay Neufeld, Staff Secretariat

PREPARATION OF MINUTES:

Carrie Peacock, Recording Secretary, Raincoast Ventures Ltd.

1. Chair's Welcome

Allan Seckel, Chair, called the meeting to order at 12:05 p.m. and welcomed attendees.

He acknowledged the recently held "It's Time" workshops and acknowledged the viewpoints and ideas shared by participants.

2. Minutes of the Previous Meeting

It was MOVED and SECONDED

That the September 6, 2017 Mobility Pricing Independent Commission Minutes be approved as presented.

CARRIED

3. Progress Overview

Daniel Firth, Executive Director, reviewed a chart of MPIC meetings, deliverables, deadlines and other activities, scheduled August 2017 to April 2018. Comments were offered regarding significant decisions anticipated at the remaining MPIC meetings, prior to the April 2018 deadline.

4. Review of Evidence on Congestion

Fearghal King, Manager, Research and Analytics, reviewed the presentation titled "Measuring Congestion", and offered comments regarding maps of key congestion locations, including:

- Fraser River crossings
- Water crossings between Richmond, YVR and Vancouver
- Major arterials in Vancouver and Burnaby
- Urban centres
- North Shore
- Northeast sector
- Regional highways
- Metropolitan core.

During discussion, the feasibility of potentially trialing shortlisted policy instruments in key congestion locations was suggested.

5. Review of Evidence on Revenue

Sabrina Lau Texier, TransLink, reviewed the presentation titled "10-Year Vision for Metro Vancouver Transportation", and offered comments regarding:

- Annual transit boardings, by regional population from 1999 to 2016
- The 10-Year Vision, including transit routes and expansion
- Phases One, Two and Three of the 10-Year Vision
- Regional revenue options and funding needs.

During discussion, comments were offered regarding:

- Recent transit improvements
- Benefits of focusing initially on revenue neutral processes
- The importance of clear and consistent public messaging
- Varying perspectives on how mobility pricing should occur

- Prioritizing three objectives: congestion, fairness and revenues
- Confirming the "vehicle of authority" of mobility pricing mechanisms.

6. Preliminary Findings of Phase 1 Engagement

Vincent Gonsalves, TransLink, reviewed the document titled, "It's Time – Phase 1 Stakeholder and Public Engagement Summary", and a series of overhead slides on the feedback received through the engagement sessions, surveys, and questionnaires. He reviewed next steps, including:

- November 28, 2017: User Advisory Panel Workshop
- November 28, 2017: Meeting with North Vancouver Council
- December 4, 2017: Presentation to stakeholders in Horseshoe Bay (e.g. BC Ferries, Squamish and Bowen Island)
- December 5, 2017: Meeting with Coquitlam City Council.

7. Coarse-Level Evaluation of Policy Instruments

Lindsay Neufeld, MPIC, reviewed the presentation titled "Policy Instrument Coarse-Level Evaluation", referred to the report titled "Road Usage Charging Policy Instruments for Motor Vehicles, Coarse-level Evaluation", dated November 21, 2017, and offered comments regarding:

- Potential policy instruments, which were coarsely evaluated against the following criteria: congestion, fairness, investment, and implementation ease
- Selecting policy instruments to further analyze, for preliminary development.

The meeting discussed the importance of ensuring that policy instruments have an impact on congestion.

Consensus Decision

By consensus, the MPIC agreed to continue to analyze an "Energy Tax" (previously referred to as a "Fuel Tax") as a baseline case rather than a solution, as it has no direct impact on congestion.

Consensus Decision

By consensus, the MPIC agreed to the following policy instrument categories:

- *Category One (Baseline case only):*
  - *Energy Tax / Fuel Tax*
- *Category Two (Recommended for Preliminary Scenario Development):*
  - *System of point charges*
  - *Cordon charges*
  - *Road user charges:*
    - *Distance/time-based*
    - *Distance-only (may possibly be switched to Category Three)*
  - *Pricing (public and private parking)*

- *Category Three (the Pathway or Portfolio List):*
  - *Corridor charges (mandatory)*
  - *Distance-only road user charge (may possibly be switched to Category Two)*
  - *Vehicle levy*
- *Category Four (Set Aside for this Initiative):*
  - *Isolated point charges*
  - *Corridor charges (voluntary)*
  - *Distance-based vehicle insurance*
  - *Parking levies.*

Consensus Decision
By consensus, the MPIC agreed to postpone discussion of the following "parking lot" items to a future MPIC meeting:
- *Ride sharing (e.g. Uber) as a means for alternative transportation*
- *Impacts of cordon charges on commercial traffic*
- *Bicycles and bike lakes*
- *Vehicle levies*
- *Taxation with provincial government involvement*
- *Single-fare public transit implications (during future discussions on "fairness" and "implementation", following completion of the pending fare review).*

8. Draft Scenario Evaluation Framework

Lindsay Neufeld, Mobility Pricing Independent Commission, reviewed the presentation titled "Draft Scenario Evaluation Framework", referred to the report titled "Proposed Evaluation Framework – Draft for Discussion and Input", and offered comments on potential evaluation criteria.

During discussion on the suggested evaluation criteria, comments were offered on:
- Different users' interpretations of "affordability" and "safety"
- Users' ability to make their own determinations on whether an approach is "consistent" or "equitable".

Consensus Decision
By consensus, the MPIC agreed that the "Evaluation Criteria" considered by MPIC at its November 27, 2017 MPIC meeting, be amended as follows:
- *Insert "Public Safety" in the "Other Evaluation Criteria" section, under the subsection "Environment and Health";*
- *Select broader wording to replace "Public Support" in the "Other Evaluation Criteria" section (i.e. "Public Understanding" or "Public Acceptance"); and*
- *Append "(geographic)" to "Availability of sufficient transportation choices" in the "Fairness" section of the evaluation criteria.*

Consensus Decision

By consensus, the MPIC directed staff to:

- *Develop scenarios for up to five "archetypal users", which citizens could relate to (e.g. citizens with mobility issues, commercial users (small businesses and trucking companies), commuters, etc.); and*
- *Then apply each of the evaluation criteria, to each of the archetypal users, to better understand their varying perspectives (e.g. consider how "Equitable distribution of user costs and benefits" would apply to each of the archetypal users; include examples where possible).*

9. Next Steps

Mr. Firth explained that during the next few months, options for each of the categories identified would be further refined, before being entered into a transportation model. He confirmed that prior to the January 2018 meeting, an email discussion could facilitate any required conversations.

10. Conclusion

The November 27, 2017 Meeting of the Mobility Pricing Independent Commission concluded at 4:45 p.m.

Certified Correct:

Allan Seckel, Chair	Carrie Peacock, Recording Secretary Raincoast Ventures Ltd.

LIST OF INFORMATION ITEMS

The following items were presented for information at the meeting:

1. Agenda for the November 27, 2017 Metro Vancouver Mobility Pricing Independent Commission
2. Draft Minutes of the September 6, 2017 Mobility Pricing Independent Commission Meeting
3. Printed copy of the presentation on the "It's Time" Regional and Local Engagement Workshops
4. Report titled "Road Usage Charging Policy Instruments for Motor Vehicles, Coarse-level Evaluation"
5. Report titled "Proposed Evaluation Framework – Draft for Discussion and Input"

Metro Vancouver Mobility Pricing Independent Commission
Minutes – Meeting 4
January 29, 2018

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Monday, January 29, 2018 at 12:00 p.m. in the Health Room, Doctors of BC, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:

Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Iain Black
Jennifer Clarke
Harj Dhaliwal
Paul Landry
Graham McCargar
Lori MacDonald
Gavin McGarrigle (arrived at 12:18 pm)
Michael McKnight
Philip (Pip) Steele
Grace Wong

REGRETS:

Elizabeth Model
Bruce Rozenhart

ALSO PRESENT:

Daniel Firth, Executive Director, Mobility Pricing Independent Commission Staff Secretariat
Fearghal King, Mobility Pricing Independent Commission Staff Secretariat
Raymond Kan, Mobility Pricing Independent Commission Staff Secretariat
Ilan Elgar, TransLink
Lee Falling, Compass Resource Management
Sally Rudd, Compass Resource Management
Lindsay Neufeld, Mobility Pricing Independent Commission Staff Secretariat
Vincent Gonsalves, Mobility Pricing Independent Commission Staff Secretariat
Adrian Lightstone, WSP Group
Hilary Farson, Context Research
Anna Lilly, FleishmanHillard

PREPARATION OF MINUTES:
Roberta Pak, Recording Secretary, Raincoast Ventures Ltd.

1. Chair's Welcome

Allan Seckel, Chair, called the meeting to order and welcomed attendees. Commission members were advised the focus of the meeting would be on gaining an understanding of the technical aspects of the modelling, in preparation for applying the knowledge to decision-making in future meetings. A summary of related meetings that have transpired since the November 3, 2017 MPIC meeting was provided.

Staff was introduced to Commission members.

2. Review of Previous Minutes

<u>It was MOVED and SECONDED</u>
That the November 3, 2017 Mobility Pricing Independent Commission Minutes be approved as presented.

<u>CARRIED</u>

3. Decision-making Process

Lindsay Neufeld, MPIC, presented an overview of the presentations to be provided during the meeting, key objectives for the next three months and the schedule of upcoming meetings:

- Round 1 Objectives – January 29, 2018
- Round 2 Objectives – February 14, 2018
- Round 3 Objectives – March 21, 2018
- Final Meeting Objectives – April 16, 2018

Daniel Firth, MPIC, noted that the final details of the submission of the Commission's report have not been finalized and may include a public announcement. Further details will be conveyed to Commissioners as they are finalized.

4. Review of Communications and Engagement Plan to Spring 2018

Vincent Gonsalves, MPIC, offered a brief overview of the process for public engagement over the Spring 2018 period.

Hilary Farson, Context Research, detailed the communication planning for this period with a series of overhead slides:

- Humanize decongestion charging:
  - Profiles of characters to be used
- Details for each communication platform
- Stakeholder Workshops to determine tolerance testing and tradeoffs:
  - January 2018 events and a tentative closing event to thank stakeholders

  - First Nations Workshop with representatives from local First Nations
  - Municipal Workshops (February 28, 2018)
  - Provincial Government Engagement – three meetings with party caucus representatives
  - Federal Engagement – one meeting
- Online Public Engagement:
  - 15-20 minute survey incorporating videos
- User Advisory Panel meetings have been scheduled
- In-person engagement with targeted communities:
  - Richmond, Surrey, New Westminster, East Vancouver and Coquitlam plus paper surveys serving senior and cultural communities
- Further public meetings to be determined
- Public opinion polling with Ipsos Reid will be available for the April 16, 2018 meeting.

During the discussion, the following responses were offered to questions raised:

- There is a higher drop-off rate with the long surveys and a focused effort and tactics will be used to mitigate that outcome
- Editorial content to date, in the mainstream media, has not been negative toward MPIC
- There may be a need to breakdown misconceptions about mobility pricing and the role of MPIC as it relates to implementation
- Public meetings will be designed to attract the 45 to 65 year old audience
- Information packages will be distributed to potential influencers
- Data relating to affordability will be available in future meetings
- A live map will show the geographic representation of where online surveys are being completed
- The level of engagement on Facebook:
  - Staff is not directing the conversation to allow the development of increased public dialogue.

Commissioners confirmed their support for the program as presented.

5. Introduction to the Regional Transportation Model

Ilan Elgar, TransLink, presented background on the Regional Transportation Model (RTM) and highlighted the strengths of incorporating this model into the decision-making process:

- The RTM will be used to analyze mobility pricing implications
- The tool was built for the region in the late 1980s, with the most recent update being a year ago:
  - These modelling tools are used worldwide

- The RTM includes the Metro Vancouver (MV) region and the Fraser Valley Regional District (FVRD) with the area dissected into 1,700 zones with a further 12 sub-regions
- RTM Inputs:
  - Networks
  - Land Use
  - Prices
  - Surveys
  - Counts
- Examples of the accuracy of forecasting as it applied to local scenarios
- Modelling issues and limitations plus wrong assumptions were identified as the main reasons for inaccurate forecasts

During the discussion, the following responses were offered to questions raised:

- The Compass card data provides data on 95% of transit trips
- Larger municipalities in the MV region use the information to build customized sub-sets
- RTM incorporates a side model to produce a similar model for goods movement
- Trucks are more sensitive to pricing than regular vehicles.

Recess

The meeting recessed at 2:06 p.m. and reconvened at 2:23 p.m.

6. Structured Decision Making – Round 1

Lee Failing, Compass Resource Management, provided an overview of the components to be utilized in the decision-making process:

- Theory of congestion pricing
- Different charging options
- Metrics and charting to visually represent modelling results
- Acceptable solutions may be a package or a pathway of options
- Iterative rounds of scenario evaluations
- Investment and gross revenue projections
- Environment i.e. greenhouse gas (GHG) emissions
- Health air contaminants and related wellness issues
- Consequences and possible trade-offs in a heat map table format:
  - Identifies the impact of various levers as they relate to different charging models.

Sally Rudd, Compass Resource Management, explained the technical aspects relating to the metrics:

- Research team selected the year 2030 as the baseline scenario for congestion metrics

- Includes the assumption that 10-Year Vision for Metro Vancouver Transit and Transportation (10-Year Vision) has been fully implemented
- Maps are less useful but provide more information
- The Origin Destination (OD) matrix represents congestion charging scenarios
- Metrics for congestion are based on the total travel time and the subset of total time of the trip spent in congestion.

Fearghal King, TransLink, introduced the optimum theory of Marginal Social Cost (MSC) pricing:

- Non-linear relationship between traffic volume and traffic time
- Empirical evidence shows the reduction in travel time is greater than the number of cars removed from the road
- Intention is for optimal economic efficiency
- Based on insights from other jurisdictions:
  - Often drivers stay in their cars and pay
  - Do not have to invest heavily in transit before introducing congestion charging because not all drivers switch to transit
- Economic theory dictates charging at the margin, known as the MSC, but the reality is MSC is not practical
- There are three key reasons why the MSC is worth modelling:
  - Protects against overcharging
  - Provides a benchmark for comparison purposes
  - Provides insight into the values considered by the Commission
- MSC pricing, as it applies to MV, depicts the majority of pairs modelling a change greater than 70%
- Vehicle kilometres travelled (VKT) is reduced by 9%
- Based on this model, there are 13 million minutes/day of total travel time savings and economic benefits of $1.2 billion/year
- MSC can achieve significant decongestion benefits
- There is a strong alignment of travel time costs and benefits.

Ms. Rudd provided insight on basic congestion point charges their use to approximate the MSC:

- Point charge theory can aggregate the charges and implement it at a single point
- Three basic point charge scenarios will be presented:
  - Point charge system around a central business district
  - Two scenarios over 12 major bridges in the region at two different rates.

Discussion ensued on:

- Consideration of implementation costs and net revenue for the various models
- Reviewing highlights from modelling:
  - Forecasts if a point charge will create a traffic diversion

  - The Bridge $1 scenario does not show a significant reduction in congestion
  - The Bridges $5 scenario depicts a 50% reduction in congestion across the region
  - Rates matter
- How modelling will highlight the impact of diversions
- Consideration of the reduction of fuel tax
- Perspective of fairness and how the point charge scenarios perform on fairness
- The Bridge $5 proposal will see many trips being charged receiving travel time benefits, however some trips are benefitting from decongestion benefits without paying a charge
- Possibilities to address differentiation in user costs:
  - Caps and discounts for charges
  - Transit investments in the corridor
  - Adjusting rates and point charge locations.

Ms. Rudd identified further issues related to point charge scenarios that require consideration by Commissioners prior to the next meeting:

- Achievement of reduction in congestion
- Addressing congestion at the regional scale versus local scale
- Maximum trip charge
- Difference in charges across trips
- Alignment of charges with travel time benefits
- Whether the charging model is understandable and transparent
- Desire for a transparent charging model with subsidies and caps
- Tradeoffs required to make the charges palatable for residents
- Creating user profiles based on the level of transit available in their community
- Whether to limit transit investments if drivers are unwilling to shift to transit.

Recess
The meeting recessed at 4:01 p.m. and resumed at 4:09 p.m.

Ms. Rudd provided highlights on the distance-based charging scenario:

- Congestion reduction is achieved, based on a flat 15 cents per kilometre across the region
- Either distance-based or point charging scenarios achieve regional scale reduction
- With a fairness metric, there would be a charge for all the internal trips within a zone
- Everyone is contributing:
  - 17% of the trips cross the bridges
- Technology is being developed to facilitate this scenario:
  - No other jurisdiction has implemented this scenario.

Ms. Rudd identified further issues related to the distance-based charging scenario that require consideration by Commissioners prior to the next meeting:

- Should congestion charges per trip be proportionate to travel/congestion time benefits?
- Should longer trips be charged more than shorter trips?
- Does it matter if some trips do not contribute revenue through a congestion pricing scheme?
- In areas with congestion, should the price should vary?
- Should there be a charge for areas without congestion?

Ms. Failing explained that the synthesis of the structured decision-making process would incorporate questions and value statements based on the following:

- What are the congestion benefits?
- Are total economic benefits important?
  - Economic benefits are potentially significant, depending on the scenario used
- How does revenue change across scenarios?
  - The efficiency of revenue collection will affect net revenue
- How important is revenue generation?
- How important is the efficiency of revenue generation?
- What is the impact on different income groups?
- Environment and health:
  - How important are GHG emissions and VKT?
- Exploration of consequences and trade-offs.

7. Closing and Other Business

Mr. Seckel suggested Commissioners digest the information presented and begin considering the principle value judgements necessary to for the next stage of decision-making, as the process moves forward.

> ***Action Item:*** *Staff was requested to distribute copies of the presentations to Commissioners.*

The January 29, 2018 meeting of the Mobility Pricing Independent Commission concluded at 4:55 p.m.

Certified Correct:

Allan Seckel, Chair

Roberta Pak, Recording Secretary
Raincoast Ventures Ltd.

Metro Vancouver Mobility Pricing Independent Commission
Minutes – Meeting 5
February 14, 2018

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Monday, February 14, 2018 at 12:00 p.m. in the Health Room, Doctors of BC, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:

Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Jennifer Clarke
Harj Dhaliwal
Graham McCargar
Lori MacDonald
Gavin McGarrigle (departed at 4:58 p.m.)
Michael McKnight
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:

Iain Black
Paul Landry
Elizabeth Model

ALSO PRESENT:

Andrew Devlin, TransLink (Item 3)
Ilan Elgar, TransLink
Lee Falling, Compass Resource Management
Daniel Firth, Executive Director, Mobility Pricing Independent Commission Staff
Vincent Gonsalves, Mobility Pricing Independent Commission Staff Secretariat
Raymond Kan, Mobility Pricing Independent Commission Staff Secretariat
Fearghal King, Mobility Pricing Independent Commission Staff Secretariat
Adrian Lightstone, WSP Group (via teleconference)
Lindsay Neufeld, Mobility Pricing Independent Commission Staff Secretariat
Sally Rudd, Compass Resource Management
Don Buchanan, City of Surrey

PREPARATION OF MINUTES:

Rae Ratslef, Raincoast Ventures Ltd.

1. Chair's Welcome

Allan Seckel, Chair, called the meeting to order at 12:08 p.m. Commissioners were advised that the minutes of the prior meeting would be considered at the next meeting.

The Chair referred to a distributed paper titled "Commissioner Profile Piece", and asked that Commissioners complete and submit it for use by staff in communicating to the public about MPIC and its membership.

In response to an invitation to provide feedback on the workshop held January 31, 2018, comments included:

- Reminder of the many and varied influencers/allies that can play a role in deepening the conversation
- Observation that there was no reporting out following the table breakouts
- Several commissioners moved from table to table to listen to the conversations
- Confirmation that any formal submissions from groups are provided to the MPIC
- Meeting with the BC Trucking Association will be held the following week
- To date the only formal submission has been from the City of New Westminster
- Appreciation for the level of engagement and recommendations received.

2. Structured Decision-Making Part A

Sally Rudd, Compass Resource Management, reviewed an overhead presentation titled "Round 2 Scenarios", and highlighted:

- SDM Process – Objectives for Today
- SDM Session Outline
  - Part A: Round 2 Scenarios
  - Part B: Direction for Round 3
- Role of the MPIC members during the SDM process.

Lee Falling, Compass Resource Management, reviewed a presentation titled "Baseline 2016 vs. Baseline 2030", and highlighted:

- Map and data on a.m. peak, off-peak, p.m. peak and total million minutes/day
- Average time in congestion (min/day per household) by home zone area based on a one day, mid-week trip diary
- Round 2 Scenarios and key learnings relative to each:
  - 2 Central Business District (CBD) Cordon Scenarios
  - Bridges Scenarios: Bridges ($5), Bridges Time of Day (TOD), Bridges TOD and Direction, and Bridges (MSC)
  - Distance-based Charging Scenarios.

Discussion ensued on:

- Interest in data on the types of peak period trips in order to assist in determining what percentage of travellers have flexibility

- 2 Central CBD Cordon Scenarios pricing and impact on congestion
- Whether to include a daily cap for the Bridges Scenarios
- Lack of a good model to reflect weekend behaviour
- Interest in data on what percentage of commuters need to be taken off the road to significantly reduce congestion, and what system would drive that outcome
- Recognition that there is also mid-day congestion, not just am/pm peak
- Potential to increase DBC for areas where there is good transit access.

Ms. Rudd led the review of an on-table document titled "MPIC Hand-Out: Summary of Evaluation Criteria, Round 2 Scenarios", and a displayed a consequence table illustrating objectives, units, Base 2030, CBD (MSC) and Bridges ($1).

Discussion ensued on:

- Interest in the costs and technology of collecting on the options
- MSC shows the alignment of charges from a congestion perspective
- Interest in the proportionate jump in costs for options as compared to income, and specifically, whether some scenarios are less regressive
- Interest to see the impact of options on different income groups
- Implications of different bridge crossing costs
- Need to focus on reducing congestion, which may mean increasing transit use
- Confirmation that in all scenarios the transit was held constant
- Whether an improvement to the transit system would translate to increased use
- Note that some scenarios have a fixed cost of collection
- Importance of considering the timeline for implementation of scenarios
- Mayors' Council target of 2021 to implement mobility pricing
- Interest in framing options from the perspective of implementation
- Note that some options may be possible but not possible to implement today
- Clarification on the amount of money that needs to be raised.

Ms. Failing provided each commissioner with a Direct Ranking Questionnaire to complete. An example ranking form was reviewed.

3. TransLink's Transit Fare Review

Andrew Devlin, TransLink, referred to a presentation titled "Transit Fare Review" and highlighted:

- Rationale, goals and objectives for a fare review
- Current three-zone fare system for SkyTrain and SeaBus
- Completion of Phase 3, and plans to finish the review by mid/late 2018
- Key learnings in Phase 1 – discovering the issues and opportunities
- Key learnings in Phase 2 – exploring options for pricing by distance, time of travel and service type

- Focus in Phase 3 on seeking public and stakeholder input on distance travelled, fare products, and customer discounts
- Shortlisted options for pricing by distance structure consulted on in Phase 3.

Discussion ensued on:

- Real vs. theoretical options
- Ability to upgrade the Compass system to base fares on km travelled
- Direction from the Board to maintain revenue from fares
- MPIC's mandate
- Need to find a way to cap fares so it is affordable for people to take longer trips
- Need to flag options that would be worse than the current system
- Inequities in the current fare system
- Suggestion that growing transit ridership should be one a key objective.

4. Structured Decision-Making Part B

Ms. Failing displayed a chart titled "Direct Weighting" indicating directors' responses to the earlier ranking exercise.

Discussion ensued on:

- CBD (MSC)
  - People could see it as a "tax grab" if there are no alternatives
  - Preference to start small where there is the most congestion
  - Does not suit the mandate of reducing congestion
  - Would create a fortress around the most expensive real estate in Canada and protect the "wealthiest of the wealthy"
- DBC TOD (2 zones)
  - There is a lot of congestion from travel that does not cross a bridge
  - Sympathetic to the idea of geographic fairness for people further east
  - There is a lot of congestion that is not in downtown Vancouver, but that relates to getting in/out of Vancouver
  - Support for a compromise/blend, e.g. distance based and point charge
  - Support for moving to 12 zones
- Bridges (TOD)
  - Seems to find the "sweet spot" in all the criteria
  - If the objective is to reduce congestion there should not be a charge during off-peak hours, it makes the most sense to charge during peak periods only and on all the bridges
  - Bridges (MSC) gives you more variables with more of an impact
  - Interest in a lower cost, e.g. \$0.10/km vs. \$0.15/km
  - Interest in a simple solution that elected officials can support
- DBC TOD:
  - TOD is more consistent with focusing on congestion

        - Raises enough money to deal with other issues, e.g. low income tax break
- Flat DBC:
    - At $0.15 raises a lot of money
    - Has a lot of support in general
- Packaging DBC and TOD:
    - Support for reducing congestion with this option, so long as there are offsets, e.g. eliminate fuel tax and lower fares
    - Need for a cap for those commuting from the northeast sector
    - Fairness, equity and affordability are key considerations
- TOD:
    - Allows some people to have the discretion to avoid the charge.

Ms. Failing led commissioners through a voting exercise at www.menti.com through which they provided individual responses to the following (Ranking of 0 = strongly disagree and 5 = strongly agree):

- **What principles should guide regional mobility pricing policy for motor vehicles?**
    - User pay ONLY (1.1)
    - User cost ONLY (1.3)
    - User pay AND user cost (4.7)

  Agreement: The system should be a combination based on user pay/user cost.

- **How much net revenue should we design for?**
    - Just enough to finance the MC 10-Year Plan (2.1)
    - More that the MC 10-Year Plan (3.5)
    - Just enough to replace the fuel tax (1.5)
    - No target – design for congestion (2.5)

  Agreement: Support for raising more than is needed for the Mayors' Council 10-Year Plan, which could be used to offset costs for low income rides, provide cheaper transit, etc.

- **If revenue raised exceeds 10-year plan needs, what should it be used for?**
    - Invest in the transportation system (4.6)
    - Offset costs for low income group (4.3)
    - Other (1.2)

  Action: Staff to report back with a "snapshot" of information on what other jurisdictions have done if revenue exceeds more than what is required to fund the system.

Agreement: Interest in learning more about ways to invest to benefit both transit users and drivers.

- **By 2030, what's the target geographical scale for reducing congestion?**
  - Small scale (1.2)
  - Medium scale (2.1)
  - Large scale (4.5).

- **Could it start out small and expand?**
  - It could make sense to start small and expand (1.7)
  - It should be region-wide from the start (4.4).

- **Would you rather…**
  - Save one minute for a million trips (1.5)
  - Save 10 minutes for 10,000 trips (4.4).

- **What is a reasonable upper limit on net household cost?**
  - 0.5% of annual income - $300/yr (2.2)
  - 1% - $600/year (2.4)
  - 3% - $1,800/year (2.3)
  - 5% - $3,000/year (1.4).

- **How simple or complex should the charging system be?**
  - Simple – no variation (1.5)
  - Somewhat complex – variation in one or two levers (3.3)
  - It depends – as much variation as warranted by the benefits (3.5).

- **To guide us in the next round of scenarios, what's more important?**
  - Achieving congestion benefits (4.5)
  - Generating revenue for the transportation system (3.9)
  - Minimizing net costs for those charged (2.5)
  - Minimizing differences in cost across users (2.7).

Action: Commissioners were asked to email any additional feedback/questions/ comments to Daniel Firth.

5. Washington Road User Charging Pilot

Don Buchanan, City of Surrey, referred to a website (https://waroadusagecharge.org) providing information on the Washington Road Usage Charge Pilot Project, highlighted:

- An invitation will be sent to all local MLAs and MPs, Mayors' Council and TransLink Board members, MPIC, professional associations and media to

participate in the pilot
- A dongle can tie into a vehicle diagnostic port or an app will report on driving
- Option of having the Department of Motor Vehicles read the vehicle odometer, or paying up front for three months of driving based on the 98th percentile
- Confirmation that the technology exists to do DBC
- The U.S. is framing the discussion as revenue replacement instead of fuel tax
- The Washington pilot is for one year; the objective is to involve 2,000 Washington drivers and 200 British Columbians
- Pilot participants will receive a mock bill

Gavin McGarrigle departed the meeting at 4:58 p.m.

- The U.S. Road User Charge Commission has been operating for four years; it meets quarterly and is televised
- Oregon is on its second pilot; California, Hawaii and Washington are doing pilots
- There is federal funding for implementation
- Washington held a Hack-a-thon to develop the app
- The Washington pilot will run February 1, 2018 to February 1, 2019
- There will be distinct reporting on the Canadian participants.

6. Closing and Other Business

The February 14, 2018 meeting of the Mobility Pricing Independent Commission concluded at 5:04 p.m.

Certified Correct:

Allan Seckel, Chair

Rae Ratslef, Recording Secretary
Raincoast Ventures Ltd.

Metro Vancouver Mobility Pricing Independent Commission
Minutes – Meeting 6
March 21, 2018

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Wednesday, March 21, 2018 at 10:30 a.m. in the Doctors of BC Health Boardroom, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:
Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Jennifer Clarke
Paul Landry
Graham McCargar
Lori MacDonald
Michael McKnight
Elizabeth Model
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:
Iain Black
Harj Dhaliwal
Gavin McGarrigle

ALSO PRESENT:
Dirk van Amelsfort, WSP
Lee Failing, Compass Resource Management Research
Daniel Firth, Staff Secretariat
Vincent Gonsalves, Staff Secretariat
Raymond Kan, Staff Secretariat
Fearghal King, Staff Secretariat
Lindsay Neufeld, Staff Secretariat
Sally Rudd, Compass Resource Management Research

PREPARATION OF MINUTES:
Roberta Pak, Recording Secretary, Raincoast Ventures Ltd.

1. Chair's Welcome

Allan Seckel, Chair, called the meeting to order and explained the meeting would be a lengthy working session focused on identifying the principles for the final report. Commission members were encouraged to use this opportunity to share ideas, including points of disagreement, and especially to focus on identifying any missing points for consideration at this stage of the process. It was noted that the documents circulated have been drafted for the purpose of this discussion.

The final report will be completed by the end of April 2018 and the Joint Regional Mobility Pricing Steering Committee (Steering Committee) will receive the report the first week of May 2018. The report will be released to the public and will be considered by the Mayors' Council on Regional Transportation (Mayors' Council) in late May 2018.

2. Review of Previous Minutes January 29, 2018 (Meeting 4) and February 14, 2018 (Meeting 5)

Related information provided with the distributed agenda material:

- *Draft Minutes of the January 29, 2018 meeting*
- *Draft Minutes of the February 14, 2018 meeting.*

It was MOVED and SECONDED

That the January 29, 2018 and February 14, 2018 Mobility Pricing Independent Commission Minutes be approved as presented.

CARRIED

3. Review of Preliminary Results from Phase 2 Engagement

Vincent Gonsalves, MPIC, offered highlights from the second phase of engagement:

- 11,518 responses were received to the online public survey on multiple language platforms
- 9,000 comments were received over social media platforms
- Increase in responses from females, with 34% received in Phase 1 and 36% received in Phase 2
- 2% increase in responses from the 55+ age group
- The 18-34 years age group had 28.2% participation
- Municipal participation:
  - Both Maple Ridge and the North Shore were extremely well represented
  - Vancouver was somewhat less represented
  - Surrey was represented less than expected
- Sample of feedback statements on the various pricing scenarios, including comments on the fuel tax.

Discussion ensued on:

- Elements which contributed to changes in public opinion from other cities in Europe, which have implemented similar programs
- Overwhelming level of negative feedback from citizens who appeared to have considered the information presented and taken the time to formulate responses
- Requirement for the data from consumers and those with a particular interest in moving goods to be separated
- Suggestion to include the age and region of the respondent, if available, when presenting the analysis on comments received
- Time restraints restricted the ability to increase opportunities for personal interaction
- If a theme becomes evident from social media comments, it should be identified in the analysis
- Public perception that this is a taxation exercise versus a solution to congestion to improve the well-being of communities
- Disconnect between data showing public transit is not the solution and the public perception that it is the solution
- Public concern for protecting low income individuals and fairness
- Potential recommendation for future public engagement to be focused on commuters who are generally not available during weekdays
- Importance of identifying the trade-offs and educating the public on the complexity around the issue of congestion.

4. Concepts for Addressing Equity and Affordability

Ray Kan, TransLink, presented preliminary concepts targeting affordability and social equity impacts for various marginalized groups, highlighting the following:

- Use of decongestion revenues for non-transportation purposes
- The first use of decongestion charging revenues should be to pay for regional transportation investments in Metro Vancouver (MV), as set out in approved regional transportation investment plans
- What should the remaining revenues be used for and to achieve what objectives?
  - Affordability
  - Direct versus indirect transfers to households
  - Universal versus targeted transfers to households
  - Transport versus non-transport expenditures
- Fairness:
  - Lower income people use 2/3 of their income for housing and transportation
  - Lower income people have a higher use of transit
- Sample concepts:
  - Replace, in part, TransLink's taxation and user pay revenues
  - Annual tax credit to lower income households

- Annual rebate to lower income individuals, based on distance-based or point charges
- Contribution to support affordable rental housing development in transit locations
- Contribution towards rent supplements for lower income households
  - Precedent for this social equity benefit with Sound Transit in Seattle contributing to a revolving affordable house fund
- Potential uses for conditional grant to municipalities:
  - Provide rebates to lower income households
  - Local transport and affordable rental housing development
  - Fund capital projects.

Discussion ensued on:

- Providing an annual transit pass as determined by income levels
- Recognition that a certain amount must be charged in order to change behavior and in doing so, excess revenue is generated:
  - Directing these revenues to municipalities is an example of wealth redistribution would not be the desired outcome
  - Other taxes and fees, relative to transportation, should be reduced given the potential for excess revenues
- A sizable reduction in taxes would greatly enhance the favorability of this type of project
- Goal to reduce the number of cars on the road, allowing increased mobility and managing the issue of affordability
- Public distrust of TransLink managing the revenues
- Need to keep the focus on transit and transportation, not affordable housing
- The redistribution model captures many of the problems within the current market
- Land value capture tactics around SkyTrain stations and the Development Cost Charges (DCCs) used for social housing.

Recess
The meeting recessed at 12:02 p.m. and reconvened at 12:38 p.m.

5. Round 3 Scenarios and Implications for Key Findings and Trade-Offs

Related materials distributed at the meeting:

- *Presentation titled "Round 3 Scenario Results"*
- *Confidential draft document titled "Round 3 Consequence Table (Selected Scenarios)".*

Sally Rudd, Compass Resource Management Research, presented summaries of the data analysis completed to date and offered an update on how the direction received at the February 14, 2018 meeting was incorporated into the creation of this third round of scenarios.

Highlights of the data analysis included:

- 23 scenarios, representing six different systems, were modelled for how decongestion charging could occur in Metro Vancouver
- 17 of the 23 scenarios have undergone comprehensive analysis at this point
- The methodology allows for the comparison of different point charge locations and rates, plus impact analysis
- Each of the following systems were run with five different rate structures:
    - Bridges + fuel tax
    - Bridges + North Road + fuel tax
    - Distance-based Charge (DBC) 2 Zones + no fuel tax
    - DBC 8 Zones + no fuel tax
    - Flat DBC = fuel tax
    - Hybrid (Point Charges and DBC) + no fuel tax.

Dirk van Amelsfort, WSP, introduced the Marginal Social Cost (MSC) Scenario which is a traditional economic theory used in analysis to identify the ideal charge for each of the roads being considered. This is used to establish base scenarios and is considered a very good first attempt for the creation of charging scenarios. Best practices have shown it can take up to eight iterations to optimize a scenario and the scenarios presented here are round three of that process.

Mr. van Amelsfort reviewed the results and highlighted:

- Potential for net economic benefits of decongestion charging to be significant
- Comparison to other investments, including the George Massey Replacement Projects, shows economic benefits vary and it is not a given that results will be positive
- The scenarios create benefits similar to other investments being considered in the region
- The implementation of charges changes the distribution between societal benefits and individual/consumer benefits
- Scenarios with lower charge rates have:
    - Higher operating costs
    - Lower economic benefits
    - Lower revenues
    - Lower out of pocket costs for users
    - Lower inconvenience costs for users

- Taking into account uncertainty in system costs, a flat Distance Based Charge (DBC) of 10 cents /km and hybrid scenarios may not have economic benefits
- All scenarios, at a minimum, should provide net economic benefits for MV.

Discussion ensued on:
- Health and road safety issues
- Accidents are random occurrences, however 40% of all traffic collisions occur in congestion
- The method needed to apply to this data to justify the reduction in the range of options.

Mr. van Amelsfort explained congestion metrics and how congestion pricing will make a significant difference in congestion problems:
- There will be a reduction in congested time
- There will be a visible time saving
- Reliability will improve 4-20% during peak hours.

Discussion ensued on the need for a map depicting total congested minutes by route during afternoon peak hours for the scenarios being considered, as the number of scenarios is reduced.

Ms. Rudd reviewed how the scenarios address revenue objectives for the region and explained that all scenarios will raise sufficient revenue to cover the costs associated with TransLink's 10-Year Vision for Metro Vancouver Transit and Transportation (10-Year Vision). The DBC scenarios will generate higher revenue, will have higher implementation costs and will have increased uncertainties associated with it.

Discussion ensued on:
- Excess revenues that could be generated by some scenarios
- Potential for $4 billion of excess revenues that could eliminate fuel tax, property taxes associated with TransLink services and streamline transportation costs for individuals
- Revenues could go directly to impacting congestion
- Consideration must be given to the net personal cost of "what is" versus "what it could be"
- Although a consumer surplus is being generated, this is considered a net loss because people are being asked to change their behavior in order to obtain some time benefits.

Ms. Rudd continued with an assessment of fairness and how the scenarios aligned with transparent and consistent pricing criteria:
- Bridges scored the highest in terms of aligning charges with time savings

- A flat DBC has the highest alignment with use
- Bridges and DBC 2 Zones and DBC 8 Zones align with the trips contributing to congestion
- A hybrid balances charges with time savings and time of use
- Even scenarios that score the best in terms of alignment of charges with transit still charge people that have poor access to transit
- People prefer other adaptations rather than modal changes
- Having access to transit is important to fairness.

Mr. van Amelsfort offered an overview of income equity, based on data compiled from household travel diaries, with the following highlights:
- High-income people travel twice the distance and spend more time in congestion
- If the system is designed to align more with user costs than with user pay, you will have few equity issues to solve.

Discussion ensued on:
- Issues relating to employers moving closer to employees and employees moving closer to employment
- Relationship between housing and transportation
- Not all municipalities support the Regional Growth Strategy (RGS)
- Need for a structured preference assessment to eliminate some proposed scenarios.

Recess
The meeting recessed at 3:00 p.m. and reconvened at 3:24 p.m.

6. Discussion of Draft Commission Principles
Daniel Firth, MPIC, spoke to the overall report structure, which would include the following components:
- Letter from the Chair
- Background and context
- Process and method
- Key findings
- Principles
- Examples and scenarios
- Recommended next steps
- Appendices:
    - How MPIC has fulfilled the Terms of Reference
    - Research and evaluation process including results
    - Engagement process and results
    - Implementation considerations
    - Meeting minutes.

Discussion ensued on:

- The importance of the report remaining relevant over the period of the upcoming municipal elections and becoming a valuable resource
- The Provincial Government is also the audience
- Expectation that there will be clear recommendations and not only next steps
- Clear benefits for the expense of undertaking the project
- The report should show value and purpose to the general public
- The report should depict how the MPIC has grappled with the issues of raising revenue and tackling congestion
- The quantity of data is difficult to digest and should be further synthesized to facilitate the decision-making process
- Net annual out of pocket costs should be added
- Necessity of utilizing good guidance from the specialized consultants and the Commissioner members exercising their judgement
- The data has allowed for the understanding of the complexity of the issues.

  Action Item*: Staff to circulate copies of any formal submissions received to MPIC members for review.*

Lee Failing, Compass Resource Management Research, initiated an exercise to establish a full set of draft principles. Proposed statements (shown below in bold) were presented for consideration and each MPIC member cast a vote by showing a green, yellow or red card. A record of the votes follows each statement. Comments offered relative to yellow cards are shown below the proposed statement.

Decongestion charging must be aligned with all the other ways we pay for mobility in MV to achieve the goals. – 10 green, 1 yellow

Decongestion charging should seek to have a significant impact on traffic congestion across the region. This must be guided by appropriate congestion reduction targets for MV. – 9 green, 2 yellow

- Further wordsmithing is required as this implies it is the only impact.

Everyone who uses the transportation system should pay something for it – and those contributing to traffic congestion should pay more. – 11 green

Mr. van Amelsfort noted that agreement with the second and third statements would eliminate a flat-rate DBC or a hybrid charge.

Fairness needs to be considered over many different dimensions. – 11 green

- Further wordsmithing is required so this does not imply it supersedes congestion.

Mobility is a basic right and so fairness principles should apply to everyone irrespective of whether they choose to drive, use transit, walk or cycle. – 5 green, 7 yellow

Differences in charges across users must be consistent and explainable. – 11 green

The design of a decongestion charging scheme should seek some alignment of charges with access to transit. This could be supported through targeted improvements, where appropriate. – 6 green, 5 yellow

- Concerns regarding the second sentence being too vague.
- Suggested amendment: ***The design of the decongestion charging scheme should seek alignment with access to transit and this can be supported through targeted improvements.*** – 11 green

Complimentary measures could be used to address some of the concerns about the affordability of both transit fares and decongestion charges. 10 green, 1 yellow

- Concern this is not a principle.

Discussion ensued on:

- This statement speaks to the issue of revenue redistribution
- Focus should be on the affordability of the decongestion charge
- All things being equal, it would be better to have less income inequality
- Balancing congestion with out of pocket costs
- Whether an element should be included to ensure the most vulnerable can afford mobility.

The first use of revenues raised from decongestion charging should be to pay for the regional transportation system. – 8 green, 3 yellow

- This appears to be more of a next step rather than a principle
- Public engagement made it clear people want to have a clear understanding of who is ensuring the efficient use of these investments and direct accountability for revenues generated.

The entity that collects and manages revenues from decongestion charging must ensure effective and transparent use of revenues. – 11 green

The design of a decongestion charge needs to be based on a good understanding of how people currently pay for mobility and how the charge design will influence the distribution of costs and benefits across road users. 10 green, 1 yellow

Raising revenues should not be the primary purpose of decongestion charging. – 11 green

Any decongestion charging system implemented must recognize and respect an individual's interests and rights to privacy and use of personal information. – 11 green

Decongestion charging approaches can and should evolve over time to more effectively address congestion. MV should actively seek out opportunities for pilots. – 11 green

- The statement regarding pilots seems like a next step rather than a principle.

7. Synthesis

Ms. Failing led a discussion focused on capturing key issues from the meeting. During the course of the discussion, several other principles were raised and voted in the same manner as the previous exercise.

Decongestion charging should be charged region wide to ensure geographic fairness. – 11 green

Net economic benefits must be the result. – 11 green

> ***Action Item****: Staff and consultants to redraft the selected principles and circulate the list for MPIC's review. An online vote or survey could be undertaken to prioritize the principles, if necessary.*

Discussion ensued on:

- Need for data to address weekend congestion
- Need to include health and environment in the proposed principles
- Reference in the report to regional transportation studies currently being undertaken by TransLink to diffuse public confusion with decongestion studies
- Consideration of caps on charges will need to be further analyzed in future studies.

> ***Action Item****: Consultants to provide guidance in narrowing scenarios and identifying possible considerations for the decision-making process. Value choices will be identified for the purpose of transparency.*

8. Close/ Other Business

The Chair reminded MPIC members of the need to allocate time over the next several weeks to review drafts and provide direction to staff, in a timely manner, as the final report is being completed.

9. Conclusion

The March 21, 2018 Meeting of the Mobility Pricing Independent Commission concluded at 5:50 p.m.

Certified Correct:

Allan Seckel, Chair	Roberta Pak, Recording Secretary Raincoast Ventures Ltd.

Metro Vancouver Mobility Pricing Independent Commission
Minutes – Meeting 7
April 16, 2018

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Wednesday, April 16, 2018 at 9:07 a.m. in the Doctors of BC Health Boardroom, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:
Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Jennifer Clarke
Harj Dhaliwal
Paul Landry
Graham McCargar
Lori MacDonald
Gavin McGarrigle
Michael McKnight
Elizabeth Model
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:
Iain Black

ALSO PRESENT:
Miranda Eng, Context Research
Hilary Farson, Context Research
Lee Failing, Compass Resource Management Research
Daniel Firth, Mobility Pricing Independent Commission Staff Secretariat
Vincent Gonsalves, Mobility Pricing Independent Commission Staff Secretariat
Raymond Kan, Mobility Pricing Independent Commission Staff Secretariat
Fearghal King, Mobility Pricing Independent Commission Staff Secretariat
Lindsay Neufeld, Mobility Pricing Independent Commission Staff Secretariat
Sally Rudd, Compass Resource Management Research

PREPARATION OF MINUTES:
Roberta Pak, Recording Secretary, Raincoast Ventures Ltd.

1. Chair's Welcome

Allan Seckel, Chair, called the meeting to order and provided updates from the recent meeting with the Joint Steering Committee.

<u>It was MOVED and SECONDED</u>
That the minutes of the MPIC March 21, 2018 meeting were adopted as presented.

<u>CARRIED</u>

2. Communications and Engagement Report Back
Hillary Farson and Miranda Eng, Context Research, presented an overview of the results of phase one and two of the #ITSTIMEMV project's stakeholder engagement process.

3. Principles
Mses. Farson and Eng reviewed the proposed principles and the data analysis supporting each statement.

Congestion – Principle A: **"A decongestion charge should seek to have a meaningful and region wide impact on congestion. This must be guided by appropriate congestion targets for MV."**

- 16% of all public comments related to this principle.

Congestion – Principle B: **"Everyone who uses the transportation system should pay something for it – and those contributing to traffic congestion should pay more. It will be important to find the right balance between paying for use and paying for congestion."**

- Data supports a preference for charging those who drive in congested areas during peak times
- Most trips occur outside peak times
- This is a value judgement
- Various scenarios perform differently in modelling exercises.

Congestion – Principle C: **"A decongestion charge should be coordinated with all the other ways we pay for mobility in Metro Vancouver to achieve regional mobility goals."**

- Public opinion polling indicates people want to be able to track their spending and monitor transportation expenses
- 68% believe it is worthwhile to consider mobility charges as part of a coordinated approach to paying for congestion.

Discussion ensued on the **congestion principles**:

- Recommendation not to weigh decisions based on negative feedback from Facebook as the opinion of professionals in the communication field is that this platform does not accurately reflect the true tone of public opinion
- A disconnection between public opinion and opinions from the User Advisory Panel (UAP) versus the opinions received from government and other stakeholders regarding the implementation of charges for decongestion:
    - Public, but not stakeholder and government, support to pay more to reduce congestion

  - Greater public willingness to pay for congestion on a cost benefit basis
- Research confirms congestion is a social detriment therefore transportation behaviour must change and mobility pricing is the means to accomplish the behavioural change
- The principles must be considered as a package
- Currently, everyone pays, either through fuel taxes or transit fares.

Fairness – Principle A: **"Differences in decongestion charges across users must be consistent and explainable."**

Fairness – Principle B: **"The design of decongestion charges should seek alignment of charges with access to transit."**
- Can be supported through targeted transit improvements
- 24% of all comments were in support of this principle
- Understanding that most people who change their behaviour do not switch to transit, but an effective transit system is a benefit and is critical for improving accessibility.

Fairness – Principle C: **"A decongestion charge should be designed in a way that seeks to promote equity. Any revenues raised above those needed for agreed transportation investments should be used to address concerns about the affordability of mobility for people on lower incomes."**
- 7% of all public comments were in support of this principle
- People with higher incomes drive more, generally and during congested times of day.

Discussion ensued on the **fairness principles**:
- Understanding the dichotomy between people saying they support investing in transit yet drivers unwilling to change modes
- Responsibility of MPIC is to report on public viewpoints relating to decongestion and to allow the Mayors' Council on Regional Transportation (Mayors' Council) to make decisions based on the findings
- Majority of public input confirmed support for mobility charging based on transit improvements that would improve the transportation options for drivers currently contributing to congestion.

Support Investment – Principle A: **"The entity that collects and manages revenues from a decongestion charge must ensure effective and transparent use of revenues."**
- 13% of public comments referred to this principle
- Strong distrust of TransLink and a demand for transparency
- Needs to include a reference to public accountability in the wording of the principle
- A neutral entity should manage the charging and revenue raised.

Support Investment – Principle B: **"Raising revenues should not be the primary purpose**

of a decongestion charge."

- Perception these two items are in conflict
- Research has proven decongestion charging is not an efficient way to raise revenues.

Discussion ensued on:

- Public sentiment regarding raising revenue
- Greater willingness to pay in congested hotspots if the charge provides an immediate benefit to the payee, otherwise the charge is considered a tax grab
- Agreement from public input that the fuel tax must be reduced if decongestion charging is implemented
- The fact that revenues are important, although not the primary goal, is not depicted in the Support Investment Principle B statement.

Other Considerations – Principle A: **"A decongestion charge must deliver positive total economic benefits for the region. It is possible and there are meaningful differences between scenarios."**

Other Considerations – Principle B: **"The design of a decongestion charge should support provincial and regional environmental objectives as well as consider implications for health and road safety."**

- Expectation that this would provide a significant reduction in vehicle kilometres travelled
- Public opinion favored a holistic planning process based on land-use planning.

Other Considerations – Principle C: **"A decongestion charge needs to be stable and predictable but can and should evolve over time to more effectively address congestion."**

- Any system implemented must be user friendly
- Decongestion charging has the flexibility to achieve better results over changing conditions and the technology is evolving.

Other Considerations – Principle D: **"A decongestion charge must recognize and respect an individual's interest and rights to privacy and use of personal information."**

Other Considerations – Principle E: **"There will need to be future communication and engagement around decongestion charging, with dedicated resources and programming for inclusive outreach to Metro Vancouver's diverse residents."**

- 70% selected the option to stay informed
- The UAP reported a significant change in opinion as they moved from an initial negative viewpoint to a more positive position as they understood the complexity of decongestion issues
- A high level of engagement and education is necessary to gain stakeholder support.

Discussion ensued on all of the principles presented:

- Future engagement needs to be more effective at connecting with ethnic communities
- Communication guidance is required to enhance engagement with various communities
- Once actual prices are introduced, the level of engagement will increase dramatically
- Mobility pricing and decongestion charging are not familiar terms:
  - In the future, there must be increased public education before the engagement process to improve public awareness of the project
- Agreement that the proposed principles are suitable for at this stage of the project
- Agreement that the proposed principles capture the themes heard during the engagement process.

Recess

The meeting recessed at 10:57 a.m. and reconvened at 11:18 a.m.

4. Returning Excess Revenues

Document titled "Using Decongestion Charging Revenues to Offset Equity Impacts", was distributed with the agenda package.

Daniel Firth, MPIC, profiled the use of decongestion charging to raise revenue beyond what is required to implement the 10-Year Vision for Metro Vancouver Transit and Transportation (10-Year Vision) and highlighted priority items for further study, based on feedback from the UAP:

- Further reduction to fuel tax or other taxes going to transportation to address equity issues
- Direct tax credit to lower income households:
  - Need for further study regarding thresholds and how individuals on either side of the threshold would be impacted
  - Some people on low incomes are driving a lot and further research is required to understand those conditions
- Reduction in transit fares
- These points would be considered within the context of the fairness principle as a means to address equity
- Agreement that the three principles would be taken forward for inclusion in the report.

Discussion ensued on:

- General support for the three principles
- Importance of well configured boundaries that encourage behavioral change
- Caps and discounts warrant more research

- Agreement that the public has sent the message that revenues will be invested in transportation however there is an appetite for dealing with fairness issues
- Prioritize transit investments and consider equity when choosing between big projects:
  - Income levels are not generally considered when prioritizing capital transportation projects
- Increased transit service has been identified as an important factor in making decongestion charging acceptable
- General need for wide research on mitigating impacts of decongestion charging issues.

5. Closing the Loop on Some Research Questions

Fearghal King, MPIC, introduced the analysis undertaken to address some of the questions raised in previous meetings and to illustrate what the analysis reveals. Responses provided to three research questions were highlighted:

- **"What happens if we charge on False Creek Bridges?":**
  - Research was undertaken in response to public sentiment of "If you are putting a charge on one bridge you should charge on all"
    - Selected a 50% Marginal Cost (MC) during peak times which is in the range of $2 to $5
  - Modelling results show a MC close to $0 for False Creek Bridges which implies there is little or no congestion during peak time, therefore the lowest charge was selected for use
  - The model shows a charge would result in a reduction of 17% in congestion
  - Unintended consequences:
    - Adding charges to False Creek Bridges contributes more to congestion
    - Traffic volume changes and travel times change
    - Conclusion that there is no congestion in the first place and that by applying a charge, it would create a diversion in traffic to the boundary corridor
  - The statement is about fairness and wanting people in the City of Vancouver to pay in addition to residents from the suburbs
  - The possibility of having Vancouver registered cars pay a targeted small levy for operating within a cordon area.
- **"What happens if we lower transit fares?":**
  - A reduction in transit fares with a charge on bridges would reduce congestion by an additional 6% however it will come at a high cost
  - More research is required to understand this type of policy
  - Lowering transit fares would increase public accessibility
- **"What happens if we increase transit supply?":**
  - With a 25% increase in transit supply beyond what is identified in the 10-Year Vision, there would be a 5% reduction in congestion
  - May restrict road space thereby contributing to congestion

    - Full-cost benefit analysis must be considered
    - Transit alone will not reduce congestion
    - Should be included in the report to show preliminary consideration was given to these ideas
    - The information released by TransLink that transit usage was up 4% and Vancouver is leading the way in transit ridership must be given further consideration.

Recess

The meeting recessed at 12:05 p.m. and reconvened at 1:00 p.m.

6. Illustrative Scenarios

Related information distributed at the meeting:

- *Document titled "Round 4 Scenario Charge Rates"*
- *Document titled "A Consequence Table"*
- *Document titled "Direct Ranking Questionnaire"*

Lee Failing, Compass Research Management, introduced four scenarios for consideration for inclusion in the final report. A recap was provided on how data from previous exercises was used to create the scenarios. Feedback from the MPIC was used to reduce the number of scenarios for consideration under the identified principles. The parameters considered for a minimal level of meaningful reduction in congestion included:

- Targets:
    - Achieve 20% region-wide savings
    - Achieve 25% of congested households realizing more than 10 minutes per day of savings
    - Net economic benefits would include the cost of congestion in terms of the relative costs for people if they do not drive
- There is a minimal level for the range from which to achieve targets:
    - The upper level could not be attained due to the value judgements of experts
- Criteria used to eliminate scenarios that did not meet the targets
- The four scenarios selected:
    - Point Charge (PC) Regional (Min)
    - PC Regional (Min+)
    - Distance-Based Charges (DBC) Multi-zone (Min)
    - DBC Multi-zone (Min+).

Discussion ensued on:

- The cost of collecting fuel taxes in comparison to collecting charging revenues
- The ability to increase the charge over time without increasing implementation costs
- The average number of vehicles per household in the region.

Ms. Failing highlighted the data depicted on the Consequence Table:

- As you move from PC Min to PC Min+ there is a 50% increase in cost
- The cost of a PC system is more expensive than a DBC
- Under DBC more people pay less, but under PC fewer people are paying more
- Greater flexibility to design a DBC system to align with other factors under consideration
- Differences in charge levels across Income Groups (% of annual income) shows both charging systems are regressive
- DBC works better for boundary effects
- DBC is more flexible for design flexibility
- PC is better for driver interaction
- Privacy perception of the PC is advantageous.

Sally Rudd, Compass Resource Management, provided the instructions for the completion of the Direct Ranking Questionnaire.

The following comments were offered during the ensuing discussion:

- **PC (Min) rated highly**:
    - Easy to be implemented and the technology is available
    - Does not achieve everything but it raises the funds
    - Not the most economic benefits but some
    - You can do it, people could understand it
    - The public thought it was easier and people were less supportive of distance-based tracking technology
    - Not as flexible but it feels simple and clean
    - Opportunity for politicians to sell this and take away fuel tax while still raising revenue
    - Middle of the road option
- **PC (Min) rated lower**:
    - Price signal was high for PC
    - Public appetite for trading off fuel tax for decongestion charging
    - If not doing the DBC, then you might as well do the bare minimum of PC
    - PC+ for trying to change people's behaviour because it would generate the most changes in people's behaviour
    - Trend of PC (Min) being favoured over the PC Min+
    - Costs are high for the PC Min+:
        - The average cost of $9/household is too high
    - The 44% time savings was significant, but also reduce the fuel tax
    - The PC for a shorter-term implementation
    - Seems like what was taken off with the tolls.
- **Advice for policy makers if the PC type system is advanced**:
    - Caps would have to be mandatory
    - Vehicle levy for people living in the Burrard Peninsula

- Geographical fairness and adjustments for boundary effects
- PC schemes charge the people with the worst access to transit
- PC would require a massive investment in transit in the outlying areas
- Concerns regarding building on First Nations' territory
- PC are simply too high for Surrey households

- **DBC (Min and Min+) considered highly:**
  - Min+ preference then you can consider fare reductions and adjust better for boundary effects
  - Pay as you go is easy to understand
  - Can show benefits to transit users and to drivers
  - The idea that one choice is less hated versus one choice being preferred
  - Seems like an affordable starting point
  - DBC system provides flexibility and a better balance between user-pay and use-cost
  - The Min+ is not doable but the DBC Min is a good starting point
  - Affordability will make or break the success of the option
  - DBC Min has the highest revenue efficiency
  - Consideration of the bottom line as it relates to the driver's trip experience
  - DBC (Min) is a concern because the technology is not readily available
  - Sticker shock is less if you remove the fuel tax making it more accessible
  - DBC Min+ has much greater benefits and the positives outweigh the costs
  - DBC preferred over PC because it is fairer and more flexible
- **Advice for policy makers if the DBC type system is advanced:**
  - Unanticipated adverse effects
  - Impact on different modalities
  - Higher revenues demand discounts and modifications
  - The average household in the outlying areas of the region will be $6/day
    - Must be a cap to mitigate the expenses
  - Caps should still be considered from a fairness perspective
  - Net economic benefits should be the main focus on the integration of transportation with economic development
  - In the longer term, the cost of technology will decrease and other jurisdictions will have implemented it
  - Define a system that optimizes net economic benefits
  - DBC Zones should try to match transit zones
- DBC could be implemented in three to four years, but there is added risk because the technology is new
- The implementation timeframe should be highlighted in the report.

Recess
The meeting recessed at 3:03 p.m. and reconvened at 3:21 p.m.

7. General Feedback on the Draft Report

Mr. Firth invited feedback on the draft report:

- Is anything missing?
- Is there something in the report that is a massive red flag?
- Is there an area where the text should be clarified?

Comments received in response to these questions included:

- Reference should be made to other cities and the experiences they have encountered
- Create a readable document by using simple language and minimizing jargon
- Technical information should be kept in the appendices
- The report should offer a strong policy-driven proposal that is not watered down
- The text boxes, in the draft version, slowed down reading and the information within the boxes seemed repetitive
- Ensure the content reflects the debate undertaken during the project
- It may be suitable to have a longer executive summary than normal
- Need for succinctness
- Remove the description relating to the cities and closeness:
    - Identify the problem and get to the solutions
- Agreement on maintaining a positive position
- Diagrams are too small
- Emphasize the "win-win" for the public
- Acknowledgement that the MPIC and staff have done a thorough job to develop the principles
- Create a solid policy document
- MPIC only addressed what they were directed to address
- The conclusion is mobility pricing, if done right, is a good idea
- All MPIC members must sign off on the document
- Being direct removes the potential for misinterpretation
- Address all variables so the audience understands all aspects have been carefully considered
- The principles should stand the test of time
- The principles should be near the front of the document
- Emphasize that this being the first and most comprehensive mobility study in Canada to date
- The opening statement should highlight the mandate given to MPIC.

8. Lessons Learned

Vincent Gonsalves, MPIC, invited members to participate in an online survey, the results of which were viewed immediately.

MPIC members were divided into two groups and asked to consider what was done well and what areas require improvement, as it relates to each of the following topics:
Topic #1 – Staff Secretariat (what was done well and what are areas for improvement)
Topic #2 – Public and Stakeholder Engagement
Topic #3 – MPIC.

The transcribed comments are included in Appendix 1.

9. Synthesis and Any Other Business

The next meeting was scheduled for May 7, 2018, 9:00 a.m. to 11:00 a.m., will be the final opportunity to review the report before submission.

10. Conclusion

The April 16, 2018 Meeting of the Mobility Pricing Independent Commission concluded at 4:44 p.m.

Certified Correct:

Allan Seckel, Chair	Roberta Pak, Recording Secretary Raincoast Ventures Ltd.

APPENDIX 1 – TRANSCRIBED NOTES FROM FLIPCHARTS USED IN AGENDA ITEM 8

Topic #1 – Staff Secretariat

- What was done well?
  - Provided space for commission perspective
  - Were open to adjusting process based on commission feedback
  - Provided good research and were responsive to questions
  - Listened and provided information or clarification
  - Provided in-depth information
  - Presented information logically
  - Provided good summaries of research
  - Gave us both the research and summaries of it
  - Ensured commission members owned the process
  - Engaged all members to participate and respected all opinions
  - Full and open communications with Commissioners
  - Delivered on Commissioners requests or explained why it couldn't be done
  - Circulated well researched and written papers as pre-reads, available to answer questions, good session presentation by consultants, structured decision-making process was helpful to sort the mass of info into bite size chunks
  - Organized materials and structured discussions well
  - Provided background info (research) that was valuable to understanding the problem and potential solutions
  - Great in-person presentations; clear and well-prepared
- What areas require improvement?
  - More lead time with materials
  - Establish schedule of meetings sooner and send out materials with more lead time
  - Send out materials sooner
  - Doodle Polls from the start for availability
  - A bit more staff comment and analysis would have been fine
  - Clarified the purpose of the information provided
  - Planned meetings with more notice
  - Periodic (weekly?) high-level email updates
  - More background materials on communications and outreach
  - More feedback on public engagement
  - Could have shortened presentations to allow for a bit more discussion time and questions
  - Created more time for Commissioners
  - Would have been better to have more time to unpack some of the research implications
  - Data is from 2011 so is older than optimum – so how reliable is this model? I would have liked to know
  - More public engagement sessions as fewer attendees than optimum

Topic #2 – Public and Stakeholder Engagement

- What was done well?
  - Lots of opportunities using a variety of mechanisms to engage
  - Online process was very good
  - Social media and monitoring comments
  - Social media was well engaged
  - Darcy Vermeulen from Context Research was a great workshop facilitator
  - Online outreach very effective
  - Excellent online communication and engagement tools
  - Robust response given the time frame
  - Great online marketing campaign
  - Online platform was good
  - Consistent effort to meet in-person with elected officials
  - Media outreach was good
  - Attempted to engage with very diverse user groups and demographic groups
  - Questions and responses were well coordinated. Most if not all participants felt engaged
  - Multiple platforms used (surveys, meetings, social media)
- What areas require improvement?
  - More in language meetings
  - More in person meetings to hear unstructured feedback
  - In person and ethnic was poor overall
  - Timing was an issue
  - Ethnic outreach
  - Faith/community groups
  - More radio (traffic, ethnic)
  - Longer timeframe for engagement needed but process timeline restricted this
  - More face to face
  - Longer period for outreach
  - Possibly more follow-up with attendance especially with stakeholders (ie. Civic participation)
  - Social media and stakeholder outreach was effective (although some responses on Facebook weren't that great)
  - More advertising to create higher profile for initiative
  - More effort mid-stream to target under-represented groups after phase one
  - Some evening sessions to increase attendance
  - More face to face sessions with public especially in the multicultural communities
  - Hold stakeholder meetings outside work hours to engage more attendees
  - More multi-cultural outreach
  - 40-% of region is of Asian origin but low participation
  - Improve by going to temples and other gathering places with help of influencers

Topic #3 – MPIC

- What was done well?
  - More knowledge on a pressing social and economic issue

- Regional representation
- The opportunity to match anecdotal experience to research
- Seeing how much in common those with diverse viewpoints have on this topic
- Learning more
- Understanding more about regional complexity
- Hearing other perspectives
- Meeting diverse group of people with viewpoints
- Working toward consensus
- Meeting new people
- Open and respectful dialogue we had
- The open exchange with staff
- Working with a very diverse group with different perspectives led to lots of learning
- Opportunity to contribute to an important issue
- The diversity and strength of the Commissioners
- The support provided by the Secretariat
- Set up as an independent commission
- Gaining a greater sense of my community (Metro Vancouver)
- Helping to solve a problem that affects so many
- Opportunity to make a contribution to our future
- Being part of a possible solution to a problem, I have experienced for over 33 years
- Opportunity to shape an important public policy initiative that impacts all of the region
- I believe the Commissioners were from a diverse group expressing many different viewpoints, from all area in the Lower Mainland

- What areas require improvement?
    - Time frame
    - More time to bring Commissioners together especially for a Commission as large as this one
    - More time
    - Understanding time commitments
    - Similar broad background, structure
    - Longer timeframe
    - Consider the necessary phases of background work
    - Timeline should be considered
    - Smaller but more frequent project updates between meetings
    - Have more reasonable timeline for such a complex topic
    - Establish a mandate that all decision-makers can own
    - I think we'd have had higher consistent commission members participation with attention paid to setting up the schedule early. Not helpful to have a well-selected group where people can't participate so don't get all viewpoints consistently
    - More frequent updates or meetings, more advance time to read material
    - More time for preparing
    - Use model of Executive Director, Chair and Vice-Chair working together

mobility pricing Independent Commission

Metro Vancouver Mobility Pricing Independent Commission
Minutes – Meeting 8
May 7, 2018

Minutes of the Metro Vancouver Mobility Pricing Independent Commission (MPIC) Meeting held Monday, May 7, 2018 at 9:07 a.m. in the Doctors of BC Health Boardroom, 1665 West Broadway, Vancouver, British Columbia.

PRESENT:
Allan Seckel, Chair
Joy MacPhail, Vice-Chair
Jennifer Clarke
Harj Dhaliwal
Paul Landry
Graham McCargar
Lori MacDonald
Gavin McGarrigle
Michael McKnight
Elizabeth Model
Bruce Rozenhart
Philip (Pip) Steele
Grace Wong

REGRETS:
Iain Black

ALSO PRESENT:
Daniel Firth, Mobility Pricing Independent Commission Staff Secretariat
Vincent Gonsalves, Mobility Pricing Independent Commission Staff Secretariat
Fearghal King, Mobility Pricing Independent Commission Staff Secretariat
Lindsay Neufeld, Mobility Pricing Independent Commission Staff Secretariat

PREPARATION OF MINUTES:
Vincent Gonsalves

1. Chair's Welcome
Allan Seckel, Chair, called the meeting to order and welcomed all members of the commission.

2. Chair Update
Allan provided an update on the project and requested endorsement of the final report

from all members of the Commission. All members approved and endorsed the final report. Iain Black was not in attendance but had previously shared his endorsement of the report directly with Allan Seckel.

3. Next Steps

Daniel Firth presented the first timeline slide shared with the Commission at the start of the project. Key deliverables in the timeline which the Commission initially set out to achieve have now been completed. Allan agreed and stated that the Commission had in fact done more than was planned at the start of the project.

A timeline of the next few weeks was shared with the following key dates:

- May 7 – Commission endorse report
- Week of May 7 – Report sent to TransLink
- May 11 – Report reviewed by steering committee
- May 24 – Report shared at Mayor’s Council public meeting

Allan thanked all members of the Commission and staff secretariat for their participation in the project.

4. Conclusion

The May 7, 2018 Meeting of the Mobility Pricing Independent Commission concluded at approximately 9:40 a.m.

Certified Correct:

Allan Seckel, Chair	Vincent Gonsalves

APPENDIX B

Research and Evaluation

APPENDIX B. RESEARCH AND EVALUATION

CONTENTS

GLOSSARY

Term	Definition
Benefiter pay principle	A concept in which users are charged in proportion to how much they benefit (e.g. the time savings and reliability improvements they experience).
Congestion point charging (CPC) / Point charge (PC)	A decongestion charging approach in which vehicles are charged for travelling past a given point or system of points on the road network. In this report the terms "point charge" and "point charging" are used as a short form of "congestion point charge" and "congestion point charging".
Decongestion charging	A form of mobility pricing used to combat road traffic congestion.
Decongestion charging approaches	Ways in which decongestion charging could be applied. Distance-based charging and congestion point charging are examples of approaches.
Distance-based charging (DBC)	A decongestion charging approach in which vehicles are charged by distance travelled on all or parts of the road network.
Externality costs of congestion	The societal costs of congestion which include: travel time delays to other travellers, lower economic productivity, and associated additional air pollutant and greenhouse gas emissions.
Fuel tax	A fee added to the purchase of motor vehicle fuel. In Metro Vancouver, drivers pay a $0.17 fuel tax per litre to support the regional transportation system, which works out to about $0.018/km on average across vehicles in Metro Vancouver.
GNSS	Global Navigation Satellite System, the generic term for satellite-supported geo-spatial positioning systems, including GPS, GLONASS, Galileo, Beidou and other regional systems.
Greenhouse gases (GHG)	Greenhouse gases include carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. Human activity, particularly through the burning of fossil fuels, have contributed to increasing the amount of greenhouse gases in our atmosphere. As a result, the Earth's surface temperature is rising.
Mobility pricing	A range of fees that are or could be applied for the use of transportation services. Examples of fees include car insurance, bike sharing fees, parking fees, fuel taxes, and transit fares.
Marginal social cost (MSC)	According to economic theory, vehicles should be charged to use the roads at a rate equal to the costs that driving imposes on society – a concept called *marginal social cost pricing*. While implementing this pricing scheme would be highly complex, it is used as a reference benchmark.

Objectives	Goals defined in the Commission's Terms of Reference. The three objectives are: reduce congestion, promote fairness, and support transportation investment. These objectives guided research and engagement activities and the development of the Commission's recommendations.
Policy tools	Used to achieve policy objectives such as reducing congestion and raising revenue. In this case, decongestion charging approaches are forms of policy tools.
TOD	Time of day. Decongestion charging may vary by time of day to focus on peak traffic hours.
User cost principle	A concept in which users are charged in proportion to how much they contribute to congestion in busy locations during busy times of the day (addresses externality costs).
User pay principle	A concept in which users pay in proportion to how much they use the road network. In this report, road use is measured in terms of kilometres travelled.
VKT	Vehicle Kilometres Travelled.

PART 1

Introduction

PART 1. INTRODUCTION

Background

The Terms of Reference of the Mobility Pricing Independent Commission ('the Commission') require it to evaluate the viability and acceptability of potential regional road usage charging alternatives for motor vehicles in Metro Vancouver. Based on this evaluation, the Commission is to make recommendations on how the region should proceed with developing and implementing a more coordinated regional road usage charging policy and system that supports three regional objectives for mobility pricing: managing congestion, promoting fairness and supporting investment in the transportation system.

The Commission's final report was delivered to the Metro Vancouver Mayors' Council on Regional Transportation and TransLink Board of Directors in May 2018. This appendix to that report describes the Commission's evaluation of the viability of road usage charging – referred to as "decongestion charging" – and the analysis that supported that evaluation. Select data is used here to illustrate findings, but this does not represent all data considered in the process. More detailed information about modelling and evaluation methods and assumptions are provided in appendices B-1 - B-4.

The Commission's final report does not recommend or define a specific proposed system of decongestion charging. The focus of the evaluation work was instead on promoting learning around the parameters and trade-offs inherent in designing a decongestion charge for Metro Vancouver. This was used to formulate a series of principles the Commission recommends be used in formulating a mobility pricing policy.

The Commission's work can be considered the first phase of a feasibility study. More work will be needed to develop the Commission's recommendations into something that can be implemented. That is estimated to take around six to twelve months.

Overview of the Research and Evaluation Process

The research and evaluation process was carried out in two phases.

Phase 1 research and evaluation activities

The purpose of first phase, carried out in the second half of 2017, was to understand the issues, narrow the focus to a smaller number of decongestion charging approaches, and develop an evaluation framework.

Understanding the issues

Research was carried out using available data from multiple sources, in particular the 2011 Regional Trip Diary, 2016 Census, and existing regional policy documents. The purpose was to understand the main issues surrounding the Commission's three objectives:

- **Congestion**: the current and projected regional congestion problem, along with measures already planned to address it, were analyzed. Eight congestion "hot-spots" were identified.
- **Fairness**: available evidence on various definitions of fairness as it relates to decongestion charging was assessed, along with a study of available literature.
- **Revenues**: in particular, the stability of the fuel tax as a revenue source was evaluated.

A report on the findings – *Moving around Metro Vancouver: Exploring New Approaches to Reducing Congestion* – was published in October 2017.

This initial research was validated through a public and stakeholder engagement (phase 1 report).

Narrowing down the road usage charging policy instruments

A policy instrument is defined here as a broad approach, such as a cordon charge or vehicle levy, that can be used to achieve policy objectives, such as reducing congestion or raising revenue. Since there are many candidate instruments, a coarse-level evaluation was conducted to better understand the strengths and weaknesses of different instruments for use in this region. The coarse-level evaluation characterized, using literature review, experience in other jurisdictions, and expert judgment, the potential of a broad range of policy instruments to address the Commission's core objectives of managing congestion, promoting fairness, and supporting investment in transportation. It also described some key implementation considerations.

Based on the evaluation results, a subset of instruments was recommended for further consideration through more detailed scenario analysis. This resulted in a decision by the Commission to take forward two approaches for further study: congestion point charges and distance-based charges.

A full report of the coarse level evaluation is found in Appendix C of the Commission's phase 1 report.

Learning from other jurisdictions

A number of jurisdictions have implemented or studied a form of decongestion charging. There is a great deal of information available in literature describing each system, its attributes, and its achievements in terms of managing congestion and raising revenues. This project focused on bringing together the lessons learnt, with a particular focus on understanding the implications for fairness and the development of public support and acceptance.

The *Decongestion charging policy and global lessons learned* report can be found in Appendix B of the Commission's Phase 1 report.

Preparing for Phase 2 evaluation

Work was also carried out in phase 1 to prepare for a more detailed evaluation of decongestion charging scenarios for Metro Vancouver in phase 2. This included ensuring the Regional Transportation Model (RTM) was able to be used to analyze a large number of scenarios in a short period of time, securing other data sources, and confirming metrics.

Drawing on the Commission's Terms of Reference, as well as input from phase 1 public engagement, a set of fundamental values that matter in forming preferences across alternatives was identified. These were developed into evaluation criteria.

Phase 2 research and evaluation activities

In phase 2, carried out in the first quarter of 2018, the Commission was taken through the evaluation process in order to understand the parameters and trade-offs inherent in designing a decongestion charge for Metro Vancouver. This was used to develop a series of principles to inform the development of a mobility pricing policy.

Iterations to refine and develop scenarios

Phase 2 of the research and evaluation process consisted of a series of iterations and evaluations. Scenarios were developed by the project team and run through the RTM to produce results. The results were analyzed and presented to the Commission to highlight information about how important parameters affect outcomes. The Commission discussed trade-offs and provided direction to the project team to inform the development of new scenarios. In total, four iterations, or rounds, were carried out.

The Commission's discussions and recommendations were further informed by results from the phase 2 engagement, described in Appendix C.

This scenario development and evaluation process is described in detail in the rest of this appendix.

Notes on this Report

Interpreting Results

Because the scenarios discussed in this appendix are not yet optimized, caution needs to be taken to avoid drawing premature conclusions. For example, it would be premature to form preferences between a 2-zone or an 8-zone distance-based charging system based on these results because their relative advantages/disadvantages may change with refinement of the zones and charge rates.

The analysis presented in this appendix holds only for the specific scenarios modelled and analyzed (locations and charge rates). Results and conclusions thus cannot be generalized to all systems that are structured similarly at different rates, or have similar rates but a very different structure.

All numbers presented are best estimates based on the modelling and analysis done to date.

Work needs to be carried out to understand the desire for, and impact of, caps on the level of charges an individual or household pays (e.g. daily, monthly), as well as discounts and exemptions for certain types of users and/or types of vehicles.

Use of the word “scenario” and how it relates to “concept” and “example”

In this appendix, the word “scenario” is used to describe a particular application of decongestion charging that has been modelled in the RTM. In a scenario, the location of charge points, or distance-based charging zones has been defined within the model, along with charge levels by location, time of day, and in some cases by direction.

In Part 4 of the Commission’s final report, the term “illustrative concept” is used. This is to communicate that much more work will be needed to define the locations of charge points/ zones, charge levels, caps, discounts, and exemptions before any decision on implementation can be made.

In the phase 2 engagement, described in Appendix C, the word “example” is used. The seven examples, which include *indications* of charge point locations and zones, but without any information on costs, were developed to support discussions with the public and stakeholders in order to understand issues and preferences. Many of the examples were also used as starting points for the scenario iterations.

To summarize:

- **Examples** were used in engagement to help gather information to inform the principles. They formed the starting point for the development of **scenarios**.
- **Scenarios** were developed through an iterative process to demonstrate important parameters and trade-offs, the discussion of which also informed the development of principles. Two scenarios with two different charge rates are included in the Commission’s final report as illustrative **concepts**.
- **Concepts** illustrate how the principles could be achieved in a decongestion charging system, and are used to describe the costs, benefits, and other impacts.

Regional Transportation Model (RTM)

Scenarios were modelled using the Regional Transportation Model (RTM), which simulates travel behaviour and traffic flow patterns for Metro Vancouver. The model produces numerous outputs related to travel time, congestion, mode share, VKT, and user costs. Where model outputs are not available or sufficient for assessing an evaluation criterion, a combination of post-model analysis, research from other jurisdictions, and expert judgement was used to characterize expected performance.

The RTM simulates travel demand patterns across the region according to several factors that are known to influence travel choices (such as the geographical distribution of housing, work, education, services, shopping, leisure, etc.), as well as travel time and cost with different available travel modes). The RTM is not able to simulate all possible adaptations that people could make to a decongestion charge, for example changing time of travel is not simulated. **This means that the RTM's prediction for the amount of change induced by a decongestion charging system is a conservative estimate and the estimates for time savings, mode shift, and vehicle distances travelled are best used to compare scenarios to one another.**

All scenarios are modelled for 2030.

For more details on the RTM methods see Appendix B-2.

PART 2

Scenario Development and Evaluation

PART 2. SCENARIO DEVELOPMENT AND EVALUATION

Overview

The framework for evaluating decongestion charging scenarios involved defining evaluation criteria and metrics, developing a range of scenarios, modelling and estimating their consequences, and evaluating trade-offs.

Scenarios are specific and illustrative applications of decongestion charging to Metro Vancouver based on the two approaches that came out of the coarse evaluation: congestion point charges and distance-based charges. Each scenario is defined by three things:

1. A charging approach (point charges or distance-based charges),

2. The locations and times at which the charges are applied, and

3. The charge rates

The scenarios were evaluated against the evaluation criteria, with the goal of clarifying strengths and weaknesses, identifying trade-offs and uncertainties, and identifying outstanding issues and questions. Ultimately, the scenario analysis served as a means to inform Commission learning, deliberations, and recommendations.

Scenarios were developed and evaluated through four rounds of iterative analysis. Many of these scenarios have been guided by ideas and suggestions that emerged from the research and engagement findings, as well as Commission discussions throughout the course of the project. The process and results are briefly summarized below, with more detail provided for each of the rounds in later sections of this report. The scenarios are described in detail in Appendix B-1.

In Rounds 1 and 2, illustrative scenarios were designed to gain a preliminary understanding of how various charging levers (location, rate, time of day, direction) influence the objectives (reduce congestion, promote fairness, and support investment). The focus was on shared learning, and the intent was to test the effect of different levers, refine modelling methods, and test whether the draft evaluation criteria and metrics were providing useful information to the Commission. A scenario with charge rates equal to the *Marginal Social Cost* (MSC) was also modelled to understand the charge rates that are recommended by economic theory which capture the full costs of congestion and achieve the optimum outcome for society. This created a useful benchmark for designing charge rates that are aligned with the level of congestion in other scenarios.

After review, the Commission provided the following feedback to guide the development of Round 3 scenarios:

- Scenarios should be guided by both user pay and user cost principles – i.e. everyone should pay something in proportion to use, and those trips that contribute to congestion should pay more;
- Those who pay should experience time savings (benefiter pay principle);
- Scenarios should be designed to achieve benefits on a regional scale;
- Scenarios could be reasonably complex, if warranted by the benefits;
- Scenarios should generate sufficient revenue and should collect revenue efficiently;

- Scenarios should seek some alignment with availability of transportation options;
- Scenarios should explore a range of charge rates to understand the balance between congestion benefits and other impacts including household out-of-pocket costs.

Based on this direction, the Central Business District (CBD) cordon and other localized cordons were eliminated from consideration as stand-alone approaches as they would not address congestion at the regional scale. This direction also led to developing or refining metrics used to report on the objectives, with emphasis on alignment with various pricing principles and impacts on household out-of-pocket costs. Commission direction to align charges with time savings put an emphasis on scenarios that vary charges by time of day and location in accordance with congestion levels.

Round 3 focused on a set of point charging and distance-based charging (DBC) scenarios with a base charge rate at all times of day and higher charge rates in the peak periods. The peak period charge rates varied by location according to local congestion levels. Two point charge systems and two multi-zone DBC systems were modelled, each with five different rates set as a proportion of MSC rates (25%, 37.5%, 50%, 75%, and 100% of MSC rates). Setting rates in proportion to MSC rates supports alignment between what vehicles are charged and their contribution to congestion – i.e. vehicle trips that contribute more to congestion will generally be charged more.

After reviewing the key findings and trade-offs from Round 3, the Commission provided the following direction to guide the development of Round 4 analysis:

- Scenarios should produce meaningful/visible congestion benefits;
- Scenarios should produce revenue efficiently and generate net economic benefits; and,
- For a given level of congestion reduction, out-of-pocket costs to road users should be minimized.

The project team was directed to:

- Characterize what a “meaningful” reduction of congestion could be, recognizing that the definition of what is meaningful/visible involves some combination of expert knowledge and value-based judgment; and,
- Narrow down the range of scenarios based on the Commission’s input, leading to a subset of scenarios that produce a meaningful reduction in congestion.

In Round 4, analysis focused on two refined concepts for decongestion charging: one point charge concept with charges on 12 major bridges and on the Burrard Peninsula, and one distance-based concept with multiple zones. Charges vary by time of day and location for both of these concepts, as well as by direction of travel for the point charge concept. Each concept was modelled using two charge levels, one designed to produce a minimum level of congestion reduction judged to be meaningful *(Min)*, and a second designed to produce a higher level of congestion reduction *(Min+)*.

The threshold for the minimum level of meaningful congestion reduction was defined by three metrics:

- Total Regional Congested Time (>20% reduction from Baseline 2030 scenario)
- Visible Congested Time Savings (>25% of households experiencing high levels of congestion achieve visible time savings)
- Net economic benefits (positive and robust to uncertainty)

The Commission reviewed the evaluation results of the Round 4 scenarios and discussed various opportunities, challenges and considerations for moving forward with any of the Round 4 scenarios. This discussion informed the development of the illustrative concepts presented in Part 4 of the Commission's final report.

Evaluation Criteria

The evaluation criteria represent the fundamental interests or values that are important when considering and making decisions about decongestion charging. They include the Commission's three core objectives as well as other criteria that emerged through engagement and analysis (Table 1).

The criteria only include things that help to evaluate and form preferences among scenarios. For example, they do not include issues like transparency and accountability which, while important, do not vary across scenarios; these issues are addressed by the Commission in the recommended principles for a mobility pricing policy (see Part 3 of Commission's final report). Where applicable, measurable metrics were modelled or calculated and used to compare scenarios. For criteria without measurable metrics, qualitative evaluations were considered.

Table 1: Evaluation Criteria

Evaluation Criteria related to MPIC Terms of Reference Objectives
Congestion • Time savings for people and goods • Travel time reliability for people and goods
Fairness • Consistency in the application of charges • Availability of transportation choices • Household charges (including magnitude and distribution of charges) • Income equity
Investment / Revenue • Net revenue • System costs and revenue collection efficiency
Other Evaluation Criteria
Economic Benefits • Consumer surplus • Societal benefits
Environment and Health • Regional contribution to climate change from vehicle greenhouse gas (GHG) emissions • Health benefits associated with reduced vehicle kilometres travelled (VKT) (e.g. local air quality improvements, increased active transportation, fewer vehicle crashes)
Regional Growth Strategy and Regional Transportation Strategy • Contribution to supporting sustainable transportation choices • Contribution to supporting focused growth

Local Effects

- Neighbourhood traffic volumes
- Local economic effects

Privacy

- Potential risk for privacy infringement

Future-proofing

- Robustness to possible future changes in the transportation system

Implementation

- Public support
- User experience

The criteria and the interests they address are summarized below. The metrics were refined through each round of analysis to reflect the consequences and trade-offs of most interest to the Commission. They are summarized in the sections that follow. Each evaluation criterion was assessed to different degrees depending on the availability of data and robust analysis methods, as well as the time available and the relative importance of that criterion for answering questions within a particular round of analysis. Some criteria are more difficult to assess when there are many scenarios under consideration (e.g., local effects, privacy, and implementation). These criteria warrant a more comprehensive assessment when a narrower set of scenarios are identified and/or in the detailed system design phase.

Congestion

Time savings for people. This represents the interest of travellers in experiencing minimal travel time delays. Slower movement of people around the region also has impacts on economic efficiency and productivity. The evaluation explored the effect of charging scenarios on total travel time as well as time spent in congestion, at both a trip level decongestion as well as aggregated annually across the region.

Time savings for goods. There is also an interest in maximizing the efficiency of transporting goods to and through Metro Vancouver. Metro Vancouver is a gateway for importing and exporting goods, and the regional economy is strengthened by maintaining a competitive environment for efficient goods movement. In this process, travel time delays for goods were not reported separately from travel time for people. While it's expected that there will be a high degree of correlation, future work will need to look more closely at effects on the movement of goods.

Travel time reliability for people and goods. This represents the interest of travellers in having predictable travel times on their regular routes of travel. Research and engagement indicate that the acceptability of a delay depends in part on its predictability. Individuals tend to remember the worst delays and adjust their travel times accordingly, meaning they leave earlier to ensure they get to their destination on time. While it is difficult to predict changes in reliability precisely, methods were developed to provide an estimate of differences across scenarios.

Fairness

Fairness has multiple dimensions, and different people place different importance on these dimensions. As a result, it is not possible to objectively define what is fair. However, it is possible to identity and report on these dimensions. Evaluating whether a scenario is fair then involves balancing across multiple dimensions and transparently considering any important trade-offs. The following evaluation criteria represent different dimensions of fairness that have been identified as important and relevant to consider when evaluating decongestion charging scenarios.

Consistency in the application of charges. Any charging system that is designed to affect behaviour will result in differences in charges across users. A key element of fairness is that differences in charges should be explainable through the consistent application of transparent pricing principles. From the literature on decongestion pricing, as well as the Commission's Terms of Reference and input from public and stakeholder engagement, the project team defined three relevant pricing principles:

- **Alignment with *user pay* principle:** This represents a belief that people should pay in proportion to their use of the transportation system, so that the more you use it, the more you pay.
- **Alignment with *user cost* principle:** This represents a belief that people should pay in proportion to the costs they impose on other users of the transportation system. In the context of decongestion charging, the primary cost is the travel time delay imposed on users by one another. Thus this dimension of fairness suggests that those trips which (or that) contribute more to congestion and delays should cost more. Because decongestion charging can influence overall vehicle kilometres travelled (VKT), a decongestion charging policy could have co-benefits of reducing other externalities associated with vehicle use such as emissions that contribute to climate change and local air quality, noise, road maintenance, and road safety. These other externalities were not incorporated into the user cost principle for this analysis.
- **Alignment with *benefiter* pay principle:** This represents a belief that people should pay in proportion to the benefits they receive. The evaluation focused on one important dimension of this, namely the extent to which the people who pay a decongestion charge receive benefits in the form of time savings and/or more reliable journey times.

Availability of transportation choices. This represents a belief, strongly expressed throughout the public and stakeholder engagement, that if charges are applied to vehicles for the use of roads, alternatives to personal vehicle travel should exist (e.g. there are good options for transit, cycling, and walking) to enable people to adapt to the charge if they choose through changing mode. Traffic modelling as well as empirical evidence from other jurisdictions suggests that the number of people who actually switch to public transit as a result of decongestion charging is limited – other adaptation strategies are more common, and most people don't change their behaviour that much. Nonetheless, the availability of alternatives can affect perceptions of fairness, whether those alternatives are used or not.

Household charges. Affordability was a key interest raised in public and stakeholder engagement. It is a complex and individual calculation. To support an understanding of how decongestion charging could influence individual affordability, the evaluation estimated changes in typical household costs from different scenarios. Household costs were compared both spatially and for different income groups.

Income equity. A decongestion charging policy is likely to be regarded as unfair if it involves a redistribution of resources from the poor to the rich. Because driving is expensive, higher-income households tend to do more of it than lower-income households and so will likely pay more decongestion charges. However, like all fees and taxes that are not explicitly based on income or wealth they will cost lower-income households a larger proportion of their incomes than higher-income households, in the absence of complementary policies to guide the redistribution of revenues collected. The evaluation reported household charges for people of different income groups as a proportion of their annual income to explore whether some charging scenarios were more or less equitable than others. The evaluation also estimated the revenue redistribution necessary to improve the equity of a scenario.

Investment / Revenue

Net revenue. This represents an interest in a sustainable source of revenue. Of most interest is the net revenue – gross revenues less system costs – resulting from each decongestion charging scenario.

System costs and revenue collection efficiency. This represents a belief that raising revenue to support public services should be done in a financially efficient manner – i.e. a manner that minimizes the costs incurred to raise revenue, including all capital and operating costs of infrastructure, technology and administrative systems. The evaluation estimated both total system costs and total system costs as a proportion of gross revenues. It also identified important differences in the degree of certainty associated with these costs.

Economic Benefits

Consumer Surplus. This represents the private welfare gains and losses from a decongestion charging scenario, including travel time savings, inconvenience costs, and travel costs (including fuel, maintenance, and decongestion charges).

Societal Benefits. This represents the public or shared welfare gains and losses under each scenario, including greenhouse gas (GHG) emissions, road infrastructure and maintenance savings, revenue from the decongestion charge and fuel taxes, as well as system costs of the decongestion charge.

Environment and Health

Climate change. To the extent that decongestion charging influences total VKT and given the present fuel mix in the vehicle fleet, it will influence regional contribution to climate change from vehicle greenhouse gas (GHG) emissions. The evaluation assesses and reports these emissions. Note that light duty GHG emissions made up 36% of the region's total GHG emissions in 2015[1].

Health. This represents an interest in having a transportation system that supports positive outcomes for health. Increasing the proportion of trips taken by active transportation modes (transit, cycling, walking) is associated with improved air quality, increased physical activity, and reduced injuries from vehicle crashes. The evaluation assesses changes in VKT/capita, GHG emissions, and the proportion of trips taken by active transportation modes as proxies for health effects.

Regional Growth Strategy and Regional Transportation Strategy

Metro Vancouver's Regional Growth Strategy[2] and TransLink's Regional Transportation Strategy[3] have two key goals that will be influenced by any decongestion charging scenario: **(1)** to support sustainable transportation choices; and, **(2)** to support focused growth in Urban Centres and Frequent Transit Development Areas, and other appropriate areas along TransLink's Frequent Transit Network (RGS Strategy 5.1.7). The evaluation assesses the proportion of trips taken by sustainable modes (i.e. transit, cycling, walking, and high-occupancy vehicles) and changes in VKT/capita to report a scenario's contribution to supporting sustainable transportation choices. The alignment of decongestion charging with regional goals for focusing growth will need to be considered in more detail during the system design phase. *Key considerations are discussed in the Regional Growth Strategy/Regional Transportation Strategy Evaluation Brief, within Appendix B-3.*

1 Source: *2015 Lower Fraser Valley Air Emissions Inventory and Forecast* (March 2018) (available online: http://www.metrovancouver.org/services/air-quality/AirQualityPublications/2015LowerFraserValleyAirEmissionsInventory.pdf)
2 *Metro Vancouver 2040: Shaping Our Future* (2011) (available online: http://www.metrovancouver.org/services/regional-planning/PlanningPublications/RGSAdoptedbyGVRDBoard.pdf)
3 *Regional Transportation Strategy: Strategic Framework* (2013) (available online: https://www.translink.ca/-/media/Documents/plans_and_projects/regional_transportation_strategy/rts_strategic_framework_07_31_2013.pdf)

Local Effects

It is possible that a charging system designed to address congestion at a regional scale could have unintended consequences at a local level.

Neighbourhood traffic volumes. This represents an interest in minimizing adverse local community effects associated with diversion of traffic onto streets that are not designed to accommodate high traffic volumes. Adverse effects could include increased noise, vibration and local air pollution, and higher safety risks to pedestrians and cyclists. Neighbourhood traffic volumes can increase if charges cause drivers to change routes to streets not designed to accommodate high traffic volumes. Neighbourhood traffic volumes could also be affected positively by a decongestion charging scenario if it encourages less vehicle use. Scenarios were designed with an intention to minimize incentives to change routes to avoid charges; modelling results were then examined for any residual effects. Ultimately, this will need to be examined in more detail when a narrower set of scenarios are under consideration and/or during the system design phase. *Key considerations are discussed in the Local Effects Evaluation Brief, within Appendix B-3.*

Local economic effects. This represents an interest in minimizing adverse local effects on businesses arising from decongestion charging. Effects will likely differ depending on what type of systems are advanced for further analysis and thus will need to be examined in more detail when a narrower set of scenarios are under consideration and/or during the system design phase. *Key considerations are discussed in the Local Effects Evaluation Brief, within Appendix B-3.*

Privacy

Potential risk for privacy infringement. As any decongestion charging scenario contains some form of collecting data on road usage, privacy is an important implementation issue. The evaluation examined the issues behind privacy concerns, identified important differences in the potential for privacy infringement across scenarios, and explored the various means of implementing decongestion charging in a way that protects privacy. *Key considerations are discussed in the Privacy Evaluation Brief, within Appendix B-3.*

Future-proofing

Future-proofing is the process of anticipating future changes and seeking solutions that will be robust to these changes. In practice, this means making decisions that support the ability to adapt when and if these changes occur. Anticipated changes in Metro Vancouver's transportation system include the introduction of automated vehicles and the expansion of shared mobility services (e.g., car sharing, ride-hailing, bike sharing). Different decongestion charging scenarios may be more or less adaptable to these and other possible future changes in the transportation system. Important future-proofing considerations when designing a decongestion charging system for Metro Vancouver are discussed in the *Future-Proofing Evaluation Brief.*

Implementation Considerations

Public support. This recognises an interest in advancing policies that have broad public support. Research from other jurisdictions has shown that public support of decongestion charging policies is often low before implementation and can rise after implementation as people experience the benefits of reduced congestion. These issues are discussed, along with strategies for improving public support over time, in the *Public Support Evaluation Brief.*

User experience. This recognizes that some scenarios may involve greater effort or burden on the part of vehicle owners and operators. For example, a system that is difficult to understand (such as a complex rate schedule) or that requires active involvement of the user (such as a need for complex on-board units) could trigger implementation challenges.

PART 3

Round 1 Analysis

PART 3. ROUND 1 ANALYSIS

The Round 1 scenario analysis involved the *Baseline 2030* scenario, the *Marginal Social Cost (MSC)* scenario, and four simple decongestion charging scenarios to understand the influence of scale, charge rates, and system types (point charging vs. distance-based charging). A short description of each of these scenarios is provided in Table 2, with more detailed descriptions, including all charge rates, available in Appendix B-1.

The modelling and evaluation of these scenarios helped to provide insight on the following questions:

- What metrics and scales are needed to understand how decongestion charging scenarios will reduce congestion and travel times?
- How are congestion levels expected to change in the future in the absence of decongestion charging?
- What could be achieved if rates are set according to economic theory? – i.e. how much could congestion be reduced if rates were set according to MSC pricing theory?
- How do congestion outcomes change when decongestion charging scenarios vary by scale, charge rates, and system types?

The following sections answer these questions in turn using the Round 1 modelling results for illustration.

Table 2: Scenarios evaluated in Round 1 analysis

Scenario	Description*
Baseline 2030	This scenario includes baseline assumptions for what will happen in the region in 2030, assuming continued population and employment growth and including infrastructure changes, but in the absence of decongestion charging. It is a benchmark for comparing the performance of other scenarios.
Marginal Social Cost (MSC)	This scenario is determined by the economic theory of decongestion charging. The charge levels are applied on a per kilometre basis, and vary depending on the level of congestion, with high congestion associated with high charges.
CBD ($5/passing)	This scenario involves point charges around the Central Business District (CBD, downtown Vancouver). Key assumptions include: • All Baseline conditions (fuel tax, infrastructure changes, etc.) • $5/passing at all point charge locations; chosen because it was believed $5/passing would reduce congestion and is in line with charges in other jurisdictions • The charge rate does not vary by location, time of day, or direction of travel

Bridges ($5/passing)	This scenario involves point charges at twelve major bridges throughout the region: (1) Lions Gate, (2) Ironworkers/2nd Narrows, (3) Arthur Laing, (4) Knight, (5) Oak, (6) Queensborough, (7) George Massey (in the *2030 Baseline* the tunnel has been replaced by a 10-lane bridge), (8) Alex Fraser, (9) Pattullo (in the 2030 Baseline this bridge has been replaced by a new 4-lane bridge), (10), Port Mann, (11) Pitt River, (12) Golden Ears (Figure 1). Key assumptions include: • All Baseline conditions (fuel tax, infrastructure changes, etc.) • $5/passing at all point charge locations; chosen because it was believed $5/passing would reduce congestion and is in line with charges in other jurisdictions • The charge rate does not vary by location, time of day, or direction of travel
Bridges ($1/passing)	This scenario is identical to *Bridges ($5/passing)* except that the charge is reduced to $1/passing. This rate was chosen because charging 'a buck a bridge' was an idea frequently raised by stakeholders and the public during engagement, and allows a direct comparison of the effect of different charge levels.
Distance-based Charge (DBC) ($0.15/km)	This scenario involves charging vehicles a flat per km rate based on distance travelled. Key assumptions include: • All Baseline conditions (fuel tax, infrastructure changes, etc.) • $0.15/km across the region was chosen because it was believed it would reduce congestion based on previous modelling analysis • The charge rate does not vary by location, time of day, or direction of travel

*Note that the charge rates described in this table are for personal single occupancy vehicles (SOV) and high occupancy vehicles (HOV). The modelling of these scenarios assumed variation in charge rates for different classes of vehicles as follows: light goods vehicles are charged twice as much as SOVs/HOVs and heavy goods vehicles are charged three times as much as SOVs/HOVs. This is a default assumption that was revised in Rounds 3 and 4 to charge all vehicle types the same rates.

A key issue with presenting trip-level time savings is that they cannot easily be summarised in one statistic like an average time saving over all trips. A 12-zone origin-destination (OD) table was used to present and analyse trip-level time savings. These zones have been previously defined and used within the model and represent an aggregation of neighbouring municipalities. Because of this, a significant amount of aggregation remains in these OD tables – impacts on all trips between a given origin and destination of a zone are averaged, regardless of specific start/end points or route taken within or between the zones – but they provide a reasonable level of detail regarding impacts on different kinds of trips and geographical areas.

A map illustrating the size and location of the 12 zones is shown in Figure 1 (which also includes the locations of charge points for some of the 'Bridges' scenarios), while the estimated number of daily trips between these 12 zones in the *2030 Baseline* is shown in Table 3.

Figure 1: Map of 12 zones used within the RTM, and point charge locations for *Bridges* scenarios

Table 3: Daily auto trips between 12 zones in the *2030 Baseline*[4]

BASELINE - 2030												Trips/Day
Daily	West Van	North Van	CBD	Vancouver	Burn/ NW	North East	Richmond	South Delta	Surrey	White Rock	Maple/ Pitt	Langley
West Van	60,411	32,906	10,782	14,725	5,138	1,763	2,289	454	1,562	235	340	548
North Van	30,859	172,387	15,534	36,201	25,339	6,563	4,761	1,156	5,110	700	1,065	1,646
CBD	10,788	16,619	53,038	107,933	19,536	4,965	12,615	1,808	4,463	1,006	808	1,279
Vancouver	13,361	33,515	96,591	670,964	133,276	21,456	85,925	10,595	22,558	4,024	2,959	4,889
Burn/NW	4,918	25,002	18,579	141,636	365,036	82,842	28,297	8,821	62,215	5,322	5,552	8,104
North East	1,532	6,123	4,947	22,159	83,035	376,983	5,971	3,674	51,681	4,315	24,756	12,596
Richmond	2,210	4,728	11,198	88,329	29,807	6,640	349,771	23,624	26,736	6,621	1,740	4,284
South Delta	421	1,125	1,703	10,710	9,873	4,212	22,288	77,883	29,848	6,289	1,154	3,674
Surrey	1,263	4,219	3,604	21,361	58,365	46,908	23,590	27,361	747,414	54,798	18,016	100,889
White Rock	179	591	759	3,674	4,909	3,872	5,412	5,596	56,665	180,624	2,341	27,222
Maple / Pitt	265	909	640	2,782	5,276	23,038	1,391	934	18,024	2,355	152,361	18,135
Langley	418	1,416	994	4,868	7,598	11,589	3,542	3,410	102,007	26,976	18,159	268,417

Note: rows represent trip origin; columns represent trip destination.

What metrics are needed to understand how charging could reduce congestion and travel times?

There is no one metric that can adequately describe the full impact of a decongestion charging scenario on congestion, time savings and increased reliability for road users. Multiple metrics and reporting scales are needed and an individual or organization's preferred metric(s) for understanding congestion will depend on what matters most to them. In the Round 1 analysis, various tests were conducted to explore how the congestion effects of decongestion charging can be understood and reported.

Two ways of reporting time benefits were considered: (1) reduced *travel times* and (2) reduced time in congestion or *congested time*. Travel time is defined as the time to complete a trip from origin to destination. Congested time is the amount of time within a trip that experiences congested conditions, where congested conditions have been defined in this project as level of service (LOS) D or worse (see Appendix B-2 for further discussion).

4 This includes trips from single-occupancy vehicles (SOV), high-occupancy vehicles (HOV), light-goods vehicles (LGV), and heavy-goods vehicles (HGV). It excludes bus and rail.

Methods were developed to report three levels of scale for both travel time and congested time benefits: (1) trip scale, (2) household scale, and (3) region-wide scale. Time benefits can be reported in either absolute terms as minutes saved or in relative terms as a percent reduction from baseline.

In this evaluation report, time benefits are often reported as a percentage change in congested time relative to the baseline at both the trip scale and region-wide scale. This presentation of congestion metrics is chosen for the following reasons:

- **Congested time:** Decongestion charging has little influence on travel time unless a trip is experiencing congestion. In other words, a decongestion charging policy will not improve upon the travel times that can be achieved under free-flow conditions. Only when a trip is experiencing delays due to traffic volumes that are near or over the vehicle capacity of the road is there much potential to save time through charging.
- **Percent reduction from baseline:** Presenting time savings relative to the baseline provides more context for how effective a scenario is at reducing congestion. For example, a time saving of 2 minutes on a trip that has 20 congested minutes in the baseline (-10%) is very different from a time saving of 2 minutes from a baseline of 4 congested minutes (-50%). The maximum reduction in congested minutes (i.e. -100%) is defined by the total number of congested minutes in the baseline.
- **Trip and region-wide scales:** Considering both trip and region-wide scales provides a fuller understanding of a scenario's congestion effects. Looking only at the region-wide scale does not tell us how the time savings are distributed across trips (i.e. whether many people are seeing small savings or fewer people are seeing larger savings). Similarly, looking only at the trip scale does not lend itself well to comparing results across scenarios.

An origin-destination (OD) table of the 12 zones revealing the percentage change in congested minutes for an ***example*** scenario is shown in Table 4.

Table 4: 12-zone OD table for an example charging scenario

[Example Charging Scenario]									% CHANGE IN CONGESTED MINUTES			
PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-20%	-30%	-20%	-30%	-40%	-40%	-30%	-30%	-40%	-40%	-40%	-40%
North Van	-20%	-10%	-20%	-30%	-30%	-40%	-30%	-30%	-40%	-40%	-40%	-40%
CBD	-20%	-20%	-10%	-20%	-20%	-30%	-30%	-30%	-30%	-40%	-40%	-40%
Vancouver	-20%	-20%	-30%	-20%	-20%	-30%	-30%	-30%	-30%	-40%	-40%	-40%
Burn/NW	-30%	-30%	-30%	-20%	-20%	-20%	-30%	-20%	-20%	-30%	-30%	-30%
North East	-30%	-30%	-40%	-30%	-10%	-10%	-30%	-10%	-20%	-30%	-20%	-30%
Richmond	-30%	-20%	-20%	-20%	-20%	-20%	-10%	-10%	-20%	-40%	-40%	-40%
South Delta	-30%	-30%	-20%	-20%	-10%	-20%	0%	0%	-10%	-30%	-30%	-30%
Surrey	-40%	-40%	-40%	-30%	-10%	-20%	-20%	0%	-20%	-20%	-30%	-20%
White Rock	-50%	-50%	-50%	-40%	-30%	-30%	-30%	0%	-20%	0%	-30%	-20%
Maple Ridge	-40%	-40%	-50%	-40%	-20%	-20%	-30%	0%	-30%	-30%	-20%	-10%
Langley	-40%	-40%	-60%	-50%	-30%	-40%	-40%	-20%	-20%	-20%	-30%	0%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

Note: rows represent trip origin; columns represent trip destination. Negative numbers represent a reduction in congested minutes compared to the Baseline 2030.

How are congestion levels expected to change in the future?

The Regional Transportation Model (RTM) has three baseline scenarios – 2016, 2030 and 2045. For this project, the main baseline model scenario used was *Baseline 2030*, which represents what travel conditions are expected to be in 2030 in the absence of a decongestion charging policy. All decongestion charging scenarios are developed for 2030, and compared to the *Baseline 2030* scenario.

The *Baseline 2030* scenario assumes that all infrastructure and service improvements defined or assumed in the Mayors' 10-Year Vision[5] for transportation have been implemented, in addition to some key bridge infrastructure replacements, including:

- 11 New B-lines;
- 30% additional transit service;
- Millennium Line Broadway Extension to Arbutus;
- LRT in Surrey;
- A number of road and intersection improvements;
- Upgraded Pattullo Bridge; and
- 10-lane Massey Bridge replacement.

The *Baseline 2030* scenario can be compared to the Baseline 2016 scenario to understand the projected growth in regional congestion without a decongestion charging policy or any other additional measures to manage congestion. The *Baseline 2030* is projected to have a 40% increase in the amount of time vehicle users spend in congestion, from 10.6 million minutes per day in 2016 to 14.8 million minutes per day in 2030. Table 5 shows that while most of the growth in congestion occurs during the off-peak, the increase in absolute terms is larger in both the AM and PM peak periods[6]. Figure 2 shows the predicted state of congestion for the AM peak period in 2030.

Table 5: Congested minutes: *Baseline 2016* vs. *2030 Baseline*

Congested Minutes* (Million min/day)			
Time Period	*Baseline 2016*	*Baseline 2030*	% Change
AM Peak	3.7	4.7	27%
Off Peak	0.3	0.7	136%
PM Peak	6.5	9.4	43%
Total	10.6	14.8**	40%

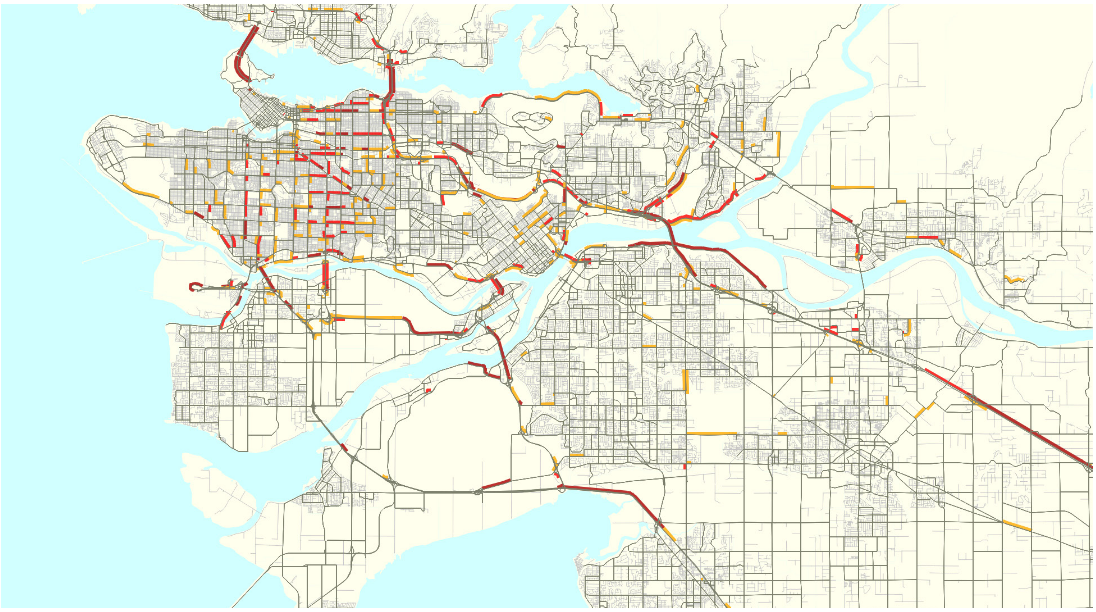
* Congested minutes includes personal vehicles and goods vehicles, but not transit vehicles.

**A model update between Round 1 and Round 3 resulted in an increase to the estimate of congestion levels in the *2030 Baseline*. Prior to this update, the value was calculated at 14.0 million minutes per day.

5 *Regional Transportation Investments: A Vision for Metro Vancouver* (2014) (available online: https://tenyearvision.translink.ca/documents/10%20Year%20Vision%20for%20Metro%20Vancouver%20Transit%20and%20Transportation.pdf).

6 Note that within the Regional Transportation Model (RTM), the AM peak hour is from 7:30am – 8:30am, while the PM peak hour is from 4:30pm – 5:30pm, from Monday to Friday. Off-peak conditions are captured from 12pm – 1pm. These time periods are then 'blended' by direction (inbound and outbound) to form a daily value. This process is described in more detail in Appendix

Figure 2: Estimated travel time delays in *2030 Baseline* AM peak period



Note: Congestion is defined as aggregate vehicle hours of delay on each link experienced in the AM peak hour, where vehicle delay is calculated as hours of delay over and above the LOS D performance level multiplied by the vehicle volume (Legend: Orange: 10-30 hours; Red: 30-60 hours; Maroon: >60 hours).

What could be achieved if rates are set according to economic theory?

According to economic theory, vehicles should be charged to use the roads at a rate equal to the congestion costs that driving imposes on society – a concept called *marginal social cost (MSC)* pricing. MSC pricing is explained in more detail in Appendix B of the Commission's phase 1 report, as well as in Appendix B-1 of this report.

In Round 1, a scenario based on MSC pricing was defined and modelled to represent a theoretical maximum level of congestion reduction to the selected baseline of LOS D performance. Charging more than the MSC rates would mean that vehicles are being overcharged according to MSC pricing theory – i.e. they are being charged more for the use of the roads than the cost they are imposing on others in terms of travel time delays.

Marginal social cost pricing is a theoretical starting point. In its purest form, charging rates would need to vary dynamically by different road segments, times of day, days of the week, and directions of travel. This dynamic nature would make MSC charges very difficult for an individual traveller to accurately predict and use as a factor in making travel decisions. Further, MSC rates do not consider fairness issues such as the ability of someone to pay the charge or the distribution of costs and benefits. The *MSC* scenario is nonetheless a useful benchmark to compare other decongestion charging scenarios. It can also be used to inform the charge rates used in other scenarios so that rates are set in proportion to a vehicle trip's contribution to congestion.

The RTM predicted that the *MSC* scenario would reduce time spent in congestion by 70% - from 14.0 million min/day in the Baseline 2030 scenario to 4.2 million min/day. These reductions would be experienced region-wide.

When the modelled road segments are aggregated to the 12 zone level, the peak period charge rates for vehicle trips within and between zones in the *MSC* scenario vary between \$0.04/km and \$0.81/km and off peak charge rates vary between \$0.02/km and \$0.23/km (Table 6). Since charge rates are set based on local congestion levels, the trips with the highest charge rates are ones to, from, and within the Central Business District, the City of Vancouver, and Burnaby/New Westminster. The trips with the lowest charge rates are trips that stay on the North Shore, South of the Fraser, and in Maple Ridge/Pitt Meadows. The modelling showed that, as designed, the MSC charge rates are closely aligned with a trip's contribution to congestion in the baseline scenario and a trip's experience of time savings in the *MSC* scenario.

A key finding of modelling the *MSC* scenario is that the large reductions in congestion are due to small changes in behaviour across many trips. The model predicts that 91% of VKT remain in the *MSC* scenario compared to the *Baseline 2030* scenario. In other words, most people stay and pay and there is a reduction in VKT of 9 percentage points compared to Baseline 2030. The most important adaptations in the model for the *MSC* scenario are taking shorter trips (responsible for a reduction in VKT of 6 percentage points) and shifting to transit (responsible for a reduction in VKT of 3 percentage points).

Table 6: *Marginal Social Cost* OD table for charge value ($/km) for PM peak and mid-day periods

MARGINAL SOCIAL COST - 2030 — CHARGE VALUE ($ / KM)

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	$0.06	$0.17	$0.49	$0.47	$0.45	$0.45	$0.56	$0.50	$0.44	$0.38	$0.40	$0.41
North Van	$0.13	$0.12	$0.50	$0.52	$0.55	$0.50	$0.53	$0.57	$0.49	$0.41	$0.43	$0.42
CBD	$0.62	$0.71	$0.32	$0.67	$0.81	$0.61	$0.66	$0.50	$0.51	$0.43	$0.48	$0.43
Vancouver	$0.50	$0.61	$0.35	$0.53	$0.61	$0.52	$0.56	$0.46	$0.46	$0.40	$0.44	$0.41
Burn/NW	$0.39	$0.52	$0.35	$0.40	$0.39	$0.47	$0.33	$0.40	$0.56	$0.41	$0.42	$0.37
North East	$0.28	$0.31	$0.19	$0.23	$0.26	$0.35	$0.35	$0.44	$0.50	$0.38	$0.45	$0.39
Richmond	$0.51	$0.59	$0.49	$0.53	$0.48	$0.52	$0.19	$0.34	$0.38	$0.35	$0.35	$0.33
South Delta	$0.40	$0.51	$0.35	$0.34	$0.42	$0.50	$0.20	$0.17	$0.39	$0.36	$0.38	$0.34
Surrey	$0.30	$0.34	$0.24	$0.24	$0.30	$0.42	$0.14	$0.14	$0.27	$0.21	$0.36	$0.23
White Rock	$0.25	$0.26	$0.19	$0.19	$0.20	$0.28	$0.11	$0.10	$0.15	$0.14	$0.29	$0.14
Maple Ridge	$0.25	$0.26	$0.16	$0.19	$0.18	$0.22	$0.21	$0.23	$0.24	$0.24	$0.14	$0.26
Langley	$0.27	$0.26	$0.18	$0.20	$0.18	$0.29	$0.15	$0.17	$0.20	$0.14	$0.38	$0.14

MARGINAL SOCIAL COST - 2030 — CHARGE VALUE ($ / KM)

MIDDAY	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	$0.06	$0.06	$0.23	$0.16	$0.11	$0.09	$0.17	$0.14	$0.09	$0.07	$0.07	$0.09
North Van	$0.08	$0.04	$0.19	$0.13	$0.10	$0.07	$0.14	$0.14	$0.08	$0.07	$0.06	$0.07
CBD	$0.13	$0.11	$0.10	$0.12	$0.14	$0.08	$0.14	$0.11	$0.08	$0.06	$0.06	$0.06
Vancouver	$0.13	$0.12	$0.13	$0.12	$0.12	$0.08	$0.14	$0.10	$0.08	$0.06	$0.07	$0.07
Burn/NW	$0.12	$0.11	$0.13	$0.12	$0.08	$0.08	$0.10	$0.10	$0.08	$0.05	$0.06	$0.05
North East	$0.10	$0.09	$0.08	$0.09	$0.09	$0.06	$0.14	$0.18	$0.09	$0.07	$0.07	$0.07
Richmond	$0.15	$0.14	$0.16	$0.15	$0.12	$0.11	$0.05	$0.07	$0.06	$0.04	$0.07	$0.05
South Delta	$0.14	$0.15	$0.13	$0.13	$0.12	$0.14	$0.10	$0.06	$0.05	$0.04	$0.10	$0.06
Surrey	$0.10	$0.09	$0.09	$0.09	$0.09	$0.08	$0.06	$0.06	$0.05	$0.04	$0.05	$0.05
White Rock	$0.08	$0.07	$0.06	$0.06	$0.06	$0.06	$0.04	$0.04	$0.04	$0.03	$0.05	$0.04
Maple Ridge	$0.08	$0.07	$0.06	$0.07	$0.06	$0.07	$0.08	$0.10	$0.05	$0.06	$0.02	$0.08
Langley	$0.10	$0.08	$0.06	$0.07	$0.06	$0.06	$0.06	$0.06	$0.05	$0.04	$0.07	$0.04

Note: rows represent trip origin; columns represent trip destination.

How do congestion outcomes change when point charge scenarios vary by scale?

In Round 1, two scales of congestion point charge scenarios were compared – a small scale system with a point charge cordon around the Central Business District (CBD) in the City of Vancouver and a regional system with point charges at 12 major bridges. Both scenarios were modelled using the same baseline conditions and the same charge rates ($5/passing), meaning differences in the performances between these scenarios are a result of differences in the location and scale of the point charge system.

The modelling of these two scenarios shows that, as expected, in the *CBD* scenario, time savings are limited to trips with an origin or destination in the CBD while in the Bridges scenario, time savings occur across all destinations. Another key difference is that the *CBD* scenario produces increases in congestion as some vehicles that had been travelling through the CBD from the North Shore in the Baseline divert to the Ironworkers Bridge to avoid the point charge (Table 7).

Table 7: *CBD ($5/passing)* scenario vs. *Bridges ($5/passing)* scenario - OD table for % change in congested minutes compared to *2030 Baseline* scenario

CBD ($5 / PASSING) - 2030 — % CHANGE IN CONGESTED MINUTES

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-5%	-14%	-92%	-40%	1%	-3%	-36%	-24%	-2%	-2%	-3%	-5%
North Van	11%	17%	-85%	-2%	4%	-1%	-6%	0%	0%	0%	0%	-1%
CBD	-70%	-70%	-77%	-48%	-35%	-32%	-40%	-33%	-30%	-28%	-28%	-28%
Vancouver	-40%	7%	-54%	-7%	-3%	-2%	-8%	-5%	-1%	-1%	0%	-1%
Burn/NW	23%	24%	-30%	5%	1%	1%	3%	2%	2%	2%	2%	2%
North East	22%	23%	-29%	5%	3%	2%	3%	2%	2%	3%	1%	2%
Richmond	-34%	5%	-40%	-1%	3%	3%	0%	5%	3%	3%	4%	3%
South Delta	-10%	10%	-33%	-1%	3%	3%	1%	1%	2%	2%	4%	2%
Surrey	18%	18%	-32%	1%	2%	2%	3%	3%	3%	3%	2%	2%
White Rock	19%	19%	-33%	-2%	3%	3%	3%	3%	3%	1%	2%	2%
Maple Ridge	21%	20%	-26%	5%	2%	2%	4%	3%	2%	2%	1%	2%
Langley	17%	20%	-24%	2%	1%	2%	3%	2%	1%	2%	2%	1%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

BRIDGES ($5 / PASSING) - 2030 — % CHANGE IN CONGESTED MINUTES

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-6%	-25%	-62%	-57%	-54%	-40%	-62%	-67%	-56%	-58%	-52%	-53%
North Van	-9%	-27%	-65%	-64%	-60%	-41%	-68%	-69%	-57%	-58%	-52%	-56%
CBD	-53%	-54%	-21%	-12%	-4%	3%	-51%	-62%	-39%	-60%	-27%	-31%
Vancouver	-50%	-52%	-28%	-14%	-4%	4%	-56%	-63%	-43%	-60%	-23%	-33%
Burn/NW	-50%	-59%	-17%	-18%	-15%	5%	-64%	-51%	-46%	-56%	-27%	-38%
North East	-49%	-61%	-19%	-12%	-5%	3%	-46%	-31%	-45%	-41%	-53%	-46%
Richmond	-61%	-62%	-68%	-64%	-44%	-25%	-15%	-51%	-51%	-47%	-59%	-42%
South Delta	-64%	-67%	-72%	-70%	-56%	-33%	-49%	-26%	-43%	-37%	-59%	-32%
Surrey	-62%	-68%	-61%	-60%	-56%	-39%	-39%	3%	-4%	-2%	-65%	-8%
White Rock	-65%	-71%	-80%	-76%	-66%	-34%	-46%	-5%	0%	-6%	-64%	-5%
Maple Ridge	-62%	-69%	-57%	-45%	-31%	-68%	-51%	-51%	-52%	-40%	-31%	-60%
Langley	-59%	-68%	-52%	-45%	-48%	-46%	-33%	-3%	-6%	-4%	-65%	-8%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

Note: rows represent trip origin; columns represent trip destination.

The OD tables for both scenarios show that there are greater reductions in congestion for trips that pass through a point charge location – indicating that trips that pay the charge are the ones that experience time savings benefits. The OD table for the *Bridges* scenario shows that trips that are not charged also experience time savings benefits, however these benefits tend to be lower than trips that pass through a point charge location. For example, trips that stay on the Burrard Peninsula (trips to and from CBD, Vancouver, Burn/NW and North East) tend to experience congested time savings between 5% and 25% even though they do not pass a point charge location. Trips that pass through a point charge location tend to experience congested time savings between 30% and 80%.

How do congestion outcomes change with different point charge rates?

In Round 1, two rates for congestion point charge scenarios were compared – a $5/passing charge rate compared to a $1/passing charge rate. Both scenarios were modelled using the same baseline conditions and the same location for the charges (12 major bridges), meaning differences in the performance of these scenarios are solely a result of differences in the charge rate.

The modelling of these scenarios shows that, as expected, congested time savings are significantly lower at $1/passing compared to $5/passing. As shown in Table 8, most trips that are charged $1/passing in the PM peak period experience congested time savings of between 15% and 20%, while at $5/passing they experience congested time savings of between 50% and 70%. Congested time savings, as a percentage of *Baseline 2030* congested minutes, are higher in the off-peak than in the peak, but this is a function of a very low number of congested minutes in the baseline (i.e. 1 congested minute reduced by 100% to 0).

Table 8: *Bridges ($1)* and *Bridges ($5)* - OD Table for % change in congested minutes compared to *2030 Baseline* scenario

BRIDGES ($1 / PASSING) - 2030 — % CHANGE IN CONGESTED MINUTES

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-1%	-4%	-17%	-15%	-13%	-9%	-16%	-18%	-14%	-16%	-14%	-13%
North Van	-1%	-6%	-18%	-17%	-16%	-10%	-18%	-21%	-15%	-17%	-14%	-14%
CBD	-13%	-13%	-4%	0%	1%	3%	-10%	-15%	-8%	-14%	-5%	-5%
Vancouver	-12%	-13%	-5%	-1%	1%	3%	-13%	-16%	-11%	-15%	-5%	-7%
Burn/NW	-12%	-16%	-2%	-3%	-3%	3%	-18%	-16%	-12%	-15%	-8%	-8%
North East	-12%	-15%	-2%	-1%	2%	3%	-15%	-6%	-10%	-9%	-13%	-13%
Richmond	-17%	-17%	-19%	-17%	-11%	-4%	-1%	-13%	-11%	-10%	-16%	-9%
South Delta	-20%	-21%	-23%	-22%	-18%	-7%	-14%	-7%	-9%	-6%	-15%	-5%
Surrey	-18%	-20%	-19%	-20%	-18%	-9%	-11%	-1%	1%	1%	-20%	0%
White Rock	-20%	-23%	-28%	-27%	-22%	-11%	-12%	0%	6%	0%	-20%	1%
Maple Ridge	-17%	-19%	-11%	-8%	-4%	-16%	-22%	-34%	-19%	-14%	-6%	-18%
Langley	-16%	-20%	-14%	-13%	-14%	-19%	-9%	-2%	0%	0%	-22%	-1%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

BRIDGES ($5 / PASSING) - 2030 — % CHANGE IN CONGESTED MINUTES

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-6%	-25%	-62%	-57%	-54%	-40%	-62%	-67%	-56%	-58%	-52%	-53%
North Van	-9%	-27%	-65%	-64%	-60%	-41%	-68%	-69%	-57%	-58%	-52%	-56%
CBD	-53%	-54%	-21%	-12%	-4%	3%	-51%	-62%	-39%	-60%	-27%	-31%
Vancouver	-50%	-52%	-28%	-14%	-4%	4%	-56%	-63%	-43%	-60%	-23%	-33%
Burn/NW	-50%	-59%	-17%	-18%	-15%	5%	-64%	-51%	-46%	-56%	-27%	-38%
North East	-49%	-61%	-19%	-12%	-5%	3%	-46%	-31%	-45%	-41%	-53%	-46%
Richmond	-61%	-62%	-68%	-64%	-44%	-25%	-15%	-51%	-51%	-47%	-59%	-42%
South Delta	-64%	-67%	-72%	-70%	-56%	-33%	-49%	-26%	-43%	-37%	-59%	-32%
Surrey	-62%	-68%	-61%	-60%	-56%	-39%	-39%	3%	-4%	-2%	-65%	-8%
White Rock	-65%	-71%	-80%	-76%	-66%	-34%	-46%	-5%	0%	-6%	-64%	-5%
Maple Ridge	-62%	-69%	-57%	-45%	-31%	-68%	-51%	-51%	-52%	-40%	-31%	-60%
Langley	-59%	-68%	-52%	-45%	-48%	-46%	-33%	-3%	-6%	-4%	-65%	-8%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

Note: rows represent trip origin, columns represent trip destination.

How do congestion outcomes change between point charging and distance-based charging?

In the Round 1 analysis, a simple region-wide distance-based charging (DBC) scenario was modelled to compare to the Bridges point charge scenarios. Both the DBC and Bridges scenarios represented large scale applications of decongestion charging. The DBC scenario was modelled at a flat $0.15/km across Metro Vancouver, meaning the $/km charge was held constant in all locations and all times of day, regardless of local and temporal congestion conditions. Here the *DBC ($0.15/km)* scenario is compared to the *Bridges ($5/passing)* scenario.

Congestion outcomes for the *Bridges ($5/passing)* and *DBC ($0.15/km)* are presented in Table 9, where the OD table for *DBC ($0.15/km)* shows lower levels of congestion reduction for trips that pass over the 12 major bridges, but shows higher levels of congestion reduction for trips within the Burrard Peninsula and within zones. The OD table for *Bridges ($5/passing)* shows the highest congestion reduction occurring for trips that travel over one or more of the 12 charged bridges and lower congestion reduction for trips remaining on the Burrard Peninsula and within zones.

While regional congested time savings are similar between these scenarios, the *DBC ($0.15/km)* scenario charges for all trips across the region, whereas only 20% of daily regional trips cross a bridge that would be charged in the *Bridges* scenarios. The *Bridges* scenarios do not charge trips that are contained within municipalities (52% of total regional daily driving trips), trips that are contained within the North Shore (5% of total regional daily driving trips), trips that stay within the Burrard Peninsula (36% of total regional daily driving trips) and trips that stay South of the Fraser (30% of total regional daily driving trips).

Table 9: *DBC ($0.15/km)* and *Bridges ($5/passing)* - OD Table for % change in congested minutes compared to *2030 Baseline* scenario

DBC ($0.15 / KM) - 2030 — % CHANGE IN CONGESTED MINUTES

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-17%	-30%	-17%	-26%	-36%	-38%	-28%	-30%	-40%	-44%	-42%	-43%
North Van	-20%	-14%	-22%	-30%	-32%	-35%	-31%	-32%	-36%	-42%	-39%	-43%
CBD	-20%	-22%	-9%	-23%	-23%	-29%	-28%	-30%	-34%	-43%	-37%	-39%
Vancouver	-23%	-22%	-30%	-22%	-23%	-30%	-25%	-28%	-30%	-42%	-35%	-39%
Burn/NW	-28%	-25%	-26%	-22%	-16%	-19%	-28%	-19%	-19%	-29%	-30%	-35%
North East	-35%	-33%	-44%	-33%	-13%	-11%	-27%	-14%	-21%	-30%	-22%	-28%
Richmond	-26%	-25%	-24%	-19%	-19%	-23%	-9%	-11%	-24%	-41%	-40%	-40%
South Delta	-32%	-28%	-24%	-22%	-10%	-16%	0%	0%	-13%	-29%	-31%	-31%
Surrey	-40%	-37%	-41%	-34%	-13%	-24%	-17%	-1%	-15%	-24%	-30%	-20%
White Rock	-48%	-47%	-45%	-41%	-32%	-35%	-26%	0%	-18%	0%	-33%	-16%
Maple Ridge	-43%	-41%	-51%	-42%	-24%	-16%	-30%	0%	-28%	-33%	-19%	-12%
Langley	-40%	-43%	-56%	-45%	-34%	-36%	-38%	-21%	-15%	-19%	-25%	-2%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

BRIDGES ($5 / PASSING) - 2030 — % CHANGE IN CONGESTED MINUTES

PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	-6%	-25%	-62%	-57%	-54%	-40%	-62%	-67%	-56%	-58%	-52%	-53%
North Van	-9%	-27%	-65%	-64%	-60%	-41%	-68%	-69%	-57%	-58%	-52%	-56%
CBD	-53%	-54%	-21%	-12%	-4%	3%	-51%	-62%	-39%	-60%	-27%	-31%
Vancouver	-50%	-52%	-28%	-14%	-4%	4%	-56%	-63%	-43%	-60%	-23%	-33%
Burn/NW	-50%	-59%	-17%	-18%	-15%	5%	-64%	-51%	-46%	-56%	-27%	-38%
North East	-49%	-61%	-19%	-12%	-5%	3%	-46%	-31%	-45%	-41%	-53%	-46%
Richmond	-61%	-62%	-68%	-64%	-44%	-25%	-15%	-51%	-51%	-47%	-59%	-42%
South Delta	-64%	-67%	-72%	-70%	-56%	-33%	-49%	-26%	-43%	-37%	-59%	-32%
Surrey	-62%	-68%	-61%	-60%	-56%	-39%	-39%	3%	-4%	-2%	-65%	-8%
White Rock	-65%	-71%	-80%	-76%	-66%	-34%	-46%	-5%	0%	-6%	-64%	-5%
Maple Ridge	-62%	-69%	-57%	-45%	-31%	-68%	-51%	-51%	-52%	-40%	-31%	-60%
Langley	-59%	-68%	-52%	-45%	-48%	-46%	-33%	-3%	-6%	-4%	-65%	-8%

% Change
-75%
-50%
-25%
0%
25%
50%
75%

Note: rows represent trip origin; columns represent trip destination.

Round 1 Key Considerations

The Round 1 analysis raised several important questions for further consideration, summarized in Table 10. Some of these questions are addressed in later rounds of this evaluation, while others are value judgements which will need to be considered in future phases of work.

Table 10: Key Questions identified through Round 1 analysis

Topic	Key Questions
Congestion	• How important is the level of time savings achieved? • Which metric best captures what really matters about time savings – i.e., is travel time savings or congested time savings more important? • Does it matter if congestion benefits are regional or local?
Fairness	• How much is too much? Should there be a constraint on **maximum cost**? • How important is the **difference** in cost across trips? • How important is aligning costs with **benefits** (time savings)? • How important is it to align charges with **use** of the system? • How important is it to align charges with **congestion costs**? • How important is **income equity**? • How best to balance these multiple dimensions of fairness?
Revenue	• How much is enough? Should there be a target? Or ability to scale up over time? • How important is the efficiency of revenue generation?

PART 4

Round 2 Analysis

PART 4. ROUND 2 ANALYSIS

The Round 2 scenario analysis involved modifying the Round 1 scenarios by varying charge rates by time of day, location, and direction. The intent of this analysis was to understand the influence that these rate design variables have on congestion, revenue, and fairness metrics. A short description of each of these scenarios is provided in Table 11, with more detailed descriptions, including all charge rates, available in Appendix B-1.

The modelling and evaluation of these scenarios helped to provide insight on the following questions:

- How does time in congestion change when charges are varied by time, direction, and location?
- How does rate design influence alignment with user pay and benefiter pay pricing principles?
- How do system costs, revenue collection efficiency, and net revenue compare across different point charge and DBC scenarios?
- What are key trade-offs between a flat-rate and variable-rate charging system?

The following sections answer these questions in turn using the Round 2 modelling results for illustration.

Table 11: Scenarios evaluated in the Round 2 analysis

Scenario Name*	Description
CBD (MSC)	Charges in the CBD cordon that vary rates by time of day and direction to approximate MSC charge levels. The charge rate is consistent across all entry/exit points to/from the CBD.
Bridges TOD (="time of day")	Same as Bridges ($5) but only charges during AM and PM peak periods. No charge for off-peak periods.
Bridges TOD and Direction	Same charging locations as other Bridges scenarios but varies rates by time of day and direction. In AM peak: $6.50 per passage inbound (towards Vancouver CBD) and $3.25 per passage outbound. In PM peak, $3.25 per passage inbound and $6.50 per passage outbound. No charge for off-peak periods. For the Golden Ears Bridge, inbound is defined as southbound, outbound is defined as northbound).
Bridges (MSC)	Same charging locations as other Bridges scenarios but rates vary by point location, time of day, and direction to approximate MSC charge levels (details on how this was conducted is described in Appendix B-2).
DBC TOD	$0.15/km fee in AM and PM peak periods. No charge for off-peak periods. (TOD = Time of Day)
DBC TOD (2 Zones)	$0.20/km fee inside the Burrard Peninsula and $0.10/km outside the Burrard Peninsula in the AM and PM peak periods only.
Round 1 Scenarios	For comparison, all scenarios that were included in the Round 1 analysis were also included in the Round 2 scenario analysis. A description of these scenarios can be found in Table 2.

*Note that the charge rates described in this table are for personal single occupancy vehicles (SOV) and high occupancy vehicles (HOV). The modelling of these scenarios assumed variation in charge rates for different classes of vehicles as follows: light goods vehicles are charged twice as much as SOVs/HOVs and heavy goods vehicles are charged three times as much as SOVs/HOVs. This is a default assumption that was revised in Rounds 3 and 4 to charge all vehicles the same rates.

How does time in congestion change at the trip level when charges are varied by time, direction and location?

The modelled congested time for trips can be compared across Round 2 scenarios to understand the relative differences when charges are varied by time of day, direction, and location. Table 12 compares the average change in travel times in the midday between *Bridges ($5/passing)* (where a charge is placed on all bridges at all times of day) and *Bridges (TOD)* (where the charge has been removed in the off-peak). There appears to be little or no change in travel time in the off-peak regardless of whether a charge is in place or not. This is because the number of congested minutes per trip in the off-peak in *Baseline 2030* is quite low (0-6 minutes across the OD table – see Table 13).

Table 12: *Bridges ($5)* and *Bridges (TOD)* – OD table for average change in midday travel time compared to *2030 Baseline*

BRIDGES ($5 / CROSSING) - 2030										AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)		
MIDDAY	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	0	0	-3	-3	-1	-1	-4	-3	-1	-1	-2	-1
North Van	0	0	-2	-1	-1	-1	-3	0	-1	0	-1	-1
CBD	0	-1	0	0	0	0	-1	-1	1	5	0	0
Vancouver	-1	-1	0	0	0	0	-1	0	2	1	0	1
Burn/NW	-1	-1	0	0	0	0	-1	1	0	3	0	0
North East	-1	-1	0	0	0	0	-1	0	0	0	-1	1
Richmond	-2	-3	-2	-1	-2	-2	0	0	-1	0	-1	0
South Delta	-2	-1	-2	-2	0	0	-1	0	0	0	0	0
Surrey	-1	-1	1	1	1	0	0	0	0	0	0	0
White Rock	0	0	5	0	2	0	0	0	0	0	-1	0
Maple Ridge	-1	-1	0	0	0	0	1	0	0	0	0	0
Langley	-1	-1	0	1	0	2	0	0	0	0	0	0

BRIDGES TOD ($5 / CROSSING, NO MIDDAY) - 2030										AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)		
MIDDAY	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	0	0	-2	-1	-1	-1	-2	-2	-1	-1	-1	-1
North Van	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
CBD	0	0	0	0	0	0	-1	-1	-1	-1	-1	0
Vancouver	0	0	0	0	0	0	0	0	-1	0	-1	0
Burn/NW	-1	-1	0	0	0	0	-1	-1	0	0	-1	0
North East	-1	-1	0	0	0	0	-1	-1	0	-1	0	0
Richmond	-1	-1	-1	-1	-1	-1	0	0	0	0	-1	0
South Delta	-2	-2	-1	-1	-1	-1	0	0	0	0	0	0
Surrey	-1	-1	-1	-1	-1	0	0	0	0	0	0	0
White Rock	-1	-1	-1	-1	0	0	0	0	0	0	0	0
Maple Ridge	-1	-1	-1	-1	0	0	0	0	0	0	0	0
Langley	-1	-1	-1	-1	0	0	0	0	0	0	0	0

Note: rows represent trip origin; columns represent trip destination

Table 13: *2030 Baseline* – OD table for midday congested minutes per trip

BASELINE - 2030										CONGESTED MINUTES PER TRIP (MIN / TRIP)		
MIDDAY	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	1	0	5	5	1	1	6	5	2	1	1	1
North Van	1	0	3	1	0	1	2	2	1	1	1	0
CBD	1	0	0	0	1	1	1	1	1	1	1	0
Vancouver	1	1	0	0	0	0	1	1	1	1	1	0
Burn/NW	2	1	0	0	0	0	1	1	0	1	1	0
North East	2	1	0	0	0	0	2	3	1	0	0	1
Richmond	2	2	1	1	1	3	0	0	1	0	2	1
South Delta	3	3	2	2	1	3	1	0	0	0	1	0
Surrey	2	2	1	1	1	1	1	0	0	0	0	0
White Rock	2	2	1	1	1	1	0	0	0	0	0	0
Maple Ridge	2	1	0	0	1	0	1	1	0	0	0	0
Langley	2	1	0	1	1	0	1	0	0	0	0	0

Note: rows represent trip origin; columns represent trip destination

Table 14 builds on the idea of varying the charge rates by time of day (TOD) by comparing the *Bridges TOD* scenario to one in which the charges vary by time of day *and* direction *Bridges (TOD & Dir.)*, where charges are higher for peak direction of travel ($6.50/passing), and lower for the counter-flow direction ($3.25/passing). By re-balancing the charge rates on bridges in this way, it appears to further reduce travel times in the peak (i.e. more heavily congested) direction, while having a negligible impact in the counter-flow direction.

Table 14: *Bridges (TOD)* vs. *Bridges (TOD & Dir.)* – OD Tables for average change in AM peak (counter-flow travel direction) and PM peak (peak travel direction) travel time compared to *2030 Baseline*

BRIDGES TOD ($5 / CROSSING, NO MIDDAY) - 2030								AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)				
AM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
CBD	-3	-3	0	0	0	0	-2	-2	1	2	-1	0
Vancouver	-5	-4	-1	0	0	0	-2	-2	1	0	-1	0
Burn/NW	-6	-5	-1	-1	0	0	-3	-1	0	1	-1	0
North East	-6	-5	-1	0	0	0	-1	-1	0	0	-3	-1

BRIDGES TOD AND DIRECTION - 2030								AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)				
AM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
CBD	-3	-3	0	0	0	0	-2	-2	0	0	-2	0
Vancouver	-4	-4	-1	-1	0	-1	-1	-2	0	-1	-2	0
Burn/NW	-6	-5	-1	-1	0	0	-2	-2	0	0	-1	0
North East	-4	-3	0	1	1	0	0	-1	0	1	-3	0

BRIDGES TOD ($5 / CROSSING, NO MIDDAY) - 2030								AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)				
PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
CBD	-5	-6	0	-1	-1	-1	-6	-9	-6	-13	-5	-5
Vancouver	-6	-6	0	-1	-1	0	-4	-7	-5	-11	-3	-4
Burn/NW	-6	-5	0	-1	0	0	-4	-4	-3	-8	-2	-3

BRIDGES TOD AND DIRECTION - 2030								AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)				
PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
CBD	-6	-6	0	-1	-1	-1	-7	-10	-6	-14	-4	-5
Vancouver	-6	-6	0	-1	0	0	-5	-8	-5	-12	-2	-4
Burn/NW	-6	-6	0	-1	0	0	-4	-3	-2	-8	-1	-3

Note: rows represent trip origin; columns represent trip destination.

A further layer of complexity is added when the *Bridges (TOD & Dir.)* scenario is compared to *Bridges (MSC)*, where the rates vary by both time of day and direction as well as by location with different charge rates on different bridges. *Bridges (MSC)* achieves the highest reductions in travel time compared to other scenarios which is a result of this scenario having rates set in proportion to different levels of congestion.

Table 15: *Bridges (TOD & Dir.)* vs. *Bridges (MSC)* – OD Table for average change in PM peak travel time compared to the *2030 Baseline*

BRIDGES TOD AND DIRECTION - 2030								AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)				
PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	0	0	-4	-5	-6	-5	-11	-13	-9	-9	-9	-9
North Van	0	0	-4	-5	-5	-4	-10	-10	-8	-8	-8	-8
CBD	-6	-6	0	-1	-1	-1	-7	-10	-6	-14	-4	-5
Vancouver	-6	-6	0	-1	0	0	-5	-8	-5	-12	-2	-4
Burn/NW	-6	-6	0	-1	0	0	-4	-3	-2	-8	-1	-3
North East	-6	-5	-1	-1	0	0	-4	-2	-3	-3	-4	-4
Richmond	-9	-10	-4	-3	-3	-1	0	-3	-8	-9	-13	-8
South Delta	-11	-11	-5	-4	-4	-3	-1	0	-4	-6	-11	-5
Surrey	-8	-7	-2	-2	-1	-1	-1	0	0	0	-6	0
White Rock	-8	-7	-3	-3	-1	0	-1	0	0	0	-6	0
Maple Ridge	-8	-7	-2	-2	-1	-3	-2	-2	-2	-2	0	-2
Langley	-8	-7	-1	-1	-1	-1	-1	0	0	0	-5	0

BRIDGES (MSC APPROX.) - 2030								AVERAGE CHANGE IN TRAVEL TIME (MIN / TRIP)				
PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	0	-1	-7	-8	-11	-11	-15	-18	-18	-18	-10	-18
North Van	0	0	-7	-8	-9	-9	-13	-16	-16	-17	-9	-17
CBD	-8	-9	0	-1	-3	-3	-8	-11	-11	-16	-1	-10
Vancouver	-9	-9	-1	-1	-1	-2	-5	-8	-9	-13	0	-9
Burn/NW	-9	-8	-1	0	-1	0	-4	-5	-5	-9	1	-7
North East	-10	-8	-1	-1	-1	0	-5	-5	-6	-6	-3	-7
Richmond	-14	-14	-6	-5	-6	-4	0	-3	-8	-9	-14	-8
South Delta	-14	-12	-7	-6	-4	-4	-2	0	-4	-6	-11	-5
Surrey	-11	-10	-2	-1	-1	-2	-2	0	0	0	-6	0
White Rock	-11	-10	0	-3	0	-1	-1	0	0	0	-6	0
Maple Ridge	-12	-10	-2	-2	-2	-3	-2	-3	-2	-3	0	-3
Langley	-11	-10	-2	-1	-2	-2	-1	0	0	0	-5	0

Note: rows represent trip origin; columns represent trip destination.

How does rate design influence alignment with user pay and benefiter pay pricing principles?

Any charging system that is designed to affect behaviour will result in differences in charges across users. A key element of fairness is that differences in cost should be explainable in a way that is consistent and transparent. From the literature on decongestion charging, this project identified three common transportation pricing principles:

1. **User Pay** – People should pay in proportion to their use of the transportation system. In other words, the more you use it, the more you pay.
2. **Benefiter Pay** – People should pay in proportion to the time savings they experience.
3. **User Cos**t – People should pay in proportion to the costs they impose on other users of the transportation system, in the form of delays. In other words, people should pay more for those trips that contribute more to congestion.

For the Round 2 analysis, metrics were developed to assess a scenario's relative alignment with the first two pricing principles – user pay and benefiter pay (a metric for the user cost principle is included in the Round 3 analysis). To develop these metrics, scatterplots were produced with either trip distance or travel time savings per trip on the y-axis and charges per trip on the x-axis. The strength of the relationship is tested through adding a linear trend line (regression analyses) to the scatterplot and calculating the R-squared value of the trend line. R-squared is a statistical metric that measures how well a relationship (e.g. a linear regression) fits a set of data. Specifically, it is the proportion of the variation in the dependent variable that is explained by the fit line. R-squared values are between 0 and 1, and the closer an R-squared value is to 1, the stronger the relationship. The 12 zone OD table data is the basis for the scatterplot and, for simplicity, data is unweighted and only personal vehicles are included.

The results of this analysis are summarized in Table 16, and scatterplots for selected scenarios are shown in Figure 3.

Key conclusions from this analysis include:

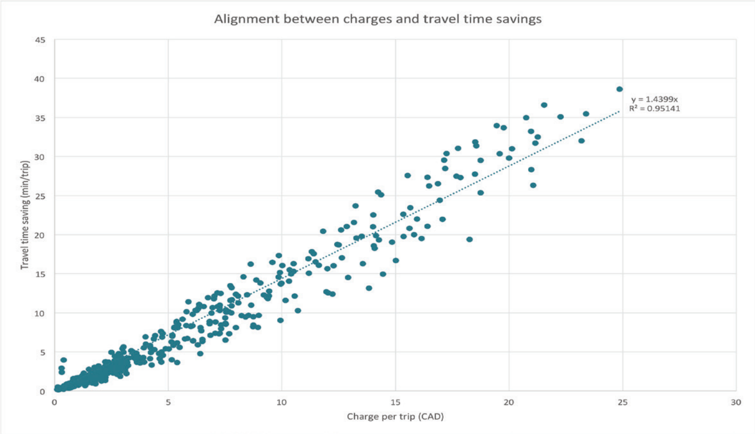
- **Alignment of charges with time saved:** The *MSC* scenario is designed to have a strong relationship between charges per trip and time saved per trip, and so performs well. Other charges designed to vary according to the level of congestion, *Bridges (MSC), Bridges TOD and DIR*, and *DBC TOD (2 zones)* also show strong alignment between charges and time saved. Scenarios with flat charging all day have weak alignment between charges per trip and time saved per trip – this includes *CBD ($5), Bridges ($1), Bridges ($5),* and *DBC ($0.15/km). CBD (MSC)* would have good alignment between charges and time saved for charged trips into and out of the CBD, but this metric includes all trips across the region.
- **Alignment of charges with use:** The flat DBC scenario (*DBC ($0.15/km)*) is designed to align charges with use. The other flat all-day charges, (*Bridges ($1)* and *Bridges ($5)*) also show strong alignment. Varying charges by time and location in the other scenarios significantly reduces alignment of charges with use. The CBD scenarios have zero alignment of charges with use on account of the charge being applied to only a small percentage of regional trips.

Table 16: Alignment of charges with time saved and use for Round 2 scenarios

Metric	Units	MSC	CBD ($5)	CBD (MSC)	Bridges ($1)	Bridges ($5)	Bridges TOD	Bridges TOD and Dir	Bridges (MSC)	DBC ($0.15/km)	DBC TOD	DBC TOD (2 zones)
Alignment of charges with **time saved**	R^2 value	1.0	0.2	0.2	0.4	0.3	0.6	0.7	0.8	0.3	0.6	0.7
Alignment of charges with **use**	R^2 value	0.3	0.0	0.0	0.5	0.5	0.2	0.2	0.3	1.0	0.3	0.3

Figure 3: Scatterplots for alignment between charges and travel time savings for selected Round 2 scenarios

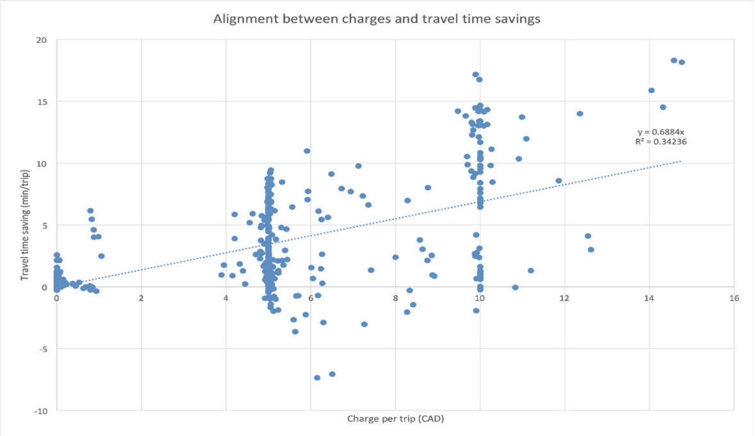
Marginal Social Cost



The marginal social cost *(MSC)* rate is designed to ensure that there is strong alignment between the charge paid per trip, and the travel time savings achieved for that trip.

R-squared = 0.95

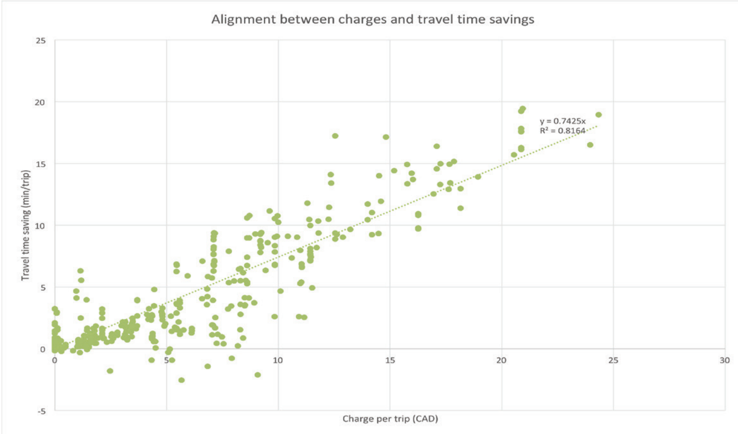
Bridges ($5/crossing)



Applying a flat all-day charge of $5 per crossing on 12 of the major bridges does not give a strong alignment between the cost per trip and the travel time savings of that trip. This is because the charge rate is fixed for all bridges in both directions all day regardless of the level of congestion.

R-squared = 0.34

Bridges (MSC)



Applying the approximated MSC rates to bridges achieves a better alignment between the charge paid per trip and the travel time savings of that trip. The rates vary between bridges, as well as by time of day and direction of travel, with higher charge rates associated with higher congestion.

R-squared = 0.82

How does revenue change across scenarios?

For the Round 2 analysis, methods were developed to estimate the system costs of each scenario so that net revenue and revenue collection efficiency could be calculated. A best estimate, or "likely" estimate, of system costs was developed in the following way across the different systems:

- **CBD:** Estimate based on a parametric analysis of the congestion charging system costs implemented in London, UK, and Gothenburg, Sweden.
- **Bridges:** Estimate based on the costs of TreO Radio Frequency Identification Technology used on Metro Vancouver's Port Mann Bridge prior to the removal of the tolls.
- **DBC:** Estimate based on bids received by the government of the Netherlands in 2006 to implement a distance-based charge system with on-board units that allows for variable charging by time and location.

To get a high contingency estimate, the system costs of point charging scenarios were increased by 30% and the system costs of distance-based charging scenarios were increased by 50%. The higher contingency factor for distance-based system costs reflects that there is greater uncertainty. While several other cities are considering the implementation of variable distance-based charging, the technology has not yet been implemented in an urban area. See *System Costs and Revenue Evaluation Brief (within Appendix B-3)* for details on the cost estimate methods.

The results of this analysis are displayed in Table 17. Key findings with respect to system costs and net revenue include:

- The CBD scenarios would generate net revenue to support regional transportation investment[7] and have the best revenue collection efficiency.
- *Bridges ($1)* does not generate sufficient net revenue to support regional transportation investment and has the worst revenue collection efficiency (>50%).
- The Bridges and DBC scenarios generate more net revenue than the benchmark. Bridges scenarios have lower system costs and higher revenue collection efficiency than DBC scenarios.
- The reduction in system costs of *Bridges TOD* compared to *Bridges ($5)* is due to the lower operating cost of processing a lower number of transactions when off-peak charges are removed.
- Removing the off-peak charges in *Bridges TOD* and *DBC TOD* results in a significant reduction

7 In evaluating the net revenues across scenarios, revenue of between $200 million to $400 million was used as a benchmark for whether a scenario was meeting the investment objective as set out in the Terms of Reference for the MPIC project.

in net revenue compared to flat charging all day in *Bridges ($5)* and *DBC ($0.15/km)* – *Bridges TOD* generates about $400 million less per year than *Bridges ($5)* and *DBC TOD* generates about $800 million less per year than *DBC ($0.15/km).*

Table 17: Decongestion charge revenue metrics for Round 2 scenarios

Metric	Units	CBD ($5)	CBD (MSC)	Bridges ($1)	Bridges ($5)	Bridges TOD	Bridges TOD and Dir	Bridges (MSC)	DBC ($0.15/km)	DBC TOD	DBC TOD (2 zones)
System Cost											
System Cost (likely)	$ / year	$30	$30	$210	$180	$120	$120	$180	$370	$380	$380
System Cost (high)	$ / year	$40	$40	$270	$230	$160	$160	$270	$555	$570	$570
Revenue											
Gross Revenue	$ million / year	$380	$340	$390	$1,615	$1,140	$1,120	$1,690	$2,210	$1,425	$1,350
Net Revenue (likely)	$ million / year	$350	$310	$180	$1,435	$1,020	$1,000	$1,510	$1,840	$1,045	$970
Net Revenue (high)	$ million / year	$340	$300	$120	$1,385	$980	$960	$1,420	$1,655	$855	$780
Revenue Collection Efficiency											
System Cost (likely) / Gross Revenue	%	8%	9%	54%	11%	11%	11%	11%	17%	27%	28%
System Cost (high) / Gross Revenue	%	11%	12%	69%	14%	14%	14%	16%	25%	40%	42%

What are the trade-offs between flat and variable charging?

Through changing variables in the rate design of scenarios, the Round 2 analysis aimed to highlight the trade-offs associated with rate design decisions. Table 18 and Table 19 highlight the trade-offs across the point charging and distance-based scenarios respectively.

Key observations from these tables include:

- Charges that vary by time and location are better aligned with time saved than flat all-day charges. The trade-off is that variable charging reduces alignment with use and reduces net revenues.
- Removing the off-peak charge in *Bridges TOD* and *DBC TOD* also reduces regional congested time savings compared to *Bridges ($5)* and *DBC ($0.15/km)*, respectively. This is likely due to a large number of trips saving very small amounts of time in the off-peak periods.
- *Bridges (MSC)* performs the same or better than *Bridges ($5)* across all of the criteria except alignment of charges with use.

Table 18: Round 2 analysis for point charge scenarios.

Objective	Units	Dir	CBD (MSC)	Bridges ($1)	Bridges ($5)	Bridges TOD	Bridges TOD and Dir	Bridges (MSC)
Congestion								
Regional Congested Time Savings	% change from baseline	L	-4%	-4%	-26%	-19%	-19%	-26%
Revenue (Congestion Charge)								
Net revenue	$million/year	H	$300 - $310	$120 - $180	$1385 - $1435	$980 - $1020	$960 - $1000	$1420 - $1510
Revenue Collection Efficiency								
Cost / Gross Revenue	%	L	9% -12%	54% - 69%	11% - 14%	11% - 14%	11% - 14%	11% - 16%
Fairness - Alignment with pricing principles								
Alignment of charges with time saved	R squared value	H	0.3	0.4	0.4	0.7	0.7	0.8
Alignment of charges with use	R squared value	H	0.0	0.5	0.5	0.2	0.2	0.3

Table 19: Round 2 analysis for DBC scenarios.

Objective	Units	Dir	MSC	DBC ($0.15/km)	DBC TOD	DBC TOD (2 zones)
Congestion						
Regional Congested Time Savings	% change from baseline	L	-70%	-23%	-16%	-17%
Revenue (Congestion Charge)						
Net revenue	$million/year	H	N/A	$1655 - $1840	$855 - $1045	$780 - $970
Revenue Collection Efficiency						
Cost / Gross Revenue	%	L	N/A	17% - 25%	27% - 40%	28% - 42%
Fairness - Alignment with pricing principles						
Alignment of charges with time saved	R squared value	H	1.0	0.3	0.6	0.7
Alignment of charges with use	R squared value	H	0.3	1.0	0.3	0.3

Commission Direction for Round 3

The Commission provided the following feedback to guide the development of Round 3 scenarios:

- Scenarios should be guided by both user pay and user cost – i.e. everyone should pay something in proportion to use, and people should pay more at times and in locations where congestion is greater;
- Those who pay should experience time savings (benefiter pay principle);
- Scenarios should be designed on a regional scale;
- Scenarios could be reasonably complex (in terms of charges that vary by location, time of day, etc.), if warranted by the benefits;
- Scenarios should generate sufficient revenue and should collect revenue efficiently;
- Scenarios should seek some alignment with availability of transportation options; and,
- Scenarios should explore a range of charge rates to understand the balance between congestion benefits and other impacts including household costs.

This direction led to the elimination of the following scenarios:

- *CBD* cordon and other localized cordon approaches, as these approaches would not address congestion at the regional scale.
- *Bridges ($1)* due to its poor revenue collection efficiency and congestion reduction performance.
- Flat rate charging scenarios, as similar congestion savings and revenue needs could be met with improved alignment of charges with time saved through varying rates in proportion to the MSC rates.

PART 5

Round 3 Analysis

PART 5. ROUND 3 ANALYSIS

In Round 3, a wide range of scenarios were defined and modelled to respond to the Commission's direction from Round 2. Generally, the approach was to model regional point charges and distance-based charges with variable charge rates to meet the user cost and benefiter pay principles while still maintaining a low flat base-rate (either through maintaining the fuel tax in the point charge scenarios or an all-day low per km charge in the distance-based scenarios) to meet the user pay principle. Key questions in the Round 3 analysis were:

- How do visible time savings and travel time reliability change across scenarios?
- What is the magnitude and distribution of charges across households?
- To what extent do the scenarios support regional objectives for transportation contained in the regional growth and transportation strategies?
- What are the trade-offs in objectives across scenarios?
- What are the net economic benefits of scenarios?

The Round 3 scenarios included:

Scenario Name	Description
Bridges	Charges applied to all 12 major regional bridges. Charges vary between bridges, as well as by time of day and by direction. Five charge levels based on a percentage of the MSC (25%, 37.5%, 50%, 75%, and 100%) were assessed (see Appendix B-1, Table B1-7 for full charge table). This scenario maintained the fuel tax at current rates to meet the user pay principle.
Bridges + NR	Similar to the Bridges scenario above, but with an additional cordon charge on the Burrard Peninsula applied along North Road (NR) which forms the boundary between Burnaby and New Westminster to the west and Port Moody and Coquitlam to the east. Five charge levels based on a percentage of the MSC (25%, 37.5%, 50%, 75%, and 100%) were assessed (see Appendix B-1, Table B1-7 for full charge table). This scenario was assumed to exist alongside the fuel tax at current rates to meet the user pay principle.
DBC 2 Zones Transit	Distance-based charge (DBC) for two zones that varies by time of day. A higher per km rate was applied to an "inner zone" that has generally more density, better transit accessibility, and greater congestion, with a lower per km rate applied to an "outer zone" (see Appendix B-1, Figure B1-5 for zone map) . Five charge levels based on a percentage of the MSC (25%, 37.5%, 50%, 75%, and 100%) were assessed (see Appendix B-1, Table B1-10 for full charge table). This scenario was assumed to replace the fuel tax, using a low per km charge in the off-peak period to meet the user pay principle.
DBC 8 Zones	DBC for eight zones based on aggregating areas with similar MSC rates that varies by time of day (see Appendix B-1, Figure B1-6 for zone map and Table B1-11 for zone descriptions). Five charge levels based on a percentage of the MSC (25%, 37.5%, 50%, 75%, and 100%) were assessed (see Appendix B-1, Table B1-12 for full charge table). This scenario was assumed to replace the fuel tax, using a low per km charge in the off-peak period to meet the user pay principle.

DBC Flat	Two charge levels were assessed based on flat rates of $0.10/km and $0.12/km. This scenario maintained the fuel tax at current rates. This scenario did not align with Commission direction from Round 2 but was run for comparison purposes.
Hybrid	A flat DBC of $0.08/km combined with a $3 charge on all bridges in the AM and PM peak hours only. This scenario replaced the fuel tax.

The range of charge rates at peak and off-peak times is displayed in Table 20 for each scenario. A range is provided here as the charges vary by bridge and direction for the point charge scenarios, and by zone for the DBC scenarios.

Table 20: Scenarios evaluated in the Round 3 analysis

Scenario Name	Charge Rate	Peak Charges	Off-Peak Charges	Regional Fuel Tax
Bridges (5 charge rates)	25% MSC	$1.08-$2.76	$0.26-$0.53	$0.018/km (on average across vehicles in Metro Vancouver)
	37.5% MSC	$1.63-$4.14	$0.39-$0.79	
	50% MSC	$2.17-$5.52	$0.52-$1.06	
	75% MSC	$3.25-$8.27	$0.78-$1.59	
	100% MSC	$4.33-$11.03	$1.05-$2.11	
Bridges + NR (5 charge rates)	25% MSC	$0.42-$2.76	$0.18-$0.53	$0.018/km (on average across vehicles in Metro Vancouver)
	37.5% MSC	$0.63-$4.14	$0.27-$0.79	
	50% MSC	$0.85-$5.52	$0.36-$1.06	
	75% MSC	$1.27-$8.27	$0.54-$1.59	
	100% MSC	$1.69-$11.03	$0.72-$2.11	
DBC 2 Zones Transit (5 charge rates)	25% MSC	$0.05-$0.09/km	$0.01-$0.02/km	$0/km
	37.5% MSC	$0.08-$0.13/km	$0.02-$0.03/km	
	50% MSC	$0.11-$0.18/km	$0.02-$0.04/km	
	75% MSC	$0.16-$0.26/km	$0.03-$0.06/km	
	100% MSC	$0.21-$0.35/km	$0.04-$0.08/km	
DBC 8 Zones (5 charge rates)	25% MSC	$0.01-$0.13/km	$0.01-$0.04/km	$0/km
	37.5% MSC	$0.02-$0.20/km	$0.02-$0.05/km	
	50% MSC	$0.02-$0.27/km	$0.02-$0.07/km	
	75% MSC	$0.03-$0.40/km	$0.03-$0.11/km	
	100% MSC	$0.04-$0.53/km	$0.04-$0.14/km	
DBC Flat (2 charge rates)	DBC Flat ($0.10/km)	$0.10/km	$0.10/km	$0.018/km (on average across vehicles in Metro Vancouver)
	DBC Flat ($0.12/km)	$0.12/km	$0.12/km	
Hybrid (1 charge rate)	Flat DBC + bridge charge in peak hours	$0.08/km + $3/passing all bridges	$0.08/km	$0/km

*Note that charge rates in Round 3 and 4 scenarios are the same for all vehicle classes (single occupancy vehicles, high occupancy vehicles, light good vehicles, and heavy goods vehicles). This was updated from the differentiated charges assumed in the model in Round 1 and 2 scenarios.

Evaluation Criteria and Metrics

The evaluation criteria and metrics used to compare Round 3 and Round 4 scenarios are described in Table 21.

Table 21: Evaluation criteria and metrics for Rounds 3 and 4.

<table>
<tr><th>Evaluation Criteria</th><th>Metric</th><th colspan="2">Description</th></tr>
<tr><td colspan="4">Congestion</td></tr>
<tr><td>Congested time savings</td><td>% change from baseline</td><td colspan="2">Reports the change in time spent in congestion for vehicle trips, relative to the Baseline 2030 scenario, where “congestion” is defined as traffic volume above a level of service D. Includes single occupancy and high occupancy personal vehicles (SOV/HOV), and light and heavy goods vehicles (LGV/HGV). Does not include transit vehicles.</td></tr>
<tr><td>Travel time savings</td><td>% change from baseline</td><td colspan="2">Reports the change in travel time for vehicle trips relative to the Baseline 2030 scenario. Includes SOV, HOV, LGV, HGV, and transit vehicles.</td></tr>
<tr><td>Visible congested time savings</td><td>% of congested households > 10 cong. mins savings</td><td colspan="2">Reports the % of households experiencing high levels of congestion that save more than 10 congested minutes per day. In the Baseline 2030 scenario, 23% of households that drive experience high levels of congestion, defined as households with >20 congested minutes/day.</td></tr>
<tr><td colspan="4">Fairness</td></tr>
<tr><td rowspan="3">Consistent treatment of users</td><td>Alignment of charges with use (R-squared)</td><td>Reports the degree of alignment between charges ($/trip) and use (km/trip). Answers the question: do the people who use the road system more contribute more?</td><td rowspan="3">The R-squared values can be interpreted as follows:
• < 0.2 = Very weak alignment
• 0.2 to 0.4 = Weak alignment
• 0.4 to 0.6 = Moderate alignment
• 0.6 to 0.8 = Strong alignment
• >0.80 = Very strong alignment</td></tr>
<tr><td>Alignment of charges with congestion contribution (R-squared)</td><td>Reports the degree of alignment between charges and contribution to congestion. Answers the question: To what extent are trips that contribute more to congestion being charged?</td></tr>
<tr><td>Alignment of charges with time saved (R-squared)</td><td>Reports the degree of alignment between charges and time saved. Answers the question: To what extent are those who pay more getting greater time-saving benefits?</td></tr>
<tr><td>Availability of transportation choices</td><td>Alignment of charges with the ratio of transit time/ personal vehicle time</td><td colspan="2">Reports the degree of alignment between trip charges and transit options. Answers the question: does the scenario have higher charges for trips that can be relatively easily conducted by transit, and lower charges for trips where transit is a less good substitute?</td></tr>
</table>

Evaluation Criteria	Metric	Description
Household charges – Households that pay decongestion charge (Household charges for baseline travel patterns)	Daily ($/day/ household)	Household charges are estimated based on household travel patterns in the baseline scenario (based on the 2011 Metro Vancouver Regional Trip Diary Survey). This metric includes both decongestion charges and fuel taxes where applicable. Statistical distributions of daily charges for two groups were calculated: (1) households that make at least one trip in the Trip Diary Survey that would pay a decongestion charge, and (2) all households that drive at least once in the Trip Diary Survey.
	Annual ($/year/ household)	The daily charges as determined by the Trip Diary are multiplied by a factor of 335 to get an annual charge per household. This is consistent with expansion factors used elsewhere in transportation demand modelling. Statistical distributions are calculated for the same groups as for daily charges.
Income equity	Charges as a % of annual income for low, medium, and high income groups	Reports the distribution of charges per year as a % of household income, for three income classes: (1) low: <$50,000/year, (2) medium: $50,000-$100,000/year, and (3) high: >$100,000 per year. Based on the 2011 Trip Diary with data on the regional travel patterns for households of different income levels.
	Amount needed to offset income inequity	The total amount of revenue needed to offset income inequity for a given decongestion charging scenario.
Investment / Revenue		
Decongestion charge (DC) revenue	DC gross revenue	Amount of revenue collected from the decongestion charge prior to any deductions for system costs or other costs.
	DC system costs (likely)	The likely capital and ongoing cost of operating the decongestion charging system, or the best estimate of annual operating cost.
	DC system costs (high contingency)	High contingency capital and operating cost estimate for the decongestion charging system. Should be interpreted as a low probability worst case scenario.
	DC net revenue (likely)	Gross revenue minus the annual capital and operating costs for the *likely* estimate of system costs.
	DC net revenue (high contingency)	Gross revenue minus the annual capital and operating costs for the *high contingency* estimate of system costs.
Other revenue	Fuel tax net revenue	Annual revenue generated by the regional fuel tax (i.e. $0.17/L).

Evaluation Criteria	Metric	Description
Revenue collection efficiency (decongestion charge)	System costs (likely) / Gross Revenue	This ratio represents the likely revenue collection efficiency – i.e. what portion of a dollar collected goes toward paying the cost of implementing and operating the decongestion charge.
	System costs (high contingency) / Gross Revenue	Same as above but represents the revenue collection efficiency using the high contingency system cost estimate.
Environment, Health & Contribution to Regional Transportation Strategy (RTS)		
Climate change	% change in transportation-related GHG emissions from 2030 baseline	Reports the GHG emissions from all modes of travel as a % change from the *Baseline 2030* scenario (note that GHG emissions from light duty vehicles makes up about 36% of total GHG emissions in the region).
Environment, health, & RTS Target 1	Mode share, transit; walking and biking, high occupancy vehicles (% of daily trips)	Reports % of daily trips made by walking, cycling, transit, and high occupancy vehicles.
Environment, health & RTS Target 2	% change in VKT/capita from 2016 baseline	Reports the VKT/capita and the percent change in VKT/capita from the *2016 Baseline* scenario. The higher the reduction in VKT/capita compared to the *2016 Baseline* scenario, the more a scenario is contributing to achieving the RTS target to reduce distance travelled per capita by one third by 2045.

How do visible time savings change across scenarios?

In Round 3, analysis was done to explore possible metrics for comparing the performance of scenarios on *visible time savings* at the household scale. Research shows that reducing time in congestion by 1 to 2 minutes tends not to be noticeable to road users, while savings of 10 minutes or more will have more likelihood of being perceived as a benefit. The relative and absolute savings in congested time was calculated across households in the 2011 Trip Diary dataset (~650,000 households) and for subsets of these households according to the amount of congested time per day a household experiences in the *Baseline 2030* scenario: 0-5 min (47% of households), 5-10 min (13% of households), 10-20 min (17% of households), 20-35 min (14% of households), >35 min (10% of households) and >20 min (23% of households). Note that this only takes into account "normal" congestion, and does not consider travel time variability caused by incidents in the road network that account for a proportion of delays.

This analysis determined that looking at the proportion of households that save more than 10 congested minutes within the subset of households experiencing >20 congested minutes per day in the baseline is a meaningful indicator of a scenario's performance on visible time savings at the household scale (Table 22). Looking at time savings across all households is also useful for understanding the benefits of decongestion charging for the population at large (Table 23). However, in interpreting the numbers for all households, note that 60% of these households experience less than 10 minutes of congested time per day in the *Baseline 2030* scenario and therefore have no possibility to save more than 10 minutes of congested time in "normal" congestion in a decongestion charging scenario. Again, the analysis does not account for diminished journey time reliability caused by incidents or other "non-recurring" congestion.

Table 22: Relative and absolute congested time savings for households that experience >20 congested min/day in Baseline 2030.

	All Households with >20 cong min/day in Base							
	Relative Daily Congested Time Savings				Absolute Daily Congested Time Savings			
Scenario	>20%	>30%	>40%	>50%	>5 min	>10 min	>15 min	>20 min
Bridges (37.5%)	31%	6%	1%	0%	44%	10%	2%	1%
Bridges (75%)	59%	40%	18%	4%	68%	39%	13%	5%
Bridges + NR (37.5%)	36%	9%	2%	0%	52%	15%	4%	1%
Bridges + NR (50%)	52%	23%	5%	1%	64%	25%	8%	2%
Bridges + NR (75%)	67%	45%	21%	6%	76%	44%	17%	6%
DBC ($0.10/km)	16%	2%	1%	0%	41%	8%	2%	1%
DBC 2 Zone Transit (25%)	3%	1%	0%	0%	15%	2%	1%	0%
DBC 2 Zone Transit (37.5%)	9%	1%	1%	0%	32%	6%	1%	0%
DBC 2 Zone Transit (50%)	46%	7%	1%	0%	64%	19%	6%	2%
DBC 2 Zone Transit (75%)	74%	29%	4%	1%	81%	32%	12%	4%
DBC 2 Zone Transit (100%)	91%	69%	31%	6%	93%	58%	27%	13%
DBC 8 Zone (25%)	4%	1%	1%	0%	20%	4%	1%	0%
DBC 8 Zone (37.5%)	20%	2%	1%	0%	43%	10%	3%	1%
DBC 8 Zone (50%)	58%	17%	1%	1%	71%	25%	9%	3%
DBC 8 Zone (75%)	77%	45%	15%	1%	83%	41%	18%	8%
DBC 8 Zone (100%)	91%	74%	46%	19%	92%	65%	35%	18%
Hybrid	50%	25%	7%	1%	67%	26%	7%	2%
MSC	100%	100%	100%	100%	100%	100%	97%	73%

Table 23: Relative and absolute congested time savings for all households that drive.

	All Households							
	Relative Daily Congested Time Savings				Absolute Daily Congested Time Savings			
Scenario	>20%	>30%	>40%	>50%	>5 min	>10 min	>15 min	>20 min
Bridges (37.5%)	29%	12%	6%	4%	12%	2%	1%	0%
Bridges (75%)	48%	34%	20%	10%	22%	9%	3%	1%
Bridges + NR (37.5%)	31%	14%	7%	4%	14%	3%	1%	0%
Bridges + NR (50%)	41%	23%	11%	6%	18%	6%	2%	1%
Bridges + NR (75%)	52%	37%	23%	12%	24%	11%	4%	1%
DBC ($0.10/km)	23%	9%	5%	4%	10%	2%	0%	0%
DBC 2 Zone Transit (25%)	10%	5%	4%	3%	4%	0%	0%	0%
DBC 2 Zone Transit (37.5%)	19%	9%	5%	4%	8%	1%	0%	0%
DBC 2 Zone Transit (50%)	43%	17%	9%	6%	16%	4%	1%	0%
DBC 2 Zone Transit (75%)	61%	33%	15%	9%	22%	8%	3%	1%
DBC 2 Zone Transit (100%)	74%	56%	32%	17%	29%	14%	6%	3%
DBC 8 Zone (25%)	12%	6%	4%	3%	5%	1%	0%	0%
DBC 8 Zone (37.5%)	25%	10%	6%	4%	10%	2%	1%	0%
DBC 8 Zone (50%)	48%	22%	10%	6%	18%	6%	2%	1%
DBC 8 Zone (75%)	59%	39%	20%	10%	24%	10%	4%	2%
DBC 8 Zone (100%)	70%	56%	39%	23%	30%	16%	8%	4%
Hybrid	47%	25%	12%	6%	19%	6%	2%	1%
MSC	99%	99%	99%	98%	49%	35%	24%	17%

How do congested time savings compare with the MSC scenario?

In the visible time savings analysis above, the *MSC* scenario outperforms the point charging and distance-based scenarios significantly, even for those scenarios that are so-called "100%" of the recommended rates of the *MSC* scenario. The reason for this is that the *MSC* scenario is charging each road link in the model according to travel time costs on that link and is dynamically changing rates based on travel demand. The point charging and distance-based charging scenarios in Round 3 are fixing the charge in a particular location and time of day to approximate the more dynamic pricing at the road link level in the *MSC* scenario. For example, for a distance-based charge, approximating the MSC recommended rates involves averaging the MSC rates across the road-links in a particular zone and time period. As a result of this averaging, road links are typically over or under the MSC recommended rate. When charge rates are above the MSC recommended rate, this brings down alignment of charges with travel time savings compared to what is achieved in the *MSC* scenario. When charge rates are below the MSC recommended rate, it results in lower levels of congested time savings compared to the *MSC* scenario.

How does travel time reliability change across scenarios?

In addition to the congested time savings from a decongestion charging scenario, another important benefit is improved travel time reliability. Travel time reliability is a function of the variation in travel times for a given trip. As traffic volumes increase, travel time reliability decreases. That is because even a small disturbance of traffic conditions, such as a single vehicle breaking down on a highway, will generate large consequences where there is no capacity margin. Individuals tend to remember the worst delays, and will often have to adjust their everyday departure times to be able to account for those worst cases when they occur. This leads to additional loss in other productive time, family time, or recreation time. Therefore, reducing the variance of travel times can have a larger effect on the total time that is 'allocated' to travel, and on the total perceived cost of travel time, than it has on average journey times.

The RTM does not directly simulate changes in travel time reliability. Refer to Appendix B-2 for a description of how this metric was developed. Improvements in travel time reliability can be found for all Round 3 scenarios. For the scenarios where the charge rate is based on an approximation of the MSC, reliability improves by 7-10% at the low-end of the charge rates (25% MSC), and improves by up to 22-29% at the very high-end of the charge rates (100% MSC), where the distance-based scenarios outperform the bridge scenarios.

Table 24: Regional Travel Time Reliability for Round 3 scenarios

		MSC Rates				
Scenario		25%	37.5%	50%	75%	100%
Bridges		-10%	-13%	-16%	-20%	-22%
Bridges + NR		-10%	-14%	-17%	-20%	-23%
DBC 2 zones		-7%	-11%	-17%	-21%	-27%
DBC 8 zones		-8%	-12%	-18%	-23%	-29%
DBC ($0.10/km)	-13%					
DBC ($0.12/km)	-15%					
Hybrid	-19%					

What is the magnitude and distribution of charges across households?

Daily Charges

Household charges are estimated based on household travel patterns in the 2011 Trip Diary. That is, they do not take account of any behavioral adaptations in response to the price signal and they do not take into account any caps, discounts, or exemptions that might be applied. The household charges reported here represent the price signal that households experience in any given scenario and therefore provide an upper bound of estimated costs. In reality, some households will choose to reduce costs by changing their behaviour in response to this price signal and other households will choose to stay and pay. That makes these estimates an overestimate of the likely actual out-of-pocket household charges. This metric includes the costs of both decongestion charges and fuel taxes.

Statistical distributions of daily charges for two sets of households were calculated: (1) households that make at least one trip in the Trip Diary that would pay a decongestion charge, and (2) all households that drive at least once in the Trip Diary. For distance-based scenarios, these two sets of households are identical – all households that drive also pay the decongestion charge. For point charging scenarios, only households that pass a point charge location as per their travel patterns in the Trip Diary are included in the first set. For the *Bridges* scenarios, 37% of households that drive in the Trip Diary would pay the decongestion charge. For the *Bridges + NR* scenarios, 45% of households that drive in the Trip Diary would pay the decongestion charge.

Boxplots for the estimated range of daily household charges are shown in Figure 4. As expected, as the charge rates increase across each scenario (*Bridges, Bridges+NR, DBC 2 Zone Transit, and DBC 8 Zone*), the daily household charges also increase. There is also a trend across all scenarios whereby higher charge rates result in higher variability in household charges (i.e. a larger difference in charges across households). Across all scenarios, the average charges are higher than the median, indicating that the average is being pulled upwards by high outliers. A daily cap, if implemented, would bring this average down.

How to read a 'Boxplot'

Boxplots are used to illustrate the range of household costs. They allow us to see the difference between those households paying the most and those paying the least. The larger the box, the greater the spread of values from highest to lowest.

All box plots in this report are structured as follows: The bottom and the top of each box represent the 25th and 75th percentiles respectively. The ends of the whiskers represent the 10th and 90th percentiles, respectively. The line in the middle is the median and the dot is the average.

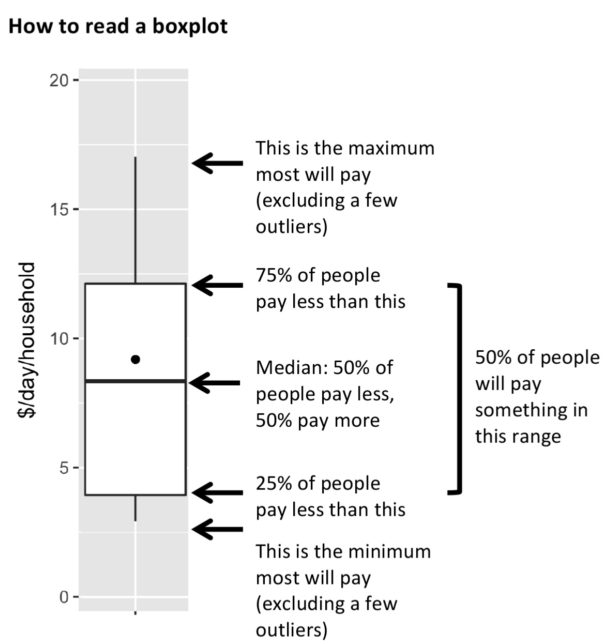
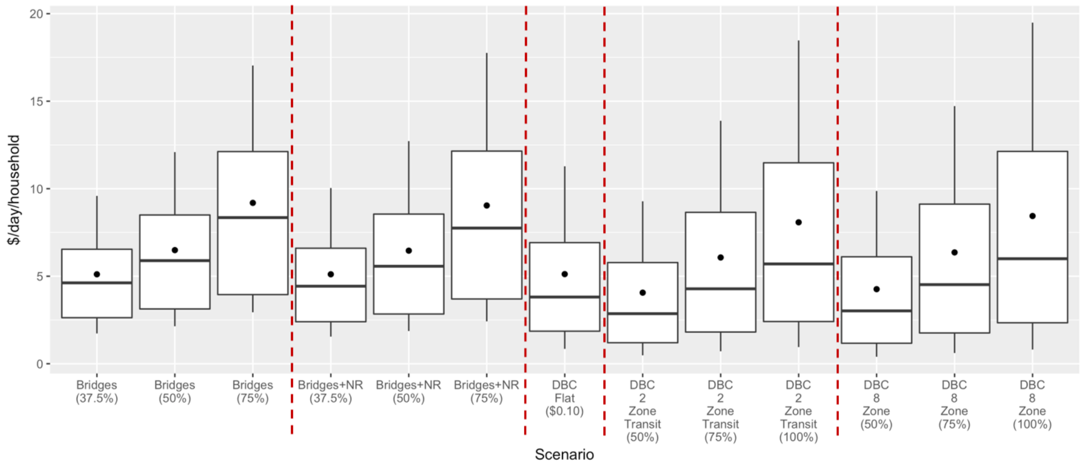


Figure 4: Boxplots of daily household charges for selected Round 3 scenarios



Note: These boxplots include decongestion charges and fuel taxes as defined by each scenario. The output represents households that "paid" based on the Trip Diary (i.e. it does not include households that did not make a driving trip or, for the Bridges and Bridges+NR scenarios, that did not pass a point charge location and thus would have paid $0).

Annual Charges and Income Equity

The daily charges as determined by the Trip Diary are multiplied by a factor of 335 to estimate an annual charge per household[8]. All of the scenarios result in higher income households paying more in absolute terms than lower income households. Because driving is expensive, lower-income households have likely already reduced their discretionary trips. However, lower income households will pay more as a percentage of their annual income than higher income households. Decongestion charges, like all fees and taxes not explicitly based on income, have this outcome in the absence of complementary policies to guide the redistribution of revenues collected. Consequently, how the funds from the charging policy are used, and the distributional profile of those expenditures, will matter for the overall equity of the charge. For selected Round 3 scenarios, the cost per household and the percentage of annual income is calculated for low, medium, and high income groups, and is shown in Table 25.

Table 25: Median household charges (decongestion charge and fuel tax) by income group for households that pay decongestion charge.

Metric	Units	Income group	Bridges + NR (37.5%)	Bridges + NR (75%)	DBC 2 zone Transit (37.5%)	DBC 2 zone Transit (75%)
Annual Household Charges* *(for median household in each income group)*	$/yr/ household	Low	$1300	$2300	$500	$1000
		Medium	$1400	$2400	$700	$1300
		High	$1600	$3000	$1000	$2000
	% annual income	Low	4.1%	7.5%	1.6%	3.2%
		Medium	1.8%	3.2%	0.9%	1.8%
		High	1.0%	1.8%	0.6%	1.2%

*Annual household charges presented in this table are calculated by taking the median daily charges per household in each income group, multiplying by a scalar of 335, and rounding to the nearest hundred dollars. Proportion of annual income is calculated by multiplying the median annual charges by the median income of each income group. Low income group is defined as households with income < $50,000/year and a median income of $31,000/year. Medium income group is defined as households with income of $50,000 to $100,000/year and a median income of $75,000/year. High income households are defined as households with income >$100,000/year and a median income of $162,000. Median household incomes for each category are from the 2011 Metro Vancouver Regional Trip Diary Survey.

8 This expansion factor is consistent with annual expansion factors used elsewhere in transportation demand modelling.

To what extent do the scenarios support regional objectives?

TransLink's Regional Transportation Strategy (RTS) Strategic Framework, issued in 2013, contains two headline targets for 2045:

- make half of all trips by walking, cycling and transit; and,
- reduce the distances people drive by one-third.

See Appendix B-3 (RGS/RTS Evaluation Brief) for more on the Regional Transportation Strategy framework and the Regional Growth Strategy.

The change in mode share, VKT, and greenhouse gas (GHG) emissions results are shown in Table 26 for point charge and distance-based scenarios with lower and higher charge rates. Since the RTM does not include all of the ways that people will adapt to a decongestion charge, these results are a conservative or lower bound estimate of change for these metrics.

Summary conclusions from these results include:

- All decongestion charging scenarios will reduce GHG emissions, increase mode share for walking, cycling, and transit, and reduce VKT relative to the *Baseline 2030* scenario. Generally, the performance of scenarios on these metrics is driven by the magnitude of the decongestion charge across trips and the number of vehicle trips that are covered by a decongestion charge.
- Even at the higher end of charge rates modelled in Round 3, the RTM is not predicting significant mode shift as a direct result of decongestion charging. In *Bridges + NR (100%)* and *DBC 8 Zone (100%)*, the increase in mode share for walking, cycling and transit is 1 and 2 percentage points respectively. This result—that most people tend to stay and pay or make adaptations other than mode shift (like driving less and/or driving to different destinations)—is consistent with the experience of decongestion charging in other jurisdictions; however, the RTM is not highly sensitive to mode shift to walking and cycling, so mode share results must be interpreted cautiously.
- At scenarios with higher charges (100% MSC rates), the reduction in total VKT and VKT/capita is in the range of 7-9% percent change from *Baseline 2030*, while at the lower charge levels (25% MSC rates), reduction in total VKT and VKT/capita is about 2% (note that *Baseline 2030* predicts an 8% reduction in VKT/capita from 2016 in the absence of a decongestion charging policy).
- Reduction in GHG emissions across scenarios generally tracks reduction in VKT.

Table 26: Greenhouse gas (GHG) emissions, mode share, and vehicle kilometres travelled (VKT) for selected Round 3 scenarios.

Metric	Units	Dir	Baseline 2030	DBC Flat ($0.10)	Bridges+NR (25%)	Bridges+NR (100%)	DBC 8 Zone (25%)	DBC 8 Zone (100%)
Environment, Health, & Contribution to Regional Transportation Strategy (RTS)								
GHG Emissions (all modes)	% change from 2030 baseline	L	0%	-3%	-1%	-5%	-1%	-6%
RTS Target 1: Mode Share Walking, Cycling, Transit	% daily trips	H	26%	27%	26%	27%	26%	28%
Mode share - High occupancy vehicles	% of daily trips	H	34%	34%	34%	34%	34%	34%
Mode share - Single occupancy vehicles	% of daily trips	L	40%	39%	39%	38%	39%	38%
RTS Target 2: VKT/Capita (private car)	vkt / capita / year	L	4,572	4,373	4,474	4,217	4,493	4,139
RTS Target 2: VKT/Capita (private car)	% change from 2016 baseline	L	-8%	-12%	-10%	-15%	-10%	-17%
Total VKT (all modes)	million vkt / year	L	15,230	14,610	14,930	14,140	14,990	13,890
Total VKT (all modes)	% change from 2030 baseline	L	0%	-4%	-2%	-7%	-2%	-9%

Legend
Better than selected
Worse than selected
Selected
Within 10% difference of selected
*"Dir" column indicates preferred direction of change; "H" indicates higher values are preferred and "L" indicates lower values are preferred (all else equal).

How do the point charge scenarios compare?

Round 3 allows for the comparison of the Bridges scenario, where point charges are located just on the 12 major bridges, and the *Bridges + North Road (NR)* scenario where point charges are added along North Road (which forms the boundary between Burnaby and New Westminster to the west and Port Moody and Coquitlam to the east) to capture additional traffic and congestion on the Burrard Peninsula (Table 27). As expected, congestion reduction, gross and net revenues, and household charges all rise as charge rates rise, while cost as a percentage of gross revenues drops. Other findings include:

- The addition of point charges along North Road increases gross revenues, system costs, and net revenue. Overall congestion reduction improves slightly with a more substantial improvement in visible congestion reduction. Household charges are roughly unchanged, though the proportion of households that pay on a typical day increases.
- A difference between the *Bridges and Bridges + NR* scenarios is in their alignment of charges with time saved and contribution to congestion. Adding the charge points along North Road captures more trips that are contributing to congestion and thus improves *Alignment of Charges with Congestion Contribution*. However, *Bridges + NR (75%)* performs worse on *Alignment of Charges with Time Saved*. More investigation would be needed to confirm what is driving this difference.

How do the DBC scenarios compare?

Round 3 allows for a comparison of a distance-based charging scenario that is 'flat' (stays the same at all locations and times of day), with different 'variable' distance-based charge scenarios that vary charges by location and time of day. Table 28 compares results for a *DBC Flat ($0.10)* with results for *DBC 2 Zone Transit* and *DBC 8 Zone*, each at four different rates – 25%, 50%, 75% and 100% of the rates recommended by the *MSC* scenario. Similar to the point charge scenarios, congestion reduction, gross and net revenues, and household charges all rise as charge rates rise, while cost as a percentage of gross revenues drops. Other findings include:

- **Alignment of Charges:** The metrics for *Consistent Treatment of Users* shows that no DBC scenario has a strong relationship on all three of the metrics representing benefiter pay, user pay, and user cost pricing principles:
  - *DBC Flat ($0.10)* performs the best on *Alignment of Charges with Use*, but has a weak relationship for *Alignment of Charges with Time Saved and Alignment of Charges with Congestion Contribution.*
  - All of the multi-zone DBC scenarios have a moderate to strong relationship for *Alignment of Charges with Time Saved* and *Alignment of Charges with Congestion Contribution* and have a weaker relationship for *Alignment of Charges with Use*, relative to *DBC Flat ($0.10/km).*
  - *DBC 2 Zone Transit* scenarios have a stronger relationship for A*lignment of Charges with Use* than *DBC 8 Zone* scenarios.
  - The *Hybrid* scenario improves *Alignment of Charges with Use* relative to the multi-zone DBC scenarios and improves *Alignment of Charges with Time Saved* relative to *DBC Flat ($0.10/km)* but does not perform as well on *Alignment of Charges with Congestion Contribution* as the *DBC 8 Zone* scenarios.
- **Benefits of more zones:** *DBC 8 Zone* scenarios perform similarly to *DBC 2 Zone Transit* scenarios across many metrics, but noticeable differences are that at comparable MSC rates (e.g. 75% and 100%), *DBC 8 Zone* scenarios perform better on *Visible Time Savings*

and *Alignment of Charges with Time Saved*, indicating that adding zones allows for closer approximation of the rates recommended in the *MSC* scenario (the *MSC* scenario performs better than any other scenario in Rounds 1 to 4 on both *Visible Time Savings* and *Alignment of Charges with Time Saved).*

- **Further optimization required.** Closer examination of the modelling results is likely to identify ways to refine/optimize charges to improve performance under both the 2-zone and 8-zone approach, and may suggest a different number of zones or different zone boundaries.

Table 27: Evaluation matrix for selected Round 3 point charging scenarios

Metric	Units	Dir	Bridges (37.5%)	Bridges (75%)	Bridges+NR (37.5%)	Bridges+NR (50%)	Bridges+NR (75%)
Congestion							
Total Regional Congested Time Savings	% change from Base	L	-14%	-23%	-16%	-19%	-24%
Visible Time Savings	% congested HHDs > -10 cong min	H	10%	39%	15%	25%	44%
Revenue - Decongestion Charge (DC) and Fuel Tax							
DC Gross Revenue	$2017million/year	H	$660	$1,180	$740	$950	$1,310
DC System Costs	$2017million/year	H	$130 - $170	$120 - $160	$150 - $200	$150 - $190	$140 - $180
DC Net Revenue	$2017million/year	H	$490 - $530	$1020 - $1060	$540 - $590	$760 - $800	$1130 - $1170
Fuel Tax Gross Revenue	$2017million/year	H	$287	$281	$286	$284	$280
Revenue Collection Efficiency - Decongestion Charge							
System Costs / Gross Revenue	%	L	20% - 26%	10% - 14%	20% - 27%	16% - 20%	11% - 14%
Consistent Treatment of Users							
Alignment of Charges with Time Saved	R2 of min/trip vs $/trip	H	0.8	0.8	0.8	0.8	0.7
Alignment of Charges with Use	R2 of Km/trip vs $/trip	H	0.4	0.3	0.4	0.4	0.3
Alignment of Charges with Cong. Contribution	R2 of min/trip vs $/trip	H	0.6	0.6	0.7	0.7	0.7
Alignment of Charges with Transit Time	R2 of transit/car time vs $/trip	H	0.3	0.3	0.3	0.3	0.3
Household Charges - Households that pay decongestion charge							
Median - Daily	$/day/household	L	$5	$8	$4	$6	$8
75th percentile - Daily	$/day/household	L	$7	$12	$7	$9	$12
Environment, Health, & Contribution to Regional Transportation Strategy (RTS)							
GHG Emissions (all modes)	% change from 2030 baseline	L	-2%	-3%	-2%	-2%	-3%
RTS Target 1: Mode Share Walking, Cycling, Transit	% daily trips	H	26%	27%	26%	27%	27%
RTS Target 2: VKT/Capita (private car)	% change from 2016 baseline	L	-11%	-13%	-11%	-12%	-14%

Legend
*"Dir" column indicates preferred direction of change; "H" indicates higher values are preferred and "L" indicates lower values are preferred (all else equal).

Table 28: Evaluation matrix for selected Round 3 distance-based scenarios. "N/A" means data not available for this cell.

Metric	Units	Dir	DBC Flat ($0.10)	DBC 2 Zone Transit (25%)	DBC 2 Zone Transit (50%)	DBC 2 Zone Transit (75%)	DBC 2 Zone Transit (100%)	DBC 8 Zone (25%)	DBC 8 Zone (50%)	DBC 8 Zone (75%)	DBC 8 Zone (100%)	Hybrid
Congestion												
Total Regional Congested Time Savings	% change from Base	L	-13%	-7%	-18%	-23%	-30%	-8%	-20%	-25%	-33%	-21%
Visible Time Savings	% congested HHDs > -10 cong min	H	8%	2%	19%	32%	58%	4%	25%	41%	65%	26%
Revenue - Decongestion Charge (DC) and Fuel Tax												
DC Gross Revenue	$2017million/year	H	$1,380	$750	$1,450	$2,140	$2,750	$720	$1,380	$2,020	$2,590	$1,650
DC System Costs	$2017million/year	H	$380 - $580	$390 - $590	$380 - $570	$380 - $560	$370 - $550	$390 - $590	$380 - $570	$380 - $570	$370 - $550	$380 - $570
DC Net Revenue	$2017million/year	H	$800 - $1000	$160 - $360	$880 - $1070	$1580 - $1760	$2200 - $2380	$130 - $330	$810 - $1000	$1450 - $1640	$2040 - $2220	$1080 - $1270
Fuel Tax Gross Revenue	$2017million/year	H	$283	$0	$0	$0	$0	$0	$0	$0	$0	$0
Revenue Collection Efficiency - Decongestion Charge												
System Costs / Gross Revenue	%	L	27% - 42%	52% - 78%	26% - 39%	18% - 26%	13% - 20%	54% - 82%	28% - 41%	19% - 28%	14% - 21%	23% - 35%
Consistent Treatment of Users												
Alignment of Charges with Time Saved	R2 of min/trip vs $/trip	H	0.3	0.6	0.6	0.6	0.6	0.7	0.7	0.9	0.7	0.7
Alignment of Charges with Use	R2 of Km/trip vs $/trip	H	1.0	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.5
Alignment of Charges with Cong. Contribution	R2 of min/trip vs $/trip	H	0.2	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.5
Alignment of Charges with Transit Time	R2 of transit/car time vs $/trip	H	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Household Charges - Households that pay decongestion charge												
Median - Daily	$/day/household	L	$4	$1	$3	$4	$6	$2	$3	$5	$6	$3
75th percentile - Daily	$/day/household	L	$7	$3	$6	$9	$11	$3	$6	$9	$12	$7
Environment, Health, & Contribution to Regional Transportation Strategy (RTS)												
GHG Emissions (all modes)	% change from 2030 baseline	L	-3%	-1%	-3%	-4%	-6%	-1%	-3%	-4%	-6%	-3%
RTS Target 1: Mode Share Walking, Cycling, Transit	% daily trips	H	27%	26%	27%	27%	28%	26%	27%	27%	28%	N/A
RTS Target 2: VKT/Capita (private car)	% change from 2016 baseline	L	-12%	-10%	-13%	-15%	-18%	-10%	-13%	-14%	-17%	-14%

Legend
*"Dir" column indicates preferred direction of change; "H" indicates higher values are preferred and "L" indicates lower values are preferred (all else equal).

What are the total economic benefits of scenarios?

In addition to a multi-attribute evaluation, an economic benefits analysis was completed for Round 3 scenarios. Total economic benefits is a measure for understanding and communicating the value of a policy or investment to society as a whole according to established economic methods. The calculation of total economic benefits includes both values that are monetized in the market economy (e.g. out-of-pocket household travel costs) and non-monetized values (e.g. travel time and inconvenience). In calculating total economic benefits, non-monetized values are given a monetary value through various economic methods. For example, a monetary value for time can be determined by looking at how people choose between travel options that are different in travel times and travel costs.

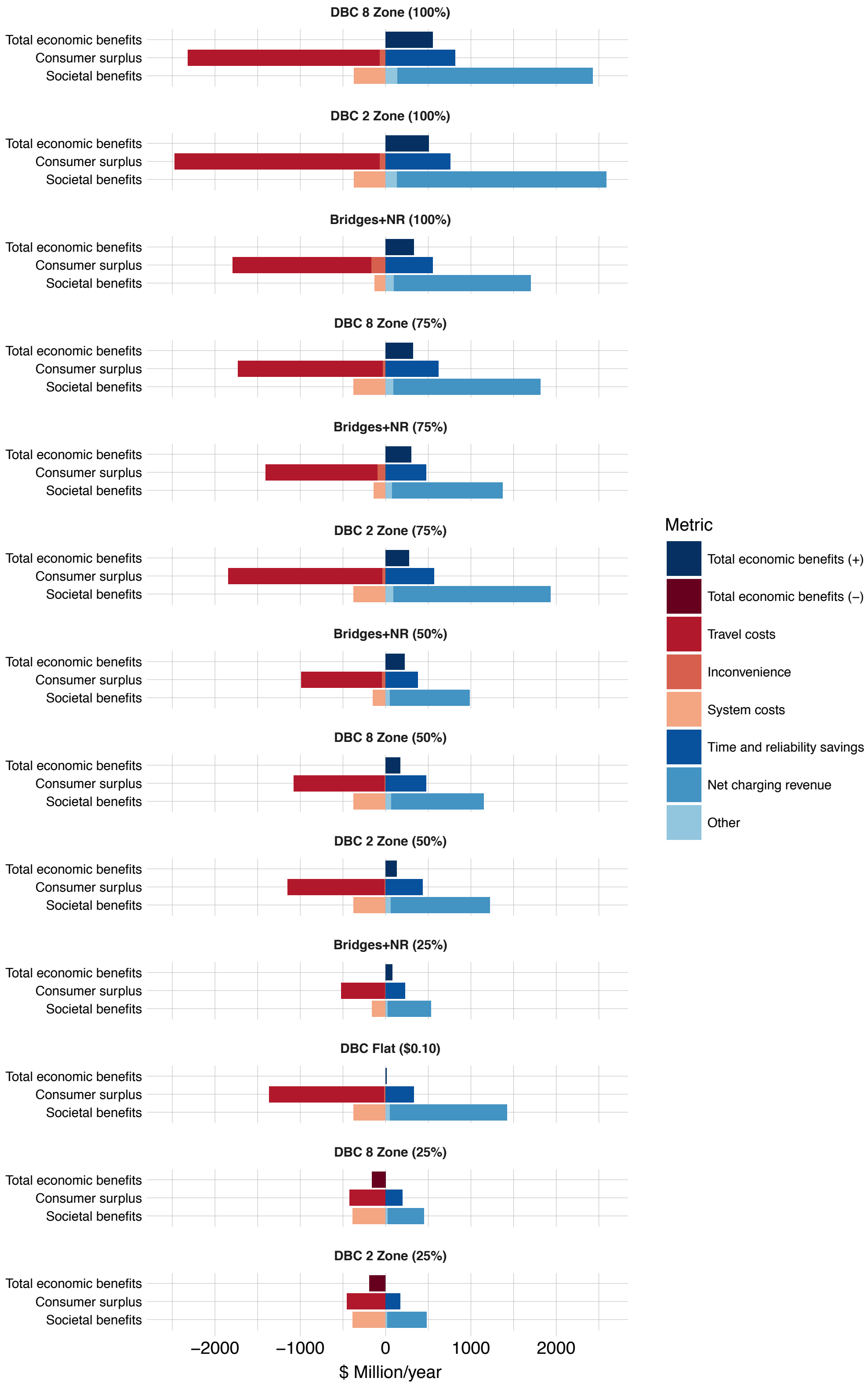
In this project, the calculation of total economic benefits involved the estimation of gains and losses across the following components:

- **Consumer Surplus** – the private welfare gains and losses from a decongestion charging scenario, including:
  - *Travel time savings* – the welfare gain experienced due to time savings for vehicle and transit trips (including gains in travel time reliability).
  - *Inconvenience costs* – the welfare loss experienced because some people have shifted modes or destinations to their 'second best' option which typically has a higher travel time than their first best option in the baseline scenario.
  - *Travel costs* – the change in welfare associated with a change in travel costs under a given scenario, including changes in financial costs for fuel, maintenance, and decongestion charges.
- **Societal benefits** – the public or shared welfare gains and losses under the scenario, including:
  - *GHG emissions* - the welfare gain associated with reducing greenhouse gas emissions caused by congested road conditions.
  - *Road infrastructure and maintenance* – the financial cost savings for reinvestment in road infrastructure and maintenance associated with lower peak travel demand and lower VKT.
  - *Decongestion charging and fuel tax revenue* – the societal gain from using revenue for public purposes (such as investment in transportation sector) or reducing other public taxes and fees (Note that charges are also included as a loss in the calculation of consumer surplus. In the total economic benefits these two items balance out).
  - *System costs* – the costs for providing and operating the necessary technical and administrative system. The likely system cost estimate is used in the economic benefits calculation.

For details on the calculation methods for economic benefits, see Appendix B-3, *Economic Benefits EvaluationBrief.*

The results of the economic analysis are shown in Figure 5 for selected Round 3 scenarios.

Figure 5: Economic benefits results for selected Round 3 scenarios. Cool colours (blues) indicate positive values and warm colours (reds) indicate negative values. Total economic benefits are the sum of consumer surplus and societal benefits value. The value of the total economic benefit of each scenario is written on each panel.



Key conclusions from the economic benefits analysis include:

- Total economic benefits for a given scenario are driven mainly by the balance between a welfare gain in time savings and a welfare loss in the cost of operating the decongestion charge. Inconvenience costs and other components (value of GHG emissions and reduced road maintenance) are more minor factors in the calculation of total economic benefits. Other components, such as travel costs and net charging revenue do not amount to a significant net gain/loss. In an economic analysis they represent a transfer of value from private individuals (represented in the consumer surplus category) to society.
- The multi-zone DBC scenarios with the highest charge rates (100%) produce the most economic benefits out of all of the Round 3 scenarios.
- *DBC 2 Zone (25%)* and *DBC 8 Zone (25%)* both have negative total economic benefits, indicating that these scenarios do not produce enough time savings benefits to offset the cost of the decongestion charging system.
- *DBC Flat ($0.10)* economic benefits are marginal and are therefore not robust to the greater uncertainty in system costs for DBC scenarios (the economic benefits are calculated using the likely cost estimate).
- At lower MSC charge rates (25% and 50%), the regional point charge scenarios *(Bridges + NR)* have higher total economic benefits than the multi-zone distance-based scenarios *(DBC 2 Zone, DBC 8 Zone)*. At the higher MSC charge rates (75% and 100%), the situation is reversed and the multi-zone distance-based scenarios have higher total economic benefits. This is because costs remain relatively fixed across these different scenarios, and distance-based charges have considerably higher scenario costs than point charges. For this reason, distance-based charges need to achieve higher time savings benefits than point charging systems to generate positive economic benefits that are robust to cost uncertainty. The higher time savings benefits can only happen in the scenarios with higher charge rates.

Key conclusions from Round 3

The Round 3 scenarios were considerably more refined than the Round 1 and 2 scenarios. However, it is important to note that reaching an optimal scenario will require multiple rounds of iteration. Studies in other jurisdictions with well-defined objectives have involved as many as eight or more iterations prior to implementation. This includes iteration on both the charge rates ($/passing, $/km, charge differentiation by vehicle type, specific time periods for peak/off peak charges, etc.) as well as locations (for point charging, the location of the points, and for distance-based charging, the number and boundaries of the zones). Because these scenarios are not yet optimized, some caution is needed to avoid drawing premature conclusions. For example, it would be premature to form preferences between a 2-zone or 8-zone distance based charge based on these results because their relative advantages/disadvantages may change with refinement of the zones and charge rates.

Nonetheless, the project team was confident in drawing the following conclusions from the Round 3 analysis:

- **In a distance-based charge the use of variable charging across multiple zones and times of day appears to provide the best opportunity** for a regional solution that aligns charges with the pricing principles and transit options. Further iteration is needed to determine the optimal number of zones (e.g. between 2 and 8, or more than 8), as well as to refine the boundaries of the zones and the charge rates per zone.

- **For point charging, a scenario based on the 12 main bridges supplemented by additional point(s) to cover more trips appears to provide the best opportunity** for a regional solution. The modelling done so far has placed these internal points along North Road (which forms the boundary between Burnaby and New Westminster to the west and Port Moody and Coquitlam to the east). This internal boundary improves alignment with user pay and user cost principles by capturing more of the vehicle trips contributing to congestion as well as road users that rarely cross bridges. Further iteration is needed to explore the optimal location of charge points both at or near bridges and at other locations.
- **A hybrid scenario** that combines a flat distance-based charge with point charges has the same system costs as a variable distance-based charge but will create more boundary issues and has a lower alignment of charges with transit options. Unless there is a compelling reason based on the availability of technology, there does not appear to be a rationale for preferring this scenario over a multi-zone distance-based approach given that household charges are similar for similar levels of congestion reduction. In the short-term, the most cost-effective way to charge (a proxy for) a flat rate for distance travelled is through the fuel tax.
- **Either a distance-based charge or a point charge can be designed for some degree of alignment with user pay and user cost principles,** with the exact balance varying across scenarios. For point charge scenarios, alignment with the user pay principle is dependent upon continuation of the fuel tax. It is uncertain how long the fuel tax will be a good representation of this, depending on the fuel mix in the vehicle fleet.
- Either a distance-based charge or a point charge can reduce congestion and produce revenue; the **magnitude of congestion reduction and revenue raised will be driven more by charge rates and locations than the choice of distance-based versus point charging.**
- Charging systems have significant fixed and variable costs. At present, the implementation of a **distance-based charge has a higher and more uncertain fixed cost than point charges** that achieve similar congestion benefits. This is partly a function of the greater uncertainty of the costs of distance-based charges. In scenarios with lower charge rates and relatively lower revenues, the efficiency of the charging scenario (revenues produced per unit cost) and the net economic benefits to society drop substantially.
- **There is a fundamental trade-off between congestion reduction and out-of-pocket costs.** At charge rates sufficient to meaningfully reduce congestion, out-of-pocket costs to households are potentially significant.

Commission Discussion and Direction for Round 4

After review of the Round 3 scenarios, the Commission provided the following direction to guide the development of Round 4 analysis:

- The charge should produce meaningful/visible congestion benefits;
- The charge should generate net economic benefits;
- For a given level of congestion reduction, out-of-pocket costs to road users should be minimized.

The project team was directed to:

- Characterize what a “meaningful” reduction of congestion could be, recognizing that the definition of what is meaningful/visible involves some combination of expert knowledge and value-based judgment.
- Narrow down the range of scenarios based on the above Commission input, leading to a subset of scenarios that produce a meaningful reduction in congestion.

PART 6

Round 4 Analysis

PART 6. ROUND 4 ANALYSIS

In Round 4, the project team established a proposed definition for a minimum threshold of meaningful congestion reduction and evaluated a subset of the Round 3 scenarios that would either meet or exceed this minimum threshold.

Minimum Threshold of Meaningful Congestion Reduction

The proposed definition for minimum meaningful congestion reduction was based on three metrics:

1. ***Total Regional Congested Time Savings.*** This is defined as the reduction in congested conditions region-wide and reflects the extent to which a decongestion charging scenario is predicted by the model to address the congestion problem in Metro Vancouver. **For a meaningful reduction in congestion, it is proposed that a scenario should achieve a minimum of 20% for this metric.**

2. ***Visible Congested Time Savings.*** This metric considers the proportion of households that will see a noticeable reduction in congestion by looking at the congested minutes saved per day for the proportion of households who experience high (>20 mins/day) congestion levels in the baseline. Following analysis, a value judgement was made to define a "noticeable reduction" as a saving of >10 mins/day (for the households experiencing congestion of >20 mins/day). **It is proposed that a minimum threshold of 25% of these households should be set as a benchmark for achieving this reduction.**

3. ***Total economic benefits.*** This is a metric for understanding the value of a policy or investment to society according to established economic methods. For scenarios with marginal economic benefits, there is lower confidence that the congestion benefits would be judged to be worthwhile in consideration of the cost of the decongestion charging system. **This metric is aligned with the Commission's direction in Round 3 that scenarios should be achieving net economic benefits.**

While no one metric is definitive, a value judgement was made that if a scenario meets or exceeds the minimum performance on all three, congestion reduction would be meaningful and visible. If basic thresholds for these metrics are not being met, there is less confidence that regional stakeholders and residents would perceive the benefits to be outweighing the costs.

Round 4 Scenarios

For Round 4, a subset of the Round 3 scenarios was selected that represent two different concepts of decongestion charging – regional congestion point charges (CPC) and multi-zone distance-based charges (DBC) - both of which vary charges by time of day and location (as well as by direction of travel for CPC). For each scenario, two charge levels were defined: one that would achieve the minimum level of meaningful congestion reduction as described above *(Min)*, and one that would produce a somewhat higher level of congestion reduction *(Min+)*. The scenarios are described below with additional details on charge rates in Table 29.

Two different scenarios with two charge rates were analyzed:

- **Regional CPC (Min):** Charges applied to all 12 major regional bridges, plus additional point charges to cover congested travel on the Burrard Peninsula and/or other congested points. For the purposes of this scenario, the Burrard Peninsula points are along North Road, however, the best location for these points requires further study. Charges are differentiated by location, time of day and direction, as guided by the MSC analyses. This results in charge rates at points being set to reflect local congestion conditions (higher point charges for locations, times and directions with higher levels of congestion). Charge rates are at a level that will produce the minimum level of congestion benefits judged to be meaningful. The charge rates required to achieve this minimum level of congestion reduction are approximately 50% of the MSC rates for the *Bridges+NR* scenario from Round 3. The fuel tax is maintained to meet the user pay principle.

- **Regional CPC (Min+):** Identical to the *Regional CPC (Min)* scenario, but with charge rates that produce a somewhat more ambitious level of congestion reduction. The rates required to achieve a more ambitious congestion reduction are approximately 75% of the MSC rates for the *Bridges+NR* scenario from Round 3.
- **Multi-zone DBC (Min):** DBC for 8 zones; however, the number and boundaries of zones need to be further refined. Charges are differentiated by zone and time of day, as guided by the MSC analyses. This results in higher charge rates in zones with higher levels of congestion, which generally co-relates with density and transit options. Charge rates are at a level that will produce the minimum level of congestion benefits judged to be meaningful. Once again, the rates required to meet this minimum threshold for congestion reductions are approximately 50% of the MSC rates for the *DBC 8-zone* scenario from Round 3.
- **Multi-zone DBC (Min+):** Identical to *Multi-zone DBC (Min)*, but with charge rates that produce a somewhat more ambitious level of congestion reduction. The rates required to achieve a more ambitious congestion reduction are approximately 75% of the MSC rates for the *DBC 8-zone* scenario from Round 3.

Table 29: Charge rates for Round 4 scenarios.

Round 4 Scenarios	Charge structure	Direction	Time of Day	Lions Gate and Ironworkers	Arthur Laing, Oak and Knight	Queens-borough, Pattullo, and Port Mann	George Massey and Alex Fraser	Pitt River and Golden Ears	North Road
Regional CPC (Min)	50% MSC ($/passing)	Inbound (towards CBD)	AM Peak	$3.55	$3.59	$4.25	$2.68	$2.80	$2.60
			Off Peak	$1.06	$0.91	$0.74	$0.76	$0.54	$0.36
			PM Peak	$4.92	$3.54	$3.54	$3.05	$2.41	$1.03
		Outbound (from CBD)	AM Peak	$4.30	$2.24	$2.17	$2.18	$2.72	$0.85
			Off Peak	$0.86	$0.81	$0.65	$0.55	$0.52	$0.41
			PM Peak	$4.59	$3.92	$5.52	$3.51	$4.15	$2.27
Regional CPC (Min+)	75% MSC ($/passing)	Inbound (towards CBD)	AM Peak	$5.32	$5.38	$6.37	$4.03	$4.19	$3.90
			Off Peak	$1.59	$1.36	$1.11	$1.13	$0.81	$0.54
			PM Peak	$7.38	$5.30	$5.30	$4.58	$3.61	$1.54
		Outbound (from CBD)	AM Peak	$6.45	$3.36	$3.25	$3.27	$4.08	$1.27
			Off Peak	$1.29	$1.21	$0.98	$0.83	$0.78	$0.62
			PM Peak	$6.89	$5.87	$8.27	$5.27	$6.23	$3.41

Round 4 Scenarios	Charge structure	Time of Day	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Multi-zone DBC (Min)	50% MSC ($/km)	AM Peak	$0.25	$0.20	$0.17	$0.12	$0.11	$0.14	$0.08	$0.02
		Off Peak	$0.07	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
		PM Peak	$0.27	$0.22	$0.15	$0.11	$0.14	$0.12	$0.10	$0.03
Multi-zone DBC (Min+)	75% MSC ($/km)	AM Peak	$0.38	$0.30	$0.25	$0.17	$0.16	$0.20	$0.11	$0.03
		Off Peak	$0.11	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
		PM Peak	$0.40	$0.32	$0.23	$0.17	$0.20	$0.18	$0.15	$0.04

Evaluation Results

The evaluation criteria were reduced from Round 3 to include only those criteria that were sensitive to differences among Round 4 scenarios. These criteria are shown in Table 30.

Key results from the evaluation are summarized below.

Congestion: By design, *Regional CPC (Min)* and *Multi-zone DBC (Min)* produce a similar magnitude of congestion reduction and the Min+ scenarios both increase the level of congestion reduction to a similar degree. The biggest change is in visible time savings from the *Min* to *Min+* scenarios, where the proportion of households that achieve visible time savings increases from 25% to 41-44%.

Net Revenue: For similar levels of congestion reduction, the *Regional CPC* and *Multi-zone DBC* scenarios generate similar net revenue (including fuel tax revenue) based on the best estimates for system costs.

Revenue Collection Efficiency: There are three main points to consider. First, efficiency improves as revenues rise. Thus, from the *Min* to *Min+* scenarios, cost as a percentage of gross revenues improves. For the *Multi-zone DBC* scenarios, efficiency improves from 26-40% to 18-27%, and for *Regional CPC* scenarios efficiency improves from 17-22% to 11-14% (a lower percentage is better here as it represents system costs as a proportion of gross revenue). Second, the *Regional CPC* scenarios produce revenue more efficiently than the *Multi-zone DBC* scenarios, largely because DBC systems have higher operating costs. Third, there is greater uncertainty in operating costs for DBC systems because variable distance-based charging has not yet been implemented in an urban context (the *likely* system cost estimate is based on a proponent's bid to implement a system in 2006, not on realized costs in other jurisdictions.)

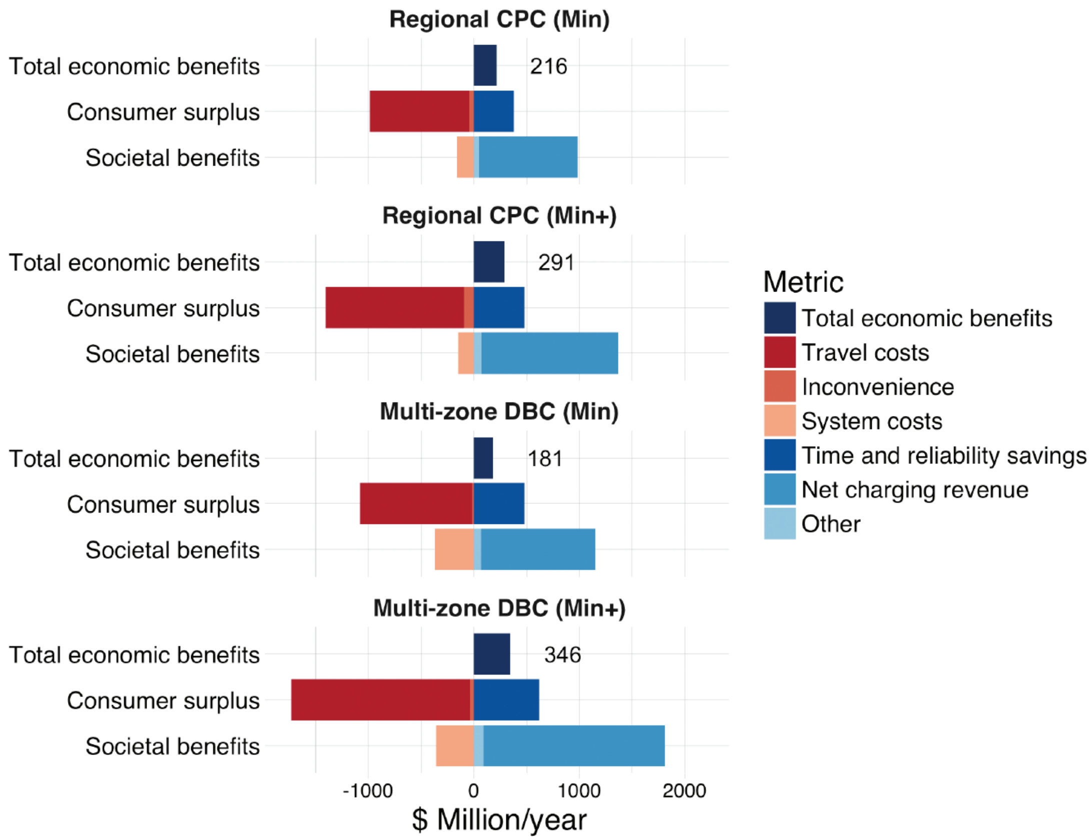
Economic Benefits: At the *Min* level of congestion reduction, *Regional CPC* produces higher total economic benefits than *Multi-zone DBC*. At the higher level of congestion reduction (*Min+*), the situation is reversed and *Multi-zone DBC* produces higher economic benefits than *Regional CPC*. The total economic benefits here are being driven largely by the value of travel savings generated in a scenario (an economic gain) and the cost of implementing the decongestion charging system (an economic loss). At the lower level of congestion reduction, the high system cost along with higher cost uncertainty of DBC systems means that *Multi-zone DBC (Min)* is less justified from an economic benefits perspective compared to the other three scenarios. Figure 6: Economic benefits for Round 4 scenario analysis Figure 6 shows the components of these economic benefits in greater detail.

Table 30: Evaluation matrix for Round 4 analysis.

Evaluation Criteria	Units	Dir*	Regional CPC (Min)	Regional CPC (Min+)	Multi-zone DBC (Min)	Multi-zone DBC (Min+)
Economic Benefits						
Total Net Economic Benefits	$million/year	H	$220	$290	$180	$350
Congestion						
Total Regional Congested Time Savings	% of Baseline	L	-20%	-25%	-20%	-25%
Visible Congested Time Savings	% congested HHDs >10 mins	H	25%	44%	25%	41%
Net Revenue						
Total Net Revenue	$million/year	H	$1010 - $1100	$1420 - $1500	$850 - $1000	$1460 - $1600
Revenue Collection Efficiency						
System Cost / Gross Revenue	%	L	17% - 22%	11% - 14%	26% - 40%	18% - 27%
Household Charges - Payers of Decongestion Charge						
Average - Daily	$/day/household	L	$6	$9	$4	$6
75th percentile - Daily	$/day/household	L	$9	$12	$6	$9
Average - Annual	$/year/household	L	$2,200	$3,000	$1,400	$2,100
Other Considerations						
Boundary Effects	Better=1, Worse =2	L	2	2	1	1
Design Flexibility	Better=1, Worse =2	L	2	2	1	1
Driver Interaction	Better=1, Worse =2	L	1	1	2	2
Privacy Perceptions	Better=1, Worse =2	L	1	1	2	2

Legend
*"Dir" column indicates preferred direction of change; "H" indicates higher values are preferred and "L" indicates lower values are preferred (all

Figure 6: Economic benefits for Round 4 scenario analysis



Note: Blue colours indicate positive values and red colours indicate negative values. Total economic benefits are the sum of consumer surplus and societal benefits value. The value of the total economic benefit of each scenario is written on each panel.

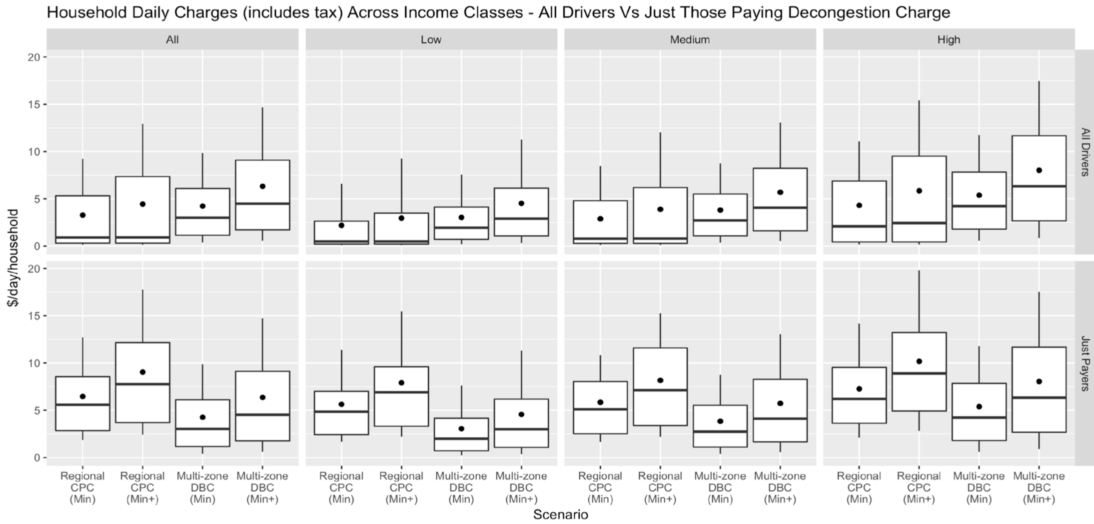
Figure 7 shows the statistical distribution of household daily charges across scenarios for two household groupings: (1) all households that drive and (2) the subset of households that drive and pay the decongestion charge on a given day. It also shows the distribution of daily charges across income groups.

Average Household Charges: For households that pay the decongestion charge on a given day, average household charges are around $4/day for *Multi-zone DBC (Min)* and $6/day for *Regional CPC (Min)*. For both *Multi-zone DBC* and *Regional CPC* scenarios, moving from the Min to Min+ scenarios increases the price signal for payers by nearly 50%.

Distribution of household charges: A key conclusion of this analysis is that for a given level of congestion reduction, in the *Multi-zone DBC* scenarios, more people will pay less, but under the *Regional CPC* scenarios, fewer people will pay more on a given day. Even though the total revenue generated (or the total amount paid by paying households) is higher under the *Multi-zone DBC* scenarios, it is spread over every road user on every trip, so the daily and annual costs experienced by paying households are lower.

Figure 8 shows the distribution of daily charges for households located on the Burrard Peninsula compared to households in other parts of the region for the Min scenarios. Under the *Regional CPC* scenarios, households on the Burrard Peninsula are paying less than those in other parts of the region, while for the *Multi-zone DBC* scenarios, households on the Burrard Peninsula pay more.

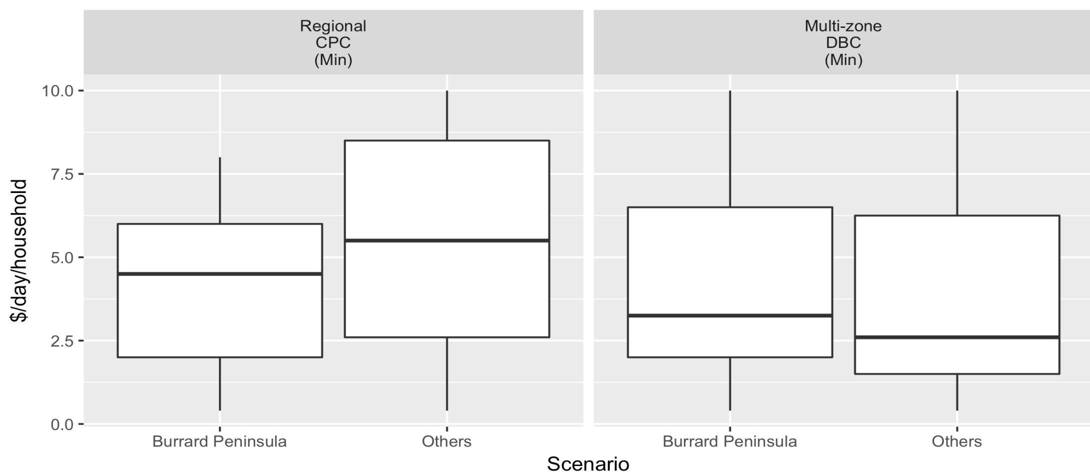
Figure 7: Boxplots for household daily charges (includes fuel tax) by Drivers/Payers and by income level.



Note: These boxplots are shown for all households that drive ("All Drivers") and all households that pay the decongestion charge on a given day ("Just Payers"), as well as shown in aggregate ("All") and broken into low, medium, and high income groups. Note that household daily charges are lower when all drivers are considered for Regional CPC scenarios because not all households are paying the charge on a given day and the zero values bring down the distribution relative to "Just Payers".

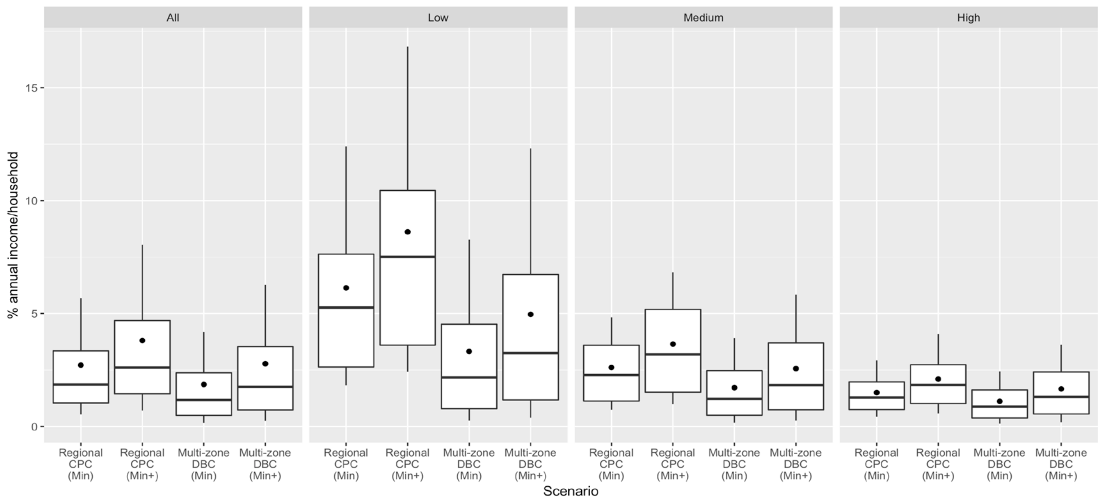
How to read boxplots: All box plots in this report are structured as follows: The bottom and the top of each box represent the 25th and 75th percentiles respectively. The ends of the whiskers represent the 10th and 90th percentiles, respectively. The line in the middle is the median and the dot is the average.

Figure 8: Boxplots for household daily charges for households paying the decongestion charge.



Based on existing travel patterns in the 2011 Trip Diary, in all scenarios higher income households would pay more than lower income households in absolute terms (as shown through the daily household charges in Figure 7), but less as a percentage of their total income (assuming households chose not to adapt to the charge by changing their travel behaviour). The difference in charges as a % of annual income between low and high income groups is bigger for *Regional CPC* scenarios than *Multi-zone DBC* scenarios (as shown in Figure 9), however, there would be fewer low income households paying in the *Regional CPC* scenario (about 30% of low income households that drive pay the point charge on a given day) than in the *Multi-zone DBC* scenarios (100% of low income households that drive pay a charge every day).

Figure 9: Boxplots for annual household charges as a % of annual income (includes fuel tax)



Note: these boxplots are shown for all households that pay a decongestion charge, and are shown in aggregate ("All") and broken into low, medium, and high income groups.

Comparing Point Charging and Distance-based Charging

The following summarizes some of the key trade-offs between congestion point charging (CPC) and distance-based charge (DBC) approaches:

- **System Costs and Uncertainty.** Point charging systems have been implemented in many jurisdictions, including Metro Vancouver (i.e. previous tolls on the Port Mann and Golden Ears bridges). The technology for distance-based systems that vary by time and location has not yet been implemented on a large scale in an urban area. Since point charging technology is more developed than the technology that would allow for multi-zone distance-based charging, point charging systems would, if implemented today, be able to achieve a given level of congestion reduction with lower system costs and lower cost uncertainty. At lower levels of congestion reduction, point charge systems will produce economic benefits with more certainty than DBC systems.
- **Paying for Use and Contribution to Congestion.** Under DBC approaches, drivers pay every time they drive. The distance-based charge incorporates both paying for congestion and paying for use (i.e. meeting the user pay and user cost principles). Under a point charge, drivers only pay for congestion when they pass a charge point. The fuel tax can be maintained in the short term to incorporate a proxy for paying for use. It is uncertain at what point the fuel mix in the vehicle fleet, in particular the proportion of electric vehicles, makes this user pay element obsolete.
- **Boundary Effects.** A key drawback of point charges is that they create a boundary at which users are charged the same regardless if they make a short trip or long trip across the boundary. Multi-zone distance-based charges also have boundaries, but crossing the boundary comes at a significantly reduced cost and the length of a trip is taken into account. If there is a strong desire to treat users consistently, then a distance-based charge does that better than a point charge.
- **Design Flexibility.** There is more flexibility in a multi-zone distance-based charge to design for specific policy objectives, like aligning charges with density/transit options or integrating with a broader mobility pricing policy, or to adapt to changing congestion conditions.
- **Driver Interaction**. Currently, distance-based systems that vary charges by time of day and location will require on-board GNSS units. This means that more interaction may be required between the vehicle owner and the charging technology than in a point charge system where the role of the vehicle owner is more passive. On-board unit (OBU) technology means that there will be some responsibility for vehicle owners to install and maintain the OBU. In the future, this may be simplified by ensuring that OBUs are built in to vehicles.

- **Privacy Perceptions.** Although there are a variety of technologies and procedures that guard the privacy of road users, these measures may not be broadly understood by the public. Engagement results suggest that there are some public concerns about systems that track vehicles, like the on-board GNSS units that would be required in a distance-based system. See *Privacy Evaluation Brief* (in Appendix B-3) for more details.

Commission Discussion on Round 4 Scenario Analysis

Based on the above analysis, the Commission summarized the key trade-offs associated with the choice between the two systems (DBC vs Point Charging):

- Either DBC or Point charge systems can be designed to produce similar results in terms of congestion reduction, average household costs and revenues.
- Distance-based charging appears to have considerable flexibility for refinement, for example in targeting congestion and aligning with transit access and a broader mobility pricing policy.
- The uncertainty as to the maturity of the available technology for distance-based charging may suggest a more cautious implementation timescale.
- In sum, the decision between DBC and point charging may depend on whether regional decision makers consider the congestion problem and the need for revenues to be acute.

With respect to the choice between a *Min* and *Min+* level, Commissioners noted that the magnitude of household costs, particularly at the *Min+* level under a point charging system, are likely to be felt as high. The acceptability to stakeholders and the public likely depends critically on measures to offset costs for the most affected users (e.g., caps, rebates, etc.).

Key considerations for implementation of either system include:

- Optimal number and location of charge points (point charging) and zones (distance-based charging)
- Ways to address impacts for people on low incomes, including the return of revenues
- Application of discounts and exemptions
- Price caps to mitigate high costs borne by some users (especially for *Min+*)
- The possibility of using excess revenues to reduce transit fares
- Targeted transit investment and park and ride to ensure that transportation options are available
- Considerations for new and emerging transportation services like transportation network companies and automated vehicles
- Considerations for point charging specifically include:
- Ways to address trips that benefit from reduced congestion but do not pay (i.e., trips that do not cross a charge point)
- Ways to mitigate boundary effects
- Options for reducing the fuel tax
- Considerations for distance-based charging specifically include:
- Exploration of the current and projected future state of the rapidly developing technology for distance-based charging

The Commission's perspectives on the opportunities, challenges, and key considerations for Round 4 scenarios are included in the Commission's *final report*.

PART 7

Summary and Conclusion

PART 7. SUMMARY AND CONCLUSION

The Commission's work as described in this appendix can be considered the first phase of a feasibility study. More work will be needed to develop the Commission's recommendations into something that can be implemented. That is estimated to take around six to twelve months and is described in detail in Appendix A. The following studies should be prioritized:

- Further iterations and development of the scenarios discussed in round four (called "illustrative concepts" in the Commission's final report);
- A thorough assessment of affordability and equity impacts, including the role of caps and discounts and the opportunities for returning or redistributing revenues;
- Impacts for businesses; and
- An assessment of available technology for distance-based charging.

Because the scenarios discussed in this appendix are not yet optimized, caution needs to be taken to avoid drawing premature conclusions. The analysis presented in this appendix holds only for the specific scenarios modelled and analyzed (locations and charge rates). Results and conclusions thus cannot be generalized to all systems that are structured similarly at different rates, or have similar rates but a very different structure.

All numbers presented are best estimates based on the modelling and analysis done to date.

APPENDIX B-1

Scenario Descriptions

APPENDIX B-1. SCENARIO DESCRIPTIONS

CONTENTS

PART 1

Introduction

PART 1. INTRODUCTION

This appendix summarizes the scenarios that were modelled and analyzed for the *It's Time* project. It is organized by scenario "type" and describes the iterations developed for four rounds of evaluation. Detailed descriptions, maps, and charge rate tables are provided for each scenario, and high-level considerations are included for each round.

The full list of scenarios developed from Round 1 to Round 4 is displayed in Table B1-1. All scenarios include the same baseline conditions regarding population and employment projections, infrastructure changes, value of time, etc.

The modelling of Round 1 and 2 scenarios assumed variation in charge rates for different classes of vehicles. All charge rates noted for these scenarios are for personal single occupancy vehicles (SOV) and high occupancy vehicles (HOV). Light goods vehicles are charged twice as much as SOVs/HOVs and heavy goods vehicles are charged three times as much as SOVs/HOVs. Charge rates in Round 3 and 4 scenarios were applied equally across all vehicle classes.

Table B1-1: List of Scenarios

Scenario Type	Round 1	Round 2	Round 3	Round 4
Marginal Social Cost (MSC)	*MSC* (benchmark)			
Congestion Point Charges (CPC)	*CBD ($5)*	*CBD (MSC)*		
	Bridges ($1) *Bridges ($5)*	*Bridges TOD* *Bridges TOD & Dir.* *Bridges (MSC)*	*Bridges (25%, 37.5%, 50%, 75%, 100% MSC)*	
			Bridges + NR (25%, 37.5%, 50%, 75%, 100% MSC)	*Regional CPC Min (=50% MSC)* *Regional CPC Min+ (=75% MSC)*
Distance-based Charges (DBC)	*DBC ($0.15/km)*	*DBC TOD*	*DBC Flat ($0.10/ km)* *DBC Flat ($0.12/ km*	
		DBC TOD (2 zones) *DBC (MSC)*	*DBC 2-zone Transit (25%, 37.5%, 50%, 75%, 100% MSC)* *DBC 8-zone (25%, 37.5%, 50%, 75%, 100% MSC)*	*Multi-zone DBC Min (=50% MSC)* *Multi-zone DBC Min+ (=75% MSC)*
Hybrid (CPC + DBC)			*Hybrid (CPC + DBC)*	

PART 2

Marginal Social Cost Scenario

PART 2. MARGINAL SOCIAL COST SCENARIO

A scenario determined by the economic theory of decongestion charging was modelled and analyzed in Round 1 to provide a benchmark for further rounds of scenario development. This scenario is designed to maximize economic benefits to society and it dynamically matches costs with congestion levels throughout the road network.

According to economic theory, vehicles should be charged to use the roads at a rate equal to the congestion costs that driving imposes on society – a concept called *marginal social cost (MSC)* pricing. MSC pricing is explained in more detail in Appendix B of the Commission's phase 1 report, as well as in Appendix B-2 of this report.

Round 1: MSC

In Round 1, a scenario based on MSC pricing was defined and modelled to represent a theoretical maximum level of congestion reduction to the selected baseline of Level of Service (LOS) D. Charging more than the MSC rates would mean that vehicles are being overcharged according to MSC pricing theory – i.e. they are being charged more for the use of the roads than the cost they are imposing on others in terms of travel time delays.

When the modelled road segments are aggregated to the 12-zone level, the peak period charge rates for vehicle trips within and between zones in the ***MSC*** scenario vary between $0.04/km and $0.81/km and off peak charge rates vary between $0.02/km and $0.23/km (Table B1-2). Since charge rates are set based on local congestion levels, the trips with the highest charge rates are ones to, from, and within the Central Business District, the City of Vancouver, and Burnaby/New Westminster. The trips with the lowest charge rates are trips that stay on the North Shore, South of Fraser, and Maple Ridge/Pitt Meadows.

The ***MSC*** scenario was used as a benchmark in later rounds to compare other decongestion charging scenarios and to inform the charge rates used in other scenarios so that rates are set in proportion to a vehicle trip's contribution to congestion.

Table B1-2: Marginal Social Cost OD Table for charge value ($/km) for PM peak and mid-day periods

MARGINAL SOCIAL COST - 2030											CHARGE VALUE ($ / KM)
PM PEAK	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	$0.06	$0.17	$0.49	$0.47	$0.45	$0.45	$0.56	$0.50	$0.44	$0.38	$0.40	$0.41
North Van	$0.13	$0.12	$0.50	$0.52	$0.55	$0.50	$0.53	$0.57	$0.49	$0.41	$0.43	$0.42
CBD	$0.62	$0.71	$0.32	$0.67	$0.81	$0.61	$0.66	$0.50	$0.51	$0.43	$0.48	$0.43
Vancouver	$0.50	$0.61	$0.35	$0.53	$0.61	$0.52	$0.56	$0.46	$0.46	$0.40	$0.44	$0.41
Burn/NW	$0.39	$0.52	$0.35	$0.40	$0.39	$0.47	$0.33	$0.40	$0.56	$0.41	$0.42	$0.37
North East	$0.28	$0.31	$0.19	$0.23	$0.26	$0.35	$0.35	$0.44	$0.50	$0.38	$0.45	$0.39
Richmond	$0.51	$0.59	$0.49	$0.53	$0.48	$0.52	$0.19	$0.34	$0.38	$0.35	$0.35	$0.33
South Delta	$0.40	$0.51	$0.35	$0.34	$0.42	$0.50	$0.20	$0.17	$0.39	$0.36	$0.38	$0.34
Surrey	$0.30	$0.34	$0.24	$0.24	$0.30	$0.42	$0.14	$0.14	$0.27	$0.21	$0.36	$0.23
White Rock	$0.25	$0.26	$0.19	$0.19	$0.20	$0.28	$0.11	$0.10	$0.15	$0.14	$0.29	$0.14
Maple Ridge	$0.25	$0.26	$0.16	$0.19	$0.18	$0.22	$0.21	$0.23	$0.24	$0.24	$0.14	$0.26
Langley	$0.27	$0.26	$0.18	$0.20	$0.18	$0.29	$0.15	$0.17	$0.20	$0.14	$0.38	$0.14

MARGINAL SOCIAL COST - 2030											CHARGE VALUE ($ / KM)
MIDDAY	West Van	North Van	CBD	Vancouver	Burn/NW	North East	Richmond	South Delta	Surrey	White Rock	Maple Ridge	Langley
West Van	$0.06	$0.06	$0.23	$0.16	$0.11	$0.09	$0.17	$0.14	$0.09	$0.07	$0.07	$0.09
North Van	$0.08	$0.04	$0.19	$0.13	$0.10	$0.07	$0.14	$0.14	$0.08	$0.07	$0.06	$0.07
CBD	$0.13	$0.11	$0.10	$0.12	$0.14	$0.08	$0.14	$0.11	$0.08	$0.06	$0.06	$0.06
Vancouver	$0.13	$0.12	$0.13	$0.12	$0.12	$0.08	$0.14	$0.10	$0.08	$0.06	$0.07	$0.07
Burn/NW	$0.12	$0.11	$0.13	$0.12	$0.08	$0.08	$0.10	$0.10	$0.08	$0.05	$0.06	$0.05
North East	$0.10	$0.09	$0.08	$0.09	$0.09	$0.06	$0.14	$0.18	$0.09	$0.07	$0.07	$0.07
Richmond	$0.15	$0.14	$0.16	$0.15	$0.12	$0.11	$0.05	$0.07	$0.06	$0.04	$0.07	$0.05
South Delta	$0.14	$0.15	$0.13	$0.13	$0.12	$0.14	$0.10	$0.06	$0.05	$0.04	$0.10	$0.06
Surrey	$0.10	$0.09	$0.09	$0.09	$0.09	$0.08	$0.06	$0.06	$0.05	$0.04	$0.05	$0.05
White Rock	$0.08	$0.07	$0.06	$0.06	$0.06	$0.06	$0.04	$0.04	$0.04	$0.03	$0.05	$0.04
Maple Ridge	$0.08	$0.07	$0.06	$0.07	$0.06	$0.07	$0.08	$0.10	$0.05	$0.06	$0.02	$0.08
Langley	$0.10	$0.08	$0.06	$0.07	$0.06	$0.06	$0.06	$0.06	$0.05	$0.04	$0.07	$0.04

*Rows represent origin for trip; columns represent destination

Considerations

- Marginal social cost pricing is a theoretical starting point. In its purest form, charge rates would need to vary dynamically by different road segments, times of day, days of the week, and directions of travel. This dynamic nature would make MSC charges very difficult for an individual traveller to accurately predict and use as a factor in making travel decisions.
- MSC rates do not consider fairness issues such as the ability of someone to pay the charge or the distribution of costs and benefits.
- The Regional Transportation Model (RTM) predicted that the ***MSC*** scenario would reduce time spent in congestion by 70% from the Baseline 2030 scenario. These reductions would be experienced region-wide. **This represents a theoretical maximum level of congestion reduction to the selected baseline of LOS D performance.**
- The RTM shows that the large reductions in congestion in the ***MSC*** scenario are due to small changes in behaviour across many trips, predicting that 91% of VKT would remain in the MSC scenario compared to the Baseline 2030 scenario. In other words, most people stay and pay and there is a reduction in VKT of 9 percentage points compared to Baseline 2030. The most important adaptations in the model for the MSC scenario are taking shorter trips (responsible for a reduction of 6 percentage points in VKT) and shifting to transit (responsible for a reduction of 3 percentage points in VKT). **These results represent a benchmark for VKT reduction and mode shift as a direct result of decongestion charging.**

PART 3

Congestion Point Charge Scenarios: CBD Cordon

PART 3. CONGESTION POINT CHARGE SCENARIOS: CBD CORDON

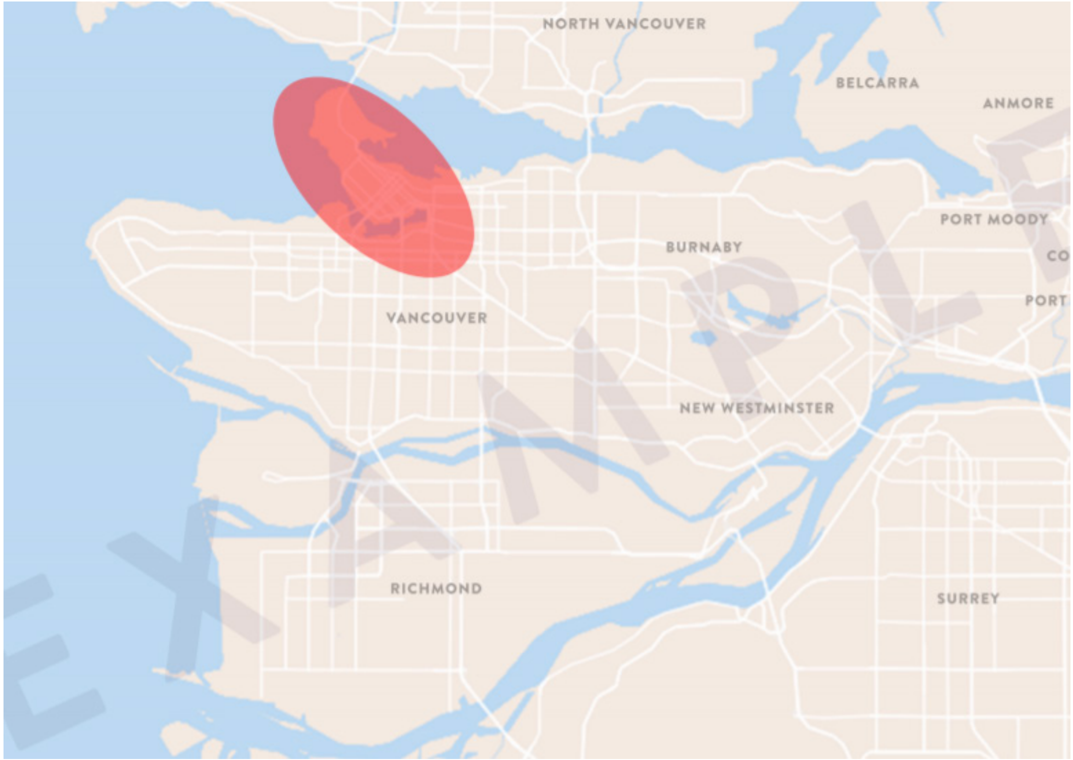
Scenarios that apply point charges in a cordon around the Central Business District (CBD) of Metro Vancouver were selected for analysis because:

- A CBD cordon addresses one of the major congestion issues identified in Metro Vancouver (i.e. congestion in and around downtown); and
- The majority of decongestion charging systems that have been implemented in other jurisdictions follow this model, including London, Stockholm, and Gothenburg.

CBD scenarios were modelled and evaluated in Rounds 1 and 2, but were not taken forward for further iterations in following rounds as they did not meet the Commission's direction that scenarios should have a region-wide impact on congestion.

For the purposes of this analysis, the CBD was broadly defined to extend beyond Vancouver's downtown peninsula to include most of the central Broadway area. (Figure B1-1).

Figure B1-1: Illustration of point charge locations in *CBD* scenarios



Round 1: Flat rate – CBD ($5)

In ***CBD ($5),*** vehicle trips into and out of the Central Business District (CBD) are charged $5/passing at all times of day and in all directions. The $5/passing rate was selected as a starting point for analysis because it was believed this rate would reduce congestion and it is in line with charges in other jurisdictions.

All trips to, from and through the CBD are charged. Trips entirely within the CBD are not. Trips travelling through the CBD (i.e. not stopping in CBD) are charged at two points – one time at entry and another time when exiting the CBD.

Round 2: Variable rate – CBD (MSC)

In Round 2, a CBD scenario using charge rates that approximate the Marginal Social Cost (MSC) charge levels was developed to test the impact of variable rates on this type of scenario.

In ***CBD (MSC),*** vehicle trips into and out of the CBD are charged at a rate that is more closely reflective of their travel time delay cost (estimated through the ***MSC*** scenario). These rates vary by time and direction, but are consistent across all entry/exit points to/from the CBD (Table B1-3).

All trips to, from and through the CBD are charged. Trips entirely within the CBD are not. Trips travelling through the CBD (i.e. not stopping in CBD) are charged at two points – one time at entry and another time when exiting the CBD.

Table B1-3: *CBD (MSC)* charge rates

Time of Day	Direction	All Point Charge Locations*
AM Peak	Inbound	$6.00
	Outbound	$4.00
Off Peak	Inbound	$1.50
	Outbound	$1.25
PM Peak	Inbound	$5.00
	Outbound	$7.00

Inbound = towards CBD; Outbound = away from CBD

Round 1 and 2 considerations

- Congested time savings are limited to trips with an origin or destination in the CBD; there are negligible impacts on congestion elsewhere in the region.
- Relatively few trips pass the charge points and there are good transit options for many of these trips.
- Many trips are not charged in proportion to their use of the road network or their contribution to congestion elsewhere in the region.
- Additional point charges may be desirable to address considerable traffic diversion from the charged Lions Gate Bridge to the uncharged Ironworkers Bridge.
- Detailed analysis was not carried out on the local impacts to congestion and/or parking in the densely populated areas just outside the cordon.

PART 4

Congestion Point Charge Scenarios:
Bridges / Bridges + North Road

PART 4. CONGESTION POINT CHARGE SCENARIOS: BRIDGES / BRIDGES + NORTH ROAD

Scenarios that apply point charges at 12 major bridges[1] around the region were selected for analysis because:

- Point charges on bridges addresses one of the major congestion issues in Metro Vancouver (i.e. congestion on and approaching bridges) and has the potential to address additional congestion issues due to the regional application.
- Charging all major bridges in Metro Vancouver results in less differentiation in charges for trips across the region than the previous tolls on the Port Mann and Golden Ears bridges.
- Charging all major bridges avoids traffic diversion that creates increased congestion since there is no way to avoid charges by changing trip route.

Scenarios that apply additional point charges to North Road (NR,) which forms the boundary between Burnaby and New Westminster to the west and Port Moody and Coquitlam to the east, were developed in later rounds of analysis because:

- The zones within the Burrard Peninsula (CBD, Vancouver, BBurnaby/New Westminster, and the North East Sector) generally have more congestion.
- Charging at a cordon somewhere on the Burrard Peninsula covers long east-west trips along the peninsula that do not cross a bridge and thus would not be charged in ***Bridges*** scenarios.

For the purposes of this analysis, point charges were applied to 12 major bridges around the region (Figure B1-2), but not to the bridges between Vancouver and CBD across False Creek, as it was believed that charges on the False Creek bridges would lead to significant traffic diversion to other nearby routes (see Part 4 of the Commission's final report for more details on this). North Road was selected as a location for additional Burrard Peninsula point charges because it addresses one of the identified congestion issues, namely trips to and from the northeast sector, and takes advantage of geographical features (Burnaby Mountain and Brunette River) to minimise boundary effects.

1 In the RTM, all scenarios modelled at 2030 include the 10-lane George Massey bridge replacing the existing 3-lane tunnel.

Figure B1-2: Point charge locations in *Bridges* scenarios

Rounds 1 and 2 evaluated ***Bridges*** scenarios only, while ***Bridges+NR*** (North Road) scenarios were added in Round 3.

Round 1: Flat rate – Bridges ($1) and Bridges ($5)

In Round 1, two ***Bridges*** scenarios were modelled and analyzed as a starting point for considering the results of region-wide Congestion Point Charge scenarios, and to examine the impacts of different charge rates.

In these scenarios, vehicles are charged a flat rate of either $1/passing or $5/passing at all times of day and in all directions (***Bridges ($1)*** and ***Bridges ($5)***). The $5/passing rate was selected as a starting point for analysis because it was believed this rate would reduce congestion and it is in line with charges in other jurisdictions. The $1/passing rate was selected because charging "a buck a bridge" was an idea frequently raised by stakeholders and the public during engagement and it allows a direct comparison of the effect of different charge levels on a region-wide scale.

These scenarios charge the following types of trips:

- Trips to and from the North Shore
- Trips to and from the Burrard Peninsula
- Trips to and from Sea Island and Richmond
- Trips to and from South of Fraser (South Delta, White Rock, Surrey, Langley)
- Trips to and from Maple Ridge/Pitt Meadows.

The scenarios do not charge the following trips:

- Trips within any one of the 12 zones
- Trips within the North Shore (West Vancouver and North Vancouver zones)
- Trips within the Burrard Peninsula (CBD, Vancouver, Burnaby/New Westminster, North East sector)
- Trips within the South of Fraser area (South Delta, White Rock, Surrey, Langley)

Considerations

- All bridges are charged equal amounts at all times of day and in all directions regardless of the congestion experienced on or around each bridge.
- Trips are not charged in proportion to their use of the road. Short trips across a point charge are priced the same as long trips, and trips that do not pass through a point charge location are charged nothing.
- Trips that stay on the Burrard Peninsula experience congested time savings even though they do not pass a point charge location.
- Congested time savings are significantly lower at $1/passing compared to $5/passing.
- ***Bridges ($1)*** does not generate sufficient net revenue to support regional transportation investment and has the worst ratio of costs as a proportion of gross revenue (>50%) of all modelled scenarios.

Round 2: Variable rates – Bridges TOD, Bridges TOD & Dir., and Bridges MSC

In Round 2, three additional Bridges scenarios were modelled and analyzed to examine the impacts of varying the rate by time of day, ***Bridges TOD***, by time of day and direction, ***Bridges TOD & Dir.***, and by level of congestion, ***Bridges MSC.***

Bridges TOD charges the same $5/passing rate as ***Bridges ($5),*** but only charges during AM and PM peaks, with no charge in the off peak.

Bridges TOD & Dir. introduces variable pricing by time of day and direction (Table B1-4). In the AM peak period, the charge is $6.50 per passage for trips travelling inbound (i.e. toward CBD) and $3.25 per passage for trips travelling outbound (i.e. away from CBD). In the PM peak period, the charge is $6.50 per passage for trips travelling outbound (i.e. away from CBD) and $3.25 per passage for trips travelling inbound (i.e. toward CBD). Note that for the Golden Ears bridge, inbound (outbound) in the AM peak is southbound (northbound), and vice versa for PM. No trips are charged in the off-peak period. Trips that are inbound/outbound relative to the CBD generally correspond with peak directions, but there are routes that do not fit this pattern.

Bridges MSC approximates the MSC charge for each bridge and direction (Table B1-5). These rates are more closely aligned with peak directions. Charge rates vary by location, time of day, and direction.

The same types of trips are charged as described above for ***Bridges ($1)*** and ***Bridges ($5).***

Table B1-4: *Bridges TOD & Dir.* charge rates

Time of Day	Direction	All Point Charge Locations*
AM Peak	Inbound	$6.50
	Outbound	$3.25
Off Peak	Inbound	$0
	Outbound	$0
PM Peak	Inbound	$3.25
	Outbound	$6.50

Inbound = towards CBD; Outbound = away from CBD

Table B1-5: *Bridges (MSC)* charge ratess

		Point Charge Location				
Direction	Time of Day	Lions Gate and Ironworkers	Arthur Laing, Oak and Knight	Queens-borough, Pattullo, and Port Mann	George Massey and Alex Fraser	Pitt River and Golden Ears
Inbound (towards CBD)	AM Peak	$7.10	$7.18	$8.49	$5.37	$5.59
	Off Peak	$2.11	$1.81	$1.47	$1.51	$1.08
	PM Peak	$9.84	$7.07	$7.07	$6.11	$4.81
Outbound (away from CBD)	AM Peak	$8.60	$4.48	$4.33	$4.37	$5.44
	Off Peak	$1.72	$1.62	$1.30	$1.11	$1.05
	PM Peak	$9.19	$7.83	$11.03	$7.03	$8.31

Considerations

- In ***Bridges TOD*** and ***Bridges TOD & Dir.*** the same rates apply on all 12 bridges regardless of the relative congestion experienced on or around each bridge. In ***Bridges MSC,*** trips that contribute to congestion are charged (as long as they pass through a point charge location) in relation to the travel time delay costs they impose on others.
- Charges that are higher at peak periods and in peak directions mean that trips that are contributing more to congestion are charged more than trips that are contributing less to congestion.
- Varying charges by time and location significantly reduces alignment of charges with use.
- Approximately 20% of daily trips in the region involve crossing one of the 12 bridges in the Baseline 2030.
- When flat charges are changed to variable charges by time and location, alignment of charges with time saved improves significantly. The trade-offs are that variable charging reduces alignment of charges with use and reduces net revenues, which then has a negative impact on revenue collection efficiency.
- The most significant improvement in aligning charges with time saved comes with varying charges by time of day; modest gains are then made by further varying charges by direction in ***Bridges TOD & Dir***.
- ***Bridges (MSC)*** performs the same or better than ***Bridges ($5)*** across all of the criteria except alignment of charges with use.

Round 3: Varied MSC rates and additional point charge cordon on the Burrard Peninsula

In Round 3, two scenarios were modelled and analyzed at five charge rates each to examine the impacts of adding additional point charges on the Burrard Peninsula (***Bridges+NR***) and of different percentages of MSC charge levels (summarized in Table B1-6).

Additional charge points were added to Burrard Peninsula because the zones within it generally have more congestion and to cover long east-west trips along the peninsula that do not cross a bridge and thus would not be charged in the ***Bridges*** scenarios. North Road was chosen because it addresses one of the identified congestion issues, namely trips to and from the northeast sector and takes advantage of geographical features (Burnaby Mountain and Brunette River) to minimise boundary effects.

Charge rates vary by location, time of day, and direction in proportion to the recommended rates from the ***Bridges MSC*** scenario (Table B1-7). Different percentages of the ***Bridges MSC*** rates were chosen to respond to the Commission's direction from Round 2 evaluation that:

- Scenarios should be guided by both user pay and user cost (i.e. everyone should pay something in proportion to use, and people should pay more at times and locations where congestion is greater);
- Those who pay should experience time savings (benefiter pay principle);
- Scenarios could be reasonably complex (in terms of charges that vary by location, time of day, and direction) if warranted by the benefits; and
- Scenarios should explore a range of charge rates to understand the balance between congestion benefits and other impacts including household costs.

These scenarios were assumed to exist alongside the regional fuel tax at current rates to meet the user pay principle.

Table B1-6: Round 3 *Bridges MSC* (%) and *Bridges+NR MSC* (%) scenarios

Scenario Name	Charge rate	Peak Charges	Off-Peak Charges	Fuel Tax
Bridges (5 charge rates)	25% MSC	\$1.08-\$2.76	\$0.26-\$0.53	\$0.018/km (on average across vehicles in Metro Vancouver)
	37.5% MSC	\$1.63-\$4.14	\$0.39-\$0.79	
	50% MSC	\$2.17-\$5.52	\$0.52-\$1.06	
	75% MSC	\$3.25-\$8.27	\$0.78-\$1.59	
	100% MSC	\$4.33-\$11.03	\$1.05-\$2.11	
Bridges+NR (5 charge rates)	25% MSC	\$0.42-\$2.76	\$0.18-\$0.53	\$0.018/km (on average across vehicles in Metro Vancouver)
	37.5% MSC	\$0.63-\$4.14	\$0.27-\$0.79	
	50% MSC	\$0.85-\$5.52	\$0.36-\$1.06	
	75% MSC	\$1.27-\$8.27	\$0.54-\$1.59	
	100% MSC	\$1.69-\$11.03	\$0.72-\$2.11	

*Note that charge rates in Round 3 and 4 scenarios are the same for all vehicle classes (single occupancy vehicles, high occupancy vehicles, light good vehicles, and heavy goods vehicles). This was updated from the differentiated charges assumed in the model in Round 1 and 2 scenarios.

Table B1-7: MSC approximate charge rates applied to the *Bridges* and *Bridges+NR* scenarios

Charge structure	Direction	Time of Day	Point Charge Location					
			Lions Gate and Ironworkers	Arthur Laing, Oak and Knight	Queensborough, Pattullo, and Port Mann	George Massey and Alex Fraser	Pitt River and Golden Ears	North Road
25% MSC	Inbound (towards CBD)	AM Peak	$1.77	$1.79	$2.12	$1.34	$1.40	$1.30
		Off Peak	$0.53	$0.45	$0.37	$0.38	$0.27	$0.18
		PM Peak	$2.46	$1.77	$1.77	$1.53	$1.20	$0.51
	Outbound (from CBD)	AM Peak	$2.15	$1.12	$1.08	$1.09	$1.36	$0.42
		Off Peak	$0.43	$0.40	$0.33	$0.28	$0.26	$0.21
		PM Peak	$2.30	$1.96	$2.76	$1.76	$2.08	$1.14
37.5% MSC	Inbound (towards CBD)	AM Peak	$2.66	$2.69	$3.19	$2.01	$2.10	$1.95
		Off Peak	$0.79	$0.68	$0.55	$0.57	$0.41	$0.27
		PM Peak	$3.69	$2.65	$2.65	$2.29	$1.81	$0.77
	Outbound (from CBD)	AM Peak	$3.22	$1.68	$1.63	$1.64	$2.04	$0.63
		Off Peak	$0.65	$0.61	$0.49	$0.42	$0.39	$0.31
		PM Peak	$3.45	$2.94	$4.14	$2.64	$3.12	$1.70
50% MSC	Inbound (towards CBD)	AM Peak	$3.55	$3.59	$4.25	$2.68	$2.80	$2.60
		Off Peak	$1.06	$0.91	$0.74	$0.76	$0.54	$0.36
		PM Peak	$4.92	$3.54	$3.54	$3.05	$2.41	$1.03
	Outbound (from CBD)	AM Peak	$4.30	$2.24	$2.17	$2.18	$2.72	$0.85
		Off Peak	$0.86	$0.81	$0.65	$0.55	$0.52	$0.41
		PM Peak	$4.59	$3.92	$5.52	$3.51	$4.15	$2.27
75% MSC	Inbound (towards CBD)	AM Peak	$5.32	$5.38	$6.37	$4.03	$4.19	$3.90
		Off Peak	$1.59	$1.36	$1.11	$1.13	$0.81	$0.54
		PM Peak	$7.38	$5.30	$5.30	$4.58	$3.61	$1.54
	Outbound (from CBD)	AM Peak	$6.45	$3.36	$3.25	$3.27	$4.08	$1.27
		Off Peak	$1.29	$1.21	$0.98	$0.83	$0.78	$0.62
		PM Peak	$6.89	$5.87	$8.27	$5.27	$6.23	$3.41
100% MSC	Inbound (towards CBD)	AM Peak	$7.10	$7.18	$8.49	$5.37	$5.59	$5.20
		Off Peak	$2.11	$1.81	$1.47	$1.51	$1.08	$0.72
		PM Peak	$9.84	$7.07	$7.07	$6.11	$4.81	$2.05
	Outbound (from CBD)	AM Peak	$8.60	$4.48	$4.33	$4.37	$5.44	$1.69
		Off Peak	$1.72	$1.62	$1.30	$1.11	$1.05	$0.82
		PM Peak	$9.19	$7.83	$11.03	$7.03	$8.31	$4.54

Considerations

- The addition of point charges along North Road increases gross revenues, system costs, and net revenue. Overall congestion reduction improves slightly with a more substantial improvement in visible congestion reduction. Household charges are roughly unchanged, though the proportion of households that pay on a typical day increases.
- Adding the charge points along North Road covers more trips that are contributing to congestion and thus improves *Alignment of Charges with Congestion Contribution.*
- There is a fundamental trade-off between congestion reduction and out-of-pocket costs. At charge rates sufficient to meaningfully reduce congestion, out-of-pocket costs to households are potentially significant.

Round 4: Congestion Point Charge Illustrative Concept

Based on the findings and evaluation results of congestion point charge scenarios, an illustrative concept of this approach was developed for Round 4 that represents the Commission's values and directions.

Following direction from the Commission, the project team established a proposed definition for a minimum threshold of meaningful congestion reduction and evaluated Round 3 scenarios that would either meet or exceed this threshold. The proposed definition was based on three metrics:

1. *Total Regional Congested Time Savings.* This is defined as the reduction in congested conditions region-wide and reflects the extent to which a decongestion charging scenario is predicted by the model to address the congestion problem in Metro Vancouver. **For a meaningful reduction in congestion, it is proposed that a scenario should achieve a minimum of 20% on this metric.**
2. *Visible Congested Time Savings.* This metric considers the proportion of households that will see a noticeable reduction in congestion by looking at the congested minutes saved per day for the proportion of households who experience high (>20 mins/day) congestion levels in the

baseline. Following analysis, a value judgement was made to define a "noticeable reduction" as a saving of >10 mins/day (for the households experiencing congestion of >20 mins/day). **It is proposed that a minimum threshold of 25% of these households should be set as a benchmark for achieving this reduction.**

3. *Total economic benefits.* This is a metric for understanding the value of a policy or investment to society according to established economic methods. For scenarios with marginal economic benefits, there is lower confidence that the congestion benefits would be judged to be worthwhile in consideration of the cost of the decongestion charging system. **This metric is aligned with Commission's direction in Round 3 that scenarios should be achieving net economic benefits.**

While no one metric is definitive, it was judged that if a scenario meets or exceeds the minimum performance on all three, congestion reduction would be meaningful and visible. If these metrics are not being met, there is less confidence that regional stakeholders and residents would perceive the benefits to be outweighing the costs.

One scenario with two charge rates (Table B1-8) was analyzed:

- **Regional Congestion Point Charges (CPC) (Min)**: Charges applied to all 12 major regional bridges, plus additional point charges to cover congested travel on the Burrard Peninsula and/or other congested points. For the purposes of this scenario, the Burrard Peninsula points are along North Road, however, the best location for these points requires further study. Charges are differentiated by location, time of day and direction, as guided by the MSC analyses. This results in charge rates at points being set to reflect local congestion conditions (higher point charges for locations, times and directions with higher levels of congestion). Charge rates are at a level that will produce the minimum level of congestion benefits judged to be meaningful. The charge rates required to achieve this minimum level of congestion reduction are **approximately 50% of the MSC rates for the Bridges+NR scenario from Round 3.** The fuel tax is maintained to meet the user pay principle.
- **Regional CPC (Min+):** Identical to Regional CPC (Min), but with charge rates that produce a somewhat more ambitious level of congestion reduction. The rates required to achieve this are **approximately 75% of the MSC rates for the *Bridges+NR* scenario from Round 3.**

Table B1-8: Charge rates for Round 4 Congestion Point Charge Illustrative Concept

Round 4 Scenarios	Charge structure	Direction	Time of Day	Lions Gate and Ironworkers	Arthur Laing, Oak and Knight	Queens-borough, Pattullo, and Port Mann	George Massey and Alex Fraser	Pitt River and Golden Ears	North Road
Regional CPC (Min)	50% MSC ($/passing)	Inbound (towards CBD)	AM Peak	$3.55	$3.59	$4.25	$2.68	$2.80	$2.60
			Off Peak	$1.06	$0.91	$0.74	$0.76	$0.54	$0.36
			PM Peak	$4.92	$3.54	$3.54	$3.05	$2.41	$1.03
		Outbound (from CBD)	AM Peak	$4.30	$2.24	$2.17	$2.18	$2.72	$0.85
			Off Peak	$0.86	$0.81	$0.65	$0.55	$0.52	$0.41
			PM Peak	$4.59	$3.92	$5.52	$3.51	$4.15	$2.27
Regional CPC (Min+)	75% MSC ($/passing)	Inbound (towards CBD)	AM Peak	$5.32	$5.38	$6.37	$4.03	$4.19	$3.90
			Off Peak	$1.59	$1.36	$1.11	$1.13	$0.81	$0.54
			PM Peak	$7.38	$5.30	$5.30	$4.58	$3.61	$1.54
		Outbound (from CBD)	AM Peak	$6.45	$3.36	$3.25	$3.27	$4.08	$1.27
			Off Peak	$1.29	$1.21	$0.98	$0.83	$0.78	$0.62
			PM Peak	$6.89	$5.87	$8.27	$5.27	$6.23	$3.41

Considerations

Refer to Part 4 of the Commission's final report and Part 6 of Appendix B for detailed discussion on the illustrative concepts.

PART 5

Distance-based Charge Scenarios

PART 5. DISTANCE-BASED CHARGE SCENARIOS

Distance-based charge (DBC) scenarios that charge per kilometre driven were selected for analysis because:

- DBC is an emerging approach to decongestion charging and many jurisdictions are beginning to study it
- It has the potential to achieve consistent treatment of users across the entire region and in alignment with the user pay and user cost principles
- Charges can vary by distance, time, and location to target congested times and locations

Round 1: Flat rate – DBC ($0.15/km)

In Round 1, a flat-rate distance-based charged was modelled and analyzed as a starting point for examining the impacts of this type of charge.

In ***DBC ($0.15/km)***, vehicles are charged a flat $0.15 per kilometre driven within Metro Vancouver at all times of day and in all directions (Figure B1-3). The $0.15 per km rate is considered very preliminary and was chosen as a starting point because it was believed this rate would reduce congestion based on previous modelling analysis.

Figure B1-3: Illustration of Flat Rate DBC charge area

Considerations

- Trips in Metro Vancouver are charged in direct proportion to the use of the road network as measured by kilometres driven.
- The concept of a distance-based charge is similar to the existing fuel tax but charges directly for road network use, charges vehicles equally regardless of fuel efficiency, and is more sustainable over time as vehicle fleet efficiency and electrification increase.
- A distance-based system reduces the boundary effects that occur with a point charging system (where short trips that cross the boundary are charged the same as longer trips).
- With the charge set at $0.15 per km, some trips are charged more than what is recommended by the ***MSC*** scenario, meaning these trips are overcharged with respect to the principle that charges should be aligned with the travel time delay costs imposed on others (user cost principle).

Round 2: Variable rates – DBC TOD, DBC TOD (2-zone), and DBC (MSC)

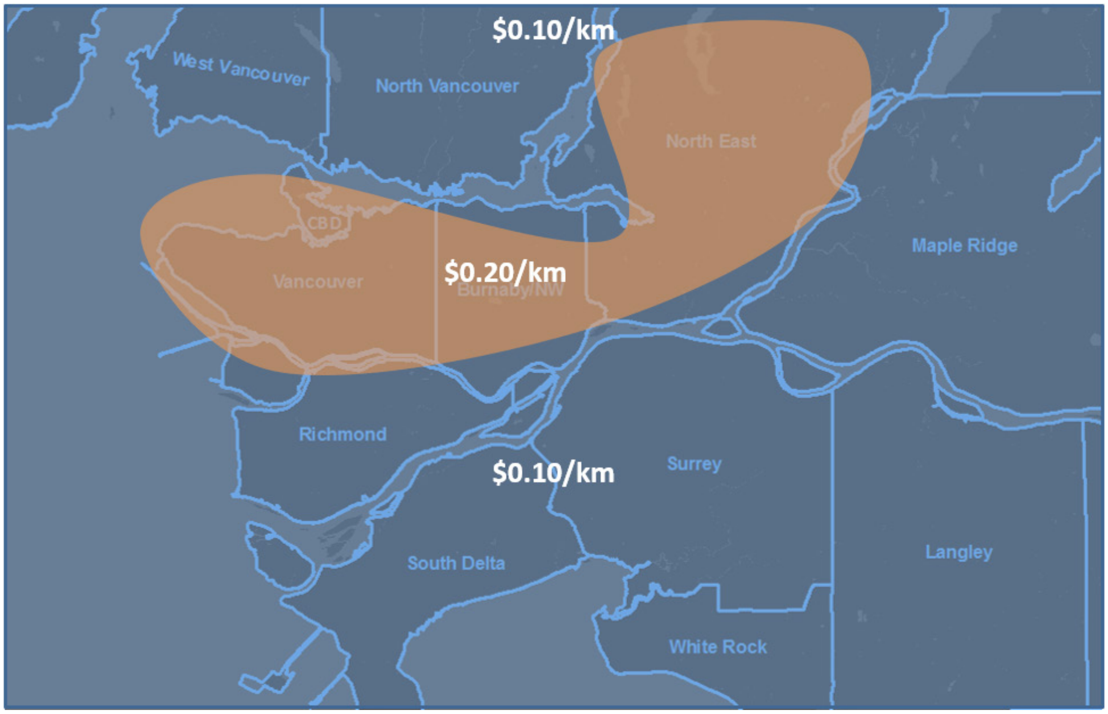
In Round 2, two additional DBC scenarios were modelled and analyzed to examine the impacts of varying the rates by time of day (***DBC TOD***), and by time of day and location (***DBC TOD 2-zone***). A third DBC scenario, where rates would vary across multiple zones based on the level of congestion ***(DBC MSC***), was developed as a concept but not modelled in this round of analysis due to time and resource constraints.

DBC TOD charges the same $0.15 per km rate as ***DBC ($0.15/km)***, but only charges during AM and PM peaks, with no charge applied to the off-peak.

DBC TOD (2-zone) varies rates by time of day in the same way as ***DBC TOD*** above, but charges $0.20 per km inside the Burrard Peninsula and $0.10 per km outside the Burrard Peninsula in AM and PM peak periods only. Inside Burrard Peninsula is defined to include Vancouver, Burnaby/New Westminster, and the North East sector. Outside Burrard Peninsula includes all other Metro Vancouver areas (North Shore, Maple Ridge/Pitt Meadows, Richmond, south of the Fraser) (Figure B1-4). The charge rates were selected as a first iteration from the $0.15 per km rate.

DBC (MSC) varies per km charge rates across the 12 major zones in the RTM to approximate the charges recommended in the MSC scenario. This scenario was not modelled and charge rates for each zone were not calculated; rather, it was posed to the Commission to illustrate the possibility for more complexity and targeted charge rate differentiation, and to obtain their direction on whether to move forward with further iterations of multi-zone DBC scenarios beyond 2 zones.

Figure B1-4: Illustration of *DBC TOD (2-zone)* charge areas



Considerations

- Varying charges by time and locations increases alignment of charges with contribution to congestion and time saved, but significantly reduces alignment of charges with use.
- The most significant improvement in aligning charges with time saved comes with varying charges by time of day; time of day and direction.
- Even with multiple zones, a distance-based system reduces the boundary effects that occur with a point charging system (where short trips that cross the boundary are charged the same as longer trips).
- DBC scenarios have higher system costs and lower revenue collection efficiency than ***Bridges*** scenarios.
- Removing the off-peak charges in ***DBC TOD*** results in a significant reduction in net revenue compared to flat charging all day in ***DBC ($0.15/km)***.

Round 3: Lower flat rate, refined multi-zone scenarios, and varied MSC rates

In Round 3, three DBC scenarios were modelled and analyzed at multiple charge levels to examine the impacts of location-based rate differentiation, and of charges based on different percentages of MSC charge levels (summarized in Table B1-9).

DBC Flat ($0.10/km) and ***DBC Flat ($0.12/km)*** are one-zone, flat per km rate charges applied at all times of day in the same way as ***DBC ($0.15/km)*** in Round 1. The rationale for developing this scenario was to address an interest amongst some Commission members to see the results of a distance-based charge at a lower rate than that which was previously presented (i.e. lower than $0.15/km), but that could still raise revenue. In addressing this request, only the user pay principle is included in this scenario, and not the user cost principle. This scenario maintained the regional fuel tax at current rates.

DBC 2-zone Transit refines ***DBC TOD (2-zone)*** from Round 2 to design zones that broadly reflect transit accessibility (as well as congestion, and population and employment density), recognising that this attribute is not fully captured in the first iteration (Figure B1-5). A higher distance-based charge is applied in the inner zone (including areas both inside and outside the Burrard Peninsula), with a lower charge applied in the outer zone where there are typically less opportunities for travel by transit, walking, and cycling. Because the charge rate variations for this scenario are determined according to transit access, density, and congestion, the zone boundaries for this scenario do not follow existing municipal boundaries. The boundaries of these zones were identified only as a starting point for seeking alignment of charges with transit accessibility. Charge rates vary by zone and time of day in proportion to the recommended rates from the ***MSC*** scenario (Table B1-10).

DBC 8-zone refines the conceptual 12-zone ***DBC (MSC)*** scenario introduced in Round 3. Eight zones have been designed to group together areas with similar congestion levels, based on information from the ***MSC*** scenario (Figure B1-6). Levels of congestion generally align with population density and transit accessibility. Because the zones have been designed with the lens of congestion, as with the above scenario, the boundaries of these zones do not follow existing municipal boundaries (Table B1-11). The boundaries of these zones were identified only as a starting point for seeking alignment of charging zones with congestion. Charge rates vary by zone and time of day in proportion to the recommended rates from the ***MSC*** scenario (Table B1-12).

Different percentages of the MSC level were chosen for the multi-zone scenario to respond to the Commission's direction from Round 2 evaluation that:

- Scenarios should be guided by both user pay and user cost (i.e. everyone should pay something in proportion to use, and people should pay more at times and locations where congestion is greater);
- Those who pay should experience time savings (benefiter pay principle);
- Scenarios could be reasonably complex (in terms of charges that vary by location, time of day, and direction) if warranted by the benefits; and
- Scenarios should explore a range of charge rates to understand the balance between congestion benefits and other impacts including household costs.

The multi-zone DBC scenarios were assumed to replace the regional fuel tax, using a lower per km charge in the off peak period to meet the user pay principle.

Table B1-9: Round 3 DBC scenarios

Scenario Name	Charge Rate	Peak Charges	Off-Peak Charges	Fuel Tax
DBC Flat (2 charge rates)	DBC Flat ($0.10/km)	$0.10/km	$0.10/km	$0.018/km (on average across vehicles in Metro Vancouver)
	DBC Flat ($0.12/km)	$0.12/km	$0.12/km	$0.018/km (on average across all vehicles in Metro Vancouver)
DBC 2-zone Transit (5 charge rates)	25% MSC	$0.05-$0.09/km	$0.01-$0.02/km	$0/km
	37.5% MSC	$0.08-$0.13/km	$0.02-$0.03/km	
	50% MSC	$0.11-$0.18/km	$0.02-$0.04/km	
	75% MSC	$0.16-$0.26/km	$0.03-$0.06/km	
	100% MSC	$0.21-$0.35/km	$0.04-$0.08/km	
DBC 8-zone (5 charge rates)	25% MSC	$0.01-$0.13/km	$0.01-$0.04/km	$0/km
	37.5% MSC	$0.02-$0.20/km	$0.02-$0.05/km	
	50% MSC	$0.02-$0.27/km	$0.02-$0.07/km	
	75% MSC	$0.03-$0.40/km	$0.03-$0.11/km	
	100% MSC	$0.04-$0.53/km	$0.04-$0.14/km	

Figure B1-5: Map of *DBC 2-zone Transit* charge areas

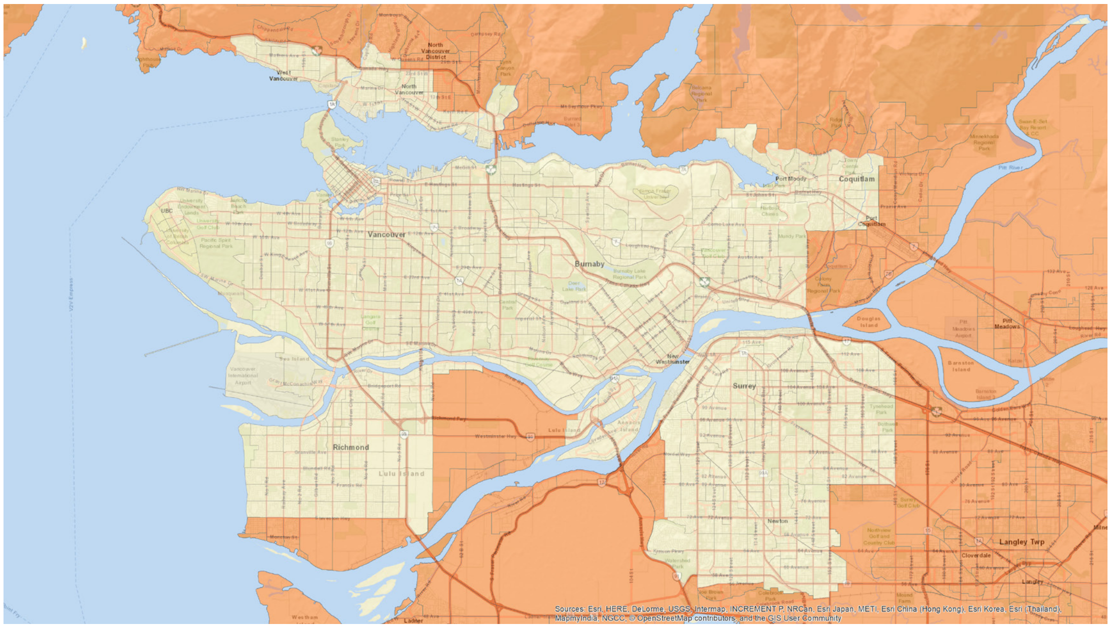


Table B1-10: MSC approximate charge rates applied to the *DBC 2-zone Transit* scenario

Charge rate	Time of Day	Inner zone	Outer zone
25% MSC	AM Peak	$0.08/km	$0.05/km
	Off Peak	$0.02/km	$0.01/km
	PM Peak	$0.09/km	$0.06/km
37.5% MSC	AM Peak	$0.12/km	$0.08/km
	Off Peak	$0.03/km	$0.02/km
	PM Peak	$0.13/km	$0.08/km
50% MSC	AM Peak	$0.17/km	$0.11/km
	Off Peak	$0.04/km	$0.02/km
	PM Peak	$0.18/km	$0.11/km
75% MSC	AM Peak	$0.25/km	$0.16/km
	Off Peak	$0.06/km	$0.03/km
	PM Peak	$0.26/km	$0.17/km
100% MSC	AM Peak	$0.33/km	$0.21/km
	Off Peak	$0.08/km	$0.04/km
	PM Peak	$0.35/km	$0.22/km

Figure B1-6: Map of *DBC 8-zone* charge areas

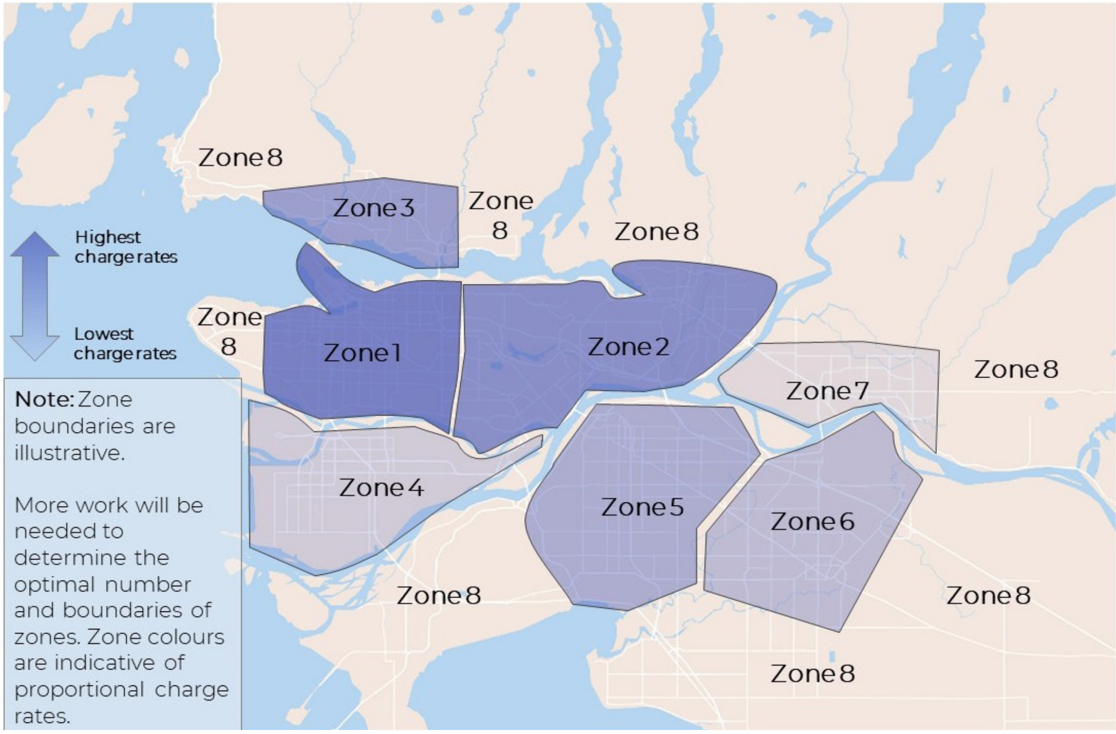


Table B1-11: Definitions of zones in *DBC 8-zone*

Zone #	Zone Description
1	City of Vancouver (excluding UEL), also extending into western Burnaby.
2	City of Burnaby (excluding western parts), New Westminster, Port Moody, Coquitlam, Port Coquitlam. Road links from “considerably large” TAZs in Coquitlam are excluded.
3	Excluding “mountain TAZs”, roads/areas west of Cypress Bowl Rd., and Deep Cove area.
4	Includes all of Richmond and YVR.
5	Excludes south and east Surrey, boundary drawn along Serpentine river, western boundary extended into eastern Delta.
6	Includes part of east Surrey (east of Serpentine river), cut off east of 216th St. on 40th Ave.
7	Maple Ridge and Pitt Meadows. Only small TAZs in the south of MP and PR, no further east of 240th St.
8	Everywhere else in Metro Vancouver outside of these zones.

Note: TAZ refers to Traffic Analysis Zone, a spatial unit used in the Regional Transportation Model (1,700 TAZs total across the region). See Appendix B-2 for more information on the RTM.

Table B1-12: MSC approximate charge rates applied to the *DBC 8-zone* scenario

Charge structure	Time of Day	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
25% MSC	AM Peak	$0.13/km	$0.10/km	$0.08/km	$0.06/km	$0.05/km	$0.07/km	$0.04/km	$0.01/km
	Off Peak	$0.04/km	$0.01/km	$0.01/km	$0.01/km	$0.01/km	$0.01/km	$0.01/km	$0.01/km
	PM Peak	$0.13/km	$0.11/km	$0.08/km	$0.06/km	$0.07/km	$0.06/km	$0.05/km	$0.01/km
37.5% MSC	AM Peak	$0.19/km	$0.15/km	$0.12/km	$0.09/km	$0.08/km	$0.10/km	$0.06/km	$0.02/km
	Off Peak	$0.05/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km
	PM Peak	$0.20/km	$0.16/km	$0.11/km	$0.08/km	$0.10/km	$0.09/km	$0.08/km	$0.02/km
50% MSC	AM Peak	$0.25/km	$0.20/km	$0.17/km	$0.12/km	$0.11/km	$0.14/km	$0.08/km	$0.02/km
	Off Peak	$0.07/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km	$0.02/km
	PM Peak	$0.27/km	$0.22/km	$0.15/km	$0.11/km	$0.14/km	$0.12/km	$0.10/km	$0.03/km
75% MSC	AM Peak	$0.38/km	$0.30/km	$0.25/km	$0.17/km	$0.16/km	$0.20/km	$0.11/km	$0.03/km
	Off Peak	$0.11/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km	$0.03/km
	PM Peak	$0.40/km	$0.32/km	$0.23/km	$0.17/km	$0.20/km	$0.18/km	$0.15/km	$0.04/km
100% MSC	AM Peak	$0.50/km	$0.40/km	$0.33/km	$0.23/km	$0.21/km	$0.27/km	$0.15/km	$0.04/km
	Off Peak	$0.14/km	$0.04/km	$0.04/km	$0.04/km	$0.04/km	$0.04/km	$0.04/km	$0.04/km
	PM Peak	$0.53/km	$0.43/km	$0.30/km	$0.22/km	$0.27/km	$0.24/km	$0.20/km	$0.05/km

Considerations

- Adding zones allows for closer approximation of the rates recommended in the MSC scenario, and can achieve similar or better congestion reduction and revenue generation compared to flat rate DBC scenarios with considerable improvement in alignment of charges with time saved.
- Closer examination of the modelling results is likely to identify ways to further refine optimal number of zones, zone boundaries, and charge rates.
- Because DBC approaches have considerably higher system costs than CPC approaches, DBC approaches need to achieve higher time savings benefits than CPC approaches for the system to generate positive economic benefits that are robust to cost uncertainty. This higher time savings benefits can only happen in the scenarios with higher charge rates.
- There is a fundamental trade-off between congestion reduction and out-of-pocket costs. At charge rates sufficient to meaningfully reduce congestion, out-of-pocket costs to households are potentially significant.

Round 4: Distance-based Charge Illustrative Concept

Based on the findings and evaluation results of distance-based charging scenarios, an illustrative concept of this approach was developed for Round 4 that represents the Commission's values and directions.

Following direction from the Commission, the project team established a proposed definition for a minimum threshold of meaningful congestion reduction and evaluated Round 3 scenarios that would either meet or exceed this threshold. The proposed definition was based on three metrics:

1. *Total Regional Congested Time Savings*. This is defined as the reduction in congested conditions region-wide and reflects the extent to which a decongestion charging scenario is predicted by the model to address the congestion problem in Metro Vancouver. **For a meaningful reduction in congestion, it is proposed that a scenario should achieve a minimum of 20% on this metric.**
2. *Visible Congested Time Savings*. This metric considers the proportion of households that will see a noticeable reduction in congestion by looking at the congested minutes saved per day for the proportion of households who experience high (>20 mins/day) congestion levels in the

baseline. Following analysis, a value judgement was made to define a "noticeable reduction" as a saving of >10 mins/day (for the households experiencing congestion of >20 mins/day). **It is proposed that a minimum threshold of 25% of these households should be set as a benchmark for achieving this reduction.**

3. ***Total economic benefits.*** This is a metric for understanding the value of a policy or investment to society according to established economic methods. For scenarios with marginal economic benefits, there is lower confidence that the congestion benefits would be judged to be worthwhile in consideration of the cost of the decongestion charging system. **This metric is aligned with Commission's direction in Round 3 that scenarios should be achieving net economic benefits.**

While no one metric is definitive, it was judged that if a scenario meets or exceeds the minimum performance on all three, congestion reduction would be meaningful and visible. If these metrics are not being met, there is less confidence that regional stakeholders and residents would perceive the benefits to be outweighing the costs.

One scenario with two charge rates (Table B1-13) was analyzed:

- ***Multi-zone DBC (Min):*** DBC for 8 zones; however, the number and boundaries of zones need to be further refined. Charges are differentiated by zone and time of day, as guided by the MSC analyses. This results in higher charge rates in zones with higher levels of congestion, which generally co-relates with density and transit options. Charge rates are at a level that will produce the minimum level of congestion benefits judged to be meaningful. The rates required to meet this minimum threshold for congestion reduction are **approximately 50% of the MSC rates for the *DBC 8-zone* scenario from Round 3.**
- ***Multi-zone DBC (Min+):*** Identical to Multi-zone DBC (Min), but with charge rates that produce a more ambitious level of congestion reduction. The rates required to achieve this are **approximately 75% of the MSC rates for the *DBC 8-zone* scenario from Round 3.**

Table B1-13: Charge rates for Round 4 Distance-based Charge Illustrative Concept

Round 4 Scenarios	Charge structure	Time of Day	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Multi-zone DBC (Min)	50% MSC ($/km)	AM Peak	$0.25	$0.20	$0.17	$0.12	$0.11	$0.14	$0.08	$0.02
		Off Peak	$0.07	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
		PM Peak	$0.27	$0.22	$0.15	$0.11	$0.14	$0.12	$0.10	$0.03
Multi-zone DBC (Min+)	75% MSC ($/km)	AM Peak	$0.38	$0.30	$0.25	$0.17	$0.16	$0.20	$0.11	$0.03
		Off Peak	$0.11	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
		PM Peak	$0.40	$0.32	$0.23	$0.17	$0.20	$0.18	$0.15	$0.04

Considerations

Refer to Part 4 of the Commission's final report and Part 6 of Appendix B for detailed discussion on the illustrative concepts.

PART 6

Hybrid Congestion Point Charge and Distance-based Scenarios

PART 6. HYBRID CONGESTION POINT CHARGE AND DISTANCE-BASED SCENARIOS

A “hybrid” scenario that applies both a flat distance-based charge and point charges around the region was selected for analysis in Round 3 because:

- A hybrid scenario meets both the user cost and user pay principle (i.e. everyone should pay something in proportion to use, and people should pay more at times and locations where congestion is greater) in a different way than either a distance-based or congestion point charge approach on its own.
- One hybrid scenario was modelled and evaluated in Round 3, but was not taken forward for further iterations in following rounds for the following reasons:
- A hybrid scenario has the same system costs as a variable distance-based system but will create more boundary issues and has a lower alignment of charges with transit options.
- Unless there is a compelling reason based on the availability of technology, there does not appear to be a rationale for preferring this system over a multi-zone distance-based system given that household charges are similar for similar levels of congestion reduction.
- The most cost-effective way to charge (a proxy for) a flat rate for distance travelled is through the fuel tax.

Round 3: Hybrid (PC + DBC)

Based on Commission direction following Round 2, one hybrid scenario was modelled and analyzed in Round 3 to examine the impacts of combining the two approaches.

Hybrid (PC + DBC) charges a flat $0.08/km charge throughout the region at all times of day, combined with a $3/passing charge on the same 12 bridges as were charged in the ***Bridges*** scenarios in the AM and PM peak periods only.

APPENDIX B-2

Modelling and Analytics

APPENDIX B-2. MODELLING AND ANALYTICS

CONTENTS

PART 1

Introduction

PART 1. INTRODUCTION

A significant amount of research and analysis was carried out as part of the *It's Time* project in order to understand the impacts of a range of decongestion charging scenarios. This appendix documents the technical approach and assumptions that were used to develop, model, and analyze these scenarios, which were then used for further evaluation and discussion amongst the Mobility Pricing Independent Commission (MPIC).

A description of the scenarios, as well as the processes of how they were developed, discussed, and evaluated is contained in the main body of Appendix B. This appendix contains a detailed description of the underlying analytical tools, the research methodologies, and the technical procedures that were undertaken to develop and support the evaluation of these scenarios. In addition to providing transparency, the intention is that this report (together with the main body of Appendix B) can serve as a guide to future researchers and modellers who may wish to revise this work with new data (e.g. 2016 Census, 2017 Trip Diary, etc.). In addition to this, there may also be a need in the future to further develop or refine the scenarios that are being considered. As such, it may be necessary to revisit some of the metrics that were used to guide the Commission through their decision-making, and perhaps update or replace these metrics with alternatives. Finally it may also be necessary to explore the impacts of price capping, or applying discounts and exemptions to certain road users. For that to happen, scenarios would need to be re-run and re-analyzed. This appendix offers a user guide to researchers and modellers to enable that process by outlining some of the main assumptions and methods that were used to develop the scenarios.

This appendix is structured as follows: the next part provides an introduction to transport demand modelling and the Regional Transportation Model (RTM) used in Metro Vancouver, which was the primary tool used for the technical analysis; part 3 outlines the approach used to model the marginal social cost; part 4 describes how congestion and travel time reliability have been estimated within the RTM; finally a summary is offered in part 5.

PART 2

Transport Demand Modelling and the RTM

PART 2. TRANSPORT DEMAND MODELLING AND THE RTM

2.1 Introduction to transport demand modelling

The Regional Transportation Model (RTM, or 'the model') is a computer package that enables the forecasting of travel behaviour in the region based on mathematical and statistical procedures. The model is capable of conducting analysis to inform a wide range of policy-relevant questions, including:

- Comparing transportation policy and project alternatives and scenarios (e.g. regional transportation strategy, mobility pricing);
- Business-casing and economic analysis (e.g. consumer benefits for transportation projects);
- Corridor and area specific plans and policies (e.g. North Shore, Port Mann Bridge tolling); and
- Transit project design and sizing (e.g. Canada Line platform size, train length and frequency, Pattullo Bridge lanes).

The model works through a series of sub-modules which simulate different stages of travel behaviour from the decision to make a trip to which route to take. Sub-modules are estimated, calibrated, and validated from a variety of sources including the regional household travel survey (a survey of ~20,000 households regarding their travel behaviour); the regional screen-line survey (flows of auto and transit trips across cordons in various parts of the region); and numerous other sources (e.g. Compass, ICBC, parking operations, etc.).

These sub-modules run sequentially and build upon each other with each sub-module modelling a specific portion of decision-making. The RTM includes two different types of sub-modules: long-term decisions (household characteristics) and short-term decisions (travel decisions). Household characteristics include the number of workers, income levels, and auto ownership per household, while travel decisions include trip generation (how many trips of each type to make), trip distribution and mode choice (where to go and how to get there), and trip assignment or route choice (what roads or transit lines to use to get to the destination).

Model inputs

A range of data is used as model inputs, including socio-economic data (such as population, households, and employment by sector), transportation network data (such as roads, transit networks, and transit service), prices (such as fuel costs, transit fares, and parking pricing), and a range of geographic factors or considerations (such as bike amenability and availability of car sharing). More information is available in the next section regarding inputs used to inform the 2030 Baseline used for this project.

Model outputs

The model provides a wide range of outputs relating to the travel of people and vehicles by time of day and mode of travel across 1,700 Traffic Analysis Zones (TAZs) throughout the region at an origin-destination (OD) and road network link levels. Examples of outputs include:

- Number of people travelling by transit from Surrey to Vancouver;
- Mode share of all trips from Vancouver (throughout the day or at the PM peak hour);
- Number of vehicles (and people) using the Second Narrows Bridge (throughout the day or in the AM peak hour);
- Travel time and congestion levels on the road network, and travel time and crowding in the transit network; and
- Regional vehicle kilometres travelled (VKT).

The model is validated against available data (including traffic counts, transit data, etc.) to ensure that the outputs are reliable and robust. In addition, model outcomes are also compared to the results of real-life policies and investments where available. Examples of where the predicted model results have been tested against real-life events include the impact of the toll removals on the Port Mann and Golden Ears bridges, where most predictions were within 3 percentage points of the actual change.

2.2 Baseline inputs and assumptions

Analysis has been carried out using the RTM for three years: 2016, 2030, and 2045. 2030 was chosen as the baseline model year for analysis within the project, since this is when the 10-year investment plan will likely be fully implemented, and when a decongestion charging policy could also theoretically be in place. Analysis of any future year requires a number of assumptions to be made in order to determine what we *think* the region will look like in that year. These assumptions include things like population and employment growth, as well as transportation infrastructure (including transit) and travel costs.

The following assumptions are included in the *2030 Baseline* scenario:

- **Land use**: Includes changes in population and employment by TAZ from Metro Vancouver (based on local government planning). Growth in the number of people and jobs assumes no large deviations from ongoing trends in birth-rate or migration to and from the region. A projected spatial distribution of residents and jobs is available between and within municipalities. No major changes are assumed in the economy – no recession or significant growth – or in the sectoral composition of the labour market.
- **Transit**: Full implementation of the 10-year investment plan (transportation), including new B-lines, a 30 percent increase in bus service, the Millennium Line Broadway Extension (Broadway Subway), and the Surrey LRT..
- **Major highway projects**: Replacement of the Pattullo bridge with a new 4-lane bridge, and replacement of the Massey tunnel with a new 10-lane bridge (a review of options to replace the tunnel is expected to report in spring 2018).
- **Prices and value of time**: Fuel, parking, and transit fares (schemes and rates) are the same as current (in real terms). People's value of time is assumed to remain unchanged.
- **Technology**: No major technological or service changes are assumed – no automated vehicles or connected vehicles, and no ride hailing services.
- **Inflation**: Constant dollars – specifically, the inflation rate is assumed to match the income growth rate.
- **Emission factors:** The emission factors used to develop GHG and air quality emissions were obtained from the California Air Resources Board (https://ww2.arb.ca.gov/).

The following tables outline the various assumptions that were used to inform the *Baseline 2030* scenario for Metro Vancouver:

Table B2-1: 2030 growth assumptions for Metro Vancouver

	2016	2030	% change
Population	2,516,176	3,108,761	24%
Employment	1,368,605	1,574,550	15%
Households	973,514	1,233,887	27%
Household vehicles	1,363,458	1,650,307	21%
VKT	13.4 billion	15.2 billion	14%
Auto driver trips per day	750,840	861,351	15%

Table B2-2: 2030 emissions factors for auto, truck and bus (g/VKT)

Pollutant	Auto	Truck	Bus
CO emissions	0.22	0.10	1.31
NOX emissions	0.02	2.37	3.12
PM10 emissions	0.00	0.01	0.03
SOX emissions	0.00	0.01	0.01
VOC emissions	0.04	0.15	0.15
CO2 emissions	116	897.26	878.28

Finally, total VKT for 2030 was split between single-occupancy vehicles (SOV, 76%), high-occupancy vehicles (HOV, 18%), light-goods vehicles (LGV, 3%), and heavy-goods vehicles (HGV, 4%).

2.3 Method for modelling decongestion charging scenarios

Most pricing scenarios were modelled by applying a charge at the roadway link level. For congestion point charges, a charge is placed on the link or links indicated by a given scenario. For distance-based charges, a charge is applied to every road link within a zone according to the rates within the scenario.

With these charges in place, the model then iterates and allows the modelled "traveller" to make a new decision based on the new cost (e.g. change routes, change modes, change destinations, etc.). This will change trip times and costs for other "travellers" and so the iteration process will repeat until a stable solution is reached. Once the model has completed these analyses, data with the results is exported (at the 'trip' and 'household' levels) for analysis in another software package. Finally, results with charging are then compared to results without charging to estimate the impact of charging.

The RTM contains a number of caveats and limitations that could potentially impact the results of the analysis. For example, a consequence of using a static assignment model is that the queuing of vehicles is not modelled in detail and that this tends to underestimate the travel savings even if the model represents travel time savings accurately in the baseline. Another point is that the model is a long term strategic model that estimates a new equilibrium situation after behavioural changes have taken effect. One implication of this is that some policymakers may expect to see the changes that are estimated from the model from day one of implementation. However, because the model is a long term equilibrium model, the new equilibrium won't take effect immediately. Finally, the model is not capable of addressing time of day choice, trip chaining, or trip suppression. Because of this, some of the potential strategies for people to deal with decongestion charging are not available in the model, and therefore not included in the output. In any event, the reality of any future scenario will never conform exactly to the assumptions that are included in any regional transportation model. Furthermore, even with these caveats, these models provide strong decision-support tools for researchers and policymakers. Despite these caveats, forecasts of changes in traffic flow are generally very robust, and, if anything, they tend to underestimate the positive effects somewhat.

2.4 Modelling the AM and PM peaks

Within the model, peak hour results for the three assigned time periods are blended by direction (inbound and outbound) to form a daily value. The blends vary by trip purpose and were calculated from travel behaviour observed in the Trip Diary. For example, commuting trips place more weight on the peak hour model results, while discretionary trips place more weight on the mid-day conditions. Similarly, commuting trips place more weight from the AM peak hour results on the home-to-work direction and more weight from the PM peak hour results on the work-to-home direction. This daily blended value is fed to the mode choice and trip distribution models.

The peak hour model results are expanded to daily and annual values based on regression models estimated from observed volume data. Expansion is by mode with separate expansion models for cars, light trucks, heavy trucks, bus, SkyTrain, and West Coast Express trips.

Because of the way in which the AM and PM peak periods are developed and blended within the RTM, it means that there is not necessarily a designated time period allocated to either of these peaks. However, if there is interest in understanding the required number of hours to apply the various peak and off-peak rates in order to generate the associated impacts on congestion and revenue, the following approximations may be used:

- **AM peak period**: 6am – 9:30am (approx.), Monday to Friday
- **PM peak period**: 3pm – 6:30pm (approx.), Monday to Friday
- **Off-peak period**: All hours outside of peak periods

2.5 Household cost estimates

In order to analyze how households would be affected by different decongestion charging scenarios, another data source is needed. The RTM does not explain how households travel, but produces forecasts on trips. It is therefore not clear from the model which combination of trips are made by one household and thus what the costs and benefits of decongestion charging would be at a household level. To overcome this, the model forecast results were joined with data from the most recent Trip Diary survey, carried out in 2011 (data from a survey carried out in fall 2017 will become available in fall 2018). In the Trip Diary, households record the trips of all household members for one day. Based on the origin, destination, mode, and time of travel of each of the reported trips, we can identify how much that trip would be charged and how much time would be saved. This assumes that households do not adapt their behaviour as a result of decongestion charging. This approach was chosen so as not to underestimate the burden that decongestion charging might put on lower income households. If their behavioural change would have been taken into account, we would get lower costs for lower income households since they are more likely to adapt their travel behaviour. However, those lower charge costs are a result of household adaptation costs that should not be ignored and are included in the calculation of overall economic benefits.

This dataset with trips per household from the Trip Diary, and the decongestion charges applicable for those trips, was then used for two different analyses:

1. Creating descriptive statistics such as the mean and percentiles of household decongestion charging costs on a daily level for the population as a whole and for different sub-selections like households with car trips, households that pay a decongestion charge at least once in any given day, and different household income classes.
2. Calculating how much funds would be needed to address the income inequities of decongestion charging. This was calculated by comparing the cumulative distributions of the percentage of annual income spent on decongestion charges for low, medium, and high-income households and correcting the low and medium distributions such that they match the high-income distribution.

Since households report about a single day in the Trip Diary, we do not know how representative the recorded travel behaviour is of the household travel behaviour throughout the year. The daily values cannot therefore be easily expanded to an annual level without introducing some extreme values. In calculating annual spending on decongestion charges and percentage of annual income, we used one annual expansion factor (335) that was consistent with expansion factors of other metrics from the model. This is a coarse approximation where extreme values need to be excluded from analyses.

PART 3

Modelling the Marginal Social Cost

PART 3. MODELLING THE MARGINAL SOCIAL COST

The theory of marginal social cost (MSC) pricing and how it works is explained elsewhere (see Appendix B of the Commission's phase 1 report). Identifying the MSC charge rates and applying them in the model is an innovative approach to rate-setting within transport demand modelling. This process of developing the MSC charge rates for the model is described here, as well as the method used to aggregate and apply these charges to bridges and distance-based zones in the scenarios.

3.1 MSC development for the Regional Transportation Model

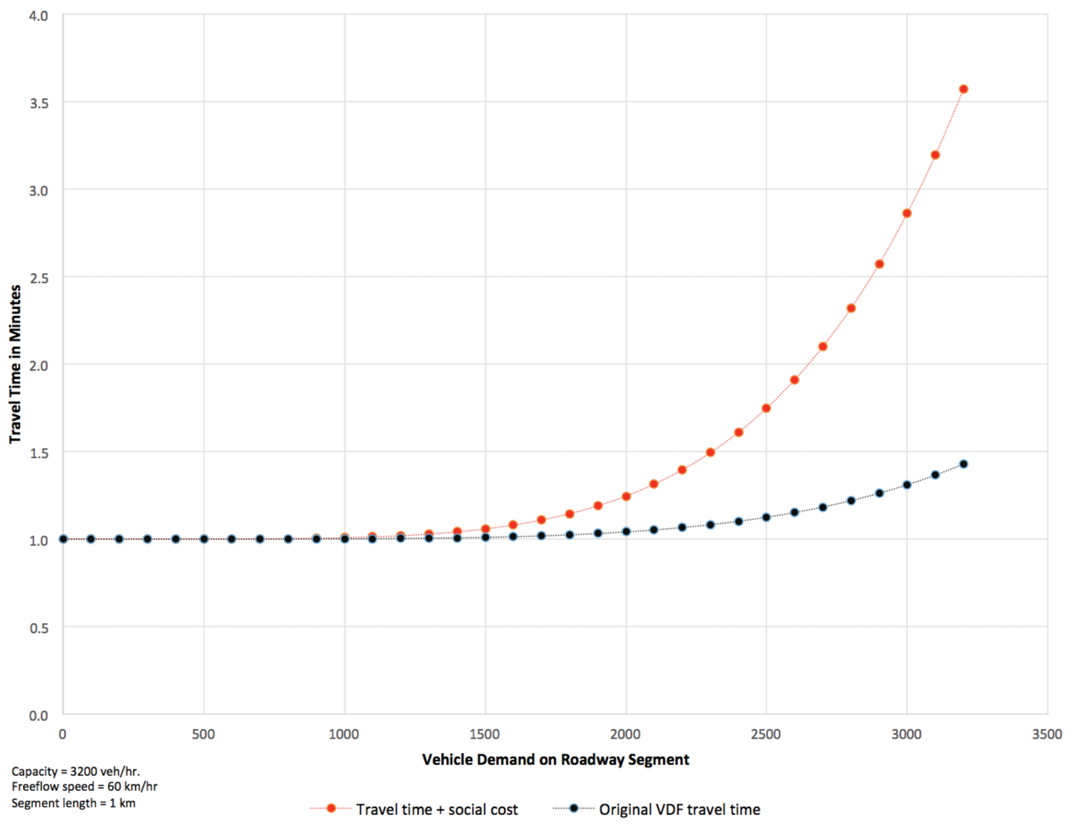
The volume delay functions (VDFs) within the model estimate travel time on a road network link given its free-flow speed, capacity, and vehicle demand. The output is travel time in minutes for each link. The RTM has four principal VDF forms:

- Highway segments;
- Arterials approaching a controlled intersection;
- Arterials with uninterrupted flow; and
- Highway ramp/merge sections.

In application, the MSC is essentially the derivative of the VDF with respect to vehicle demand. In order to apply the MSC in the model, the first step is to create a second set of VDFs. These new VDFs produce the travel time of the original VDF and add the derivative with respect to volume to each trip. This approach charges the MSC in units of time for each roadway user. A single text file is placed in the RTM inputs folder to change the link level VDFs to the MSC versions. The difference between the MSC VDF travel time and the original VDF travel time is the marginal social cost in minutes.

In Figure B2-1, the vertical distance between the *Travel time + social cost* curve and *Original VDF* travel time curve is the marginal social cost in minutes for a given vehicle demand level. Note that the original VDF is the actual travel time on the link. During the model run the original VDF travel time is still calculated to inform transit travel times (which are based on the auto travel time).

Figure B2-1: Travel time with original VDF and MSC VDF



For analysis and reporting purposes, the MSC cost in minutes is converted into dollars using weighted average values of time (VOT). However, different users and trip purposes will have different values of time, so for each peak period a weighted average VOT was calculated (AM: $14.86/hr; MD: $13.59/hr; PM: $14.67/hr). The dollar value of the MSC is specifically calculated as:

(MSC VDF travel time - original VDF travel time) / 60 * VOT

3.2 Aggregation and application of MSC charge rates

The MSC rates set for each link are dynamically priced – the charge is assigned to a specific link and it should move up or down as demand changes in response to prices there and elsewhere. When defining point charge or distance-based scenarios, the MSC model run can be used to identify locations and times where a charge should be applied.

By aggregating MSC rates into discrete point charges or into zones with the same per-kilometre charge rate, significant averaging takes place, which has some implications. First, by averaging, congestion on specific links is no longer priced at the exact marginal price – some roads are over-priced, and some are under-priced. Second, since the MSC charge levels are based on the idea that all surrounding roads also have an optimal charge, the charge levels are taken somewhat out of context if, for example, in a point charge scenario, the surrounding roads are no longer charged at all. Finally, as people change their behaviour because of charges in a scenario, they may cause new congestion somewhere else that is not correctly priced, even if that road was correctly priced before.

PART 4

Modelling congestion and travel time reliability in the RTM

PART 4. MODELLING CONGESTION AND TRAVEL TIME RELIABILITY IN THE RTM

Defining and measuring congestion is complex and dynamic. Congestion varies by time of day and by location throughout the region, and there are many metrics which could be used to measure it. However, regardless of the metric used, they will all require a reference speed or travel time to compare against. For example, one way to measure congestion is to use the travel time index (TTI). This metric compares the estimated travel time between two points (on a certain road segment at a certain time of day) to a baseline or reference travel time. Typically, the reference travel time should be one that is not represented by congested conditions – such as in free-flow or off-peak conditions.

4.1 LOS D as a reference for congestion measurements

This work used a reference travel time that replicates what could be achieved during off-peak conditions. The method chosen to do this utilized the concept of Level of Service (LOS). Level of Service is a qualitative assessment of traffic flow on a road network or segment. The range goes from LOS A (faster traffic flow and no congestion), to LOS F (slower traffic flow and heavy congestion). LOS D was used as the threshold for congestion, i.e. congestion is defined by LOS D or worse. The extent of congestion then depends on how bad the conditions are beyond LOS D.

Traditionally, researchers and practitioners have relied on using a reference travel time that replicates free-flow conditions. However, given that the reference travel time often becomes a ‘target’ for policymakers, we decided that a reference travel time that replicates free-flow conditions is neither desirable nor achievable, nor is it an economically efficient use of road space. In contrast, using travel times that can be achieved during off-peak conditions (i.e. where there is more traffic volume than during free-flow conditions) is a more realistic reference point.

4.2 Development of travel time reliability

Recent research[1] indicates that the variability of travel time can be predicted from the travel time index, which is the ratio of actual travel time to a reference travel time. Travel time data for Metro Vancouver has been obtained and validated from the Google Maps API, where data is captured at either the roadway network link level or at the origin/destination (OD) level.

Unless the route has been specified, then OD level data dampens the variability because it allows for rerouting. However, reliability can be more meaningful or understandable when applied at the trip (OD) level rather than at the link level. Furthermore, because analysis at the OD level matches other metrics used in this study, the decision was made to estimate and apply the model at the OD level.

4.3 Reference speed for travel time reliability

In order to calculate the travel time index, a reference speed is required. The majority of congestion metrics used in the study use the speed (or travel time) that can be achieved by Level of Service D (LOS D) as the reference speed (or travel time). However, while we do not have the ability to calculate LOS D speed from Google Maps data, we do have the ability to estimate the free-flow speed from this data, which is assumed to be the 10^{th} percentile observed travel time. For the purposes of this reliability model, we use free-flow speed as a reference speed because only the denominator is being changed. Doing so will change the model coefficients, but should not change the output.

1 [Gupta et al. (2018), SHRP 02 C04 (2013), SHRP 02 L04 (2013)]

4.4 Reliability model estimation and output

In order to estimate travel time reliability from Google Maps, OD pairs were constructed from 14 selected locations throughout the region. A total of 182 OD pairs were identified (14 x 14 – 14). Weekday data was collected from four months – February, March, October, November – during 2016 and 2017, with observations only included between 07:00 and 19:00 due to consistent low variability overnight. Approximately 9,500 data points were used to estimate the model.

Travel time reliability was estimated using a log-log model, with standard deviation of travel time in minutes (log) as the dependent variable. Independent variables include: travel time index (actual travel time divided by free-flow travel time) (log) interacted with peak period dummy (during AM or PM peak period); distance travelled in kilometres (log); and whether the trip crosses a bridge. Cross-validation was conducted on 25% holdout sample, and showed no signs of over-fitting. Model results are displayed in Table B2-3 below.

Table B2-3: Travel Time Reliability model coefficients and summary statistics

Term	Coef.	Std. error	Statistic	p-value	Sig.
Intercept	-3.374	0.037	-91.355	2.00E-16	***
Log Travel Time Index	3.119	0.055	57.026	2.00E-16	***
Peak Period = True	0.178	0.022	8.194	2.86E-16	***
Log Distance (km)	0.837	0.009	89.881	2.00E-16	***
Bridge Crossing = True	0.162	0.010	15.775	2.36E-55	***
I(Log TTI: Peak)	0.438	0.068	6.404	1.59E-10	***

Sig. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.3996 on 9458 degrees of freedom
Multiple R-squared: 0.6709; Adjusted R-squared: 0.6707
F-statistic: 3856 on 5 and 9458 DF, p-value: < 2.2e-16

4.5 Reliability model application and results

Applying the reliability model is done as a post-process to the RTM. As such, reliability is calculated for each scenario after the run is completed, and reliability does not impact travel behaviour in the model. Reliability is calculated at the 'super zone' level (12 x 12 GY). The output is standard deviation in minutes for a trip from a given origin zone to a given destination zone. Note that the standard deviation is plus or minus, but for trip planning purposes, the additional travel time that might be incurred due to reliability is considered. This is sometimes referred to as buffer time. More reliable trips require less buffer time.

For the purpose of economic analysis and evaluation of scenarios, the standard deviation of travel time in minutes is converted into dollars using the value of travel time reliability (VOR). In the absence of local empirical data for the VOR as a proportion of the value of time (VOT), we have turned to international research to identify a reasonable estimate. Using the average value from a wide range of empirical research (outlined in Table 3 of SHRP 2 L17) provides an estimate of 0.8 for the reliability ratio. As such, VOR is estimated at 80% of VOT. Using the weighted average VOTs discussed above yields the following VORs:

- AM: $14.86/hr * 0.80 = $11.89/hr
- MD: $13.59/hr * 0.80 = $10.87/hr
- PM: $14.67/hr * 0.80 = $11.74/hr

PART 5

Summary

PART 5. SUMMARY

This report has outlined the technical approach that was used to model a range of decongestion charging scenarios throughout the winter and spring of 2018. This work was completed by an international team of modellers and transportation experts. Research methods, analyses, and results were regularly checked for accuracy and validation, including various QA/QC (Quality Assurance/Quality Control) reviews.

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APPENDIX B-3

Evaluation Briefs

APPENDIX B-3: EVALUATION BRIEFS

CONTENTS

PART 1

Introduction

PART 1. INTRODUCTION

This appendix contains a set of briefs which describe the considerations behind the evaluation criteria identified as important in the work of the Metro Vancouver Mobility Pricing Independent Commission (MPIC). The criteria for evaluation were identified by the Commission through an assessment of the Terms of Reference and through stakeholder and public engagement carried out in fall 2017.

Some criteria have been assessed using quantitative metrics, and so the source data and methods behind those metrics is described. Other criteria have been assessed using a combination of research, qualitative analysis and experience from other jurisdictions, in which case a summary and references for this evidence is provided.

The evaluation briefs are not intended to be a thorough assessment of each of these criteria; rather they describe the methods and evidence used within this project. They also provide a starting point for further work, or for those who would wish to understand more.

The following evaluation briefs are to be found in this appendix:

- Congestion
- Fairness
- System Costs and Revenue
- Economic Benefits
- Public Support
- Consistency with the Regional Growth Strategy (RGS) and Regional Transportation Strategy (RTS)
- Local Effects
- Health, Environment, and Safety
- Privacy
- Future-proofing

PART 2

Congestion Evaluation Brief

PART 2. CONGESTION EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **traffic congestion**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: fairness; system costs and revenue; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

Congestion begins to occur as traffic volumes approach the vehicle capacity of a given road, street or intersection, resulting in reduced vehicle speeds. At a network level, this results in increased travel times and increased unreliability of travel times. Some level of congestion is economically efficient as increased traffic means additional movements of people and goods and these movements yield economic and social benefits, even at speeds well below free flow. On city streets, some level of congestion is the natural consequence of complex urban environments with many movements of vehicles and people. As traffic volumes reach or exceed the capacity limit[1] of the road or street, conditions are considered to have *excess congestion* leading to significant travel time delays and economic costs.

Transportation engineers use the concept of *level of service* (LOS) to describe different levels of traffic volume and congested conditions. This project chose to define unwanted levels of congestion or excess congestion as traffic volumes at and above LOS D[2]. At LOS D, traffic approaches unstable flows. Speeds decrease as traffic volumes increase. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease. Minor incidents are expected to create delays.

Multiple values to individuals and society as a whole are influenced by congestion.

At an individual level, time spent in congestion is often considered to be wasted time because that time could be spent on more valuable activities such as leisure or work. In causing travel time delays, congestion keeps individuals from more productive and enjoyable activities and thus impacts their overall quality of life. Many people perceive time spent in congested conditions as much worse than time spent in free flow traffic. Congestion can cause personal stress especially when it contributes to longer than usual travel time delays. Travel time reliability is particularly important as research shows that individuals tend to remember the worst delays and often adjust their travel times to account for them, meaning they leave earlier to ensure they get to their destination on time.

The impacts of congestion on individuals were confirmed through the MPIC public opinion survey in September 2017:

- Nine-in-ten residents (89%) responded that ‘delays caused by high traffic volumes’ make them feel ‘a great deal’ or ‘some’ frustration.
- Eight-in-ten residents (80%) said that they are frustrated by ‘unpredictability of travel times’.

1 The capacity limit of the road is the point where the road has maximized traffic volume flows.
2 Note that there is no direct interpretation of model data that corresponds perfectly to the concept of service levels. As a reasonable approximation, we have considered those links for which the model predicts that the traffic volume will be larger than 85% of the capacity to be congested. More details on LOS D is available in Appendix B-2.

- Eight-in-ten (81%) residents said their transportation frustrations cost them at least some time each week. The median time lost reported by respondents was just less than an hour (about 57 minutes) and slightly less than one-half (44%) said they lose an hour or more each week.
- Six-in-ten (61%) residents said their transportation frustrations have a real cost for them in money each week in terms of transportation costs and lost wages/productivity. The median loss per week reported by respondents was roughly $17 and three-in-ten (31%) said they lose more than $25 in a typical week.

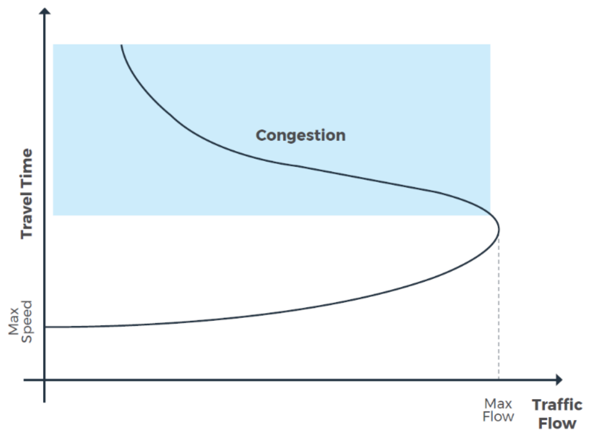
At the societal level, congestion impacts the overall productivity of the economy. With slower movement of people and goods there will be less time available for productive work. Longer commute times reduce the efficient matching of individual capabilities and specialized job opportunities, meaning that access to jobs with high potential earnings is reduced. This has impacts for the overall productivity and efficiency of the economy.

When making travel choices, people consider their own direct cost of travelling, but often not the cost imposed on others. Travellers generally consider their experienced congestion, fuel costs, insurance and direct taxes for road use, but not the societal costs of congestion, which economists call *externality costs*. The externality costs of congestion include: travel time delays to other travellers, lower economic productivity, and associated additional air pollutant and greenhouse gas emissions.

Decongestion charging increases the cost of vehicle travel to account for at least a portion of the externality costs of congestion. Note that there is a difference between the externality costs associated with congestion and the externality costs of driving in general. What is typical for externality costs related to congestion is that they vary significantly between locations and times of day. In developing a decongestion charging policy, a key policy decision involves choosing which externality costs associated with motor vehicles to internalize for drivers. In the MPIC project, emphasis was put on studying the externality cost of travel time delays caused by congestion and designing decongestion charging scenarios to reduce average travel time delays, which will also improve travel time reliability. While reducing travel time delays was the design focus for the scenarios, the predicted impact of charging scenarios on emissions was tracked and characterized as a co-benefit.

Decongestion charging works by increasing the cost of driving (or internalizing the externality costs of congestion), which decreases the demand for vehicle travel. Importantly, since there is a non-linear relationship between traffic volume and travel time (Figure B3-1), only a small portion of traffic volume needs to be reduced to get a much larger reduction in travel time. Charging will only improve travel times when and where congested conditions occur. In free flow traffic conditions, decreasing traffic volumes will not influence travel times. This means that if reducing congestion is the only objective for a charging system, charges should only be levied at busy times and locations.

Figure B3-1: Non-linear relationship between traffic flow and travel time



There is a non-linear relationship between traffic flow and travel times on a specific road segment which means small changes in demand can lead to significant changes in average travel time. This is shown in the figure above where the horizontal axis represents the traffic flow (vehicles per hour passing a given location on the segment) and the vertical axis represents the travel time. Up to a point, an increase in the volume of traffic can be accommodated and will therefore impose only marginal increases on the average travel time. However, when congestion begins – the point at which demand exceeds capacity – further increases to demand have larger and larger impacts on travel time.

Congestion Metrics and Methods

There is no one metric that can adequately describe the full impact of a decongestion charging scenario on congestion and time savings for road users. Multiple metrics and reporting scales are needed and an individual or organization's preferred metric(s) for understanding congestion will depend on what matters most to them.

Two types of time benefits are: (1) reduced *travel times* and (2) reduced time in congestion or *congested time*. Travel time is defined as the time to complete a trip from origin to destination. Congested time is the amount of time within a trip that experiences congested conditions, where congested conditions in this project have been defined as level of service D or worse. As time has a tangible value for the individual, metrics within this category have the most relevance for understanding and communicating the private benefits of decongestion charging scenarios as experienced by individuals.

The Regional Transportation Model (RTM) was used to simulate the effect of decongestion charging scenarios on travel times and congested times for the following modes:

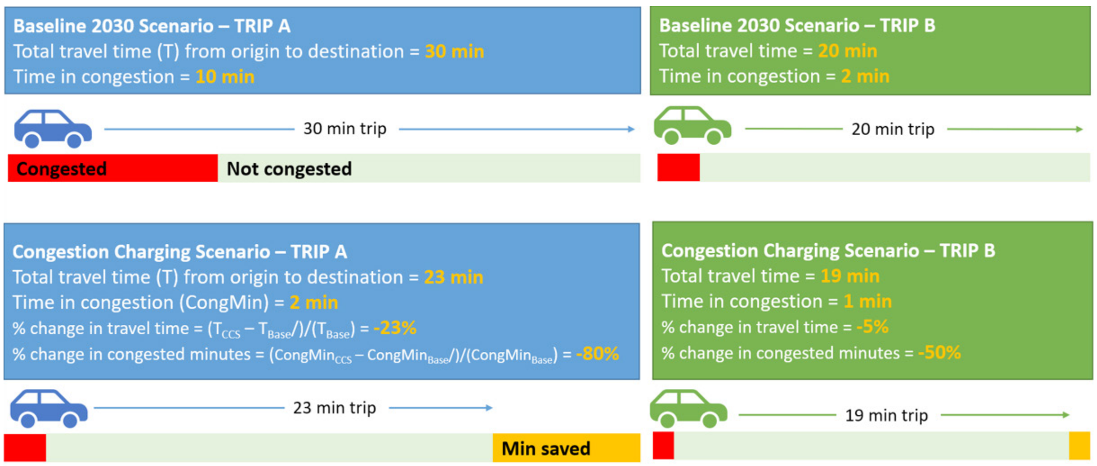
- Personal vehicles
- Transit vehicles
- Light and heavy goods vehicles.

The RTM simulates travel demand patterns across the region according to a number of factors that are known to influence travel choices (such as the geographical distribution of housing and attractive destinations, as well as travel time and travel cost with different available travel modes). While this model is quite detailed and sophisticated, it is important to recognize that it is a simplified simulation of how people would respond to a decongestion charge. Two key limitations of the model are, first, that it does not include the full range of ways that people and businesses could adapt to a decongestion charge scenario, and, second, that it does not include the full synergies of how traffic locks up in heavy congestion. As a result, the model is likely to underestimate the time savings of a charging scenario. **In particular the model is expected to underestimate time savings that will occur in the most congested periods and locations, and**

the total time savings that would be generated in the long run. The estimated travel time savings should be regarded primarily as an indication of the *relative* decongestion effects, in the comparison of different decongestion scenarios to each other.

Changes in travel time can be reported in terms of absolute minutes saved or as a percentage change to baseline travel times/congested times. When changes in travel time and congested time are reported in minutes they are almost the same. When changes to travel time and congested time are reported in terms of percentage change to the baseline scenario, they are quite different and percentage change in congested time will typically be significantly larger than percentage change in travel time (Figure B3-2). This occurs because decongestion charging has little or no influence on the amount of time it takes to get between two places when traffic volumes are at free-flow levels. Decongestion charging can only reduce overall travel times through reducing time spent in congested conditions.

Figure B3-2: Travel time vs. Congested time (Change in minutes and percent change from baseline)



In addition to the average travel time and congested time savings from a decongestion charging scenario, another important benefit is improved travel time reliability. Travel time reliability is a function of the variation in travel times for a given trip. As traffic volumes increase, travel time reliability decreases. That is because even a small disturbance of traffic conditions, such as a single vehicle breaking down on a highway, will generate large consequences where there is no capacity margin. Individuals tend to remember the worst delays, and will often have to adjust their everyday departure times to be able to account for those worst cases when they occur. This leads to additional loss in other productive time, family time, or recreation time. Therefore, reducing the variance of travel times can have a larger effect on the total time that is 'allocated' to travel, and on the total perceived cost of travel time, than it has on average journey times.

The RTM does not directly simulate changes in travel time reliability. Rather, the model's outputs are representative of average travel time changes assuming full capacity of the road infrastructure. To understand the possible travel time reliability improvements that could result from decongestion charging scenarios, this project studied the relationship between the travel time index (ratio between actual speed and desired speed) and the variability of travel time (which is a good proxy for travel time reliability). In theory, travel time reliability should improve as the travel time index approaches a value of 1 (i.e. when actual travel times are close to desired travel times). The relationship was determined using travel time data available from Google Maps, across the region of Metro Vancouver over several months. The analysis provided a relationship between congestion levels and travel time reliability that can be used in conjunction with model results to estimate the travel time reliability gains of a decongestion charging scenario. Table B3-1 provides a list and description of all the congestion-related metrics used within this project.

Table B3-1: Congestion-related metrics

Category	Metric	Description
Congested time	Million min/day (Region-wide)	Reports the time spent in congestion for vehicle trips at the regional scale where "congestion" is defined as traffic volume density at or above LOS D. This can be reported for all vehicles or disaggregated for personal vehicles and goods vehicles. Negative values represent time savings, lower is better. Also reported as a % change in congested time from Baseline 2030 scenario. Note that a portion of total minutes 'saved' in a decongestion charging scenario are a result of drivers choosing their 'second best' option compared to their preferred choice in the baseline scenario – i.e. some drivers are changing their mode or destination in the model. This adaptation cost is captured in the calculation of economic benefits.
	Mins/trip	Reports the change in time spent in congestion for individual trips during the AM peak, PM peak or off-peak period. Reported using origin-destination matrices that show the average congested time when traveling between 12 model reporting zones. Can be reported for all vehicles or disaggregated for personal vehicles, transit buses and goods vehicles.
	Mins/day/ Household (by regional zone)	Reports the average minutes per day that a household spends in congested conditions for each of the 12 model reporting zones across Metro Vancouver. As opposed to looking at trip-level data, a household scale provides a picture of how time savings add up across a day for the average household in given area of Metro Vancouver.
	% of households with >X minutes reduced congested time / day	Reports the absolute savings in congested time across households in the 2011 Metro Vancouver Regional Trip Diary Survey dataset (~650,000 households) and for subsets of these households according to the amount of congested time per day a household experiences in the Baseline 2030 scenario: 0-5 min (47% of households), 5-10 min (13% of households), 10-20 min (17% of households), 20-35 min (14% of households), >35 min (10% of households) and >20 min (23% of households).
Travel time	Million Mins/day (Region-wide)	Reports the total regional travel time across all vehicle modes per day for a given scenario. Also reported as a relative percentage change from the Baseline 2030 scenario.
	Mins/trip	Reports the change in average travel time per trip relative to the Baseline 2030 scenario. Averages over a given time period (AM peak, PM peak, off-peak), for a given mode (personal vehicles, transit buses, goods vehicles), and for a specific origin-destination pairing. Presented in origin-destination matrices. Negative #s represent time savings, lower is better.
Travel time reliability	?	Reports the relationship between the travel time index (ratio between actual speed and desired speed) and the variability of travel time (which is a good proxy for travel time reliability). The relationship was determined using travel time data available from Google Maps. The value of improved travel time reliability is also monetized within the economic benefits calculations.

PART 3

Fairness Evaluation Brief

PART 3. FAIRNESS EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **fairness**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; system costs and revenue; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

With respect to decongestion charging, fairness refers to how the costs and benefits resulting from a charge are distributed over the population. Within the literature on decongestion charging, the work of philosopher John Rawls is commonly cited as the theoretical basis for the analysis of fairness. Rawls presents three[3] principles:

- **Principle 1: A set of basic rights for everyone.** This could be interpreted as a basic right to mobility, and encompasses the notion of affordability. It is important to bear in mind that this does not imply any 'right to drive' and needs to be applied to everyone including those who do not or cannot drive.
- **Principle 2: Equal opportunities to change and adapt.** This suggests charges should be clearly and consistently applied and should not be introduced or amended without adequate notice.
- **Principle 3: Inequalities should work in favour of the less advantaged.** A decongestion charging policy is likely to be regarded as unfair if it involves a redistribution of resources from the less wealthy to the more wealthy.

In addition to research on fairness, the *It's Time* project explored what fairness means for this region in the context of decongestion charging. In October/November 2017, workshops were held with stakeholders, the User Advisory Panel, and elected officials, and a key topic was "What does fairness mean to you". Participants in the online public engagement were asked "Have we missed any important ideas related to fairness?" prompting 1,250 online comments. From all of this input, a number of common themes emerged, including:

- Not burdening those with fewer choices based on where they live and where they work.
- Increasing transit and scheduling options before implementing decongestion charging.
- Supportive and opposing opinions for paying less in areas with fewer transit options, with some comments expressing reluctance to subsidize transportation modes for people choosing to live in lower density areas in order to save money on housing.
- Considering affordability and social equity impacts for different marginalized groups (i.e. low income, seniors, students) and the working poor who have less choice in where they live and their working hours.
- Considering using the revenues from decongestion charging to replace existing taxes and fees.
- Using revenues from decongestion charging to improve the region's transportation system.

For more information on what was heard about fairness through engagement activities, see the MPIC Phase 1 Project Report.

3 Rawls, J. (1971)

Fairness Metrics and Methods

Because there are multiple dimensions of fairness, multiple metrics and reporting scales are needed to understand the fairness implications of a particular charging scenario. Different individuals and organizations will weigh different metrics differently and evaluating fairness will involve balancing across multiple dimensions. What matters is that regional decision makers can demonstrate that they have considered these multiple dimensions, sought ways to mitigate any disproportionate effects on vulnerable groups, and transparently reported important trade-offs.

There are four main categories of metrics for understanding the fairness implications of charging scenarios that relate to Rawls' principles and key themes from engagement:

1. Consistent treatment of users
    - Represents Rawls' second principle that emphasizes consistency and equal opportunities to change and adapt
2. Availability of transportation choices
    - Represents Rawls' second principle, as well as the first principle around basic rights for mobility
    - Represents feedback from engagement that emphasized improving travel options
3. Household charges
    - Linked to Rawls' first principle around basic right for mobility
    - Represents concerns heard through engagement around the affordability of living in Metro Vancouver
4. Income equity
    - Represents Rawls' third principle that inequalities should work in favour if the less advantaged
    - Represents concerns heard through engagement about how decongestion charging could affect lower income people and households

Consistent treatment of users

Any charging system that is designed to affect behaviour will result in differences in charges across users. A key element of fairness is that differences in cost should be explainable in a way that is consistent and transparent. From the literature on decongestion pricing, as well as input from MPIC engagement, the project team defined three possible pricing principles:

User Pay – People should pay in proportion to their use of the transportation system. In other words, the more you use it, the more you pay.

User Cost – People should pay in proportion to the costs they impose on other users of the transportation system, in the form of delays. In other words, people should pay more for those trips that contribute more to congestion.

Benefiter Pay – People should pay in proportion to the time savings they experience.

Decongestion charging scenarios have been evaluated for the extent to which they are aligned with and/or otherwise support these principles. It should be noted that these pricing principles are not necessarily mutually exclusive, and it is possible to develop scenarios that contain some elements of them all.

Availability of transportation choices

Public and stakeholder engagement identified improved access to modes of transportation other than driving a private vehicle, in particular transit, as an important component of fairness. It is worth noting that traffic modelling as well as empirical evidence from other jurisdictions suggests that only a limited number of trips will switch to transit as a result of decongestion charging. Other adaptation strategies are equally common, and most people will not change behaviour at all. Nonetheless, it is clear that the availability of alternatives affects the perception of the fairness for many people, whether they use the alternative or not.

Household charges

Affordability has been a key concern raised in public and stakeholder engagement. For the purposes of this evaluation, the project team was concerned with both average or median effects on households, as well as the effects on the most vulnerable or most-affected households.

There are a number of difficulties in estimating household costs for decongestion charging scenarios. One difficulty is that an individual's out-of-pocket cost is dependent on their travel patterns over time. Paying a high charge on a single occasion may be affordable, but it becomes less affordable when applied to several trips a day, all year round. The Regional Transportation Model (RTM) treats each trip separately, without linking them to households and individuals or aggregating them over time periods. Given this limitation, the project team used data from the 2011 Metro Vancouver Regional Trip Diary Survey, which allows us to explore how much the households that participated in the survey would have had to pay for their travel pattern on the day of the Trip Diary Survey. Those estimates were then expanded from a one-day travel survey to a year by multiplying by a factor of 335, which is consistent with annual expansion factors used elsewhere in transportation demand modelling.

For the more extreme travel patterns in the survey (i.e ones that were not likely to be representative of a typical day), this expansion factor is not a realistic assumption for estimating annual household charges. Therefore, with this method, expanded estimates of extreme values (above the 90th percentile of yearly cost) are likely to be too extreme compared to real annual values.

The estimated out-of-pocket costs are based on travel behaviour that took place in the absence of decongestion charging. If charging was introduced, some households would choose to reduce costs by changing their behaviour in response to this price signal, and other households would choose to pay the charge and carry on driving as before. That means that these charge amounts are an overestimate of the likely actual out-of-pocket household charges.

Income equity

Decongestion charging will result in higher income households paying more in absolute terms than lower income households. Because driving is expensive, lower-income households have likely already reduced their discretionary trips. However, lower income households will pay more as a percentage of their annual income than higher income households. Therefore, how the funds from the charging policy are used, and the distributional profile of those expenditures, will matter. To understand impacts on income equity, annual household charges as a percentage of annual income for low, medium, and high income groups are calculated. Also, the amount of money that would be needed to offset the income inequity of selected charging scenarios was calculated.

Project Metrics

Table B3-2 provides a list and description of all the fairness-related metrics used within this project. Note that the metrics for alignment with pricing principles are calculated using the 12x12 origin-destination scale data. The degree of alignment is measured by a common statistical metric (R-squared) that describes how closely two variables are related (correlated) to each other. Different metrics draw on the correlation between different pairs of variables.

Table B3-2: Fairness-related metrics

Category	Metric	Units	Description
Consistent treatment of users (Alignment with Pricing Principles)	Alignment of Charges with Use	%	Reports the degree of alignment between average charges ($/trip) and use (km/trip). *Answers the question: Do the people who use the system the most contribute the most?*
	Alignment of Charges with Time Saved	%	Reports the degree of alignment between charges and time saved. *Answers the question: To what extent are those who pay more getting greater time-saving benefits?*
	Alignment of Charges with Contribution to Congestion	%	Reports the degree of alignment between charges and contribution to congestion. *Answers the question: To what extent are trips that contribute more to congestion being charged?*
Access to Alternatives	Alignment of Charges with Transit Options	%	Reports the degree of alignment between trip charges and transit service for the trip, measured by the ratio of travel time by transit vs. personal vehicle. *Answers the question: does the system have higher charges for trips that can be relatively easily conducted by transit?*
Household Charges	Daily and Annual Household Charges	$/day/HH $/yr/HH	Reports the distribution of daily and annual household charges for different groups of households according to household travel patterns in the 2011 Metro Vancouver Regional Trip Diary Survey.
Income Equity	Impacts on Income Equity	HH charges as % of annual income	Reports the distribution of charges per year as a % of household income, for three income classes: (1) low: <$50,000/year, (2) medium: $50,000-$100,000/year, and (3) high: >$100,000 per year. Based on the 2011 Metro Vancouver Regional Trip Diary Survey with data on the regional travel patterns for households of different income levels.
	Amount needed to offset income inequity	$million/year	The total amount of revenue needed to offset income inequity in a given scenario.

References

- MPIC Phase 1 Project Report, Appendix A.
- National Academy of Sciences (2018) Assessing the Environmental Justice Effects of Toll Implementation or Rate Changes: Guidebook and Toolbox, NCHRP Research Report 860.
- Rawls, J. (1971). *A Theory of Justice*. Belknap

PART 4

System Costs & Revenue
Evaluation Brief

PART 4. SYSTEM COSTS & REVENUE EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **system costs and revenue**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

While the Commission has affirmed that revenue should not be the primary aim of a mobility pricing policy, or of a decongestion charging system specifically, supporting investment in transportation was one of the three main objectives governing the Commission's work (along with reducing congestion and promoting fairness).

This project evaluated the following:

Net revenue. This represents an interest in a sustainable source of revenue. Of most interest is the net revenue – gross revenues less system costs – resulting from each decongestion charging scenario.

System costs and revenue collection efficiency. This represents a belief that raising revenue to support public services should be done in a financially efficient manner – i.e. a manner that minimizes the costs incurred to raise revenue, including all capital and operating costs of infrastructure, technology, and administrative systems. The evaluation estimated both total system costs and total system costs as a proportion of gross revenues. It also identified important differences in the degree of certainty associated with these costs.

Metrics and Methods

Definitions

Table B3-3 outlines the systematic methodology used to estimate net revenues for the modelled decongestion charging approaches. According to the AACE International Recommended Practice guide for the Cost Estimate Classification System (AACE, 2016), these figures are understood to be compliant with the class 5 estimate definition based on a maturity level of 0% to 2% for project definition deliverables and a parametric cost estimate methodology.

Table B3-3: Definition of Parametric Estimates Used to Develop Net Revenues

Revenue/Cost	Definition	Methodology for Estimation
Gross Revenue	Gross revenue, in terms of decongestion charging, is defined as the annual amount of charge revenue collected prior to any deductions.	Input from Regional Transportation Model (RTM).

Fuel Tax Revenue	Fuel tax revenue includes the portion of annual revenue generated by the regional fuel tax and dedicated to transportation (transit and major road) improvements. Fuel taxes and their associated revenues have been included in all congestion point charge and the flat distance based charge scenarios, but have been excluded from the *DBC 8-zone, DBC 2-zone, DBC 2-zone transit*, and *Hybrid (CPC + DBC)* scenarios.	Input from RTM.
Transactions *(for CPC scenarios)*	Transactions, in terms of decongestion charging, are defined as the number of crossings that occur. For the case of a congestion point charge, a transaction occurs every time a user passes one of the charge points.	Input from RTM.
Vehicle Kilometres Travelled (VKT) *(for DBC scenarios)*	Vehicle Kilometres Travelled is defined as the number of vehicles on a given traffic network multiplied by the average length of the trip.	Input from RTM.
Capital Costs	Capital costs are an expense that primarily occurs prior to operation, but will also occur at fixed intervals during operation as infrastructure is renewed or replaced. In the context of decongestion charging, these costs would include costs for infrastructure such as charge points, back-office setup costs, technology investments (purchasing of on-board units), etc. See 'Depreciation' metric below for a description of how capital costs were annualized and included in the evaluation.	The capital cost estimates for the congestion point charge scenarios used a tolling infrastructure capital cost outlined by the Transportation Investment Corporation (TI Corp, 2013) for the TReO system used on the Port Mann bridge (see Table B3-4). The capital cost estimate for the distance-based charge scenarios was determined using a Dutch government study from 2006 (see Table B3-5).
Annual Operating Costs	Annual operating costs include expenditures that are incurred during operations. These include administrative expenses, financial/ corporate services, and/or technical services.	Annual expenses were determined using the same comparable cases as the capital costs (see Table B3-4 and Table B3-5).
Transaction Costs	Transaction costs, in terms of decongestion charging, implies the cost per transaction for transponder and/or automated license plate recognition (ALPR) readings as well as trip building costs (i.e. building a trip charge value from multiple point crossings) from the back office system.	Transaction costs were determined by understanding the annual costs for transactions for each of the case studies and scaling them according to the number of transactions during that year and the number of inputted transactions from the RTM for Metro Vancouver (as described above).

Depreciation	Depreciation represents the decrease in value of an asset over time.	For the purpose of this assessment, depreciation was assumed to be linear over a specified duration or useful life of the asset. Depreciation was calculated using a straight-line method by assuming 100% of the capital cost over the asset's useful life. The upfront capital costs and the useful life differs based on the technology employed for each of the scenarios, but is applied as a deduction to gross revenues.
Net Revenue	Net revenue is the gross revenue minus the annual operating costs. Net revenue is reported with fuel tax revenue included for all congestion point charge scenarios and for the flat distance-based charge scenarios.	
System Costs/ Revenues	This ratio represents the annual system costs for the scenario as a percentage of annual gross revenues.	
System Costs/ (Decongestion Charge + Fuel Tax) Revenues	This ratio represents the annual system costs for the scenario as a percentage of the annual gross charge revenues and annual fuel tax revenues for the cases of the congestion point charge and the flat distance based charge scenarios.	

Technology Assumptions, Data Sources, and Costing

Congestion Point Charge Scenarios

Data on costs has been compiled from TI Corporation based on the TReO RFID (Radio Frequency Identification) technology previously used to collect tolls on the Port Mann Bridge. Capital and annual costs were identified from 2012 through to 2016 which includes a back office component. The back office for this system deals with customer invoicing, charge collections, and enforcement. A division of costs between a fixed portion of the capital costs and a variable portion for the infrastructure cost per charge point has been assumed. This has been scaled to reflect the number of charge points for each scenario. Additionally, a division of costs has been assumed between the fixed annual cost of customer engagement and a variable transaction cost which was further scaled by the annual traffic on the Port Mann Bridge to determine a cost per transaction. Table B3-4 outlines capital costs and annual operating cost assumptions which have been applied for the congestion point charge scenarios.

Table B3-4: Congestion Point Charge Costs per TI Corp Annual Reports (All Figures in 2017$)

	Value	Unit	Notes
Capital Costs			
Charging infrastructure System			
Fixed	$25.0	M$	Back office costs
Variable	$8.3	M$/charge point	
Annual Expenses			
Charging Facilities	$1.7	M$/year	
Customer Engagement	$0.42	$/transaction	Based on a calculated transaction fee.
Depreciation	2.86%	%/year	Percentage of capital cost. Straight line depreciation over 35 Years.
Finance and Corporate Services	$4.7	M$/year	
Doubtful Accounts	$0.04	$/transaction	

Distance-Based Charge Scenarios

The distance-based charging scenarios include a flat per kilometre charge across Metro Vancouver, an 8-zone per kilometer charge, and a 2-zone per kilometre charge. The costing assumptions used were based on costing developed for a proposed distance-based charging system in the Netherlands. In 2006, the Ministry of Transport, Public Works, and Water Management in the Netherlands worked with three private companies to develop cost estimates for a proposed system of road pricing. These costs were updated to present dollar values for the purposes of costing a distance-based charge for Metro Vancouver. No account has been made for the development of technology since 2006.

An On Board Unit (OBU) system, proposed by T-Systems, has the capability to determine where a vehicle is being driven and apply the appropriate charge rates. This system was used to determine the cost estimate for a distance-based charge in Metro Vancouver as it has the capability to apply charges to users dynamically based on location and use, without the need for a back office to determine and apply the charges. The system only needs to interact with a back office for billing purposes. The fixed and variable costs were scaled based on inflation. The cost of the OBUs is based on the number of vehicles forecasted in Metro Vancouver in 2030, while all other costs are based on a cost per 1,000 VKT. Table B3-5 outlines the capital and operating cost estimates which were applied for the distance-based charge scenarios.

Additionally, given the capabilities of the OBUs, this methodology was used to determine the costs associated with the hybrid (congestion point charge and distance-based charge) scenario. As the OBUs have the ability to determine where the vehicle is being driven and apply the appropriate point-based charge in addition to the distance-based charges, this approach reduces the potential redundancy in capital costs of implementing additional infrastructure and technology.

Table B3-5: Distance-Based Charge Costs per Dutch Government Study (All Figures in 2017$)

	Value	Unit	Notes
Capital Costs			
OBUs	$227.40	$/vehicle	OBU costing based on estimated number of vehicles (1.2M) in Metro Vancouver in 2030.
Administrative	$4.20	$/1,000 VKT	
Collection	$4.10	$/1,000 VKT	
Enforcement	$2.90	$/1,000 VKT	
Miscellaneous	$3.10	$/1,000 VKT	Breakdown of miscellaneous costs not specified in NCHRP report.
Annual Operating Costs			
OBUs	$5.10	$/vehicle	OBU costing based on estimated number of vehicles (1.2M) in Metro Vancouver in 2030.
Administrative	$12.70	$/1,000 VKT	
Collection	$5.80	$/1,000 VKT	
Enforcement	$2.00	$/1,000 VKT	
Miscellaneous	$0.60	$/1,000 VKT	
Annual Depreciation			
OBUs	$31.80	$/vehicle	OBU costing based on estimated number of vehicles (1.2M) in Metro Vancouver in 2030.
Administrative	$0.90	$/1,000 VKT	
Collection	$1.00	$/1,000 VKT	
Enforcement	$0.40	$/1,000 VKT	
Miscellaneous	$0.01	$/1,000 VKT	

Inputs and Net Revenue

Table B3-6 summarises the inputs and net revenues for the select scenarios from Round 3 of the Commission's analysis and evaluation. As the It's Time project can be considered a conceptual screening phase and is using parametric modelling for cost estimates, a high contingency factor ranging from 30% to 100% is recommended. As the costing methodology for the congestion point charge scenarios was based on recent data from a system successfully implemented in Metro Vancouver, a high contingency factor of 30% was used. The uncertainty with the distance-based scenario methodology warranted a 50% high contingency factor.

Table B3-6: Net Revenue Summaries for Round 3 Scenarios

	Units	Bridge MSC 25%	Bridge MSC 37.5%	Bridge MSC 50%	Bridge MSC 75%	Bridge MSC 100%	Bridge + North Road MSC 25%	Bridge + North Road MSC 37.5%	Bridge + North Road MSC 50%	Bridge + North Road MSC 75%	Bridge + North Road MSC 100%	Distance Based $0.10/km	Distance Based $0.12/km	Distance Based 8 Zone MSC 25%	Distance Based 8 Zone MSC 37.5%	Distance Based 8 Zone MSC 50%	Distance Based 8 Zone MSC 75%	Distance Based 8 Zone MSC 100%	Distance Based Transit Access 2 Zone MSC 25%	Distance Based Transit Access 2 Zone MSC 37.5%	Distance Based Transit Access 2 Zone MSC 50%	Distance Based Transit Access 2 Zone MSC 75%	Distance Based Transit Access 2 Zone MSC 100%	Hybrid Distance Based + Bridges
Transactions (annual)	M Transactions	270	260	250	240	220	310	300	290	270	260													
VKT (annual)	M VKT											14,610	14,470	14,990	14,820	14,540	14,310	13,890	14,970	14,780	14,490	14,250	13,800	14,410
Revenues (annual)	M 2017$	450	660	840	1,180	1,460	510	740	950	1,310	1,620	1,380	1,640	720	1,060	1,380	2,020	2,590	750	1,110	1,450	2,140	2,750	1,650
Annual Operating Cost (Likely)	M 2017$	140	130	130	120	120	160	150	150	140	130	380	380	390	390	380	380	370	390	390	380	380	370	380
Annual Operating Cost (High Contingency)	M 2017$	180	170	170	160	150	210	200	190	180	180	580	570	590	580	570	570	550	590	580	570	560	550	570
Annual Net Revenues (Likely)	M 2017$	320	520	710	1,050	1,340	350	580	800	1,170	1,490	1,000	1,260	320	670	990	1,640	2,220	360	730	1,070	1,760	2,380	1,270
Annual Net Revenue (Low)	M 2017$	270	480	670	1,020	1,310	310	540	750	1,130	1,450	810	1,070	130	470	800	1,450	2,030	160	530	880	1,570	2,200	2,180
Operating Costs / Revenues (Likely)	%	30%	20%	15%	10%	8%	31%	21%	16%	11%	8%	28%	23%	55%	37%	28%	19%	14%	52%	35%	26%	18%	13%	23%
Operating Costs / Revenues (High Contingency)	%	40%	27%	20%	14%	10%	40%	27%	21%	14%	11%	42%	35%	82%	55%	42%	28%	21%	78%	52%	39%	26%	20%	35%
Fuel Tax Revenues (annual)	M 2017$	290	290	290	280	280	290	290	280	280	280													
Annual Net Revenue with Fuel Tax Revenue (Likely)	M 2017$	600	820	1,000	1,340	1,620	640	880	1,080	1,450	1,770	1,000	1,260	330	670	1,000	1,640	2,220	360	720	1,070	1,760	2,380	1,270
Annual Net Revenue with Fuel Tax Revenue (Low)	M 2017$	560	780	960	1,300	1,590	590	830	1,040	1,410	1,720	800	1,070	130	480	810	1,450	2,040	160	530	880	1,580	2,200	1,080
Operating Costs / Revenues + Fuel Tax Revenues (Likely)	%	19%	14%	12%	8%	7%	20%	15%	12%	9%	7%	23%	20%	55%	37%	28%	19%	14%	52%	35%	26%	18%	13%	23%
Operating Costs / Revenues + Fuel Tax Revenues (High Contingency)	%	24%	18%	15%	11%	9%	26%	20%	16%	12%	9%	35%	30%	82%	55%	42%	28%	21%	78%	52%	39%	26%	20%	35%

References

- AACE (2016) AACE International Recommended Practice 18R-97. Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (March, 2016) Available at: https://web.aacei.org/docs/default-source/toc/toc_18r-97.pdf?sfvrsn=4
- Transportation Investment Corporation (2013) Annual Report 2012/2013.
- Transportation Research Board (2011) NCHRP Report 689, Costs of Alternative Revenue-Generation Systems.

PART 5

Economic Benefits Evaluation Brief

PART 5. ECONOMIC BENEFITS EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **economic benefits**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

Total economic benefits is a measure for understanding and communicating the value of a policy or investment to society as a whole according to established economic methods. *Total economic benefits* includes both values that are monetized in the market economy (e.g. out-of-pocket household travel costs) and non-monetized values (e.g. travel time and inconvenience). In calculating total economic benefits, non-monetized values are given a monetary value through various economic methods. For example, a monetary value for time can be determined by looking at how people choose between travel options that are different in travel times and travel costs. The calculation of economic benefits provides an indicator of the overall *welfare* gains and losses across individuals, groups and society as a whole. *Welfare* is an economic concept representing peoples' overall well-being or quality of life, comprising both direct financial impacts (such as higher wages and improved business), and softer values such as more free time and less stressful travel. For the analysis, the rates that are used to monetize and weigh different types of effects together are set so that they represent the same trade-off for an average individual. Thereby, the aggregated values also represent the total benefits for society as a whole.

For decongestion charging, the calculation of total economic benefits typically involves the estimation of gains and losses across the following components:

- **Consumer Surplus** – the private welfare gains and losses from a decongestion charging scenario, including:
  - *Travel Time savings* – the welfare gain experienced due to time savings for vehicle and transit trips (including gains in travel time reliability).
  - *Inconvenience costs* – the welfare loss experienced because some people have shifted modes or destinations to their 'second best' option which typically has a higher travel time than their first best option in the baseline scenario.
  - *Travel costs* – the change in welfare associated with a change in travel costs under a given scenario, including changes in financial costs for fuel, maintenance and decongestion charges.
- **Societal benefits** – the public or shared welfare gains and losses under the scenario, including:
  - *Criteria air contaminant (CAC) and greenhouse gas (GHG) emissions* - the welfare gain associated with reducing the increased criteria air contaminant and greenhouse gas emissions caused by congested road conditions.
  - *Road infrastructure and maintenance* – the financial cost savings for reinvestment in road infrastructure and maintenance associated with lower peak travel demand and lower vehicle kilometres travelled.

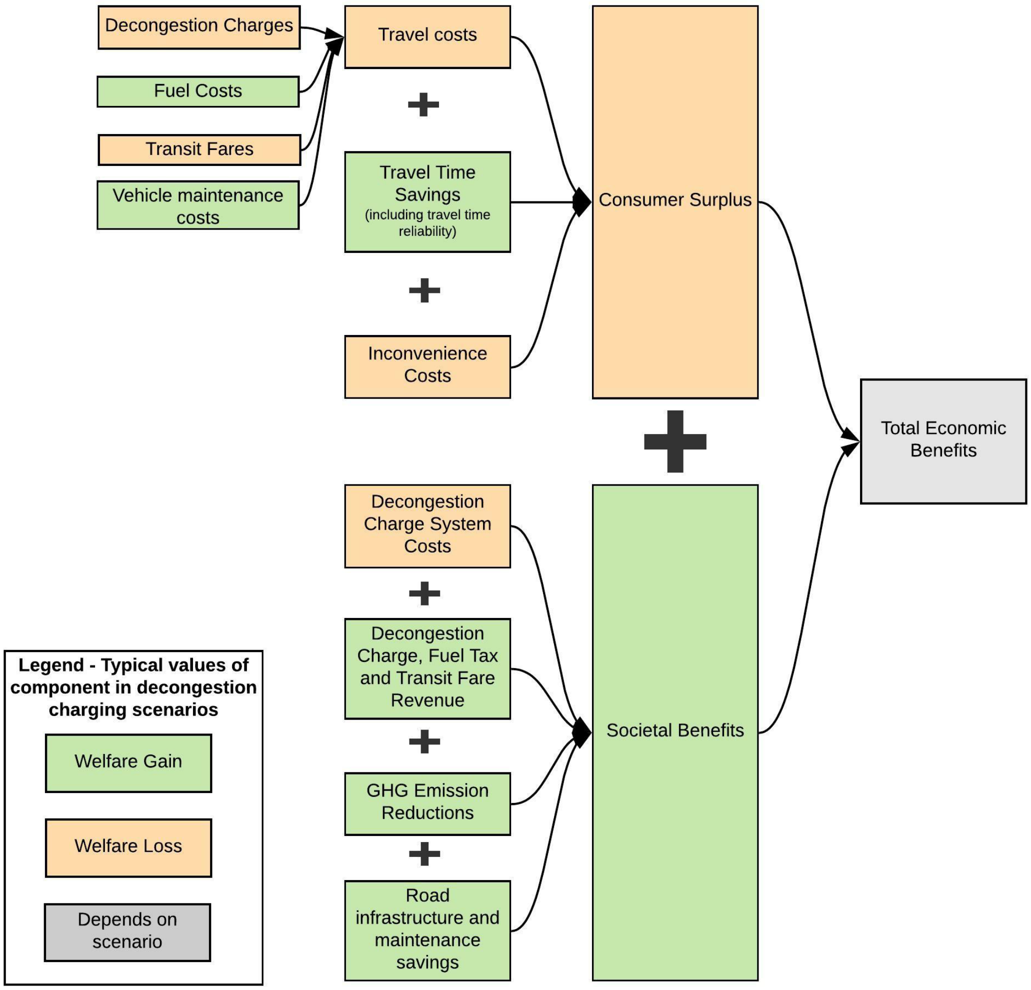
- *Decongestion charging revenue* – the value of how the revenues are used, for example, investment in transportation sector (transit service, roads), investment in other public infrastructure and services, reduction in other public taxes and fees. The revenue is regarded as a part of societal benefits. (Note that charges are also included - with a negative value - in the calculation of consumer surplus. In the total economic benefits these two terms balance out).
- *System costs* – the costs for providing and operating the necessary technical and administrative system.

In this project, all components above are included in the calculation of total economic benefits except for criteria air contaminants (see Figure B3-3 for an overview and Table B3-7 for further descriptions of how each component is calculated).

Regarding system costs, only ball-park estimates for different types of systems are available. After the model-based calculation of all other economic benefits, the net of those are compared to estimated system costs. This gives an indication of whether a scenario could be expected to generate a net benefit also when system costs are considered. The *likely* system cost estimate is used in the calculation of total economic benefits.

Regarding decongestion charges paid by individuals, it is important to note that these charges are not considered a net loss to society. While these charges are a short-term welfare loss to individuals, the revenues are assumed to be redistributed in a productive manner back to society and are thus considered a transfer rather than a net gain or loss. This assumption presumes that the individual would not have put those dollars to a more productive use. If charging is regarded as a way to generate increased revenue for public purposes, future work may want to incorporate analysis on the marginal cost of public funds to understand the productivity loss of transferring money from individuals to public purposes.

Figure B3-3: Components of Total Economic Benefits



Components of Economic Benefits

Table B3-7 provides a list and description of the components of total economic benefits.

Table B3-7: Economic Benefits

Economic Benefit Components	Description
Total Economic Benefits	The net economic benefits of the decongestion charging scenarios are reported in millions of dollars per year relative to the Baseline 2030 scenario. It is calculated as the aggregate of *Societal Benefits* and *Consumer Surplus*.
Consumer Surplus	Net costs to individual road users, made up of (1) travel time and reliability savings, (2) inconvenience costs (from shifting mode, destination or time of travel), (3) travel costs (including decongestion charge costs).
Travel Time Savings	Travel time savings are evaluated as they are *experienced*, that is: computed (only) for trips that *remain* (same mode and OD-relation as in baseline). Gains in minutes are computed per OD relation (12*12 zones), mode (7 modes), and time of day (3 periods). For each of those cells, change in average travel time is multiplied by the corresponding number of 'remaining' trips. Benefits in time are then evaluated in economic terms with the use of the Value of Time (VoT), representing how much an average user of that mode would be willing to pay to reduce their travel time by an hour. The applied values are displayed in the table below (these values are developed within the RTM, more details are available in Appendix B-2):

Values of Time per person by Travel Mode	
Mode of Travel	Value of Time ($/h)
High occupancy car	$14.29
Single occupancy car	$14.29
Heavy goods truck	$41.95
Light goods truck	$29.56
Bus	$12.00
Rail	$12.00
West Coast Express	$12.00

Economic Benefit Components	Description
Travel Time Reliability	The variability (or *standard deviation*) of travel times is measured in minutes and indicates how much travel times for a trip of average length are expected to vary from a "good" to a "bad" day under a given scenario ("good" day ≈ 15% fastest day, "bad" day ≈ 15% slowest). The standard deviation is multiplied by a per minute rate (*value of travel time reliability, VVR*). VVR is assumed to be 80% of the value of travel time. *Total value of travel time reliability* is obtained after multiplication by the total number of affected trips (see Appendix B-2 for more details).

Travel Costs	Like travel time savings, travel costs represent the *experienced* monetary effects for *remaining* trips (same mode, same OD). This includes effects on vehicle maintenance and fuel consumption due to rerouting, and also the charges themselves. A constant operating cost per kilometer for each mode was applied:

Vehicle operating costs (excl. fuel tax)	
Mode of Travel	Cost ($/km)
High occupancy car	0.08
Single occupancy car	0.18
Heavy goods truck	0.56
Light goods truck	0.24

Inconvenience	Travel time and vehicle operating costs (above) represent a direct estimate of experienced effects for *remaining* trips. On top of those experiences, there are a number of users who *leave* (or *enter*) each submarket (Mode/OD combination). They, too, will perceive changes in welfare (often a welfare loss). For them, the total effects (*adaptation* or *inconvenience*) are evaluated indirectly by the so called 'rule-of-a-half'. We look first at the opportunity they each had to remain, and what they would have lost in that case. (*Travel time effects + charges + operating cost* as above). Then, we assume that, since they chose the option to change, they must have found an alternative that they perceived as a better offer than this potential maximum loss. Therefore, their actual loss is estimated to be 50% of the loss they would have experienced if they stayed. This is aggregated over OD relations, and goes the other way around also: When there is an increase of trips in an OD relation that has improved, we assume that this reflects a 50% improvement for the newcomers.
Societal Benefits	Net benefits to society, made up of (1) travel time and reliability savings, (2) revenues from charges, transit fares and fuels taxes, (3) carbon emissions, (4) road maintenance costs, (5) charge system costs.
Revenue	Revenues from decongestion charging, fuel tax and transit fares are a direct output of the model. Revenues are treated as a transfer from individuals to society – i.e. they are not a net gain or loss in terms of total economic benefits.
System Costs	"Likely" system cost estimate was used in the economic benefit calculation.
Road maintenance costs	A constant cost of $0.014 per vehicle kilometre, independent of mode, was applied to give a crude estimate of the effect that decongestion charging (reduced traffic) may have on reducing public funding needs for road maintenance. The estimated effect is an externality that could have been included in the calculation of total economic benefits. However, it has only been presented separately.
CO_2 reduction	The total vehicle kilometres travelled are multiplied with CO_2 emission factors (see below) and monetized by the value of **$150/tonne**. Assumed emission factors are displayed in the table below:

CO2 Emission Factors	
Mode of Travel	Emissions (tonne/km)
Car	0.116
Truck	0.897

References

- MPIC Phase 1 Project Report, Appendix A.
- UTTF (Urban Transportation Task Force) (2012) The High Cost of Congestion in Canadian Cities. UTTF was established by the Council of Ministers Responsible for Transportation and Highway Safety. Downloaded from: https://comt.ca/english/uttf-congestion-2012.pdf . Downloaded on: February 21, 2018.

PART 6

Public Support Evaluation Brief

PART 6. PUBLIC SUPPORT EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **public support**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; economic benefits; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

This section provides summary highlights of the Phase 1 research questions and findings related to public support for or acceptance of decongestion charging. Further details on this research can be found in Appendix B of the Phase 1 Project Report, titled "*Decongestion Charging: Policy and Global Lessons Learned*".

Public support is a critical consideration when designing and implementing a decongestion charging system. However, it is complex and depends on numerous internal and external factors including (but not limited to) socio-demographics, levels of car ownership and use, political values, transit quality and accessibility, time, communications strategies, and opportunities for public engagement. Hamilton (2011) summarises five important factors affecting public acceptance levels among different groups (Table B3-8). Decongestion charging is a relatively new and unfamiliar idea in many jurisdictions, and the introduction of a charge for something they perceive to be getting for "free" can be a difficult idea to support. Opposition can be rooted in the view of a decongestion charge as a "just a tax grab", or can be based on concerns for the equity, fairness, and affordability of a decongestion charging policy.

Table B3-8: Factors affecting acceptance of decongestion charging

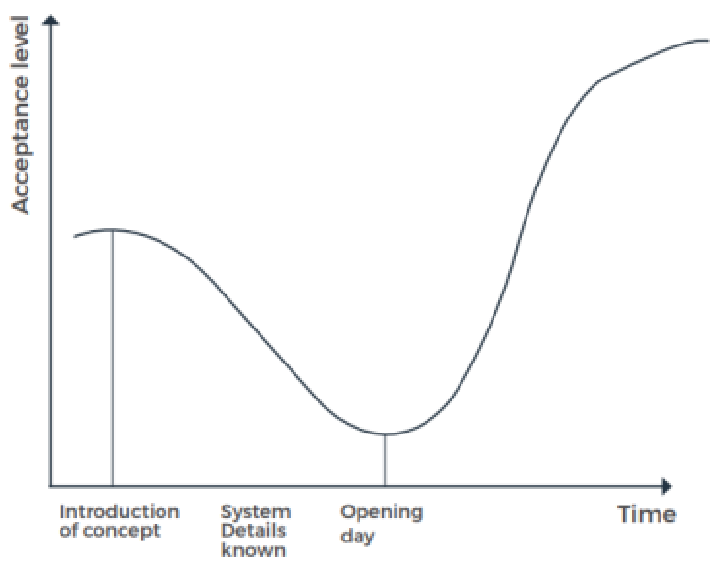
Factors affecting acceptance	Impacted Group	Effect on acceptance
Experience	People with hands-on experience with decongestion charges	↑
Attitude to government intervention	People with political views that government should intervene as little as possible	↓
Concern for environmental issues	People with (political) views that environmental problems are severe and need to be addressed	↑
Value of time	People with higher value of time perceive larger benefits when congestion is reduced	↑
Frequency of car usage	People who use their cars frequently expect to pay more	↓

Source: Hamilton (2011)

A common pattern of public acceptance has been observed in a number of jurisdictions that have implemented decongestion charging (Figure B3-4). Early in the process, when the discussion is general and the effects of charging are discussed as abstract concepts, there is typically not much formalized opposition from the public. As charging concepts progress towards implementation, more concrete definitions around the system design are developed and presented to the public. This may include definition around the geographical area or location of charges, charge rates, variance by vehicle type or time of day, etc. The increased detail typically makes many members of the public worried about negative personal consequences, and evokes a vivid public debate. The level of public acceptance decreases during this phase. However, after implementation, acceptance typically increases, and this can be attributed to a number of factors:

- Travel times improve more than motorists expected;
- Negative consequences (charges paid, mode shift) prove less problematic than what was anticipated; and
- People adapt and accept a new status quo, no longer evaluating it as a "change".

Figure B3-4: Typical Dynamic Pattern of Public Acceptance of Decongestion Charging



Source: Goodwin (2006) and Schade *et al.* (2004)

Evaluation Methods

The MPIC Terms of Reference asked the Commission to examine the public acceptability of potential regional road usage charging alternatives for motor vehicles. The Commission engaged stakeholders and the public in two phases of the *It's Time* project, and examined public acceptability through four methods:

1. **Research on public acceptability of decongestion charging in other jurisdictions where it has been implemented**

   Summarised above and contained in full in Appendix B of the Phase 1 Project Report, titled *"Decongestion Charging: Policy and Global Lessons Learned"*.

2. **Public opinion polling**

   The project conducted two rounds of public opinion polling through Ipsos Reid. The first round was in September 2017, prior to the commencement of phase one communications and engagement activities. The second round of polling was carried out in March/April 2018, following the close of the phase two communications an engagement activities. Polling is statistically valid and not limited to people who sought out participation themselves. Participants may not have had any previous introduction to the idea of decongestion charging and may or may not have been aware of the online materials for the *It's Time* project.

3. **Online public engagement**

While results of online engagement are not statistically representative, and are limited to people who self-selected to participate, the online engagement for this project did collect demographic information so that the degree of representativeness of respondents can be taken into consideration when interpreting results. Concerted efforts were made to ensure broad communication of the opportunity to participate in the online engagement.

This method allows for both informational and feedback functions. Space for open-ended comments was provided, giving the opportunity for a wide range of feedback and insight into the reasons behind respondents' answers.

4. **A User Advisory Panel**

The 15-member User Advisory Panel was selected by an external recruitment firm to be representative of a diversity of Metro Vancouver residents in terms of cultural background, employment, age, home municipality, and typical transportation modes. Participants were able to engage in dialogue and deeper learning over the course of three meetings, and to provide feedback on decongestion charging approaches, on examples of how it could be implemented, and on the Commission's draft principles for a mobility pricing policy.

Note that all methods to seek feedback from Metro Vancouver residents within this project were limited by the fact that the Commission was not able to present complete information about the decongestion charging examples used in the engagement. Information about charge rates and estimates of effects on congestion and other values was not available as the research to design and model decongestion charging scenarios was taking place simultaneously with public engagement efforts. This meant that the project could only provide high-level details about decongestion charging approaches and examples of how it could be implemented.

The level of public support for decongestion charging in Metro Vancouver is in line with that observed in other jurisdictions prior to implementation. The split was even between support/neutral/oppose in the polling, somewhat higher among UAP participants, and lower in online public engagement. Refer to Part 2 of the Commission's final report and Appendix C for detailed findings from the polling, online engagement, and UAP.

Findings pertaining to public support need to be interpreted carefully with consideration to the information limitations as outlined above, as well as the strengths and weaknesses of the methods used, the limited opportunities for face-to-face engagement, and the short timeframe provided for the project's communications and engagement efforts. Continued communications and engagement efforts will be needed in further phases of work on decongestion charging in Metro Vancouver.

References

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- MPIC Phase 1 Project Report, Appendix D, Phase 1 Engagement Report, (2017).
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PART 7

Consistency with the RGS/RTS Evaluation Brief

PART 7. CONSISTENCY WITH THE RGS/ RTS EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on the **consistency with the Regional Growth Strategy (RGS) and Regional Transportation Strategy (RTS)**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; economic benefits; public support; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

Regional Growth Strategy

Metro Vancouver is a provincially-designated regional district made up of 21 municipalities, one Electoral Area, and one Treaty First Nation that delivers regional-scale services and sets regional-level policy around land use, transportation, housing, parks, and air quality and climate change.

Metro Vancouver developed the Sustainable Region Initiative in 2002, guided by the following vision:

> *Metro Vancouver has an opportunity and a vision to achieve what humanity aspires to on a global basis – the highest quality of life embracing cultural vitality, economic prosperity, social justice and compassion, all nurtured in and by a beautiful and healthy natural environment.*
>
> *We will achieve this vision by embracing and applying the principles of sustainability, not least of which is an unshakeable commitment to the well-being of current and future generations and the health of our planet, in everything we do.*
>
> *As we share our efforts in achieving this vision, we are confident that the inspiration and mutual learning we gain will become vital ingredients in our hopes for a sustainable common future.*

A key regional challenge is to advance this vision while accommodating the expected levels of population and economic growth over the coming decades. The Regional Growth Strategy (RGS) is a key policy tool to address this challenge. The RGS, called *Metro Vancouver 2040: Shaping Our Future*, was adopted in 2011 (Metro Vancouver, 2011) and focuses on land use policies to guide the future development of the region and support the efficient provision of transportation, regional infrastructure, and community services.

The RGS sets out a series of strategies and actions for Metro Vancouver and member authorities arranged under five goals:

1. Create a compact urban area *(focusing growth in Urban Centres and Frequent Transit Development Areas)*;
2. Support a sustainable economy *(protecting industrial and agricultural lands, focusing office growth in Urban Centres, discouraging major commercial and institutional development outside of Urban Centres or Frequent Transit Development Areas)*;

3. Protect the environment and respond to climate change impacts *(protecting Conservation and Recreation lands and natural features, encouraging reduced energy consumption and improved air quality, supporting resilient land use and infrastructure)*;

4. Develop complete communities *(providing housing choices with access to services and amenities)*; and

5. Support sustainable transportation choices *(coordinating land use and transportation to encourage modes other than single-occupancy vehicles, supporting movement of goods and passengers)*.

Regional Transportation Strategy

TransLink, Metro Vancouver's regional transportation authority, is required to provide a regional transportation system that supports the RGS, air quality and greenhouse gas reduction objectives, and the economic development of the region. TransLink's Regional Transportation Strategy (RTS) Strategic Framework (TransLink, 2013) aligns its goals with the RGS and commits to making transportation decisions that:

- provide sustainable transportation choices;
- support a compact urban area;
- foster safe, healthy and complete communities;
- enable a sustainable economy; and
- protect the environment

The RTS Strategic Framework promoted the achievement of these goals by designing our communities and transportation system in a way that, by 2045:

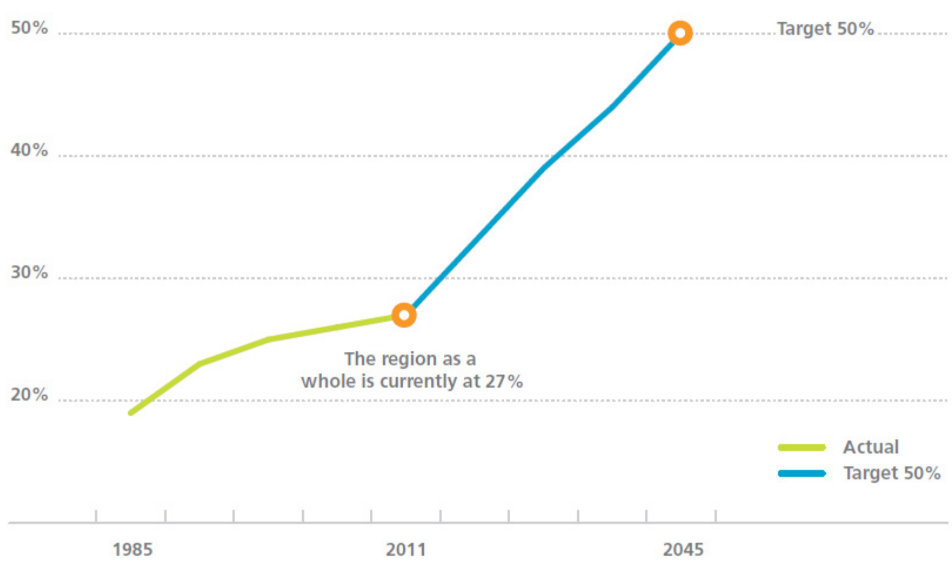
- makes it possible to make half of all trips by walking, cycling and transit; and,
- makes it possible to reduce the distances people drive by one-third

Integrated mobility pricing—for all parts of our transportation system—is identified as a key strategy to manage demand, improve efficiency, contribute to a fair system, and raise revenue. The RTS highlights that "government subsidy of roads and transit [...] makes it difficult or impossible for individuals to understand the true costs of their travel choices".

Decongestion charging can support progress towards RTS targets by revealing the full cost of road transport to properly inform location decision and by providing monetary incentives to optimize trips and/or distances travelled by personal vehicles, and increase trips by walking, cycling and transit.

The RTS Strategic Framework highlighted that the current trajectory for trips by walking, cycling and transit is not setting the region up to achieve the 50% target (Figure B3-5). TransLink is launching a process to update the RTS in 2018.

Figure B3-5: Percentage of all trips by walking, cycling, and transit



Source: TransLink (2013)

Metrics and Methods

In this project, decongestion charging scenarios are compared in terms of their contribution to supporting the achievement of the two RTS targets to increase sustainable mode share and reduce per capita VKT, and to Goal 5 in the RGS to support sustainable transportation choices. Table B3-9 describes the metrics used to compare the performance of scenarios for the RTS targets.

These metrics are calculated using outputs from the Regional Transportation Model (RTM). The RTM is not able to simulate all possible adaptations that people could make to a decongestion charge. Adaptations that could reduce decongestion charges for a user such as changing place of residence or changing time of travel are not simulated by **the RTM, meaning that the RTM's prediction for the amount of change in mode share and VKT induced by a decongestion charging scenario is a conservative estimate and these estimates are best used to compare scenarios to one another.** More detail about the RTM can be found in Appendix B-2.

Table B3-9: Metrics for RTS Targets

Category	Metric	Description
Mode Share for Personal Trips	% of trips taken by transit	Reports the proportion of personal trips taken by transit in each decongestion charging scenario for the year 2030. The higher the proportion of trips by transit, the more a scenario is contributing to achieving the RTS target to reach 50% of trips by walking, cycling and transit by 2045. The metric does not report on changes in mode share for walking and cycling because the Regional Transportation Model is limited in being able to simulate the effect of decongestion charges on these modes. Note that it is assumed within the 2030 Baseline scenario in RTM that the 10-Year Vision for Transportation is fully implemented.
	% of trips taken by multiple-occupant vehicles	Reports the proportion of personal trips taken by multiple-occupant vehicles. The Regional Growth Strategy includes strategies to encourage this type of mode option (Strategy 5.1) as a means to support the goal of sustainable transportation choices.
	% of trips taken by single-occupant vehicles	Reports the proportion of personal trips taken by single occupant vehicles.
Vehicle kilometers travelled	Vehicle kilometers travelled / capita And % change in vkt/capita compared to 2016 Baseline Scenario	Reports the vehicle kilometers travelled (VKT) per capita and the percent change in VKT/capita from the model's 2016 Baseline Scenario. The higher the reduction in VKT/capita compared to the 2016 Baseline Scenario, the more a scenario is contributing to achieving the RTS target to reduce distance travelled per capita by one third by 2045.

RGS goal 3 to protect the environment and respond to climate change impacts is addressed in the Health, Environment, and Safety Evaluation Brief. RGS goals 1, 2, and 5 relate to urban growth patterns and have not been modelled or evaluated at this stage. Evaluating the alignment of a decongestion charge with these goals should be part of any implementation monitoring or review in the future. This future evaluation can consider how decongestion charging affects land use decisions in the following areas, including but not limited to:

- Distribution of residential and employment growth in the Metro Vancouver Regional District;
- Rate of growth in Urban Centres and Frequent Transit Development Areas;
- Rate of growth in neighbouring Fraser Valley Regional District and Squamish-Lillooet Regional District;
- Attractiveness of Urban Centres for office development; and
- Effects on industrial and agricultural land and uses.

References

- Metro Vancouver (2011) Metro Vancouver 2040: Shaping our Future (Regional Growth Strategy), downloaded from: http://www.metrovancouver.org/services/regional-planning/PlanningPublications/RGSAdoptedbyGVRDBoard.pdf.
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PART 8

Local Effects Evaluation Brief

PART 8. LOCAL EFFECTS EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **local effects.** Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; health, environment and safety; privacy; and future-proofing.

Issue Overview

This brief focuses on three types of local effects that can be influenced by the design of a decongestion charge and specifically by the locations of point charges or distance-based zones. These include boundary effects, neighbourhood traffic volumes, and local economic effects. It is not intended to be inclusive of all impacts a charge would have in the Metro Vancouver region, but rather to highlight some local considerations that are not well-expressed in the aggregate metrics used for other evaluation criteria.

Boundary effects

Any boundaries created through cordons (point charges arranged in a line or ring) or zones (for distance-based charging) can have localized impacts on nearby residents, businesses, or institutions, as well as on overall travel patterns and behaviour. For example, a boundary that bisects a school catchment area or that falls between a residential community and their closest shopping district could disproportionately impact the travel of local residents.

These effects are likely to be a larger consideration for point charges than for distance-based charges. With a point charge, short trips crossing a point would be charged the same rate as a longer trip crossing the same point. For a distance-based system, a zone boundary would indicate a change in charge rate only for the kilometres travelled after passing the boundary.

Following existing community or geographical boundaries can mitigate these effects, such as locating point charges on major water crossings. Non-bridge point charge locations or zone boundaries would need to be carefully considered. Local exemptions or discounts are another mitigation method; London, for example, provides 90 percent discounts from the central London congestion charge for people living within the charging zone, and this has been extended in some cases to people living just outside the boundary in certain locations.

Boundary effects have been assessed in some jurisdictions after implementing a charging system, and in some cases this has led to system modifications:

- Transport for London, through its comprehensive monitoring of the impacts of the central London congestion charge, included a boundary case study area to understand impacts at or in the vicinity of the charging boundary[4]. The study looked at traffic and transportation impacts, as well as potential social, economic, and environmental consequences of the discontinuity caused by the presence of a charging boundary. The study did not identify any specific impacts associated with the proximity of the boundary.

4 Transport for London (2006) Chapter 7

- In Gothenburg, a study was conducted on boundary effects in a district called Backa in the north of the city[5]. With the initial implementation of the congestion charge, Backa was surrounded on roughly three sides by charge points. Residents felt this had a particularly unfair impact on their neighbourhood and caused them to make long diversions to avoid payment or to stop visiting particular supermarkets or recycling centres located on the other side of the boundary. While no empirical evidence was found to support or refute the experiences of local residents and businesses, a solution was found in co-operation with Backa residents to amend the charging system to allow trips to and from Backa to be exempt from the charge, while continuing to charge through-traffic.
- In Stockholm, the location of charge points on major bridges considerably reduces the risk for boundary effects, but considerations had to be made for residents of the island of Lidingö outside Stockholm. The location of the charging boundary meant that the only way to travel between Lidingö and the rest of Sweden was to pass through the congestion charging area. Trips to and from Lidingö were exempted, while trips between Lidingö and central Stockholm were charged in the same way as those from other parts of the city. The exemption was removed when a new charge-free highway to and from Lidingö opened in 2014[6].

Neighbourhood traffic volumes

High volumes of vehicle traffic on neighbourhood streets can have negative impacts such as increased noise and vibration, local air pollution, and higher safety risks to people walking and cycling. Decongestion charging can influence neighbourhood traffic volumes and the associated impacts positively if the system encourages less vehicle use, or negatively if the design of the system results in drivers changing routes to avoid paying a charge, particularly if the re-routing takes place on non-arterial streets that are not designed to carry high volumes of traffic.

These impacts are a larger consideration for point charges than for distance-based charges as, depending on the location of charge points, there may be more diversion to avoid charges. Implementing complementary traffic management can mitigate these effects:

- In advance of the implementation of central London's congestion charge zone, new local traffic management was introduced at locations around the boundary of the zone specifically to mitigate the impacts of potential diversion onto neighbourhood streets. This included new speed management with a large number of 20mph (32kph) zones with physical enforcement through traffic calming and average speed cameras. In addition, one-way streets and filtered permeability (the closure of streets to motor vehicles) prevented diversion onto streets inappropriate for large traffic volumes. These measures were successful in mitigating adverse local effects, and in some locations the improved flow on the major road network reduced the incentive for drivers to take short cuts on neighbourhood streets[7].

Local economic effects

Urban economies are complex and affected by a number of factors such that distinguishing the impacts of a congestion charge from all the others is difficult. There is no evidence to support the idea that congestion charges – if well designed – are damaging to local economies; rather, there is evidence to suggest that congestion itself has a negative impact on local economies and job growth[8].

For the purposes of this brief, local economic effects refers to the potential for specific impacts to businesses in or near a decongestion charging area or point rather than on the overall regional economic impact of decongestion charging. Local effects on businesses depend on how a charging system influences the movement of labour and customers, as well as on the boundary effects discussed above.

5 Göteborgs stad (2014)
6 Trafikverket and Stockholms stad (2012)
7 Transport for London 2004)
8 Sweet (2011) and (2013)

Some jurisdictions have assessed these impacts after implementation:

- Although many retailers and small business owners located within London's central congestion charging zone were concerned about the introduction of the charge, Transport for London's monitoring program has not found any distinct impacts on overall business performance or on the central London economy that can be attributed to the charge. Hotels, restaurants, and retail businesses within the charging zone reported stronger business performance after the introduction of the congestion charge, and have managed to outperform areas in inner and outer London in terms of sale, profitability, and employment growth[9]. Transport for London's boundary case study also included impacts on business. The area is characterised by smaller, more visitor intensive businesses than the average in central London. Sales tax (VAT) registrations show that the number of businesses operating in the area has been unaffected by the congestion charge and independent data showed steady growth in sales in the years immediately following the introduction of the charge. The businesses themselves did not report any negative impacts and their attitude was no more positive or negative than businesses away from the boundary[10].
- Analysis by the Swedish Research Institute of Trade (HUI) has looked at economic performance following the implementation of congestion charges in both Stockholm (as a trial in 2006 and permanently in 2007) and Gothenburg (in 2013). The studies in both cities focused on the impacts for retail and wholesale traders within the charging areas, using sales tax (MOMS) data. Surveys in Gothenburg showed that retail performance within the charging zone was broadly in line with that observed in other parts of the Gothenburg region and Sweden generally[11]. Observations in Stockholm showed a stronger retail performance within the congestion charging zone than outside it – almost 15% growth compared to less than 1% in other parts of Stockholm County and around 4% nationally[12].

Metrics and Methods

Local effects were considered in this project through a literature review, as summarized in this brief. Decongestion charging scenarios were designed with an intention to minimize these impacts, particularly in terms of boundary effects and traffic diversion, as much as possible at this preliminary phase[13]. Relevant metrics could not be developed at this stage.

The issues outlined in this brief should continue to be considered in future phases of system development and design, and monitoring should be conducted to measure and address any actual impacts following implementation.

References

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9 Transport for London (2008)
10 Transport for London (2006) Chapter 7
11 Vestin, H. (2014)
12 Stockholms Stad. (2009)
13 Note that the Regional Transportation Model (RTM) used in this analysis models traffic volumes on major roads and can provide output showing traffic diversion at this scale, but it has limited ability to model traffic volumes on local streets.

- Trafikverket and Stockholms stad (2012) Trängselskatt i Stockholm 2015 + Revidering av trängselskattezonen till följd av Norra länken och Hagastaden, available at: https://insynsverige.se/documentHandler.ashx?did=106597.
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PART 9

Health, Environment, and Safety Evaluation Brief

PART 9. HEALTH, ENVIRONMENT, AND SAFETY EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **health, the environment, and safety**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; privacy; and future-proofing.

Issue Overview

Environment, health, and safety emerged as important values raised by stakeholders and members of the public in phase 1 engagement (see Appendix A of the Commission's phase 1 report).

The potential impacts of decongestion charging on the environment and on public health are strongly linked to its influence on total vehicle kilometres travelled (VKT). Given the present fuel mix in the vehicle fleet, a reduction in VKT can reduce the regional contribution to climate change from transportation-related greenhouse gas (GHG) emissions and improve local air quality, which in turn can have positive health impacts if this occurs in areas where large numbers of people live, work, or spend time. If different charge rates are applied to vehicles dependent on their fuel type or emissions levels, these impacts can be even greater. If decongestion charging increases the proportion of trips taken by active transportation modes (e.g. walking, cycling, and transit as it usually also involves a walking or cycling component) the increased physical activity can also have positive public health effects.

The potential impacts of decongestion charging on road safety (i.e. reducing vehicle crashes, enhancing safety for people walking and cycling) are more complex. VKT per capita has been found to be a strong predictor of crash frequency and fatality rates[14], but vehicle speeds are also strongly linked to severity of crashes and thus also to fatality rates[15]. If a decongestion charge reduces traffic volumes, overall mean vehicle speeds are likely to increase, though this increase is likely to be relatively small on city streets with higher numbers of vulnerable road users (i.e. people walking and cycling) given other factors on these types of streets that keep speeds low, such as frequency of traffic signals, crosswalks, and bus stops. The balance of impacts resulting from reduced VKT and some level of increase in mean vehicle speeds, at least at some locations and times, is difficult to predict.

The impacts of decongestion charging on these criteria have been assessed in some jurisdictions that have implemented a charging system.

- In London, step-change reductions to emissions levels followed implementation of the central London charging zone in 2003, though since 2007 the impacts of the charge on emissions has been dominated by the impacts of vehicle fleet emissions performance improvements. Though reported vehicle collisions involving injury were declining across London in the years following the introduction of the central charging zone, the charge was linked to small additional decline in collisions within the zone[16].
- In Stockholm, emissions reductions can be attributed to two factors: 1) the decrease in traffic as a result of the congestion charge and 2) an increase in the number of alternative fuel vehicles, which in itself can be partly attributed these vehicles being 100 percent discounted

14 Victoria Transport Policy Institute (2017)
15 Wramborg, P. (2005); Quddus, M. (2013)
16 Transport for London. (2007).

from the congestion charge (other factors include fuel price differentials, government purchase grants and parking subsidies)[17]. The proportion of vehicle kilometres with alternative fuel vehicles in the City of Stockholm increased from four percent in 2006 to ten percent in 2008. Between 2006 and 2008 there was a 13% reduction in emissions of NOx, 3% decrease in emissions of PM_{10}, and an 8% decrease in emissions CO_2[18]. Another analysis found that Stockholm's congestion charge has reduced ambient air pollution by 5-10%, and that this reduction is associated with a significant reduction in the rate of asthma attacks amongst young children[19]. A downward trend in the number of serious injuries and fatalities resulting from vehicle collisions began before the introduction of the congestion charge. The decline within the charging zone continues to match that in the rest of the city, indicating that other measures, particularly speed management, have a greater impact[20].

- In Milan, where the Area C congestion charge also exempted hybrid, methane-powered, LPG, and biofuel vehicles until the end of 2016, significant reductions in emissions followed the introduction of the charge in 2012. By 2015, CO2 emissions had been reduced by 35%, NOx by 18%, and total PM10 by 18%. Road fatalities in Area C declined by 24% between 2011 and 2012, compared to 11% city-wide[21].

Metrics and Methods

Table B3-10 provides a list and description of the environment, health, and safety-related metrics used in this project.

The metrics used for measuring potential environment, health, and safety impacts (e.g. GHG emissions, mode share, VKT) are not mutually exclusive from one another, and the same metrics are also used in assessing potential contributions to Regional Growth Strategy and Regional Transportation Strategy objectives (see Part 7 of this appendix).

The evaluation assesses changes in VKT/capita, GHG emissions, and the proportion of trips taken by active modes as proxies for both environment and health effects, and considers changes in VKT/capita as a loose proxy for safety effects, recognizing the complexities discussed in the previous section.

17 BEST (2009)
18 City of Stockholm (2009)
19 Simeonova, E. et al. (2017).
20 Göteborgs stad (2014)
21 C40 Cities. (2015).

Table B3-10: Environment, Health, and Safety Metrics

Category	Metric	Description
Climate change *(Environment, Health)*	% change in transportation-related GHG emissions from 2030 baseline	Reports the GHG emissions from all modes of travel as a % change from the *Baseline 2030* scenario. Note that GHG emissions from light duty vehicles make up about 36% of total GHG emission in the region. See Appendix B-2 of this report for the emissions factors used.
Mode Share for Personal Trips *(Environment, Health)*	% of trips taken by transit	Reports the proportion of personal trips taken by transit in each decongestion charging scenario for the year 2030. The metric does not report on changes in mode share for walking and cycling because the Regional Transportation Model is limited in being able to simulate the effect of decongestion charges on these modes.
	% of trips taken by multiple-occupant vehicles	Reports the proportion of personal trips taken by multiple-occupant vehicles.
	% of trips taken by single-occupant vehicles	Reports the proportion of personal trips taken by single occupant vehicles. Single occupant vehicles are the least efficient mode of travel in terms of road use and emissions.
Vehicle kilometers travelled (VKT) *(Environment, Health, Safety)*	VKT/capita and % change in VKT/capita compared to 2016 baseline	Reports the VKT per capita and the percent change in VKT per capita from the RTM's 2016 baseline scenario.

These metrics – and others, including criteria air contaminant (CAC) emissions, and injuries and fatalities resulting from vehicle collisions – should be assessed on an ongoing basis following implementation of any decongestion charging system in Metro Vancouver. Health impacts in particular may take a longer period of time to become apparent[22].

22 Simeonova, E. *et al.* (2017)

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PART 10

Privacy Evaluation Brief

PART 10. PRIVACY EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **privacy**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; and future-proofing.

Issue Overview

Concerns around protection of privacy often arise when a jurisdiction is considering decongestion charging. These concerns may stem from a lack of understanding of the measures that can be put in place to safeguard the privacy of travellers. While privacy concerns did not emerge as a major theme during the stakeholder and public engagement for this project—concerns around affordability and fairness were dominant—the privacy protection needs associated with specific technologies or aspects of system design will need to be closely considered in the detailed system design phase. This brief provides a starting point through a preliminary review of technologies and key issues, and outlines ways that impacts on privacy can be minimized.

Perspectives from other jurisdictions

Privacy issues have been highlighted as major themes in recent studies and pilot programs undertaken in North America.

Oregon Road Usage Charge – OreGO charge pilot program

In April 2017, the State of Oregon released the final report of the OReGO Program exploring network-wide distance-based charges[23]. The majority of respondents in a public survey expressed moderate or high levels of concern about privacy in road charging system. Pilot program vendors and participants felt that the system protected privacy well and was comparable to credit card and mobile phone systems. The study found there were higher levels of concern with GPS/GNSS devices than other technologies that were being considered, but also that people are less concerned about privacy since the widespread adoption of smartphones. Education about privacy and security of travel data was cited as critical to mitigating concerns.

California road charge pilot program

The pilot offered participants a choice of methods to report mileage driven, believing that choice would be more acceptable to the public while also addressing privacy and income equity concerns. No security concerns were raised in the duration of the pilot, and there was a 78% participant satisfaction rating regarding privacy and data security[24].

Minnesota mileage-based user fee study

Stakeholder and public engagement raised concerns about government intrusion, location tracking, and data security. There was a general understanding that widespread smartphone technology already exists for tracking locations, however this is seen as a consumer choice which makes the privacy risks more acceptable, compared to the risk under a mandatory mileage-based user fee system[25].

23 Oregon Department of Transportation (2017)2
24 California State Transportation Agency (2017)
25 Minnesota Department of Transportation (2012)

Decongestion Charging Technologies

Effects on privacy are dependent on the type of system (point charges or distance-based charges) and the type of technology that is implemented. Below is a list of common charging technologies in use in other jurisdictions.

Automatic Licence Plate Recognition (ALPR)

All systems will use some degree of ALPR for charging and/or for enforcement purposes. ALPR uses cameras mounted on gantries or poles to produce images of license plates that can be run through a database. This ties license plate details to vehicle keepers for billing.

Dedicated Short Range Communication (DSRC) or Radio Frequency Identification (RFID)

DSRC or RFID are used for point charging by toll road operators around the world. The differences in technology do not change the functionality. An on-board unit (OBU) or tag is mounted near or on the vehicle's front window that communicates with roadside equipment which, similar to ALPR, is usually mounted on gantries or poles. These tags can be connected to vehicle keepers for billing or can be combined with pre-paid accounts, which allows for additional privacy.

Global Navigation Satellite Systems (GNSS) / Cellular Networks (CN)

GPS, the US military satellite positioning system, is one of the most well-known GNSSs, but systems are also operated by the Russian Federation (GLONASS) and the People's Republic of China (BeiDou). The European Union is in the process of creating an entirely civilian, open commercial GNSS under the name Galileo. GNSS is already widely used for vehicle location and many on-board vehicle computers have GNSS connectivity to help with trip planning and navigation. With GNSS units, privacy concerns can be mitigated through the device itself. Units with a digital map on-board (thick client) can pass along only charged amounts and cumulative distance data to a back-office, while units with back-office mapping (thin client) can be aggregated so as to limit privacy concerns. Data aggregation techniques are further discussed below[26].

Odometer Audits

A low-cost, low-technology alternative for distance-based charging is odometer readings, which can be aligned with annual insurance renewal. Privacy is maintained as time and location of travel is not recorded, but this option has limited ability to impact congestion at peak hours as the charge is not applied on a per-trip basis. It also may require significant administration by both individuals and agencies, to track distances driven inside and outside of the decongestion charging zone(s) a period of time[27].

Privacy and system precision

Technology currently exists to collect highly precise location and time data. This can already be seen in vehicles with built-in or on-board GPS units that show vehicle locations with sub-metre level accuracy, such as those in Car2Go and Evo car share vehicles around Vancouver. When considering regional distance-based charging, this high degree of accuracy and precision also has the potential for increased challenges to privacy. Data aggregation techniques discussed below could be an effective solution to pair with this technology.

Point charges will have fewer challenges to privacy than distance-based charges. Point charges will only need to record location and time when a vehicle crosses a charge point, while distance-based charges will continuously monitor vehicle location and distances travelled within charging zone(s).

26 Amelsfort, D. v. (2015)
27 Litman, T. (2011)

Data usage considerations

Below are a list of some specific issues related to the usage of data collected through decongestion charging systems (note that this is a starting point and is not intended to be a complete list of all potential data-related considerations).

Hacks and information breaches

To date, there have not been any notable data breaches from toll-road or decongestion charging systems, but information security remains a critical concern. Previous tolling operations in Metro Vancouver (i.e. Port Mann Bridge and Golden Ears Bridge) had systems that were PCI (Payment Card Industry) compliant, which means the data security standards are comparable to that of credit card companies and thus also allows credit card transactions to be processed directly[28].

Law enforcement

There are cases where ALPR cameras have been used to assist with law enforcement. In London, data from ALPR cameras in the central congestion charge zone has been shared with the Metropolitan Police in specific cases to track vehicles involved in suspected criminal offences. Data is shared only when there is evidence that a serious offence may have been committed. In Stockholm ALPR cameras used for the congestion tax are designed such that only the licence plate and vehicle make and model can be identified. Cameras cannot identify the driver of the vehicle.

Other transportation records, such as public transit data, are also shared on occasion between authorities and law enforcement. This has taken place in Southern Ontario between Metrolinx, the regional transportation authority, and local police either to aid in a criminal investigation or to help locate a missing person. This sharing of data is controlled under the Freedom of Information and Protection of Privacy Act (FIPPA) in Ontario which allows Metrolinx to disclose personal information about riders to police in certain circumstances.

As they are based on data gathered at points, both ALPR and public transit information may not be as granular as the data potentially gathered through distance-based charging, depending on technology.

Private litigation

Some current tolling records are being held for more than four years in California. There are much shorter limits in European countries, of the order of a few months, and records are deleted once users have paid their bills. There have been concerns that arise from holding tolling records for years when it comes to being subpoenaed, for marital disputes, or employment claims. This type of information can explain where people have been on a specific day and/or at a specific time[29].

Strategies for maximizing privacy protection

Privacy legislation

Any decongestion charging system would at a minimum need to adhere to existing privacy legislation designed to safeguard personal information. In BC, personal information may only be collected, used, secured, and disclosed in accordance with applicable law including the Transportation Investment Act and the Freedom of Information and Protection of Privacy Act[30].

Data aggregation

There are a number of ways to aggregate data so that an individual's travel information has limited exposure:

28 See https://www.pcisecuritystandards.org/pci_security/
29 Lee, T. (2011)
30 See https://treo.ca/privacy-statement

- **On-board aggregation** refers to situations in which travel information is determined within the vehicle's on-board unit and sent to the billing authority without specifics of travel history. This is the most effective way for maximizing privacy while still accurately billing an individual for their travel. OBUs can often be expensive, which is a trade-off of implementing a more advanced system. OBUs are typically 10-20 times more costly than a tag-based system, and cost of operation is also increased as software updates on all devices need to continually be updated[31].
- **Third-party privacy agreements** are another approach to safeguarding information through aggregation. With this approach, on-board units communicate detailed travel information to a third party agent, which aggregates the data and submits the total bill to the billing authority. The third party is required to maintain the privacy of the user, except in situations where court subpoenas are involved[32].

Data retention

A clear indication of how records will be held, and for what duration, is important to outline and explain in the implementation of a decongestion charging system. This is especially important if a distance-based charging system is pursued as the amount of information is considerably more granular than for point charges.

For the previously tolled bridges in Metro Vancouver, data was retained for three months after fees were paid for bridge crossings, while photos were kept indefinitely until fees were resolved. In Singapore, the government has committed to erasing bank transactions within 24 hours of payment[33].

Provision of options

Providing multiple options for account set-up or payment is another way to mitigate privacy concerns. There is research that suggests that optional GNSS-based pricing would have more support than mandatory GNSS-based pricing, and options have been built into several recent pilot programs. The OReGO 2012-2013 pilot allowed participants to select a mileage reporting device, not dissimilar to the choice one makes about a mobile phone provider or bank. The program also stated that GNSS technology would not be mandated upon any motorist[34]. The California Road Charge Pilot program incorporated a similar design, where participants were given a range of reporting options including smartphone apps with and without location information, OBUs, and mileage meters designed for commercial vehicles. This pilot also offered private and state managed accounts for processing charges, to further increase options for motorists to participate through whatever means they felt most comfortable[35].

In Singapore, individuals are given the option to load a pay-as-you-go smart card into their vehicle's OBU, from which appropriate charges are deducted when passing charge points. These smart cards can also be used for parking and public transportation. As long as the vehicle has a valid smart card, no information is collected at the charging point[36].

Another possibility is providing the option to pay a premium for monthly passes, which would allow unlimited travel without tracking through point or distance-based charges. A drawback of this option is the loss of the charge-trip relationship, which is particularly important when implementing charging for the purposes of reducing congestion.

31 Amelsfort, D. v. (2015)
32 Sorenson, P.A. & Taylor, B.D. (2005)
33 Pike, E. (2010)
34 Oregon Department of Transportation (2017)
35 California State Transportation Agency (2017)
36 Pike, E. (2010).

Methods and Metrics

Privacy issues were considered in this project through a literature review, as summarized in this brief. Relevant metrics could not be developed at this stage.

Privacy will need to be given close consideration in future phases of system development and design, with attention given to the ongoing risks related to the collection and usage of personal data.

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PART 11

Future-Proofing Evaluation Brief

PART 11. FUTURE-PROOFING EVALUATION BRIEF

Introduction

The Mobility Pricing Independent Commission (MPIC) evaluated a series of decongestion charging scenarios for Metro Vancouver. This evaluation brief details the methods used to evaluate the effects of decongestion charging scenarios on **future-proofing**. Other evaluation briefs summarise methods for evaluating the effect of decongestion charging scenarios on: congestion; fairness; system costs and revenue; economic benefits; public support; consistency with the Regional Growth Strategy and Regional Transportation Strategy; local effects; health, environment and safety; privacy; and future-proofing.

Issue Overview

There are many unknowns and uncertainties around emerging mobility technologies and other trends that are quickly reshaping the ways we get around. It is important to consider how decongestion charging can support potential benefits and mitigate potential disbenefits of these changes. This brief provides a starting point by highlighting key issues; more comprehensive work will need to be done in future phases of system development and design as these trends and technologies continue to advance.

Emerging Developments in Mobility

Emerging mobility technologies and services have the potential to significantly improve transportation efficiency and reduce regional congestion, but these benefits could also be outweighed if the attractiveness of these developments increases motor vehicle travel.

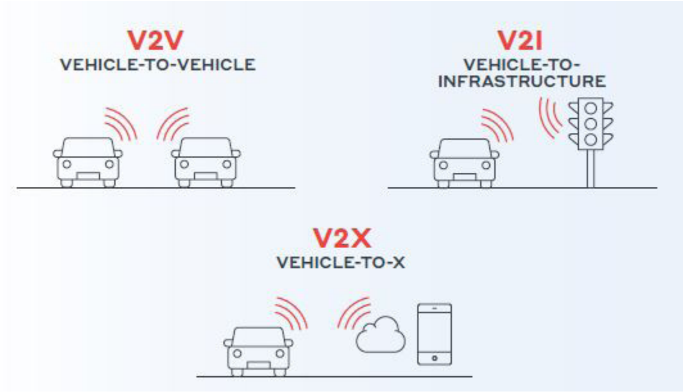
Connected Vehicles

Connected vehicles are likely to be foundational to future decongestion charging systems. There are three basic types of vehicle connectivity: vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-x (V2X), each of which will interact with decongestion charging in different ways[37] (see Figure B3-6):

- V2V can support improved efficiency of roadways, with vehicles indicating to one another where there are constraints or congestion in the network and providing travelers with enhanced navigation and planning to choose alternative routes.
- V2I is likely to be an important technical component of future decongestion charging systems, allowing the monitoring and communication technology to be built in to vehicles, rather than added in later through with an after-market device.
- V2X is covered later in this brief in the form of Mobility as a Service (Maas) and other online applications that could be associated with decongestion charging. V2X technology would enable connected vehicles to be alerted when nearing a decongestion charge zone or point charge.

37 WSP Global Inc. (2017)

Figure B3-6: Basic types of connected vehicles



Source: WSP Global Inc. (2017)

Autonomous Vehicles

It is difficult to predict the overall effect of autonomous vehicles (AVs) on congestion. Increased efficiency and reduced delays from crashes may contribute to reductions in congestion, but the reduced personal cost of congestion for travelers – because they can engage in activities other than operating the vehicle – may incentivize more vehicle travel, thus potentially increasing congestion and its impact on others[38]. The ability of vehicles to circulate or travel to other locations without occupants could potentially contribute to further increases in congestion.

At this point, there is considerable uncertainty in the timeline that the introduction of AVs will follow, how long it will take for AVs to form a substantial share of the market, and what the balance of privately owned to shared AVs may be. Government policy at all levels –municipal, regional, provincial, and federal—will be important in shaping this introduction.

Research regarding the need for pricing strategies to address the advent of autonomous vehicles is still in its infancy[39] and will need to be followed closely. A bill has recently been introduced in the Massachusetts Senate proposing, amongst other things, a baseline 2.5-cent per-mile fee for autonomous vehicles[40].

Electric Vehicles

There are already a number of electric vehicles available on the market and about 2 percent of passenger vehicles on the road in British Columbia are electric or hybrid. The number of electric vehicles is expected to increase and there are high ambitions for growth. Given the major sources of electricity in BC, electric vehicles could make a significant contribution to reducing GHG emissions from road transport.

The shift toward electric vehicles needs to be carefully considered in decongestion charging policy as congestion reduction and sustainability are weighed. The cost of fossil fuel, including fuel and carbon taxes in Metro Vancouver, operates as a small incentive toward hybrid and electric vehicles.

Several jurisdictions, including London and Stockholm, have introduced discounts or exemptions from decongestion charging for non-fossil fuel vehicles. These have been successful in driving the uptake of these types of vehicles[41] but have also caused some erosion of the congestion benefits. In Stockholm, the number of vehicles entering the congestion charging zone without paying because they met the criteria for the alternative fuels discount increased from 3 percent in 2006 to 13 percent in 2008[42], causing the exemption to be removed to preserve the congestion benefits.

38 Anderson, J. *et al.* (2016)
39 See for example Simoni, M. *et al.* (2018)
40 Commonwealth of Massachusetts. (2018).
41 BEST (2009)
42 Select Standing Committee on Crown Corporations (2018)

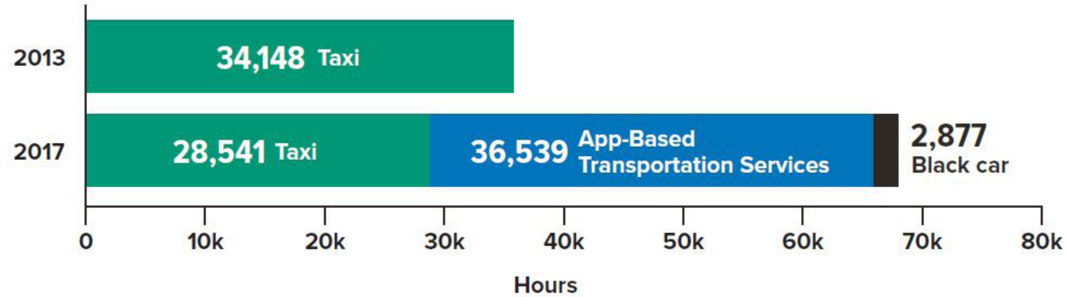
Shared Mobility

Shared mobility refers to any transportation service where users share a vehicle, bicycle or other mode. It allows users to gain short-term access to transportation on an as-needed basis. It includes things like car sharing, transportation network companies (ride hailing) and other taxi-like services.

TNCs are not currently permitted to operate in BC; however, in early 2018 a report[43] produced by the Select Standing Committee on Crown Corporations for the Second Session of the 41st Parliament of British Columbia recommended that transportation network companies (TNCs) should be permitted to operate in the province within a regulatory regime. The report makes recommendations around considerations for community impacts and the design of such a regime.

Some jurisdictions are analyzing the impact that TNCs have had on traffic volume and congestion and seeking solutions. New York City's recent congestion charging study has recommended a surcharge on for hire vehicles (FHVs, including TNCs) and taxis. The rationale comes from recent research showing that app-based transportation services have increased unoccupied FHV hours in Manhattan's CBD from nearly zero in 2013 to over 36,000 in 2017, with drivers spending an average of 11 minutes waiting between passengers[44] (Figure B3-7).

Figure B3-7: Taxi and App-Based Transportation Services unoccupied vehicle hours (between passengers) in Manhattan CBD, 2013-2017



Source: Fix NYC Advisory Panel Report (2018)

It is likely that many mobility sharing services, particularly TNCs, will at some point seek to operate automated vehicles in order to reduce costs. Applying a decongestion charge to shared AVs may operate in a similar fashion to how taxis[45], transportation network companies (TNCs) (e.g. Uber)[46], car-share vehicles[47], and rental vehicles[48] currently work. When these vehicles pass a point charge, automatic license plate recognition (ALPR) registers the license plate and charges the fee to the vehicle owner, who passes it along to the traveller (often with an additional processing fee). In the case of taxis and TNCs, fares are often added immediately and paid by the passenger. Whether to charge travelers for charge point passed or distance travelled only while they were in the vehicle, or to also charge for points passed or distance travelled by an unoccupied vehicle travelling to pick up the passenger will be an important consideration.

Mobility-as-a-Service (MaaS)

MaaS is a concept that integrates transportation services offered by multiple independent providers, such as transit, taxis, TNCs, and bike sharing, into a single mobile application. Users are able to plan and pay for their mobility needs through one application rather than sourcing options through a variety of interfaces. MaaS can show a variety of options and display the trade-offs of mode, time, and cost from origin to destination[49]. Whim, a mobile application developed by MaaS Global in 2016 and currently in operation in Helsinki, provides users a platform to find

43 Fix NYC Advisory Panel Report (2018)
44 For example, see https://www.nswtaxi.org.au/tolls
45 For example, see https://help.uber.com/h/776390a5-b197-412a-98c4-011c85799dc1
46 For example, see https://www.car2go.com/media/data/usa/files/car2go-additional-fees.pdf
47 For example, see https://www.treo.ca/tolls-and-fees/visitors-rental-cars/
48 For example, see https://www.treo.ca/tolls-and-fees/visitors-rental-cars/
49 Goodall, W. *et al.* (2017)

routes, pay fees, book tickets, and check timetables as well as access public transportation and taxis. Users can choose from pay-as-you-go or monthly plan options[50].

Changes in Goods Delivery

For several industries, Just-In-Time (JIT) deliveries are becoming common and have changed how manufacturers operate and rely on one another, specifically if warehousing and storing are not long-term options for parts and products. JIT deliveries require manufacturers to deliver as efficiently as possible and may be more directly impacted by location and time-based charges as there is less flexibility in when deliveries take place.

3D printing is also allowing small scale manufacturing to occur within short windows of time, which could impact goods movement volumes and travel patterns, and how deliveries may interact with charge systems.

The growth in online shopping and consumer delivery services has been substantial in recent years – global parcel volumes have increased almost 50% from 2014-2016—adding to traffic volumes as drivers make deliveries and circle for parking spaces in dense urban centres[51]. Automated drone delivery is continuing to expand from a technical and policy perspective, yet there are still limitations on both fronts. Automated air-based parcel delivery may impact road congestion in the future, but it is difficult to predict how much of the market place this will penetrate and on what timeline[52].

Trends in employment and commuting

Employment trends are changing with technological advancements, and these changes have the potential to impact commuting and travel patterns. It is expected that significant automation will continue to occur in some sectors such as goods production[53], while the impacts of rapid advancements in artificial intelligence (AI) in difficult to predict[54]. More people have the ability to be mobile and work from locations other than a traditional office. In Canada, working from home has declined slowly in recent years, but this is largely attributable to fewer workers in farming occupations[55]. Precarious employment is also on the rise; temporary work in Canada is growing three times faster than permanent work. . Employment in temporary positions adds a layer of complexity to decisions individuals and households make about where in the region to live how to commute.

Methods and metrics

Future-proofing issues were considered in this project through a literature review, as summarised in this brief. Relevant metrics could not be developed at this stage.

It is clear that mobility is, like many other sectors, undergoing a period of rapid change. It is less clear how quickly these change will occur or what the impacts will be. Government may need to create or adapt regulations to ensure that the outcomes are equitable and sustainable. Future feasibility work will need to monitor ongoing development in the transportation sector and consider the potential of charging to promote equitable and sustainable outcomes.

50 See https://whimapp.com/
51 Sherman, N. (2018)
52 McKinsey & Company (2016)
53 Institute for Public Policy Research (2017)
54 McKinsey & Company (2017)
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APPENDIX B-4

Implementation Considerations

APPENDIX B-4: IMPLEMENTATION CONSIDERATIONS

CONTENTS

PART 1

Introduction

PART 1. INTRODUCTION

This report contains some high-level considerations regarding the implementation of a coordinated mobility pricing policy including a decongestion charge in Metro Vancouver. It covers the main strategic implementation steps and provides some examples of governance and business models. It draws on experience from other jurisdictions that have implemented various forms of road user charging.

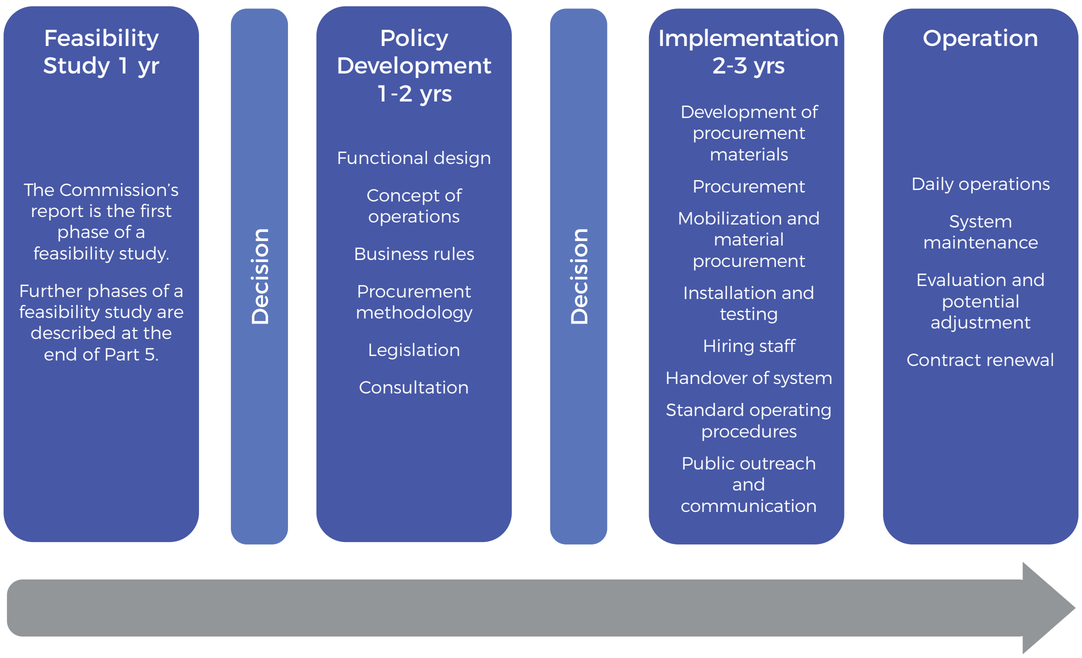
PART 2

Strategic Implementation

PART 2. STRATEGIC IMPLEMENTATION

This section outlines one possible approach for a policy design process, including the work already completed by the Mobility Pricing Independent Commission (MPIC). The four main phases for implementation include feasibility study, policy development, implementation, and operation and adjustment. Components of these phases are shown in Figure B4-1[1].

Figure B4-1: Four-phase approach to implementation



Feasibility study

The **feasibility study** focuses on collecting information on the current background by identifying whether decongestion charging would be an appropriate approach to reduce congestion, promote fairness, and raise revenue for investment in transportation as well as identifying opportunities and barriers. In this step, a high level analysis of the effects of different typologies of decongestion charging solutions are reviewed to identify the most suitable approach as well as the political constraints that may arise. The Commission's work can be considered the first stage of a feasibility study. Outstanding work to complete the feasibility study is described in Appendix A.

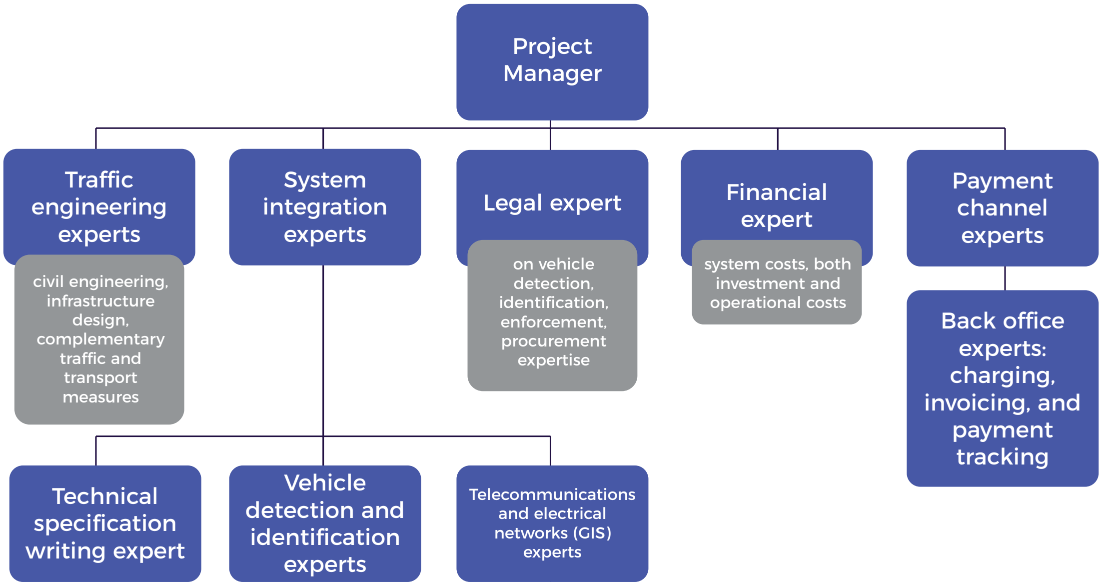
Policy Development

The policy development portion of the implementation consists of the following steps:

1. The **functional design** stage is where the chosen decongestion charging policy is defined and detailed analysis of traffic, economic, environmental, and social impacts is carried out.
2. The **concept of operation**s happens partially in parallel to the functional design. It details how the system will work, how vehicle detection will occur, how the charge and trips are built, overall technology requirements for functionality, etc. The technical system will likely consist of a combination of roadside equipment, a back office system, and customer service centre. Figure B4-2 outlines the typical skills and team members needed to support the development of a concept of operations. This step begins when the functional design is between 50-100% complete.

1 Amelsfort, D. v. (2015) *Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities*, Asian Development Bank.

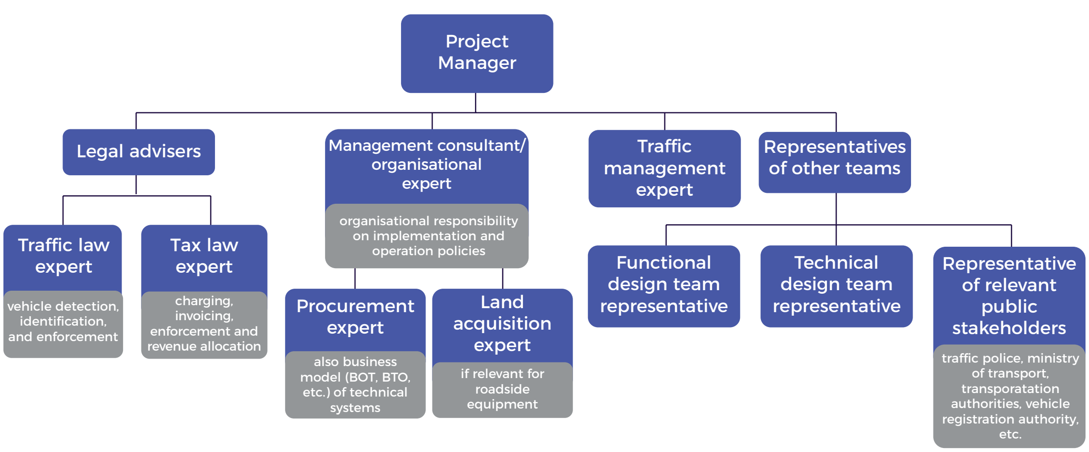
Figure B4-2: Typical skills needed to support the development of a concept of operations



3. The **business rules** document outlines the business requirements for the various charging subsystems. These documents will be initially drafted during the policy development phase and continue to be revised throughout the implementation process During the development of the business rules, a **procurement methodology** should be developed to determine the type of procurement approach that will be pursued during the implementation phase. Additionally, performance metrics will need to be developed to monitor and assess the system's performance during operation.

4. The **legislative framework** of the decongestion charge provides the legal basis around vehicle detection. The development of a legislative framework often has overlapping timelines with the development of a functional design and concept of operations. Following the development of the legislative framework, the decision to procure would be made. However, the decision to procure may be prolonged (and delay the project) at this stage if complications arise and the legislative procedures take longer to approve. Figure B4-3 outlines the skills and suggested design team for this framework.

Figure B4-3: Typical skills needed to support the development of legislation



Throughout the policy development stage, consultation and communication should be conducted. The Commission has carried out some consultation; more would be needed as further details are developed.

In total, the policy development phase could last between 1-2 years. Following the completion of the functional design and a final charging scheme has been developed and analyzed, a further decision to proceed would be required.

Implementation

The implementation portion of the process consists of:

1. The **development of procurement materials**, which can take up to 2 years depending on the procurement methodology.
2. The **procurement** is conducted through a Request for Proposal (RFP) process. An Expression of Interest (EOI) may be conducted prior to the RFP to shortlist appropriate vendors and identify standard industry procedures, areas to improve the RFP, and potential risks that may arise. Following the contract award, **mobilization and material procurement as well as installation and testing will begin.**
3. **Hiring and training of personnel, standard operating procedures,** and **system handover** can be completed simultaneously.

Throughout the process, **public outreach and communication** will be needed in order to educate the public and potential users about the system. In total, the implementation phase could take between 2-3 years.

Operation and Adjustment

The operations phase of a decongestion charge includes daily operations and systems maintenance. During the first 6 to 12 months of operation the system's performance will be measured and monitored against predetermined performance metrics developed during the policy development phase. This period will be crucial in evaluating whether the project has been deemed successful or will need further adjustment. Typically, operations contracts are renewed every 5 years, but this will be determined during the procurement methodology phase.

PART 3

Business Models

PART 3. BUSINESS MODELS

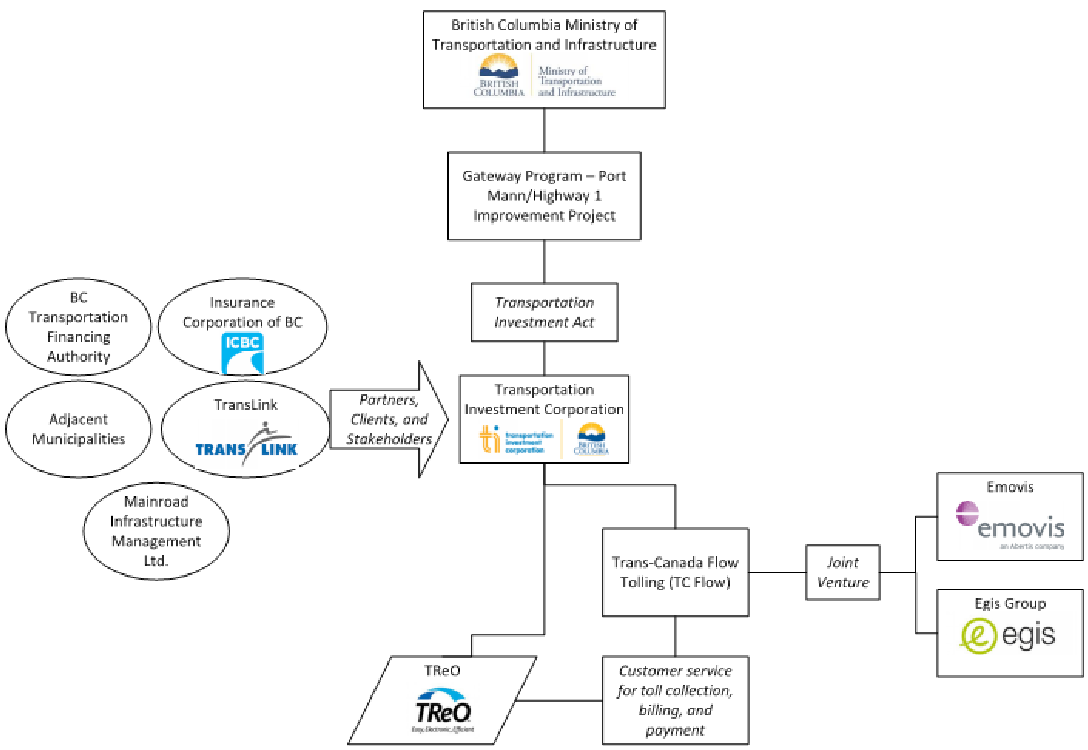
This section reviews the governance structure and business models used in the implementation of charging on the Port Mann and Golden Ears Bridges, as well as urban decongestion charging in Sweden and road usage charging in Oregon. The intention is to illustrate the complexity of some of these arrangements and the need for strategic decisions on governance models.

Port Mann Bridge

The Transportation Investment Corporation (TI Corp) is a public crown corporation established by the British Columbia Ministry of Transportation and Infrastructure to implement the Port Mann/Highway 1 Improvement Project and repay the debt by 2050. This included the construction, operations, and maintenance of 37 kilometres of improvements to the TransCanada Highway through Metro Vancouver, as well as the development, implementation, and management of tolling operations on the Port Mann Bridge to recover the project's high capital costs and subsidize operating and maintenance costs of the bridge for up to 40 years.

TI Corp is governed by a Board of Directors appointed by the Lieutenant Governor in Council. TI Corp developed TReO, an all-electronic toll technology, with more than 1.5 million registered vehicles. The Trans-Canada Flow Tolling (TC Flow) was established as a private-sector joint venture between Emovis and Egis Group to facilitate the customer service for toll collection, billing and payment from TReO customers. Figure B4-4 outlines the structure established for tolling on the Port Mann Bridge. Key partners, clients, and stakeholders include the British Columbia (BC) Transportation Financing Authority, the Insurance Corporation of BC (ICBC), adjacent municipalities, TransLink, and Mainroad Infrastructure Management Ltd[1].

Figure B4-4: Port Mann Bridge Improvement Project Business Model



As of September 2017, following a decision by the Provincial Government, tolls were removed from the Port Mann Bridge, and a $135 million annual debt service was transferred to the province of British Columbia.

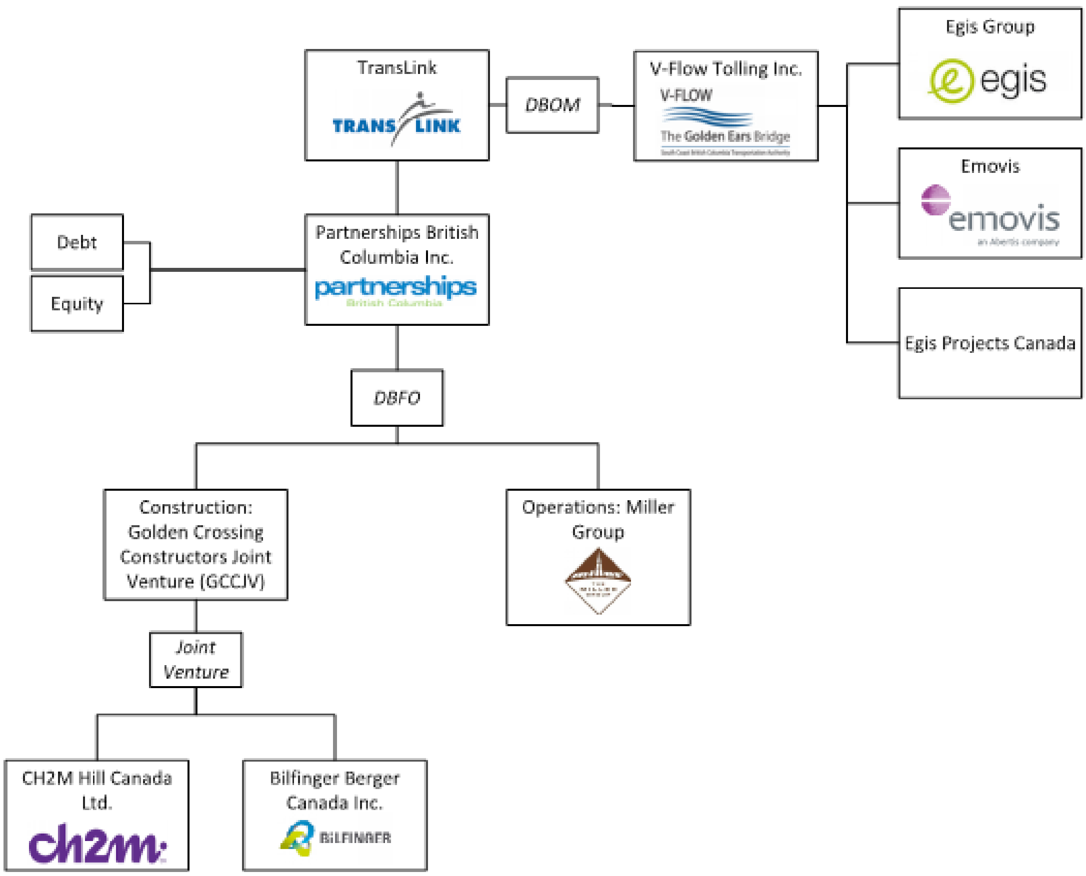
1 Source: http://www.ticorp.ca/who-we-are/governance/

Golden Ears Bridge

The construction of the Golden Ears Bridge began in June 2006 with total capital cost of $808 million. The bridge was delivered through a 35.5 year Design-Build-Finance-Operate (DBFO) public-private partnership, as depicted in Figure B4-5[3]. Partnerships BC acted as the procurement advisor for this project.

TransLink entered into a separate DBOM contract with a tolling equipment and system supplier. TransLink awarded the contract for the design, supply, operations, and maintenance of the all-electronic tolling system to V-Flow Tolling Inc.[4] Similar to the Port Mann Bridge, V-Flow consisted of both Egis and Emovis, with a subcontract for the operations and maintenance to Egis Projects Canada. This contract allowed TransLink to have 100% control of the toll setting, but also retain the revenue risk associated with the project[5]. The decision to remove tolls in September 2017 also applied to the tolls on the Golden Ears Bridge.

Figure B4-5: Golden Ears Bridge Project Business Model



2 Source: http://www.partnershipsbc.ca/files/documents/GEBcasestudy.pdf
3 Source: Egis Group (n.d.) Retrieved from: http://www.egis-group.com/sites/default/files/gb_brochure_tolling_service_provider_of_choice_for_all-electronic_tolling_projects_in_british_columbia_canada_2014.pdf
4 Source: https://www.austinchamber.com/upload/files/10-6_Farrell.pdf

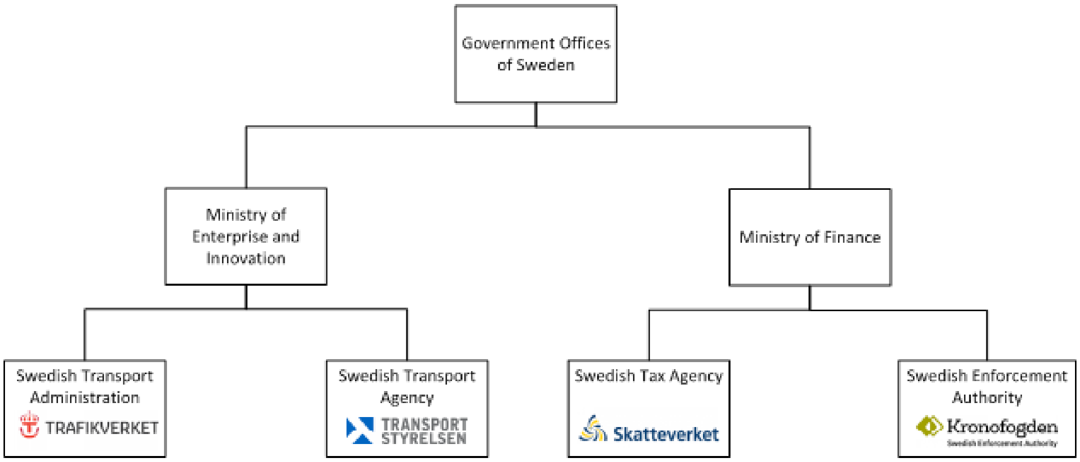
Stockholm and Gothenburg Congestion Tax

The business model and governance structure established for the Stockholm Congestion Tax in 2007 was later expanded and replicated for the Gothenburg Congestion Tax in 2013. The Gothenburg system was able to leverage the initial investment and establishment of a national back-office and customer services, databases, and collections for the Stockholm system.

As seen in Figure B4-6, under the Ministry of Enterprise and Innovation, the Swedish Transport Administration was responsible for procuring all roadside equipment for tolling as well as long-term maintenance activities. The Swedish Transport Agency was in charge of the procurement, operations and maintenance, shared back-office, maintenance of the license plate database, tax decisions, and invoicing of all vehicle related taxes for the Stockholm and Gothenburg approaches. Additionally, in the case of foreign vehicles using the system, a private debt collection organization was formed under the Swedish Transport Agency, which bears much of the risk that arises with debt collection.

Under the Ministry of Finance, the Swedish Tax Agency manages the gross revenues received by the Swedish Transport Agency, manages the national citizen database, and reviews the tax decisions from the Swedish Transport Agency. The Swedish Enforcement Authority collects any unpaid debt after initial invoices and procedures were conducted by the Swedish Transport Agency.

Figure B4-6: Swedish Road Usage Charge Business Model

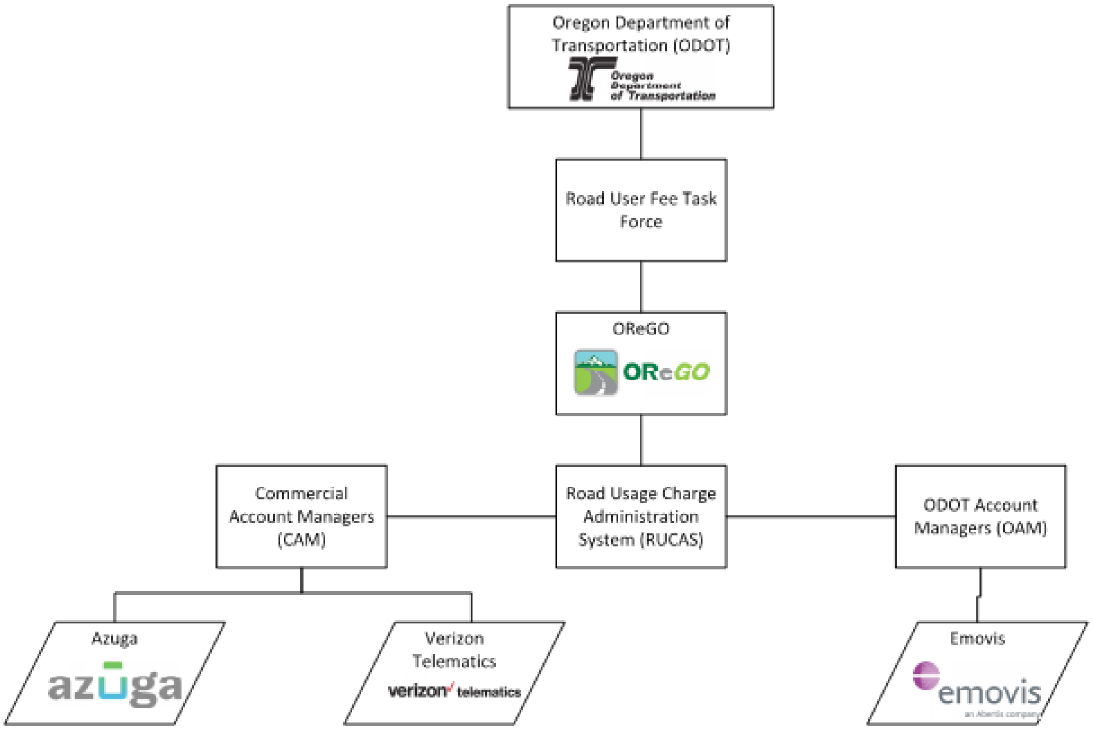


OReGO – Mileage Based User Fee

As seen in Figure B4-7, the Road Usage Charge Administration System (RUCAS) relies upon both ODOT Account Managers (OAM) as well as Commercial Account Managers (CAM). The OAM services were contracted to an operator which manages enrolment of volunteers, delivery of in-vehicle devices, performing account management services, and reconciling tax payments. Vendor submissions detailed their technical and managerial capabilities, past performance, and proposed budgets for OAM account management services for ODOT. Through this procurement process, Emovis (formerly Sanef) was selected. Emovis also created a sub-contract for the devices. The CAM services were offered through a Request for Qualification (RFQ) and awarded to Azuga and Verizon Telematics. Procurements may also be issued to additional account managers that successfully pass the ODOT contract specifications and successfully pass the certification process.

The ability to use private sector vendors has provided opportunities to decrease administrative costs for OReGO as competition amongst vendors decreases the overall account management costs for the system. Additionally, this system has been regarded well in terms of privacy as users have options on what type of system they prefer to use (GPS based, odometer based, overall performance based, etc.)[5].

Figure B4-7: OReGO Business Model and Governance Structure



5 Source: Oregon Department of Transportation (2017) *Oregon's Road Usage Charge Final Report*, Salem, OR.

APPENDIX C

Phase 2 Communications
and Engagement

APPENDIX C. PHASE 2 COMMUNICATIONS AND ENGAGEMENT

CONTENTS

INTRODUCTION

Changing the way people pay for using transportation services is deeply personal.

This appendix outlines the Phase 2 communications and engagement program to reach, inform, educate, involve, and hear from the region's residents, stakeholders, and government officials on key concerns and considerations on mobility pricing including a decongestion charge.

The Phase 2 program was designed and delivered as an extension to the Phase 1 activities and findings completed in fall 2017. The Phase 1 engagement report can be found in Appendix D of the Phase 1 full report.

PART 1. ABOUT THE PROGRAM

The *It's Time* project team launched a second public education campaign and engagement program with the public, government officials, and stakeholders. The purpose was to present two different approaches to decongestion charging – congestion point charges and distance-based charges – and show how they could work, their effects, and gather suggestions and key considerations on potential introduction.

1. Phase 2 Communication Activities

Phase 2 focused on educating the public and stakeholders on congestion point charges and distance-based charges, and how implementing either approach could impact how we manage fuel taxes in the region. The intent was to inform and equip the public and stakeholders to participate in the engagement.

Educating through communication platforms

The *It's Time* project launched the education campaign through its existing communication platforms, leveraging its Facebook, Twitter, and Medium accounts to interactively engage the public.

The education campaign outlined which decongestion charge approaches were being studied in Phase 2, and the various ways they could impact Metro Vancouver residents. This was done through a persona campaign, where impacts of a decongestion charge were illustrated through seven characters representative of various geographies, professions, lifestyles, cultural backgrounds, and modes of transportation. This persona campaign allowed the project team to communicate and humanize how a coordinated mobility pricing policy could play out for Metro Vancouver residents if implemented.

The *It's Time* social media platforms allowed members of the public to share their considerations and concerns during the education campaign.

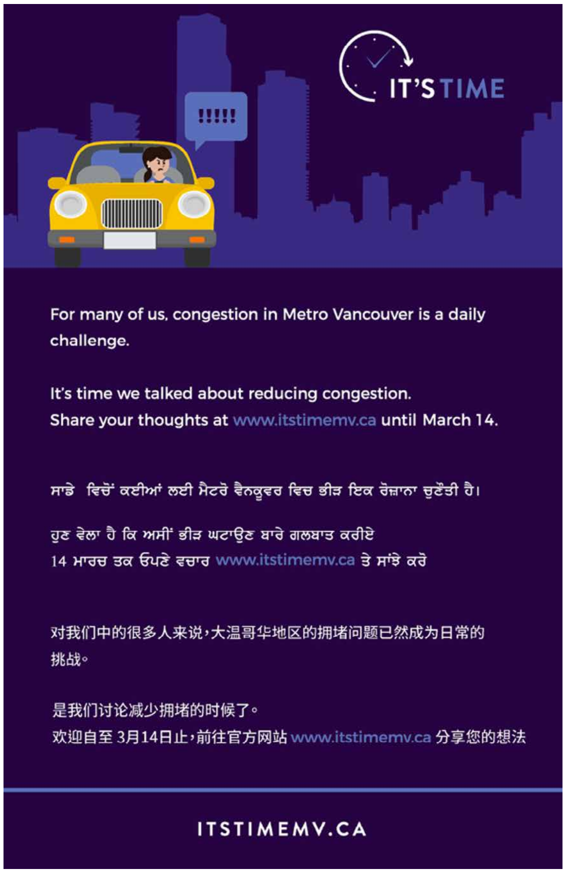
APPENDIX C

Promoting *It's Time* online engagement

Through its promotions, the project team aimed to reach and hear from a large and representative sample of Metro Vancouver's diverse population, specifically targeting municipalities and demographics that were underrepresented in the Phase 1 online public engagement.

Multilingual digital and print ads were circulated on selected online and local media platforms to build awareness and drive participation to the Phase 2 online engagement platform.

All print advertising was focused on local distribution newspapers to more effectively reach residents in their respective municipalities, including Metro News, Megaphone Magazine, Burnaby Now, Coquitlam Tri-City News, Delta Optimist, Langley Times, Maple Ridge/Pitt Meadows News, New Westminster Royal City Record, North Shore News, Richmond News, Surrey Leader, Vancouver Courier, Georgia Straight, Peace Arch News, and Abbotsford News.



Translated advertisements were circulated in non-dominant language newspapers including New Leaf, Ming Sheng Bao, Hamdard Weekly, Global Chinese Press, South Asian Post, Canadian City News, Sing Tao, Filipino Post, Punjab Guardian, Asian Post, and Canada Punjab Times.

Promotional materials were also shared with all local municipalities who were asked to distribute the material in libraries, community centres and at municipal halls.

Multilingual printed postcards and posters were also circulated and posted in public community spaces across the region, including all branches of the Surrey City Public Library, Burnaby Public Library and New Westminster Public Library. Materials were also distributed at eight public recreation facilities in New Westminster. Additionally, postcards and posters were shared with clients at 11 SUCCESS service centres across Metro Vancouver. Furthermore, materials were distributed to nine Burnaby social service agencies and public agencies during an interagency meeting.

Communications reach

The following infographic describes how many people we reached through our communication efforts, from releasing our Phase 1 report on January 16 to a few days after closing our Phase 2 online engagement on March 16.

ONLINE:

- Public opinion polling reach: **1,000**
- Multicultural digital advertising reach:
  - Traditional Chinese impressions: **103,095**
  - Simplified Chinese impressions: **152,556**
  - Punjabi impressions: **338,592**
- Website reach:
  - **16,720** sessions (distinct visits to the site).
  - **13,566** users (distinct people who visited the site).
  - **26,361** pageviews.
- *It's Time* social media reach and impressions:
  - Facebook reach: **660,465**
  - Facebook impressions: **3,848,583**
  - Twitter impressions: **213,800** (reach is not tracked by Twitter)
- Reach and impressions of mobility pricing themes on Twitter:
  - Reach: **6,365,122**
  - Impressions: **19,888,337**
- Other digital outreach: **755,465** impressions
- Most popular social media post: **5,128** people reached and **124** reactions, comments and shares

PRINT:

- Traditional media stories: **454**
- Local print media reach: **1,281,240**
  - Includes: Metro News, Megaphone, Burnaby Now, Coquitlam Tri-City News, Delta Optimist, Langley Times, Maple Ridge/Pitt Meadows News, New Westminster Royal City Record, North Shore News, Richmond News, Surrey Leader, Vancouver Courier, Georgia Straight, Peace Arch News, Abbotsford News

- Multicultural print media reach: **391,000**
  - Includes: New Leaf (Chinese), Ming Sheng Bao Pao, Asian Post E-letter, Global Chinese Press, Hamdard Weekly, Canadian City News, Canada Punjab Times, Sing Tao, South Asian Post, Punjab Guardian, The Filipino Post
- Building on Phase 1 participant reach, the project team carefully tracked and tailored our communication approach in Phase 2 to better hear from a more representative sample of Metro Vancouver residents in the second round of online public engagement, resulting in:
  - Increased female reach and participation: demonstrated from **41%** of total participants in Phase 1 to **52%** in Phase 2
  - Increased participation from other municipalities other than Vancouver:
    - Surrey: **15%** of total participants compared to **10%** in Phase 1
    - Burnaby: **9%** of total participants compared to **6%** in Phase 1
    - Maple Ridge: **7%** of total participants compared to **4%** in Phase 1
    - Richmond: **6%** of total participants compared to **4%** in Phase 1
  - Increased participation from participants over 55 years old: **29.6%** of total participants in Phase 2 compared to just **25%** in Phase 1

2. Phase 2 Engagement Activities

Phase 2 engagement launched in January 2018 with the introduction of congestion point charges and distance-based charges and examples illustrating different ways they could be applied in Metro Vancouver. This provided some concrete content and a starting point for the next round of conversation and engagement with the public and stakeholders.

Designing the engagement was a balancing act requiring the project team to juggle a variety of challenging factors within a short timeframe: educating and engaging the diverse public citizenry on a topic that is dense and technical in nature; seeking feedback from Metro Vancouver residents and stakeholders without providing dollar values or firm examples; and reaching and hearing from underrepresented voices on a complex transportation policy that could disproportionately impact them.

MEMBERS OF THE PUBLIC

The second round of online public engagement was launched to grow awareness of distance-based and congestion point charges, gauge the level of public support for implementing either system in Metro Vancouver, and gather suggestions to inform potential implementation and future research.

The online public engagement was housed on the same online platform as Phase 1 for familiarity and consistency. Particular attention was given to presenting and laying out a significant amount of information in a digestible and visual way to better inform participants' responses. Similar Phase 1 tactics to increase accessibility were again offered in Phase 2, including offering the online platforms in Metro Vancouver's four most dominant languages (English, Simplified Chinese, Traditional Chinese, and Punjabi); providing animated videos with captions to offer information; and creating and distributing paper surveys to organizations supporting senior, cultural, and lower-income communities to minimize barriers to online participation.

Public events were hosted at the Surrey City Centre Public Library and New Westminster Innovation Week to offer the public opportunities for in-person dialogue, answer questions, and drive participation on the Phase 2 online engagement through paper surveys and tablets. These events were promoted on the *It's Time* website.

Finally, the **second round of public opinion** polling was conducted following the close of the public engagement as a benchmarking exercise to see how the project had affected public understanding and sentiment on mobility pricing and decongestion charging in the region.

GOVERNMENT OFFICIALS AND STAKEHOLDERS

The project team held a second round of in-person workshops with regional and local stakeholders, government officials, and our citizen-based User Advisory Panel, building on the relationships developed in Phase 1.

At each facilitated stakeholder workshop the project team walked participants through the Phase 1 recap of research and engagement activities and findings, and sought input on fuel taxes, distance-based charging, congestion point charging, and some examples of how they can be implemented in Metro Vancouver. The invitee list of local and regional stakeholders again represented organizations and interests across advocacy, social service, health, transportation, industry, business, environment, academic, and labour sectors.

The project team met with elected officials in all three levels of government (municipal, provincial, and federal) to provide a recap of the Phase 1 research and engagement work and solicit feedback and input on distance-based and congestion point charges. This included two workshops with 17 municipal elected officials, meetings in Victoria with all three provincial caucuses amounting to 30 MLAs, and meetings either over the phone or in-person with three Members of Parliament representing the Liberal Party of Canada, Conservative Party of Canada, and federal NDP.

The project team reached out and held a small meeting with representatives from local First Nations communities to provide information on the *It's Time* project and listen to key points and concerns raised about decongestion charging from an Indigenous lens.

The project team hosted at-request meetings including the City of Maple Ridge, City of Delta, City of New Westminster, and City of Vancouver Children, Youth, and Families Advisory Committee. We reached out to meet with community organizations representing underrepresented voices including the Surrey Immigrant Advisory Roundtable and the Burnaby Neighbourhood House Interagency Network.

The Commission also received formal written submissions from certain stakeholder groups including Vancouver Coastal Health, Metro Vancouver, City of New Westminster, BC Trucking Association, and elected officials from the City of Burnaby.

USER ADVISORY PANEL

The citizen-based User Advisory Panel (UAP) was created in Phase 1 through an external recruitment firm identifying a representative group of Metro Vancouver residents from different cultural and employment backgrounds, ages, municipalities, and users of different transportation modes.

To continue advising, guiding, and providing input on the project, the UAP met again on two occasions in Phase 2: the first instance to seek input on decongestion charging and examples of how they could be implemented in Metro Vancouver; and the second instance to offer feedback on some of the Commission's draft recommendations.

Who did we engage in Phase 2?

ENGAGING METRO VANCOUVER RESIDENTS

Online engagement – **11,238** total participants, including:

- English platform – **11,046** participants
- Punjabi platform – **18** participants
- Simplified Chinese platform – **79** participants
- Traditional Chinese platform – **95** participants
- Parallel paper surveys – **46** participants

Public events

- Surrey Public Library – **40** participants
- New Westminster Innovation Week session – **150** participants

Public opinion polling – **1,000** participants representative of Metro Vancouver

TARGETED OUTREACH

Burnaby Interagency Meeting – social service agencies from eight organizations

City of Surrey – Immigrant Advisory Round Table

ENGAGING STAKEHOLDERS

2 half-day workshops with local and regional stakeholders – **63** participants representing **50** organizations

2 User Advisory Panel workshops – **13** participants

ENGAGING GOVERNMENT

3 workshops with local First Nations and Municipal Elected Officials – **19** participants

3 meetings with Provincial Elected Officials – BC NDP (**8** MLAs), BC Liberals (**20** MLAs), and BC Green Party (**2** MLAs and **2** staffers)

3 meetings with Federal Elected Officials – Federal NDP (**1** MP), Federal Liberals (**1** MP), and Federal Conservative Party (**1** MP)

PART 2. FINDINGS

Through the engagement efforts, the project team heard thousands of views on the prospect of implementing a decongestion charge in Metro Vancouver.

The following section is a report back on the recurring themes and key points we heard from the public, stakeholders, and government officials in Phase 2 on:

- General public support
- Fuel taxes
- Distance-based charging
- Congestion point charging
- Charging variables (peak hours and congestion hot spots)
- Paying for use versus paying for congestion

The summary can be found in the Commission report on the *It's Time* website.

Considerations from government officials, including First Nations, are included at the end of this section.

BEFORE WE DIVE INTO THE FINDINGS, HERE IS A RECAP:

1. How did we come up with our Public Support Scores?
The online engagement platform asked the public to rate their level of agreement with a series of statements related to the fuel tax, distance-based charges, congestion point charges, and approach preferences.

Participants responded to these statements by selecting between:

Totally Disagree	Disagree	Don't Know	Agree	Totally Agree

This report uses a **Public Support Score to summarize what we heard from the online engagement results**. This score combines the average level of agreement with the average level of consensus from all participant responses.

The Public Support Scores are ranked from a High to a Low score:

Score	Score range	What does this mean?
High	75% to 100%	A high score indicates stronger public support and responses were more consistent.
Medium high	55% to 75%	
Medium	45% to 55%	
Medium low	20% to 45%	A low score indicates weaker public support and responses were more spread and inconsistent.
Low	0% to 20%	

Note: The Public Support Score is not fully representative of Metro Vancouver. It represents those members of the public who elected to participate and self-identify in the online engagement. The participation breakdown by demographics can be found in Appendix C-1.

2. How did we come up with our public themes?
Public comments were gathered through four open-ended questions in the online engagement and parallel paper surveys.

With all 9,155 comments received, the project team reviewed and removed approximately 60 profane comments without constructive input, then analyzed the remaining comments to identify themes. **From this, the project had an understanding of the key concerns and suggestions that were important to convey to the Commission on behalf of the public.**

Each participant comment was then categorized under a theme, with some comments often falling under several themes. **From this, the project team had a better understanding of a theme's level of importance based on their number of supporting comments.**

1. On public support

The *It's Time* project was the first step in investigating and building awareness on a coordinated mobility pricing policy in Metro Vancouver. With that, it may have been the first time many residents and stakeholders heard and considered a decongestion charge in their daily lives.

General public sentiment

Throughout both phases, the project team heard a variety of recurring comments opposing a decongestion charge in Metro Vancouver. While low public acceptability aligns with the findings from the project team's Phase 1 research (refer to Appendix B), it is important to note and acknowledge the top recurring comments and concerns:

- *This is another tax grab. I already pay so much for taxes and the cost of living is already so high*
- *You're punishing me. I was forced out of the city and far from my work because of unaffordability*
- *This is unfair. I shouldn't have to pay because I didn't cause this congestion problem. I have to drive because I don't have any other options. I have to drive because of personal reasons*
- *You've already made your decision. This engagement is biased because there is no easy way to say no to decongestion charging*

From the thousands of similar comments received, the project team took the liberty of inferring some root issues personally important to Metro Vancouver residents which should be taken into account when considering a decongestion charge:

- I have to be able to move around easily
- I have to be able to get to work in an affordable way
- I don't want to pay more taxes
- I have to make ends meet and it is challenging
- I want to feel respected, understood, and enabled
- I want to have a choice and a say

Public opinion polling results

The project team contracted Ipsos to conduct a second round of public opinion polling with a representative sample of 1,000 residents from across Metro Vancouver to benchmark public sentiment and understanding of mobility pricing, decongestion charging, and the work of the Commission. Key findings are included below.

ON PUBLIC AWARENESS

- **There is increased public awareness of the term 'decongestion charging'** (14%) in Phase 2 compared to 7% in Phase 1. There is relatively higher public awareness of distance-based charging (31%) over congestion point charging (13%)
- **There remains fairly low awareness levels of mobility pricing and the Mobility Pricing Independent Commission** – Three-in-ten residents have heard about the concept of mobility pricing and 15% have heard about MPIC, both findings are consistent with Phase 1 results
- **There is increased public awareness from September 2017 that we already have existing mobility pricing in Metro Vancouver** (71%)

ON PUBLIC SUPPORT

- **Support for decongestion charging in Metro Vancouver is fairly equally split**. One-third (34%) of residents support decongestion charging (10% 'strongly', 25% 'somewhat') and one-third (34%) oppose decongestion charging (18% 'strongly', 16% 'somewhat'). Another one-third of residents (32%) say they 'neither support nor oppose' decongestion charging (25%) or 'don't know' (7%)
- **Support for mobility pricing was at 33%. The largest portion of residents (40%) say they 'neither support nor oppose' mobility pricing (28%) or 'don't know' (12%)**
- **There is higher support for "an approach where only those people who drive in congested areas and at busy times are charged" (49%) over "an approach where everyone pays a little bit every time they drive" (25%)**, with 26% remaining undecided. North Shore residents in particular preferred an approach targeted at reducing congestion
- **38% agreed that they would be willing to pay some amount of money to have less road congestion**
- **The largest proportion of residents say they would like to see the fuel tax eliminated (36%) if a decongestion charge is implemented.** This sentiment was particularly strong among residents of the Northeast (defined in this poll as Tri-Cities, Maple Ridge and Pitt Meadows) . Three-in-ten residents would like to see the fuel tax 'reduced' or two-in-ten residents want it 'maintained' (22%)

ON PUBLIC INTEREST IN DECONGESTION CHARGING

- Two-thirds (67%) of residents say they **would like to know and be able to track how much they are spending** in total to move around Metro Vancouver, increasing 7% from the September baseline poll. This is higher among Burnaby and New Westminster residents
- **More residents believe it is worthwhile to study ways to make transportation pricing in this region more efficient and fair**, increasing by 6% from Phase 1
- **There is increased interest (seven in ten residents) in taking part in engagement processes and staying informed** of the conversation on mobility pricing in Metro Vancouver, particularly among North Shore residents. It was 63% in Phase 1
- **47% of residents agree that decongestion charging supports investment in future transportation and transit**, which is consistent with Phase 1. There is higher agreement from North Shore, Burnaby, and New Westminster residents and lower agreement from Northeast residents

- **The top priority for transportation investment is 'reducing driving costs** (i.e. insurance, parking fees, fuel taxes)', selected by 55% of residents as either their first or second priority. 'Improvements to transit' (41%), 'improvements to roads and bridges' (39%), and 'affordable transit fares' (35%) were runner-up priorities from the polling results

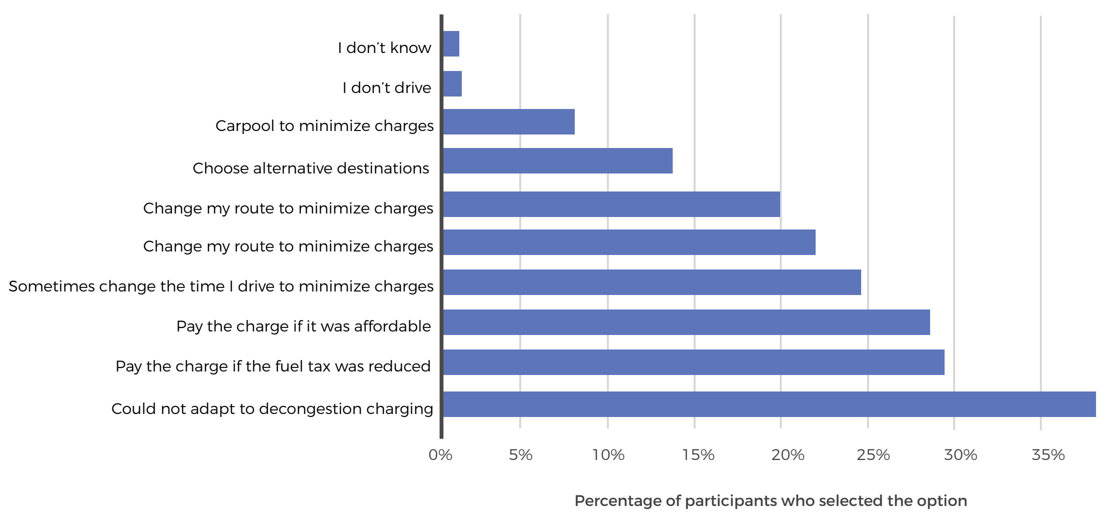
Refer to Appendix C-2 for the summary report of the spring 2018 public opinion polling.

PUBLIC RESULTS: HOW COULD YOU MAKE DECONGESTION CHARGING WORK FOR YOU?

Through the project team's research of studying other jurisdictions that have implemented decongestion charging, it was found that most people pay the charge and carry on driving, while a small number (15-20% per day) of people made some changes to their travel.

Through a closed-ended question on the online engagement platform, the project team wanted to understand what options Metro Vancouver residents consider that they have available, and their willingness to adjust if a decongestion charge was implemented. Participants were able to select more than one option, resulting in the following:

PARTICIPANT RESULTS: How could you make decongestion charging work for you?



2. On fuel taxes

Public themes

Through the online platform, the project team asked participants to rate their level of agreement with the statement: *"If decongestion charging is implemented in Metro Vancouver, I think the fuel tax should be reduced."*

Statement	Public Support Score
If decongestion charging is implemented in Metro Vancouver, I think the fuel tax should be reduced.	Medium high (63%)

WHAT DOES THIS MEAN?

On average, most participants agreed that the fuel tax should be reduced. It also received the highest level of agreement out of all responses on the online platform, however the level of agreement was quite spread across participant responses. This statement could have been interpreted by participants as a partial reduction or a full elimination of the fuel tax.

Participants who disagreed with reducing the fuel tax tended to be over 70 years old. Those with household incomes over $120,000 and males also indicated low support for reducing the fuel tax. Participants living in the District of North Vancouver and Port Moody tended to not support reducing the fuel tax. On the other hand, those in support of reducing the fuel tax tended to be residents of Maple Ridge, Port Coquitlam and the Township of Langley. Those who identify as private vehicle users indicated high support for a reduction in the fuel tax.

Refer to Appendix C-1 for the online participation demographic analysis.

WHAT IS IMPORTANT TO THE PUBLIC?

The participants' mixed views can be demonstrated by how they responded to the next question on fuel taxes: *"If decongestion charging is implemented in Metro Vancouver, would you prefer that the fuel tax is A) eliminated B) reduced or C) maintained at the current cost?"*

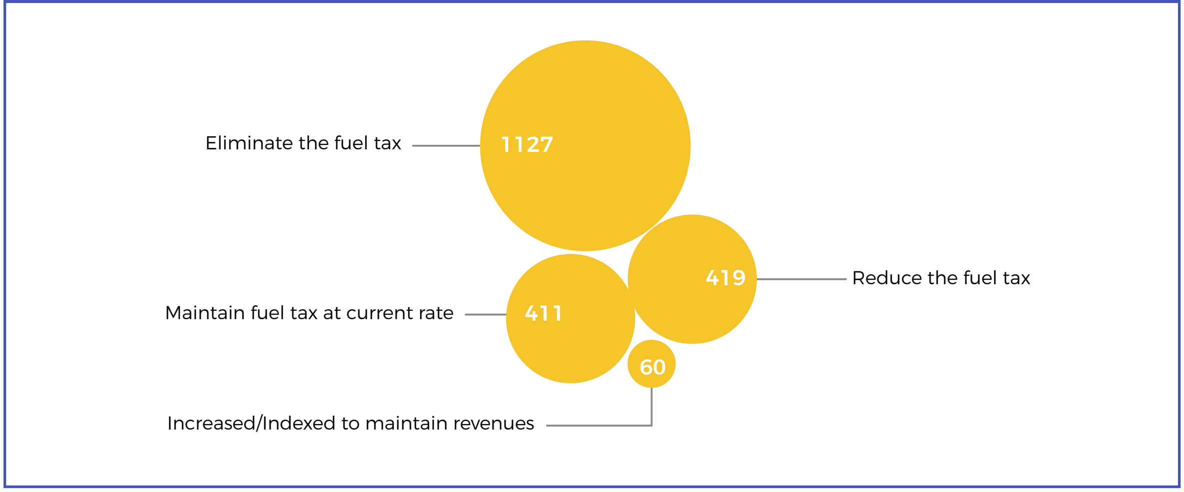
From the 2,199 public comments on fuel taxes received through the online platform, the following key themes were heard:

Note: While three options were provided in the question posed on the online engagement platform, a fourth option of 'Increasing the fuel tax' emerged from participant comments.

	ELIMINATE the fuel tax	REDUCE the fuel tax	MAINTAIN the fuel tax	INCREASE the fuel tax
Supporting comments for participant responses	• Do not want "double-dipping" • Need to cut taxes as people already pay in other forms for mobility • Already pay too many taxes	• Continues to raise funds for new infrastructure • Encourages shift to more fuel-efficient cars • Addresses two problems of reducing congestion and GHG emissions	• Already in place, so no need to take it away • Continues to raise funds for new infrastructure • Encourages shift to more fuel-efficient cars • Addresses two problems of reducing congestion and GHG emissions	• Encourages behavioural shift to other mode or transit options • More actively addresses reducing GHG emissions • Raises funds to improve and invest in new transit and transportation infrastructure

The graphic below better demonstrates the number of votes supporting each option:

Public preferences on managing the fuel tax if a decongestion charge is implemented



User Advisory Panel themes

The project team posed the three options to manage the fuel tax to UAP members. The following supporting points were discussed by members:

- **Maintaining fuel tax** offers continued investment in the transit system to be efficient and accessible
- **Eliminating the fuel tax** reduces double counting if decongestion charging revenue will serve the same purpose
- **Reducing fuel tax** supports fairness if it makes the decongestion charge more affordable and reduces double counting

Stakeholder themes

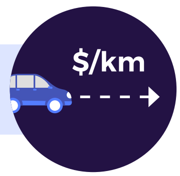
To understand stakeholders' perspectives on changing how the fuel tax is managed, the project team posed the following questions at the in-person workshops: *If decongestion charging is implemented in Metro Vancouver, what trade-offs do you see between the various fuel tax options? What are the preferences and priorities of your organization and members?*

From these questions, the project team heard the following key themes:

- Out of all stakeholder comments, **the option to maintain the fuel tax was the most polarizing** – it had the highest number of comments in favour, and also the highest number of comments in opposition
- Many responses that supported reducing or removing the tax suggested that this was conditional on some other kind of a decongestion charge being implemented
- With the options to reduce or eliminate the fuel tax, there were concerns raised about the importance of **considering the resulting environmental effects**, particularly regarding increases in the amount of vehicle emissions in Metro Vancouver
- With affordability as a recurring theme, participants raised **concerns about being taxed twice** through a combination of a fuel tax and decongestion charging

- **Equity concerns were also raised, including a perception that the fuel tax disproportionately impacts lower-income people and that wealthier people have the option to purchase more fuel-efficient vehicles**
- **The need for transparency around the fuel tax** (and any of its future changes) was a major concern for many stakeholders which swayed some responses to oppose the option to maintain it. This included questions whether gas prices would actually fall if the fuel tax were reduced or eliminated and the lack of clarity on how and where fuel tax revenues are spent
- Several responses suggested **fuel tax exemptions for private vehicle use for health reasons and/or commercial reasons** (to transport goods and services for Metro Vancouver residents)
- The relationship between the fuel tax and other modes of transportation (walking, cycling, car shares) was discussed, with responses questioning **how fuel tax revenue is and would be used to fund infrastructure for mode and transit options**

3. On distance-based charging



Public themes

Through the online platform, the project team wanted to gauge the level of support for a distance-based charge if it was designed to achieve the Commission's three objectives.

THE COMMISSION'S THREE OBJECTIVES ARE:

Reduce traffic congestion on roads and bridges across the Metro Vancouver region so people and goods can keep moving, and businesses can thrive

Promote fairness to address concerns around the previous approach to tolling some roads and bridges but not others, as well as providing affordable transportation choices

Support transportation investment to improve the current transportation system in Metro Vancouver for all users

In the online platform, the project used the key values and words emerging from the Phase 1 stakeholder and public engagement to rephrase these objectives:

- **Reducing traffic congestion** is about shorter and more predictable travel times
- **Supporting transportation investment** is about using funds transparently to improve the regional transit and transportation system
- **Promoting fairness** is about ensuring charges are affordable and providing alternative options to get around

Through these statements, the project team found there was generally a medium-low level of public support for a distance-based charge, demonstrated by the scores in the table below:

Objective	Statement	Public Support Score
Support investment	I could support distance-based charging if funds were used transparently to improve our regional transit and transportation system.	Medium low (34%)
Promote fairness	I could support distance-based charging if the fee was affordable and I had alternative options to get around.	Medium low (34%)
Reduce congestion	I could support distance-based charging if it made my travel times shorter and more predictable.	Medium low (29%)

WHAT DOES THIS MEAN?

Participants had very divergent views on a distance-based charge. There was a higher level of agreement for distance-based charging if it raised transportation investment or promoted fairness. There was generally less support for distance-based charging to reduce congestion.

Participants who indicated relatively higher levels of support for distance-based charging if it supported transportation investment, are from Coquitlam, Burnaby, Port Moody or New Westminster. Those with household incomes above $80,000 also have relatively high levels of support. This was also true for people living in households without children. On the other hand, participants from the City of Langley, Maple Ridge, and Pitt Meadows tended to be less supportive of distance-based charging if it supported transportation investment. Additionally, those who frequently or moderately drive a personal vehicle also indicated lower levels of support.

Participants with relatively higher scores in supporting distance-based charging if it promoted fairness tended to be from Port Moody, New Westminster, or Coquitlam. Those who have household incomes over $80,000 or did not have children also indicated higher levels of support. Lower levels of support tended to be from participants residing in City of Langley or Pitt Meadows and those who drive a moderate or frequent amount.

Participants indicating relatively higher scores of support for distance-based charging if it reduced congestion, tended to be from New Westminster, Port Moody, or Coquitlam, or have household incomes more than $80,000. Lower support tended to be from participants from Pitt Meadows, City of Langley, Maple Ridge, or have household incomes under $40,000. Those who also use a personal vehicle to travel moderately or frequently also indicated lower levels of support.

Refer to Appendix C-1 for the online participation demographic analysis.

WHAT IS THE PUBLIC SAYING?

The project team wanted to understand the various ways to mitigate impacts and better support the public by asking the open-ended question: "*In addition to key considerations like affordability and transportation options, what else might make Distance-Based Charging work for you?*" The project team received 1,848 public responses through the online platform.

The graphics below and on the following pages illustrate the breakdown of comments by theme as they relate to the Commission's principles of fairness, reducing congestion, and transportation investment. Additional comments that fall outside of the Commission's principles are also captured.

FAIRNESS THEMES FOR DISTANCE-BASED CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Recognize affordability concerns and feelings of being penalized	1170	• I was forced out of the city due to housing affordability and am now getting punished for living within my means • I live in the suburbs where there is no transit, I need to drive, this will punish me • Targeting people that live further away due to affordability • I need my car for work, unfair to pay • Already so expensive to live in Vancouver unfair to make it worse • The city's fault for congestion now they are asking us to pay • Already taxed so high • Not okay to affect people's freedom of movement
Improve transit and other mode infrastructure and services to provide accessible options and support implementation	784	• Improve transit first, then charge for mobility • Improve park and ride options • I would take transit more if there were incentives such as better reliability and shorter travel times • Other cities with mobility charging already have a really good transit system in place
Find ways to mitigate equity impacts on people who are senior, lower-income, and/or are differently abled	292	• This will target low income workers who depend on cars for living • System should exempt low income and disabled • Targets disabled who depend on car for livelihood and already struggle • I need to drive due to disabilities or age, unfair
Provide affordable transit fares to support fairness concerns and incentivize mode shift	56	• Fares add up when traveling across multiple zones or with a family • Offer more frequent service, efficient travel routes and improve evening, weekend and night service
Consider how and if other road users (like cyclists) will pay for decongestion charging	48	• Should have equal blanket solution for all road users • Target bicycles as well, they use the road • All road users should pay including bikers and pedestrians

CONGESTION THEMES FOR DISTANCE-BASED CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Reduce other taxes and costs people already pay for transportation to avoid "double-dipping"	430	• We already pay for decongestion in the form of fuel tax • We already pay so many taxes which are used for mobility
Study alternative ways to reduce congestion other than charging, like more efficient road use	200	• Think of alternative ways to decongest without charging people • Maximize the efficiency of the road network and infrastructure in place before charging (timing traffic lights, removing street parking during rush hour, timed bans on left turns during rush hours • Improve road infrastructure and build more bridges • Find more creative ways to decongest by maximizing current infrastructure
Reduce congestion region-wide	60	• Don't target only one area or zone • Should not redirect traffic to create new bottlenecks
Apply charges only where and when congestion is a problem, like at hot spots and/or peak hours	58	• Would prefer to pay only at problem spots • Would prefer to pay only at bridge crossings • Should only pay when congestion is a problem, during peak hours
Offer visible benefits like reduced congestion and time savings to justify charges	54	• It makes sense to pay for reduced congestion • I need to see visible benefits
Consider targeting commercial vehicles, not just private vehicles	26	• Ban all large commercial trucks during daytime or peak hours • Large heavy trucks should pay more due to causing more wear and tear on the roads

INVESTMENT THEMES FOR DISTANCE-BASED CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Address current distrust in TransLink and governments regarding how revenues have been managed and will be governed and managed	161	• TransLink and the government does not know how to manage funds • Distrust that the system will have artificially high costs to suck money out • Past mismanagement from both government and TransLink don't provide trust in managing these funds
Ensure accountable and transparent use and management of decongestion charging revenues	120	• Do not trust that the funds generated will not end up in general revenue, they should not be there • Want to see funds used to improve transit and roads • Should have clear breakdown of where funds are going • Should know where current fuel tax money is going • Want to see operation costs of the system in place • Who will manage it, we don't trust the authorities to manage it
Distribute decongestion charging benefits and revenues equitably across the region	87	• Solution should equally target all users • Funds should be used to improve transit and roads throughout the area not just specific areas • If I pay I want to see funds used to benefit where I live and what I use
Consider a simple and efficient approach in order to generate revenue	6	• Worried it will fail like the Port Mann bridge tolls • How much will it cost to implement • How much will it cost to manage it • Seems very expensive to implement and manage

OTHER THEMES FOR DISTANCE-BASED CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Ensure technology and implementation is simple, understandable	185	• Should be understandable for the public and easy to adapt to • Seems impossible to track individual driving distances • Seems technologically advanced and subject to big errors
Promote holistic planning for land use, environmental, and social benefits	158	• Promote environmental, safety and health benefits • Stop densifying urban centres as it causes congestion • Raise driving standards to get a license
Work with businesses and schools to offer support or incentives, like flexible work arrangements	86	• Incentivize businesses to have work from home options • Have different fields of work stagger operation hours • Have schools start at different times • Incentivize businesses to relocate offices to suburbs
Respect people's privacy and security	73	• How will the information be tracked and stored? • Sounds very big brother • Don't want authorities tracking my travel • How will the system monitor distance without installing tracking systems?

In addition to the themes related to fairness, reducing congestion, and transportation investment, a large number of comments from the public spoke to general opposition to a decongestion charge. Participants who generally opposed left comments such as:

- The idea to charge for decongestion is not a good idea and won't work
- Another tax grab from the government

A smaller group of participants left comments in support of a decongestion charge. Some comments that capture support included:

- Congestion is a major problem in the area, glad it is being considered
- I would pay to have my commute times reduced
- Great to start getting people out of their cars
- Good for the environment

User Advisory Panel themes

- The most frequent comments were around **access to transit and mode options** ranging from the need to provide transit options before implementation, and the benefits to improved transit options resulting from the revenue generated from decongestion charging
- **The need for simplicity was among the top themes emerging from this discussion**, where UAP members thought a multi-zone distance-based charge would be too costly to manage, vulnerable with technology failures, too complicated, and too difficult to track and plan routes
- **There were concerns expressed about affordability and being punished, particularly for people needing to travel based on their occupation. Participants also noted increased charges could also prompt behavioural changes like** deciding whether to use a car or not, moving out of high-charge areas, or potentially change jobs
- **Participants suggested the need for discounts and exemptions** for lower income residents

Stakeholder themes

To gain insight on potential impacts and glean suggestions on this decongestion charging approach, the project team posed the following questions to stakeholders: *How would your organization and its members be impacted by a distance-based charging approach and the examples of how it could be implemented in Metro Vancouver? What adjustments or considerations would make it work better?*

From these questions, the project team heard the following general themes about distance-based charging:

- Stakeholders **acknowledged the gradient of limitations and potential to tackle congestion based on the three different examples** (one zone, two zones, and multi zones). Generally high level of concern for traffic diversion for two and multi zone examples. Stakeholders felt **two, and multi zone examples could be supported on a moderate level if sufficient and accessible transit options were available and if implementation was not too complicated or threatened personal privacy**
- **Affordability and providing choices to minimize/avoid charges**: Stakeholders' main concerns were around affordability, specifically regarding residents' access to available transit options and improved transit before any decongestion charging approaches are implemented
- **Strong sense of penalization for those with lower incomes or those who have no choice but to drive**. Suggestions for caps and exemptions for seniors, businesses, truckers, non-profit meal delivery services, taxis, persons with disabilities, and low-income residents
- **Concerns about affordability regarding how mobility pricing would interact with other transportation and land use policies** (for example, Fare Review)

Stakeholders also raised a few other points in the examples of how distance-based charging could be implemented in Metro Vancouver, including:

ONE ZONE EXAMPLE

- **Moderate level of support for this example based on existing technology and ease of implementation**. Those who expressed lower levels of support highlighted the limited impacts on congestion - limitations could be curbed by adding variables such as peak travel times
- Seen as a good source of revenue if it replaced the fuel tax
- Key concerns are affordability and minimal incentive to encourage mode shift

TWO ZONE EXAMPLE

- Participants highlighted that at the core of the two, and multi zone examples are hospitals, schools, and businesses which resulted in **feeling punished for having to drive to access some of these essential services**

MULTI ZONE EXAMPLE

- Participants found this example to be very complicated, and **due to its complexity, felt this would be difficult to implement**
- At the same time, a highly targeted approach was valued to tackle congestion. **If predictable, stakeholders would moderately support this example**
- Many participants **suggested zone boundaries reflecting existing rapid transit lines** and areas where there is a high level of accessible and available transit. Stakeholders also support having more mode options available at the edges of the zones
- There was also a **high level of concern regarding traffic diversions**, and concerns regarding whether or not zones would be responsive to changes in traffic patterns

4. On congestion point charging

Public themes

Through the online platform, the project team wanted to gauge the level of support for congestion point charging if it was designed to achieve the Commission’s three objectives: reduce congestion, promote fairness, or support transportation investment. Again, these statements were phrased using the key definitions and values emerging from the Phase 1 stakeholder and public engagement.

Through the following statements, the project team found there was generally a medium low level of public support for a congestion point charging approach, demonstrated by the scores found in the table below:

Commission objective	Statement	Public Support Score
Support investment	I could support distance-based charging if funds were used transparently to improve our regional transit and transportation system.	Medium low (33%)
Promote fairness	I could support distance-based charging if the fee was affordable and I had alternative options to get around.	Medium low (34%)
Reduce congestion	I could support distance-based charging if it made my travel times shorter and more predictable.	Medium low (31%)

WHAT DOES THIS MEAN?

Participants also had divergent views on congestion point charging. There was a higher level of support for congestion point charging if it raised revenue for transportation investment or promoted fairness. Like distance-based charging, there was generally less support for congestion point charging to reduce congestion.

Participants who indicated relatively higher scores in support of congestion point charging **if funds were directed towards transportation investment** tended to be from New Westminster and Coquitlam. Participants with household incomes over $120,000 indicated similar levels of support, as did participants living in households without children and those over 55 years old. On the other hand, participants from Pitt Meadows, Maple Ridge, City of Langley tended to be less supportive. Participants who frequently drive a personal vehicle were the least supportive of congestion point charging when it comes to using funds for transportation investment.

Participants who indicated relatively higher support for congestion point charging if it **promoted fairness** reside in the City of North Vancouver or New Westminster. These participants also had household incomes of $80,000 or more. Other groups with relatively high levels of support were over 70 years old or those who live without children. Lower support tended to come from participants of City of Langley, Pitt Meadows, and Maple Ridge.

Participants who indicated relatively higher scores in supporting congestion point charging if it **reduced congestion** tended to be from the City of North Vancouver and New Westminster. Lower levels of support came from residents of Pitt Meadows, Maple Ridge, and City of Langley. Participants living in households with children or with household incomes under $80,000 also indicated lower levels of support. Lastly, participants who frequently drive expressed the lowest level of support for reducing congestion under a congestion point charge approach.

Refer to Appendix C-1 for the online participation demographic analysis.

WHAT IS THE PUBLIC SAYING?

The project team wanted to understand the various ways to mitigate impacts and better support the public by asking the open-ended question: *"In addition to key considerations like affordability and transportation options, what else might make Congestion Point Charging work for you?"* The project team received 1,632 public responses through the online platform.

The graphics on the following pages illustrate the breakdown of comments by theme as they relate to the Commission's principles of fairness, reducing congestion and transportation investment. Additional comments that fall outside of the Commission's principles are also captured.

FAIRNESS THEMES FOR CONGESTION POINT CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Recognize affordability concerns and feelings of being penalized	658	• I had to move away from the city and my work because of unaffordability I am now feeling punished • In the suburbs, I need to drive as there are no transit options • Why do I have to pay if it's not my fault for congestion (city's decision and planning) • We already pay so many taxes • It is not fair because people have to drive for work • It is not fair to affect people's freedom of movement
Improve transit and other mode infrastructure and services to provide available and accessible options before potential implementation and to absorb increased ridership	652	• Improve transit first, then charge for mobility • Improve park and ride options • I would take transit more if there were incentives such as better reliability and shorter travel times • I drive because it takes hours to travel on transit • Other cities with mobility charging already have a really good transit system in place • If you were to charge bridges that would isolate certain communities with no other mobility options (Surrey, Maple Ridge, Langley and North Vancouver (particular feelings of isolation here due to being limited to two bridges)
Find ways to mitigate equity impacts on people who are senior, lower-income, and/or are differently abled	131	• This will target lower income workers and disabled people who depend on cars for a living and already struggle • There should be exemptions for people with lower incomes or with disabilities
Consider how and if other road users (like cyclists) will pay for decongestion charging	39	• Should have equal blanket solution for all road users • Target bicycles as well, they use the road • All road users should pay including bikers and pedestrians
Provide affordable transit fares to support fairness concerns and incentivize mode shift	16	• Fares add up when traveling across multiple zones or with a family • Offer more frequent service, efficient travel routes and improve evening, weekend and night service

CONGESTION THEMES FOR CONGESTION POINT CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Reduce other taxes and costs people already pay for transportation to avoid "double-dipping"	417	• People already pay for decongestion in the form of fuel tax • People already pay for so many taxes which are used for mobility
Reduce congestion region-wide	313	• Don't target only one area or zone • Should not redirect traffic to create new bottlenecks • Should not only toll one area or specific areas • Charging certain areas could result in traffic diversions including new bottlenecks, traffic in residential areas or normally quiet areas, or could harm businesses • Consider people having to pay for short journeys if they cross a charge point or boundary
Study alternative ways to reduce congestion other than charging, like more efficient road use	286	• Think of alternative ways to decongest without charging people • Maximize the efficiency of the road network and infrastructure in place before charging (timing traffic lights, removing street parking during rush hour, timed bans on left turns during rush hours • Improve road infrastructure and build more bridges • Find more creative ways to decongest by maximizing current infrastructure
Apply charges only where and when congestion is a problem, like at hot spots and/or peak hours	170	• I am ok with charging only congestion hot spots or downtown • Should only be charged during peak hours • Should only be charged in the direction of congestion /traffic flow
Consider targeting commercial vehicles, not just private vehicles	33	• Suggestions to ban all large commercial trucks during daytime or peak hours • Suggestions that large heavy trucks should pay more as they cause greater wear and tear on the roads
Offer visible benefits like reduced congestion and time savings to justify charges	30	• I would pay to have my commute times reduced • It makes sense to pay for reduced congestion

SUPPORT INVESTMENT THEMES FOR CONGESTION POINT CHARGING

EMERGING PUBLIC THEMES	# OF COMMENTS	RECURRING COMMENTS INCLUDED WITHIN THE THEME
Address current distrust in TransLink and governments regarding how revenues have been managed and will be governed and managed	240	• Public distrust in TransLink and perception that it does not know how to manage revenues effectively • Public distrust that a decongestion charging system will have artificially high costs to generate more revenues • Past mismanagement from both government and TransLink does not provide trust in managing revenues generated
Ensure accountable and transparent use of decongestion charging revenues by demonstrating where they are going	204	• Distrust that the revenues generated from decongestion charging will be used for the stated purpose • The desire to see funds used to improve transit and roads, not for general revenue • I want to know how funds from fuel taxes are being used • Should have a clear breakdown of where generated revenues would go • People want to know who would manage the decongestion charging and the operational costs of the system
Distribute decongestion charging benefits and revenues equitably across the region	181	• Funds should be used to improve transit and roads throughout the area, not just specific areas • If I pay, I want to see funds used to benefit where I live and the services I use
Consider a simple and efficient approach in order to generate revenue	16	• Worried it will fail like the Port Mann bridge tolls • How much will it cost to implement • How much will it cost to manage • Seems very expensive to implement and manage

OTHER THEMES FOR CONGESTION POINT CHARGING		
EMERGING PUBLIC THEMES	**# OF COMMENTS**	**RECURRING COMMENTS INCLUDED WITHIN THE THEME**
Promote holistic planning approaches for land use, environmental, and social benefits	198	• Promote environmental, safety and health benefits • Stop densifying urban centres as it causes congestion • Raise driving standards to get a license
Ensure technology and implementation is simple, understandable	93	• Should be understandable for the public and easy to adapt to • Seems impossible to track individual driving distances • Seems technologically advanced and subject to big errors
Work with businesses and schools to offer support or incentives, like flexible work arrangements and start hours	81	• Incentivize businesses to offer flexible work arrangements like working from home, relocating or opening satellite offices in the suburbs, and staggered start times • Work with school boards to offer different start times
Respect people's privacy and security	7	• How will the information be tracked and stored? • How will the system monitor travel across the region without installing tracking systems?

In addition to the themes related to fairness, reducing congestion, and transportation investment, a large number of comments spoke to the general opposition of a decongestion charge. A small group of participants left comments in support of a decongestion charge in reference to a congestion point charge approach; some comments included:

- Challenges with congestion and willingness to pay for time savings
- Positive to encourage mode shifts

User Advisory Panel themes

- **Access to mode and transit options again emerged as a dominant theme in this discussion**
- Frequent affordability concerns included the boundaries of congestion point charge areas **being perceived as divisions among socioeconomic classes in Metro Vancouver**, based on who can afford to live ("elite areas") within versus outside of the charge points
- Participants observed certain examples could **create more diversion impacts** and could be costlier, and preferences were given to examples that would reduce congestion for transit users

Stakeholders themes

The project team posed the following questions to stakeholders to gain insight on potential impacts and glean suggestions on this decongestion approach:

- *How would your organization and its members be impacted by a congestion point charging approach and the examples of how it could be implemented in Metro Vancouver?*
- *What adjustments or considerations would make it work better?*

From these questions, the project team heard the following themes about the examples of how congestion point charging could be implemented:

AROUND DOWNTOWN VANCOUVER EXAMPLE

- **Low support** because the boundary is too downtown Vancouver-centric.
- Participants expressed there are some existing measures in place to deal with congestion downtown along with multiple modes of transport to choose from
- Participants expressed this example **would not address other congested areas within the city** (e.g. Broadway) or beyond, and expressed fears that this example will exacerbate congestion in other parts of the region
- Stakeholders had concerns regarding affordability, specifically feeling punished for entering the downtown core
- Stakeholders felt this example was fairer because more people are paying to use the road network
- Stakeholders would be **more supportive of this example if fairness and affordability measures were prioritized**, including exemptions and daily caps for lower-income groups and services (i.e. delivery of goods)
- **Concerns were expressed about how revenue would be distributed and managed** if only those entering Vancouver's downtown would be charged
- Through the revenue generated, stakeholders would like to see the **prioritization of accessible and available public transit that is cheaper and/or free**

AROUND THE BURRARD PENINSULA EXAMPLE

- Participants expressed a **moderate level of support for this example, stating it was a very blunt tool to deal with region-wide congestion**. Suggestions included extending boundaries to include New Westminster, Surrey, and Richmond as they host major congestion points in the region. Others suggested to include the region's congested highways and bridges. Stakeholders were **concerned about diversions that would create congestion in more localized setting**
- **Affordability was the second most dominant theme and spoke to transit and mode options as a way to mitigate. Stakeholders would like to see charges tied to the availability and accessibility of transit options**, and some suggested making transit free to alleviate congestion on roads. Participants expressed they would be more supportive if park and rides at the edge of boundaries were available. Stakeholders also stated they would need caps during non-congested times of the day

AT METRO VANCOUVER CROSSINGS EXAMPLE

- There is a moderate level of support based on ease of public understanding and **ease of implementation with clear charge points at crossings**. Participants also expressed support because this example posed fewer privacy and personal security issues
- **Lower support from a majority of stakeholders because of a perception that crossings do not address region-wide congestion**, as there would still be congested areas within urban centres and cars wouldn't be charged for travelling east and west across the region. Stakeholders thought that this **example would not incentivize shifts to alternate travel modes**. Some stakeholders were interested in having combined congestion point and distance-based charging examples to better cover other congested areas
- **Fairness was the greatest concern (particularly to the Coquitlam workshop participants). There was lower acceptability** as drivers who do not cross bridges would not be paying into the road network, and those who travel across multiple bridges would be unfairly targeted (there were many concerns about access to New Westminster). **Many expressed feelings of being punished for living in more affordable areas that would require bridge crossing(s)**
- Some stakeholders were concerned about the **balance between revenue generation and the rate of the charge**. If the rate is too low, it may not generate enough funds, but if it is too high, it will increase unaffordability. Participants expressed a **desire to see revenues from this example going back into upgrading/maintaining crossings**
- **To increase acceptability** of this example, suggestions included: **charging each crossing differently, using caps for those requiring multiple bridge crossings, providing incentives for not creating congestion, considering cost burden on seniors or those needing medical services**. Suggested caps included a maximum daily charge, bridge pass for those who make multiple trips daily, and/or monthly caps. Some felt comfortable with a $1 charge daily maximum

AT METRO VANCOUVER HOT SPOTS EXAMPLE

- **Participants had mixed views on whether this example was easy to understand, or whether it was too difficult and complex to implement**. Comments included this example being less invasive on people's privacy
- Some stakeholders found **this example fairer because more drivers would be paying into the system**. Comments stated the charges would need to be balanced to generate enough revenue for infrastructure, while considering affordability for the public
- Key fairness considerations included **participants wanting accessible, available, and affordable transit options, and mitigating the sense of punishment for having to drive past points to access health care services** (hospitals and clinics)
- Stakeholders pointed out that this **example does not address localized congestion**, and there were concerns about traffic diversion into neighbourhoods

5. On charging variables

The project team wanted to better understand preferences of only charging according to certain variables in order to better target congestion, such as time of day, day of the week, and location.

User Advisory Panel themes

The project team posed the options to apply decongestion charging only at peak hours or to congestion hot spots, and heard the following views from the User Advisory Panel:

DECONGESTION CHARGING APPLIED ONLY AT PEAK HOURS

- Consider credit for fixed child care hours
- Consider incentives for carpooling during peak hours
- Consider shifting the onus to employers/companies, including paying for employees' charges to drive downtown, and being more flexible on employee schedules and start times
- This option may be better at changing behaviours and reducing congestion than charging only at hot spots, and would only be effective if transit options are accessible and available

DECONGESTION CHARGING APPLIED ONLY AT CONGESTION HOT SPOTS

- Consider exemptions for health care locations, school zones, and neighbourhood trips
- Consider how it could be applied, whether your destination is within the hot spot or whether you're passing through the hot spot

Stakeholder themes

The project team posed the following questions to stakeholders to understand impacts and preferences on varying decongestion charges by time and location:

- *For your organization and its members, what are key considerations for a decongestion charge applied only at peak hours Monday to Friday?*
- *What about a decongestion charge applied to congestion hot spots?*

From these questions, the project team heard the following themes about charges applied only at peak hours versus only applied to congestion hot spots:

DECONGESTION CHARGING APPLIED ONLY AT PEAK HOURS

- Almost half of all comments about charging **variables identified decongestion charging applied only at peak hours as a good first step**; reasons include:
  - This option **could offer relatively more flexibility to residents** (if available) to shift schedules or modes, as mode and transit options are more available at peak hours (although less so in certain municipalities like North Vancouver)
  - This model is **easier for residents to understand** than charging only at hot spots, including how this reduces congestion and how residents can benefit (through their own movement and movement of goods)
  - It **could incentivize residents to switch modes** and reduce discretionary trips. It could also prompt businesses and employers to provide flexibility in work hours or provide bus passes
  - It could be a **starting point to raise transit investment** to support the expansion of a more comprehensive decongestion charge

- Many stakeholders pointed out that **charging only at peak hours is not comprehensive enough to meaningfully reduce congestion**, including:
  - This tool alone is an incomplete solution as it may spread congestion rather than reduce it
  - **Charging only at peak hours will limit the amount of revenue generated and may not realize the environmental and health co-benefits**
- **Peak hours may be oversimplified and should be considered more broadly**, suggestions to include weekends and dynamically varying peak hours to respond to current conditions. However, it was stressed that this must be balanced, predictable, and simple
- **Fairness concerns for those who cannot adjust travel times due to work or school schedules or required services (including health care, medical appointments, child care) only available during peak hours**. This is a particular concern from an equity perspective when lower-income employees have less influence on their working hours
- Considerations for certain commercial or service vehicles (trucks, garbage trucks, taxis who need to operate during peak hours or at congested hot spots)

DECONGESTION CHARGING APPLIED ONLY AT CONGESTION HOT SPOTS

- Special considerations or **exemptions for health care areas, schools, and commercial areas or business that provide economic benefits** (e.g. ports)
- Concerns that **this model may not reduce congestion**, with suggestions that it be combined with peak hours or be dynamic to reflect the level of congestion (so that people are not paying in a hot spot if it is not congested)
- Concerns that this approach **is more unpredictable and harder to define** than set peak hours. This added complexity could make it distracting for drivers or pose challenges in hot spots with few transit options or other modes
- Suggestions included identifying urban centres as hot spots and focusing funds from the charge on affordable housing and transportation investment

6. On paying for use versus paying for congestion

PUBLIC ENGAGEMENT RESULTS: WHICH SCENARIO DO YOU PREFER?

From researching decongestion charging theory in Phase 1, the project team found two different ways for people to pay:

- **User-pay principle:** An approach where everyone pays a little bit every time they drive, but may not have a big impact on congestion
- **User-cost principle:** An approach where only those who drive in congested areas and during busy times are charged (otherwise known as the polluter pays principle), which would have a big impact on congestion

The project team wanted to understand how the public assessed the trade-offs and pay principles. Through the online platform, the team created two scenarios and asked for the public's preference, with the following results:

Statement	Public Support Score
Scenario A (based on the User-Pay Principle) I would prefer a scenario where everyone pays a little bit every time they drive. This would mean everyone contributes to transportation investment based on how much they drive but travel times would not be noticeably reduced.	Medium low (28%)
Scenario B (based on the User-Cost Principle) I would prefer a scenario where only those people who drive in congested areas and at busy times are charged. This would mean not everyone contributes to transportation investment but travel times would be noticeably reduced.	Medium low (34%)

WHAT DOES THIS MEAN?

Online engagement results demonstrated participants' preferences for a scenario where fewer people paid and congestion was reduced than a scenario where everyone pays but congestion is relatively unaffected.

Scenario A had the lowest level of support. There were generally low scores across all demographic segments. The lowest level of support tended to be participants from City of Langley or Port Coquitlam, or those with household incomes under $40,000. Participants who identified as being frequent drivers also had low support for Scenario A.

Scenario B had a slightly higher level of support than Scenario A. Participants who indicated support for a user-cost principle tend to be residents of Port Moody or Coquitlam. Those without children and residents with incomes over $80,000 also showed a preference for this scenario. Furthermore, participants who never or rarely use a private vehicle had the highest level of support for Scenario B.

Refer to Appendix C-1 for the online participation demographic analysis.

USER ADVISORY PANEL RESULTS: WHICH SCENARIO DO YOU PREFER?

When these two scenarios were brought to the second User Advisory Panel meeting, the results matched what we heard from the public engagement, with higher support for user cost principle rather than the user pay principle.

PUBLIC OPINION POLLING RESULTS: WHICH APPROACH DO YOU PREFER?

When these two scenarios were posed to 1,000 Metro Vancouver residents from across the region through the public opinion polling, by a two-to-one margin, residents stated a preference for the user cost approach (49%) over the user pay approach (25%). Another one-quarter (26%) of residents were undecided. The preference for user pay was higher among North Shore residents.

7. On principles

Stakeholders and elected officials from all levels of government helped to shape the principles of this report. Discussions from a number of decongestion charging workshops which feed into the principles are highlighted below.

Stakeholder themes

- Plan holistically in tandem with TransLink's fare review, and regional planning and growth strategies
- The need for mode and transit options to support and absorb increased demand from residents choosing to switch modes to avoid charges
- Considerations for visitors and tourists, including how it would be confusing travelling to and within Metro Vancouver from other regions
- Reinforced principles of transparency and accountability of using funds, understandable and simple implementation, and privacy concerns
- Supporting examples that enable mode shift and encouraging transit improvements
- Suggestions to use carrots and not sticks for decongestion. Examples include working with employers to provide flexible work schedules, permission to work from home, and offering incentives to use other modes (like bus passes)
- Concerns and interest about the amount of charge and pricing structure
- Concerns about the boundaries for the distance-based charging zones or congestion points, and potential traffic diversions
- Concerns about economic impacts, such as charges being passed on to end users / customers (i.e. car share programs, taxis, truck drivers who deliver goods) and impacts on small businesses

Government elected official themes

Through conversations with elected officials from all government levels, the project team heard a number of affirming comments which reinforce stakeholder and public input and the final principles. Comments include:

- With affordability as a recurring theme, elected officials raised concerns about being taxed twice through a combination of a fuel tax and decongestion charging
- Some concern about the balance between revenue generation and the rate of the charge. If the rate is too low, it may not generate enough funds, but if it is too high it will affect affordability
- Regarding equity, there was a strong sense of penalization for those with lower incomes or those who have no choice but to drive. Caps and exemptions were suggested for certain groups such as seniors, persons with disabilities, persons travelling for medical appointments, and low-income residents
- Remarks included managing congestion by changing the way cities are planned and designed through focusing on supplying housing in transit-dense areas
- Considerations for visitors and tourists, including how it would be confusing travelling to and within Metro Vancouver from other regions
- Reinforced principles of transparency and accountability of using funds, understandable and simple implementation

- Some agreement that a distance-based charging approach with varying charges by time and location could be a more equitable option
- The risk that distance-based charging would be too complicated and difficult to implement
- Many participants suggested that if a distance-based charge were implemented, zone boundaries should reflect existing rapid transit lines and areas where there is a high level of accessible and available transit
- Moderate level of support for the Metro Vancouver Crossing example of congestion point charging based on existing public understanding and ease of implementation with clear charge points at crossings – this example would also be less problematic with regard to privacy concerns
- Some agreement in the belief that a hybrid approach combining both congestion point charging and distance-based charging would be the most effective in reducing congestion and raising revenue

8. On considerations for First Nations

In Phases 1 and 2, the project team met with the Union of BC Indian Chiefs and a few representatives from local First Nations to share information and begin understanding unique concerns and impacts of decongestion charging from an Indigenous lens. Key considerations from these conversations are noted here within this investigation phase and should be used to inform and scope future phases of research and engagement:

- **Services are not available on reserve and in rural communities:** Resources available to support First Nations, including transportation, health, and cultural services, are primarily located in the City of Vancouver. A decongestion charge could impact the communities' ability to access these resources, particularly as the larger urban Indigenous population is in Surrey or in rural communities
- **Limited mode options for communities:** Transit services can be limited in the evenings or even unavailable (including HandyDart), taxis are not an affordable option, and car sharing options do not service certain reserves and communities
- **Road network is situated on unceded Indigenous land:** Recognizing land title and First Nations people as the original owners of land and roads, it should be considered if and how it would be appropriate to apply a decongestion charge
- **Equitable cost and benefit distribution:** With transit and mode services not serving Indigenous communities, yet these communities bearing health impacts and costs from congestion and pollution, it should be considered how First Nations pay and receive benefits from decongestion charging
- **Existing engagement on transportation with First Nations is perceived to have been inadequate:** Concern that there has not been meaningful engagement on transportation projects or issues by TransLink and other authorities, so there is a need to approach future engagement differently

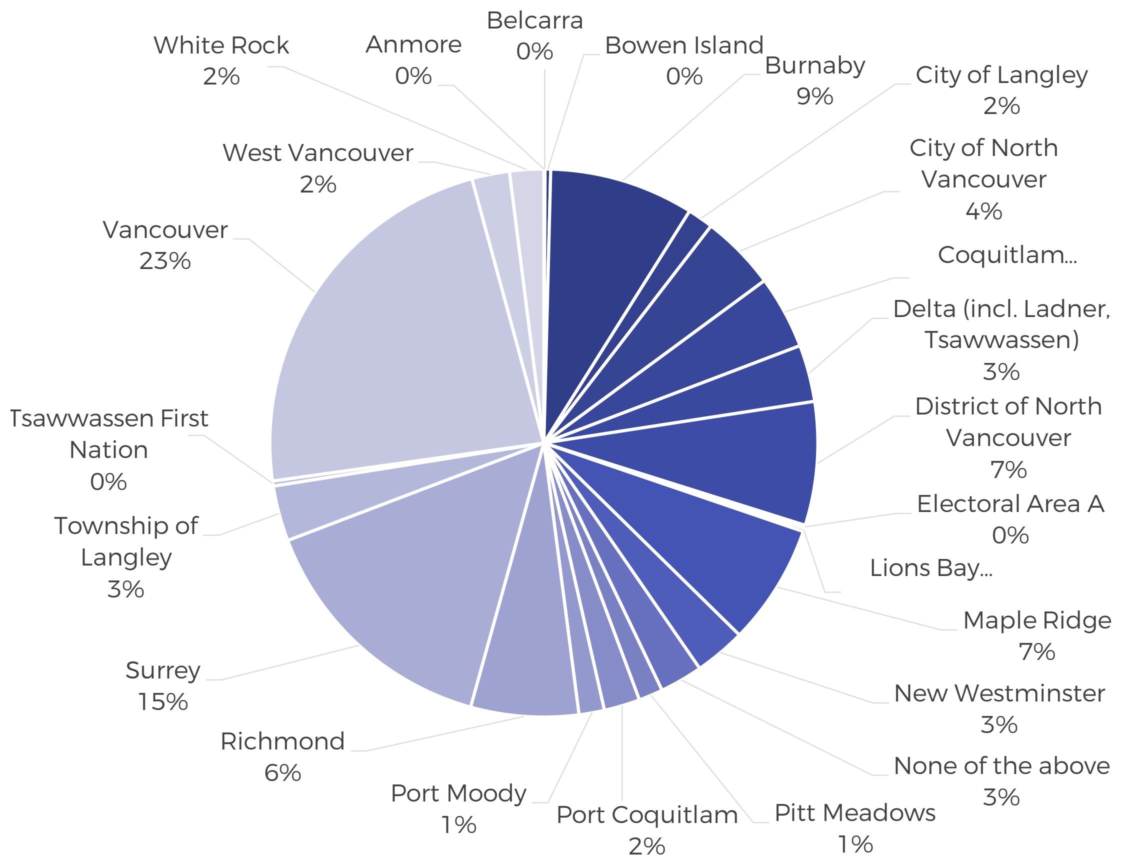
APPENDIX C-1. PARTICIPATION BREAKDOWN

Public online participation

The following figures show the breakdown of participant demographics from people who elected to provide their data through multiple choice questions on the online engagement platform.

Figures marked with an asterisk* reflect questions that allowed participants to select multiple responses. Figures without an asterisk directed participants to respond by selecting one response.

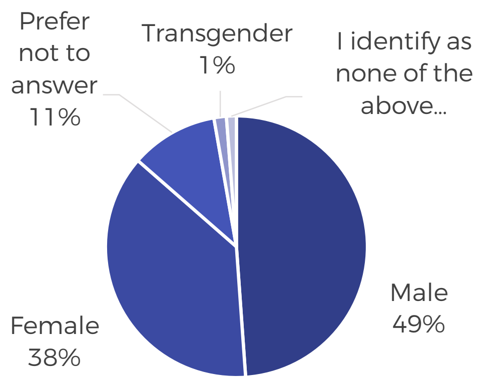
Participant Breakdown: Where in Vancouver do you live?



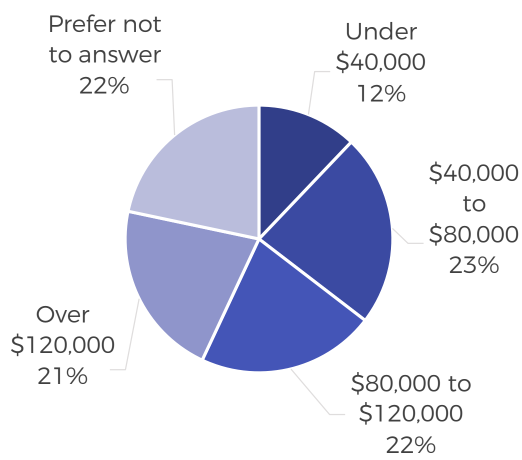
Note: Residents from Anmore, Belcarra, Bowen Island, Lions Bay, and Tsawwassen First Nation participated in the online engagement; however, the participant breakdown does not capture percentages less than 1%.

The project team targeted municipalities that were underrepresented in the first phase of engagement. Through targeted digital advertising and in-person outreach efforts, the project team increased participation in Burnaby (+3 percentage points), Richmond (+2 percentage points), and Maple Ridge (+3 percentage points). While a targeted approach was used to increase responses, certain municipalities were underrepresented when compared to the total population. Vancouver, Surrey, Burnaby and Richmond were somewhat underrepresented, whilst the District of North Vancouver and Maple Ridge were overrepresented.

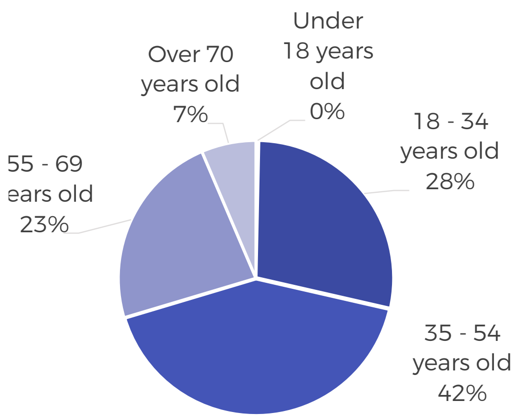
Participant Breakdown: What is your gender identity?



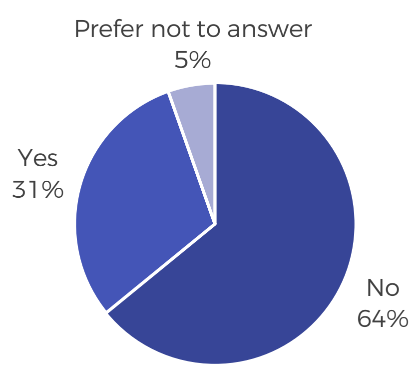
Participant Breakdown: What is your total household income before taxes?



Participant Breakdown: How old are you?



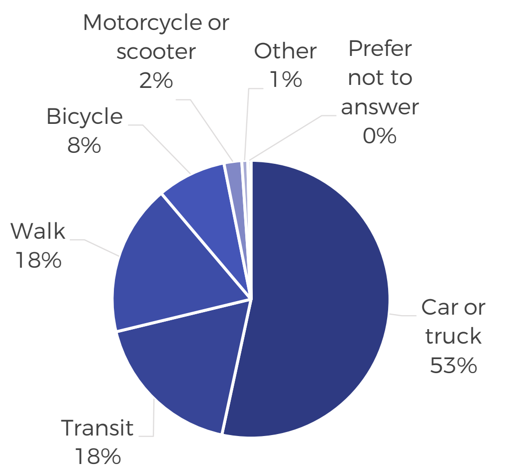
Participant Breakdown: Do you have any children under 18 at home?



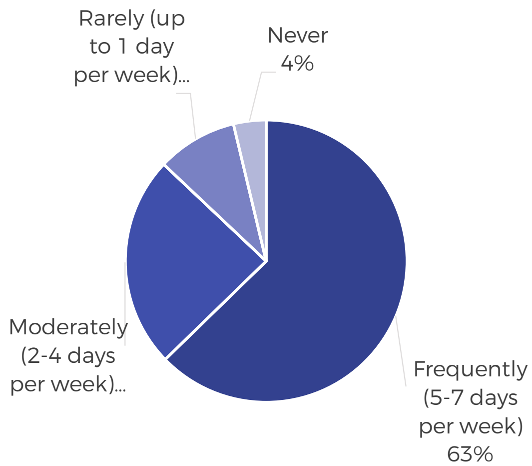
Participant Breakdown: What is your cultural identity or background?*

African	1%	East Asian	1%	Persian	1%
American	2%	East Indian	2%	Russian	1%
Arabic/Middle Eastern	1%	Eastern European	3%	South Asian	1%
Canadian	60%	Indigenous	3%	South East Asian	2%
Carribean	1%	Latin American	2%	Western European	15%
Chinese	6%	Other	3%	Prefer not to answer	16%

Participant Breakdown: What mode(s) of transport do you use most during the week?



Participant Breakdown: How often do you drive a personal vehicle during the week?



APPENDIX C

Public support scores based on demographics

A total of 8,646 online engagement participants completed demographic questions in both the paper and online platforms across all languages. The table below illustrates the Public Support Scores broken down by age, location of residence, gender, number of children, income, and frequency of personal vehicle use.

The row labelled as 'range' indicates the lower and upper values for each of the nine close-ended questions posed to participants. To show variations in the Public Support Scores based on demographics, the table below has been colour-coded. Relatively higher support is denoted in yellow using a gradient, and low support is denoted in blue using a gradient.

Public support score by demographic

		Support	Could support distance-based charging			Could support congestion point charging			Preference	
		Fuel tax reduction	If better travel times	If fee ok with options	If funding transparent	If better travel times	If fee ok with options	If funding transparent	All contribute	Drivers contribute
	Range	47 - 78%	23 - 38%	27 - 42%	27 - 41%	20 - 36%	23 - 42%	22 - 43%	19 - 33%	26 - 40%
	All participants	63%	31%	34%	33%	29%	34%	34%	28%	34%
Age	18 - 34 years old	62%	31%	34%	34%	27%	32%	32%	26%	34%
	35 - 54 years old	61%	31%	34%	33%	28%	33%	33%	29%	33%
	55 - 69 years old	64%	31%	35%	35%	31%	35%	36%	29%	36%
	Over 70 years old	50%	31%	35%	35%	33%	39%	40%	30%	38%
Location	Burnaby	69%	31%	34%	34%	29%	33%	33%	28%	34%
	City of Langley	72%	25%	27%	28%	21%	23%	25%	19%	31%
	City of North Vancouver	63%	30%	32%	33%	32%	35%	35%	28%	34%
	Coquitlam	73%	35%	37%	36%	30%	34%	34%	29%	36%
	Delta (incl. Ladner, Tsawwassen)	70%	29%	34%	31%	26%	32%	31%	28%	32%
	District of North Vancouver	59%	29%	32%	31%	29%	33%	34%	29%	32%
	Maple Ridge	78%	26%	30%	29%	20%	26%	25%	25%	29%
	New Westminster	55%	33%	37%	38%	34%	38%	38%	31%	35%
	Pitt Meadows	74%	23%	28%	27%	20%	23%	22%	27%	26%
	Port Coquitlam	78%	30%	31%	30%	25%	27%	28%	23%	30%
	Port Moody	57%	35%	37%	34%	30%	32%	32%	28%	37%
	Richmond	73%	31%	34%	33%	28%	33%	34%	27%	33%
	Surrey	72%	30%	34%	34%	25%	31%	32%	27%	34%
	Township of Langley	74%	29%	33%	33%	23%	29%	29%	25%	33%
	Tsawwassen First Nation	47%	36%	39%	40%	36%	42%	43%	32%	40%
	Vancouver	61%	28%	31%	31%	28%	30%	31%	26%	32%
	West Vancouver	61%	28%	31%	31%	28%	30%	31%	26%	32%
	White Rock	73%	27%	31%	32%	24%	31%	32%	27%	32%
Gender	Male	57%	33%	35%	35%	29%	34%	34%	28%	36%
	Female	67%	33%	37%	37%	30%	36%	36%	31%	37%
Children	No	61%	33%	37%	36%	30%	36%	36%	30%	37%
	Yes	63%	30%	32%	32%	26%	31%	30%	27%	32%
Income	Under $40,000	61%	28%	30%	31%	26%	30%	30%	25%	33%
	$40,000 to $80,000	66%	30%	33%	33%	27%	32%	33%	27%	33%
	$80,000 to $120,000	60%	35%	40%	39%	31%	37%	37%	32%	38%
	Over $120,000	54%	38%	42%	41%	34%	40%	40%	33%	39%
Personal Vehicle Use	Never	38%	50%	58%	63%	48%	61%	69%	44%	54%
	Rarely	44%	47%	53%	53%	46%	56%	58%	38%	52%
	Moderately	55%	34%	39%	38%	33%	39%	39%	31%	40%
	Frequently	74%	27%	30%	30%	24%	29%	29%	25%	30%

Legend

High level of support

Low level of support

Stakeholder participation

Representatives from the following organizations were invited to attend one of the two in-person stakeholder workshops held during phase two in Vancouver and Coquitlam. Organizations that sent representatives are listed in blue. The project team cannot list individual names due to privacy concerns.

- Automobile Retailers Association
- BC Automotive Dealers Association
- BC Chamber of Commerce
- BC Civil Liberties Association (BCCLA)
- BC Taxi Association
- BC Trucking Association
- BCCPD (Disability Alliance of BC)
- Better Environmentally Sound Transportation (BEST)
- Greater Vancouver Board of Trade
- Bowen Island Municipality
- Burnaby Board of Trade
- Burnaby Neighbourhood House
- Canadian Centre For Policy Alternatives (CCPA)
- Canadian Taxpayers Federation
- City of Burnaby
- City of Coquitlam
- City of Coquitlam Transportation Division
- City of New Westminster
- City of Surrey
- City of Vancouver Seniors' Advisory Committee
- CityHive
- Delta Chamber of Commerce
- Developmental Disabilities Association
- Douglas College Students' Union
- Dutil
- Fraser Surrey Docks LP
- Gastown BIA
- Greater Vancouver Board of Trade
- Greater Vancouver Gateway Council
- Guilt and Company
- Handydart Riders Alliance
- HUB Cycling
- Kwantlen Student Association
- Langley Adult Day Program
- Langley Chamber of Commerce
- Maple Ridge Active Transportation Advisory Committee
- MODO
- MoveUP
- North Shore Disability Resource Centre
- Simon Fraser University
- Simon Fraser University Urban Studies
- Surrey Board of Trade
- The BC Cycling Coalition
- Tri-Cities Chamber of Commerce
- United Way
- Urban Development Institute
- Vancouver City Planning Commission
- Voices of Burnaby Advocate
- West End Seniors' Network Society
- Yellow Cab

- 411 Seniors Centre Society
- ACORN
- Affiliation of Multicultural Societies and Service Agencies of BC (AMSSA)
- Alzheimer Society of BC
- Amalgamated Transit Union (ATU)
- Amyotrophic Lateral Sclerosis (ALS) Society of BC
- Association of Community Organization for Reform Now
- Association of Neighbourhood Houses BC
- BC Blind Sports
- BC Business Council (Business Council of BC)
- BC Cancer
- BC Centre For Ability
- BC Coalition of People with Disabilities
- BC Council for Families
- BC Council of Film Unions
- BC Epilepsy
- BC Federation of Labour
- BC Ferries
- BC Hydro
- BC Institute of Technology
- BC Lung
- BC Marine Terminals Association
- BC People First
- BC Poverty Reduction Coalition
- BC Rail
- BCAA
- BCIT Transportation Department
- Black Top Cabs
- BNSF Railway
- Boothroyd Communications
- Boston Consulting
- Bowen Island Health Resource Centre
- Bowen Island Municipality Advisory Committee
- Bridges to The Future and Musclefacts Youth Program
- British Columbia Rapid Transit Company - Canadian Union of Public Employee (CUPE) 7000
- Building Owners and Managers Association (BOMA)
- Burnaby Association for Community Inclusion - Advocacy Committee
- Burnaby Community Services
- Burnaby Family Life
- Burnaby Fire Department
- Burnaby School District SD41
- Burnaby Seniors Planning Table
- Business Council of BC
- Cambie Village
- Canada Post
- Canadian Deafblind Association (BC Chapter)
- Canadian Federation of Students
- Canadian International Freight Forwarders
- Canadian Manufacturers and Exporters Association (CME)
- Canadian Mortgage and Housing Corporation (CMHC)
- CNIB (Canadian National Institute for the Blind)
- Canadian Union of Public Employees
- Capilano University
- Car2Go
- Cascadia Society for Social Working

- Chamber of Shipping (COS) of British Columbia
- Chinese Benevolent Association (CBA)
- Chinese Cultural Centre of Greater Vancouver
- Citizens for Accessible Neighbourhoods
- City Centre Community Policing Centre
- City of Burnaby Social Issues Committee
- City of Coquitlam Universal Access
- City of Langley Engineering Operations Department
- City of Maple Ridge
- City of New Westminster Seniors Advisory Committee
- City of North Vancouver Integrated Transportation Committee
- City of Pitt Meadows Engineering and Operations Department
- City of Port Coquitlam Transportation Solutions and Public Works Committee
- City of Port Moody Community Care Committee
- City of Port Moody Community Planning and Advisory Committee
- City of Richmond Public Works and Transportation Committee
- City of Richmond Seniors Advisory Committee
- City of Surrey Social Planning Advisory Committee
- City of Surrey Transportation & Infrastructure Committee
- City of Vancouver
- City of Vancouver Persons with Disabilities Accessibility Advisory Committee
- Cloverdale Chamber of Commerce
- CME
- Coast Mental Health
- Coast Mountain Bus Company - Canadian Union of Public Employees (CUPE) Local 4500
- Collingwood Community Policing Centre
- Columbia College
- Commercial Drive Business Improvement Association
- Community Integration Services Society
- Community Living BC - Burnaby/Port Moody
- Community Living Society
- Community Poverty Reduction Initiative
- Connections
- Coquitlam Fire Department
- Coquitlam RCMP
- Council of Senior Citizens Organizations of BC (COSCO)
- Council of Tourism Associations
- David Suzuki Foundation
- Deafblind Services Society
- Delta Community Living Society
- Delta Seniors Advisory Committee
- Delta Seniors Community Planning Table
- Delta View Crossroads Habilitation Center

- District of North Vancouver Transportation Planning Advisory Committee
- District of West Vancouver
- District of West Vancouver Design Review Committee
- Downtown Surrey Business Improvement Association
- Downtown Vancouver Business Improvement Association
- Dunbar Village Business Improvement Association
- Electoral A Regional Planning Committee
- Evo
- Families of Mentally Handicapped Adults Society
- Family Gathering Place
- Family Services of Greater Vancouver
- Filipino Association in BC (FABC)
- Fraser Basin Council
- Fraser Health Authority
- Fraser River Industrial Association
- Fraser Street Business Improvement Association
- Fraser Valley Regional District
- Fraserside Community Services Society
- Generation Squeeze
- Global Container Terminals Canada
- Gordon Neighbourhood House
- Greater Vancouver Board of Trade: Regional Transportation Committee
- Greater Vancouver Community Services Society
- Greater Vancouver Community Services Society
- Green Peace
- Hastings Crossing Business Improvement Association
- Hastings North Business Improvement Association
- Hawthorne Tower
- Health Employees Union
- Health Employers Association Of BC
- Immigration Services Society of BC
- Inclusion BC
- India Cultural Centre of Canada
- India Mahila Association
- Indo-Canadian Cultural Association
- Indo-Canadian Friendship Society of B.C.
- International Council of Shopping Centres
- Katzie Seniors Network
- Kennedy Seniors Recreation Centre
- Kidney Foundation of Canada
- Kinsmen Retirement Centre, Kin Village
- KinVillage
- Kitsilano Business Improvement Association
- Kwantlen
- Kwantlen University College
- Langara College
- Langley Association for Community Living
- Langley Business Improvement Association
- Langley Pos-Abilities Society
- Langley RCMP
- Langley Seniors Community Action Table
- Langley Seniors Resource Society

- L'Chaim Adult Day Centre
- Learning Disabilities Association Of BC
- Life Skills Centre
- Lions Bay Fire Rescue
- Lionsview Seniors Planning Society
- Little Mountain Neighbourhood House
- MacLure's Cab
- Mainstream Association for Proactive Community Living
- Maple Ridge and Pitt Meadows Municipal Advisory Committee on Accessibility Issues
- Maple Ridge Pitt Meadows Chamber of Commerce
- Marpole Business Improvement Association
- Mckee Seniors Recreation Centre
- Metro Vancouver Alliance
- Metro Vancouver Cross-Cultural Seniors Network
- Milieu Family Services
- MOSAIC
- Multiple Sclerosis Society of BC
- MVT Canadian Bus Inc
- National Association of Industrial and Officer Properties (NAIOP)
- New Car Dealers Association of BC
- New Roots/West End ADC Society
- New Westminster Advisory Planning Commission
- New Westminster Business Improvement Association
- New Westminster Chamber of Commerce
- New Westminster Multicultural Society
- Newton Community Renal Unit
- North Shore Connexions Society
- North Shore Disability Resource Centre Association
- North Shore Multicultural Society
- North Vancouver Fire
- North Vancouver Police
- NVC - ITC
- Pacific Developmental Pathways
- Pacific NorthWest LNG
- Panorama Community Dialysis Centre
- Partnerships BC
- Paul Davis Greater Vancouver
- Persons with Disabilities Advisory Committee - City of Vancouver Council
- Philippine Women Centre of BC
- PICS Adult Day Program
- Planned Lifetime Advocacy Network (PLAN)
- Point Grey Village Business Improvement Association
- Port Coquitlam Fire
- Port Coquitlam Police
- Port Metro Vancouver
- PosAbilities
- Progressive Indo-Canadian Community Services
- Progressive Intercultural Community Services Society
- Providence Health Care
- Residences for Independent Living
- Richmond Chamber of Commerce
- Richmond Kinsmen Adult Day Center
- Richmond Multicultural Concerns Society

- Richmond Poverty Response Committee - Transportation Task Force
- Richmond Society for Community Living
- Richmond/East Vancouver Community Dialysis Units
- Ridge Meadows Assn for Community Living
- Ridge Meadows Chamber
- Ridge Meadows Police
- Robson Street Business Improvement Association
- Royal Columbian Hospital
- Semiahmoo Peninsula Seniors Community Planning Table
- Seniors Community Planning Table
- Seniors in The Communities Committee - North Shore
- Seniors Services Society
- Share Family and Community Services Society
- Sierra Club of BC
- Silver Harbour Seniors' Activity Centre
- Simon Fraser Society for Community Living
- SN Transport Ltd.
- Social Planning and Research Council (SPARC BC)
- Sources - Disability Advocacy Program
- South Burnaby Neighbourhood House
- South Granville Business Improvement Association
- South Vancouver Neighbourhood House
- South Vancouver Seniors HUB Council
- Spectrum Society for Community Living
- Spinal Cord Injury Associaton (BCPA)
- St. Paul's Hospital
- Stile Brands
- Strathcona Business Improvement Association
- Strathcona Community Centre
- SUCCESS
- SUCCESS Multi Level Care Society
- Sunset Community Centre
- Surrey Access for All Committee
- Surrey Association for Community Living
- Surrey Memorial Hospital
- Surrey Planning Table
- Surrey Poverty Reduction Coalition
- Surrey RCMP
- Surrey Seniors Community Planning Table
- The Cerebral Palsy Association of BC
- The Corporation of Delta Community Planning Advisory Committee
- Tourism Vancouver
- Township of Langley Planning and Development Department
- Tsawwassen Business Improvement Association
- UBC - Student Alma Mater Society
- UBC Civil Engineering Program
- Unifor
- UNIFOR - Vancouver Container Truckers' Association
- United Food and Commercial Workers (UFCW)
- UniverCity Trust
- University of British Columbia
- Urban Arts Architecture

- Vancouver and North Shore Community Dialysis
- Vancouver Chinatown Business Improvement Association
- Vancouver Coastal Health Authority
- Vancouver Community College
- Vancouver Foundation
- Vancouver Police
- Vancouver Seniors Advisory Committee
- Vancouver Taxi
- Victoria Drive Business Improvement Association
- Village of Anmore Advisory Planning Commission
- Village of Belcarra Public Works & Planning Committee
- Village of Lions Bay Public Works Department
- West Broadway Business Improvement Association
- West End Business Improvement Association
- West End Senior Advisory Committee
- West Vancouver Fire Department
- WESTAC
- Westbank Corp
- White Rock Business Improvement Association
- White Rock Seniors Come Share Society
- Wilson Centre Seniors' Advisory Association
- Yaletown Business Improvement Association
- YVR - Greater Vancouver Airport Authority
- Zip Car

APPENDIX C-2. SUMMARY REPORTS

This section contains the summary reports from the project team's engagement activities:

a. Public opinion polling March 2018 results
b. Public engagement results
c. Stakeholder workshops
d. User Advisory Panel workshop
e. Elected official workshop

A. Public opinion polling

This summary report was prepared by Ipsos based on results from the March 2018 public opinion polling.

Prompted Frustrations Moving Around Metro Vancouver

- Congestion is the biggest prompted frustration of moving around in Metro Vancouver. More than eight-in-ten (85%) residents say 'delays caused by high traffic volumes' make them feel 'a great deal' or 'some' frustration. The second tier of frustrations include 'unpredictability of travel times' (74%), 'condition of roads' (72%), 'crowding on transit' (71%) and 'transportation costs/affordability' (70%).
  - The largest gap by age is that younger residents are more likely than others to be frustrated by 'crowding on transit' (+8 points vs. overall).
  - The largest regional gaps occur among residents of Burnaby/New Westminster and the North Shore.
    - Burnaby/New Westminster residents are more frustrated by 'transportation costs/affordability' (+9 points vs. overall), 'crowding on transit' (+8 points vs. overall) and 'unpredictability of travel times' (+8 points vs. overall).
    - North Shore residents are more frustrated by 'bike path network and safety' (+9 points vs. overall), 'delays caused by crashes' (+9 points vs. overall) and 'delays caused by high traffic volumes' (+8 points vs. overall).
- Compared to the September 2017 baseline survey, frustration has increased by 7 percentage points with the 'condition of roads', but has decreased for both 'unpredictability of travel times' (down 6 points) and 'delays caused by high traffic volumes' (down 4 points).

Weekly Time Lost from Frustrations

- Eight-in-ten (82%) Metro Vancouver residents say their transportation frustrations cost them at least some time each week. The median time lost is just less than an hour (about 50 minutes) and about four-in-ten (39%) say they lose an hour or more each week.
  - Those most likely to lose an hour or more each week include Burnaby/New Westminster residents (+9 points vs. overall) and those under the age of 55 years (+8 points vs. overall).
- Time lost is down compared to the September 2017 baseline survey. Those losing an hour or more each week is down 5 percentage points and the median time lost is down 7 minutes.

Weekly Cost of Frustrations

- Six-in-ten (61%) residents say their transportation frustrations have a real cost for them in money each week in terms of transportation costs and lost wages/productivity. The median loss per week is roughly $13 and three-in-ten (29%) say they lose more than $25 in a typical week.
  - Those most likely to say their frustrations cost them more than $25 a week include Northeast residents (+9 points vs. overall) and those under the age of 55 years (+8 points vs. overall).
- These results are mostly consistent with the September 2017 baseline survey, although the median estimated loss per week is down $4 from the baseline.

Negative Impacts of Frustrations

- Slightly more than four-in-ten (43%) residents say that their transportation frustrations have either a 'major' (11%) or 'moderate' (32%) negative impact on their 'own quality of life'. Residents are more likely to say the transportation frustrations have a negative impact (major or moderate) on broader concerns such as 'the overall quality of life for Metro Vancouverites' (64% negative), 'the local environment' (59% negative) and 'the region's economy' (53% negative).
  - Differences by age, region and gender are not substantial.
- All of these results are consistent with the September 2017 baseline survey.

Awareness of Mobility Pricing and Commission

- Three-in-ten (30%) residents say they have heard of 'the concept of mobility pricing'. About half as many residents (15%) say they have heard of 'The Mobility Pricing Independent Commission'.
  - Awareness of 'the concept of mobility pricing' is higher among Burnaby/New Westminster residents (+11 points vs. overall) and men (+8 points vs. overall).
  - Awareness of 'The Mobility Pricing Independent Commission' is higher among North Shore residents (+8 points vs. overall).
- These results are consistent with the September 2017 baseline survey.

Awareness of Other Terms

- Three-in-ten (31%) residents say they have heard of 'the concept of distance-based charging'. Recall is much lower for terms such as 'the concept of decongestion charging' (14%), 'the concept of congestion point charging' (13%) and 'the *It's Time* project' (7%).
  - Awareness of 'the concept of distance-based charging' is higher among Burnaby/New Westminster residents (+10 points vs. overall).

Support for Mobility Pricing

- Overall impressions of the concept of mobility pricing are split, with many residents still neutral or undecided. Overall, about one-third (33%) of residents say they support the concept mobility pricing in Metro Vancouver (7% 'strongly', 26% 'somewhat') compared to about one-quarter (27%) who oppose mobility pricing (15% 'strongly', 12% 'somewhat'). The largest portion of residents (40%) say they 'neither support nor oppose' mobility pricing (28%) or 'don't know' (12%).
  - Support for mobility pricing is higher among younger residents (+9 points vs. overall) and Burnaby/New Westminster residents (+8 points vs. overall).
  - Opposition to mobility pricing is higher among Northeast residents (+10 points vs. overall).

Support for Decongestion Pricing

- Overall impressions of the concept of decongestion pricing are even more equally split, with one-third (34%) of residents supporting decongestion charging (10 'strongly', 25% 'somewhat') and one-third (34%) opposed to decongestion charging (18% 'strongly', 16% 'somewhat'). Another one-third residents (32%) say they 'neither support nor oppose' decongestion charging (25%) or 'don't know' (7%).
  - Support for decongestion charging is higher among North Shore residents (+13 points vs. overall).
- The top perceived benefits of decongestion charging in Metro Vancouver (asked on an open-ended basis) include 'less traffic/improved flow' (20%), 'encouraging alternative modes such as transit/cycling' (7%), 'reduced travel times' (6%), 'fewer vehicles on the road' (5%) and 'less pollution/more eco-friendly/better air quality' (5%).
- The top concerns about decongestion charging in Metro Vancouver (asked on an open-ended basis) include 'the cost/expensive per use' (17%), 'increased taxes' (8%), 'adding to an already high cost of living' (7%) and 'not benefiting people with lower incomes' (6%).

Preferred Decongestion Charging Approach

- Survey respondents were asked which of two approaches to decongestion charging they would prefer for Metro Vancouver.
  - **Congestion point charging:** An approach where only those people who drive in congested areas and at busy times are charged, which would have a larger impact on decongestion, but not everyone contributes to transportation investment.
  - **Distance-based charging:** An approach where everyone pays a little bit every time they drive, which could have a smaller impact on decongestion, but everyone contributes to transportation investment.
- By a two-to-one margin, residents prefer the approach of **congestion point charging** (49%) to the approach of **distance-based charging** (25%). Another one-quarter (26%) of residents are undecided.
  - A preference for congestion point charging is higher among North Shore residents (+10 points vs. overall).

Using New Decongestion Charging Revenues

- Survey respondents were informed that decongestion charging could generate revenues for transportation investment while reducing congestion. They were then asked to pick their top two priorities for using this new revenue from a list of 6 options.
- The top priority is 'reducing driving costs (i.e. insurance, parking fees, fuel taxes)', which was selected by 55% of residents as either their first or second priority. Three second tier priorities include 'improvements to transit' (41%), 'improvements to roads and bridges' (39%) and 'affordable transit fares' (35%). The two lesser priorities are 'addressing transportation pollution' (13%) and 'better walking and cycling options' (12%).
  - 'Reducing driving costs' is more likely to be selected by Northeast residents (+17 points vs, overall).
  - 'Improvements to transit' is more likely to be selected by Vancouver residents (+10 points vs. overall).
  - 'Improvements to roads and bridges' is more likely to be selected by South of Fraser residents (+8 points vs. overall).
  - 'Affordable transit fares' is more likely to be selected by Vancouver residents (+10 points vs. overall) and younger residents (+8 points vs. overall).
  - 'Addressing transportation pollution' is more likely to be selected by North Shore residents (+10 points vs. overall).

Preferred Change to Fuel Tax with Decongestion Charging

- Metro Vancouver residents have differing perspectives on what should happen to the existing fuel tax if decongestion charging is implemented. The largest proportion of residents say they would like to see the fuel tax 'eliminated' (36%). Significant numbers of residents say they would like to see the fuel tax 'reduced' (30%) or 'maintained' (22%). Only 4% want the fuel tax 'increased' while one-in-ten (9%) are undecided.
  - Overall, two-thirds (66%) of residents want to see the fuel tax 'eliminated' or 'reduced'. This viewpoint is especially strong among Northeast residents (+11 points vs. overall).
  - About one-quarter (26%) prefer to see the fuel tax 'maintained' or 'increased'. This viewpoint is highest among North Shore residents (+13 points vs. overall).
- Among the two-thirds wanting to see the fuel tax 'eliminated' or 'reduced', the top open-ended reasons include 'wanting to lower cost of fuel/make gas more affordable' (19%), 'preferring not to be taxed/sounds like another tax' (19%), 'wanting the cost to be affordable for drivers/everyone' (12%) and 'preferring a single tax/should not be double taxed' (10%).

Port Mann/Golden Ears Trips

- Nearly half (45%) of residents say they crossed either the Port Mann or Golden Ears bridges at least one day a month when they were tolled (excluding transit).
  - Residents of Northeast (+27 points vs. overall) and South of Fraser (+10 points vs overall) are the most likely to have made at least one trip over these bridges per month when they were tolled.
- Nearly seven-in-ten (68%) residents say they have not changed the way they get around since the tolls on the Port Mann and Golden Ears bridges were removed. The biggest changes in behavior have been residents using these two bridges more often (18%) and using transit more often (8%).
  - Northeast residents (+10 points vs. overall) are the most likely to say they are using the two bridges more often.

Agreement with Decongestion Charging Statements

- Survey respondents were asked to agree or disagree with four different statements about decongestion charging.
  - A slim majority (52%) of residents agree that '**decongestion charging could be more fair by paying for what I use**' (19% disagree, 29% neutral/no opinion). Agreement with this statement is consistent with the September 2017 baseline survey when it was asked in relation to 'mobility pricing'.
    - Agreement is higher among North Shore residents (+14 points vs. overall). Agreement is lower among Vancouver residents (-8 points vs. overall).
  - Nearly half (47%) of residents agree that '**decongestion charging supports investment in our future transportation and transit**' (20% disagree, 34% neutral/no opinion). Agreement with this statement is consistent with the September 2017 baseline survey when it was asked in relation to 'mobility pricing'.
    - Agreement is higher among North Shore residents (+10 points vs. overall) and Burnaby/New Westminster residents (+10 points vs. overall). Agreement is lower among Northeast residents (-10 points vs. overall).
  - Four-in-ten residents (40%) agree that '**decongestion charging could make getting around more affordable for me, in that I'll pay for what I use**' (30% disagree, 31% neutral/no opinion). Agreement with this statement is down 7 points from the September 2017 baseline survey when it was asked in relation to 'mobility pricing'.
    - Agreement is higher among North Shore residents (+16 points vs. overall). Agreement is lower among Vancouver residents (-9 points vs. overall).

- Four-in-ten residents (38%) agree that '**I would be willing to pay some amount of money to have less road congestion**' (35% disagree, 28% neutral/no opinion). Agreement with this statement is down 5 points from the September 2017 baseline survey when it was asked in the context of thinking about 'mobility pricing'.
  - Agreement is higher among North Shore residents (+12 points vs. overall) and Burnaby/New Westminster residents (+10 points vs. overall). Agreement is lower among Vancouver residents (-9 points vs. overall) and Northeast residents (-8 points vs. overall).

Drivers to Consider for Discounts/Exemptions

- Survey respondents were asked which of four groups they think should be considered for discounts or exemptions for decongestion charging.
- More than six-in-ten say they support considering discounts or exemptions for both 'people with lower incomes, such as marginalized groups, seniors, students' (63%) and 'people who operate service or emergency vehicles' (63%). A slight majority also support consideration for 'people with certain medical needs or appointments' (53%). Only one-third (33%) say they support consideration for 'truck drivers delivering goods and/or food' (33%).
  - Differences by age, region and gender are not substantial.

Yes/No Questions

Survey respondents were asked four 'yes/no' questions about transportation pricing.

- Seven-in-ten (71%) residents say they are aware that **we have mobility pricing already** in Metro Vancouver such as fuel taxes and transit fares. This is a 5 percentage point increase from the September 2017 baseline survey.
  - Awareness is higher among Burnaby/New Westminster residents (+10 points vs. overall) and among older residents (+8 points vs overall).
- Four-in-ten residents (42%) say they **would change the way they move around Metro Vancouver** if we had a decongestion charging approach where we pay directly for road use. One-third (34%) say they wouldn't make changes, while one-quarter (24%) are undecided. This result is consistent with a similar question asked about mobility pricing in the September 2017 baseline survey.
  - Older residents (-8 points vs. overall) are the least likely to say they would make changes to the way they move around the region.
- Two-thirds (67%) of residents say they **would like to know and be able to track how much they are spending** in total, to move around Metro Vancouver. Two-in-ten (20%) say they would not like to track their spending and 13% are undecided. A desire to track spending is up 7 points from the September 2017 baseline survey.
  - The desire to track spending is higher among Northeast residents (+9 points vs. overall).
- Nearly seven-in-ten residents (68%) say they believe it is **worthwhile to study ways to make transportation pricing in this region more efficient and fair** so that all users pay according to how they use the transportation system. Fewer than two-in-ten (17%) say this study is not worthwhile and 14% are undecided. Agreement there is merit in this study is up 6 percentage points from the September 2017 baseline survey.
  - Differences by age, region and gender are not substantial.

Interest in Taking Part in Engagement Process

Seven-in-ten residents (70%) say they are either 'very' (22%) or 'somewhat' (48%) interested in staying informed on the *It's Time* project and the conversation about mobility pricing in Metro Vancouver. One-quarter (25%) of residents are 'not very' or 'not at all' interested, while 6% are undecided.

- Interest ('very' or 'somewhat') is higher among North Shore residents (+9 points vs. overall).

B. Stakeholder workshops

a) Vancouver Stakeholder Workshops Summary

37 participants
January 31, 2018
Vancouver

- **Fuel tax:**
  - Increase fuel tax:
    - Generates more revenue for TransLink with only people who are driving being impacted
    - Vary fuel tax by region
  - Maintain fuel tax:
    - Because of environmental concerns
    - To force changes in behavior for drivers, employers, and businesses
  - Eliminate fuel tax because it is a declining source of revenue
- Distance-based charges:
  - One-Zone Distance-Based Charge Example:
    - One flat rate for everyone is too simplistic
    - Reluctance of people to be tracked
    - This primarily targets longer trips and penalizes people for living in suburbs
    - Needs time of day adjustment
    - Concern it will not reduce congestion adequately
  - Two- Zone Distance-Based Charge Example:
    - Boundaries do not include enough congested areas
    - Additional Park & Ride options would be required to allow drivers to switch modes
    - Consensus this is better than a one zone charge
    - Unintended consequences of diversion including parking in residential areas
    - Needs additional transit before implementing
    - More focused on transit and less about congestion
  - Multi-Zone Distance-Based Charge Example:
    - Very complicated
    - Impacts health care options because hospitals and specialized clinics are downtown
    - Needs to integrate with regional land use planning because it will shift employment and housing
    - Would require constant updating to meet changes in travel patterns
    - Those who travel furthest are impacted the most
- **Congestion Point Charges:**
  - Downtown Vancouver Example:
    - Limited in scope, with too many variables, and not a regional solution
    - Concerns regarding how and which vehicles would be charged
    - Traffic diversion will become a major problem
    - Downtown bridges are not the biggest problems areas
    - Vancouver is a multi-center region with goods movement and congestion over the Fraser River
  - Burrard Peninsula Example:
    - Concerns regarding so many medical offices and hospitals in this zone
    - The surrounding area would be impacted as commuters park to use transit into the zone
    - Concerns about the size of the zone and the number of trips excluded
    - Vancouver congestion is less than the congestion in other high growth areas of the region
    - Impacts visitors using the highway and children being driven to activities
    - Will this scenario reduce commuting time?

- Metro Vancouver Crossings:
    - Consensus this scenario misses the mark
    - Does not address the long-distance driving because of poor transit option in the suburbs
    - Not targeting other areas of congestion because 85% of travel does not cross a bridge
    - This raises revenue but does not change behavior
    - Does not address East/West traffic congestion

- **Charging Variables • Peak Hours:**
  - This scenario raises concerns about fairness and equity
  - More consideration must be given to the definition of "peak hours" because weekend travel is becoming very congested
  - Peak times vary by region
  - Opportunity to change behavior with this
  - Might encourage alternative modes of transit
  - Maximize public transit where capacity is available
  - Weakness: does not address carbon emissions
  - Public will expect to see infrastructure investment as a result of charges

- **Charging Variables • Hot Spots:**
  - Transparency needed in the billing and where investments are being made
  - Concerns this may raise revenue but miss the mark for congestion
  - Many factors influence the unpredictable nature of traffic
  - If we are all paying for mobility, why would we not all pay the same amount?
  - Not all hot spots are equal (mandatory vs. optional trip)

b) Coquitlam Stakeholder Workshop Summary

25 participants
January 31, 2018
Coquitlam

- **Fuel tax:**
  - All cars should pay for the road system including electric vehicles
  - We all pay more due to the impact on commercial costs for driving
  - People drive to the USA for cheaper fuel
  - Students want to see it eliminated due to restrictive transit services in suburban areas
  - Many misconceptions around fuel tax and no transparency

- **Distance-Based Charges:**
  - One Zone Distance-Based Charge Example:
    - Concerns for privacy
    - Does not adequately tackle congestion
    - People would stay home on the weekend and commerce would be affected
    - Better transit would be needed for fairness as not all zones are considered equal in terms of transit options
    - This would favour municipalities that have better public transit
  - Two Zone Distance-Based Charge Example:
    - May reduce single occupancy drivers
    - Better at tackling congestion areas
    - Commercial costs would increase
    - This supports regional growth planning and focuses density around transit
    - Challenges of managing through traffic

- Multi Zone Distance-Based Charge Example:
  - Too complex
  - The impact of diversion redistributes congestion
  - Mobility could decrease if transit services cannot manage the demand
  - Not just commuters are creating the problem
  - Distance-based examples do not allow for the same kind of diversion effects as congestion point charges
  - Theoretically makes sense but implementation would be difficult for users to track

- **Congestion Point Charges:**
  - Downtown Vancouver Example:
    - Need the infrastructure first
    - Diversion would be a problem
    - Does not address regional congestion
    - Downtown has less congestion
    - Has limited impact on changing behavior
    - Targets goods movement
  - Burrard Peninsula Example:
    - Parking issues at boundaries
    - Diverts congestion
    - Does not impact congestion in suburbs
    - East-west needs more public transit options
  - Metro Vancouver Crossings Example:
    - Daily caps would be needed
    - Easy to understand
    - Lack of fairness to those who live in outlying areas due to affordability
    - Penalizes people with limited transit options
    - From certain directions, drivers must cross several bridges
    - Does not relieve chokepoints leading onto the bridges
  - Metro Vancouver Hot Spots Example:
    - Fairness is an issue
    - Theoretically sensible but very impractical
    - Would need to add congestion point charges on freeways and interchanges
    - Charge would have to be low
    - Implementation should be on major corridors

- **Charging Variables • Peak Hours:**
  - Penalizes people who do not have choices regarding work or travel modes
  - Is the goal to reduce the load or spread the load?
  - Unfair for people with children needing to access services
  - Targets the main problems
  - Would encourage carpooling
  - A reasonable first step
  - Need to add incentives to shift modes of transportation

- **Hot Spots:**
  - Hospitals should be excluded
  - Should be used with time of day charging

C. User Advisory Panel workshops

a) User Advisory Panel meeting #2

11 participants
February 20, 2018
Burnaby

- One-Zone Distance-Based charge is a fair scenario but requires upgraded road infrastructure region wide
- Multi-zone charging is too complicated
- Congestion Point Charging concerns:
  - How these charges will add to the affordability issue
  - Fairness for people who drive for work
  - Paying in both directions
  - Will only shift congestion
- Transit concerns:
  - Users cannot rely on transit within outer areas
  - Key transit routes for commuters are already congested
  - There is a demand for increased Park & Ride spaces at SkyTrain stations
  - Existing system lacks predictability and accessibility
  - West Coast Express should have increased service
- Diversion concerns:
  - Need to manage the congestion getting onto bridge decks
  - Drivers will use roads not built for traffic to escape charges and this will increase road maintenance
- Congestion charging is better than fuel tax because all vehicles would pay
- Charging Variables:
  - Health care and childcare are key considerations
  - Increased incentives are needed for carpooling
  - Charging at peak hours would be more effective at changing behaviors
  - Charging in regional hot spots perhaps at a reduced rate
- Time of Day Charging Variable:
  - Would spread out congestion
  - Would entice businesses to become more flexible
  - Less crowded transit may entice new users
- Location Charging Variable:
  - School zones should not be included
  - Neighborhood trips should not be included
- Eliminate the fuel tax:
  - If charging by kilometre driven or by congestion points
  - If decongestion charge revenue is for the same purpose as fuel tax revenue
  - To distribute infrastructure costs evenly
- Reduce the fuel tax:
  - Gradually reduce tax to $0 allowing for interim revenue to go to infrastructure
  - Creates fairness across the region
- Maintain the fuel tax:
  - Balance revenue requirements from different options
  - Would make the transit system more efficient

b) User Advisory Panel meeting #3

11 participants
April 3, 2018
Burnaby

- Transparency in the management of revenue generated from decongestion charging
- General consensus that people should see where the money collected is spent (e.g. when sufficient funds are raised a new line will be added to SkyTrain)
- A new agency should be created to oversee the implementation of mobility pricing
- Fairness resonates with all participants
- Time must be dedicated to educating the public on the complexity of the decongestion problem
- Revenues generated should be directed to transportation and transit
- Various concerns were raised regarding rebates or tax credits
- UAP members feel better informed and are able to educate others within their circle of influence
- The professional management of comments on social media diffused negative comments and added integrity to the process
- Create a transit system that residents are proud of and keen to use

D. Government workshops

a) Meeting with First Nations representatives

February 27, 2018
Vancouver

The Commission had a broad-based discussion with First Nations representing two different local bands about issues pertaining to decongestion charging, objectives/principles to be considered around mobility pricing policy, and the impact of congestion to their communities. The considerations for the Commission to keep in mind with regard to fairness and community needs as they relates to Indigenous communities in Metro Vancouver were also discussed:

- There needs to be a discussion on how to fix the fact that currently transit takes longer than driving
- Further transit investment needs to be a priority if a decongestion charge were put in place
- Important to clearly define road network ownership and the role of First Nations in these discussions
- Commutes are long, because many First Nations cannot find jobs in the area they live and so must travel downtown. Many of these individuals are on a limited income and gas is expensive, and so affordability and fairness needs to be considered
- Driving to medical appointments is for many First Nations the only means of transportation. This needs to be factored in as decisions are made
- Mobility pricing would be an additional issue for an already struggling First Nation community, especially since most reserves do not have access to transit
- Car-sharing is not available to most First Nations, since they cannot drive on to the reserve
- Organizations that are providing services to the First Nations are mostly located in Vancouver, which requires those living further out to drive in
- Some First Nation communities provide travel benefits for their clients who seek medical attention but some do not. This is therefore a challenge when people from rural communities need to travel to the city since now they may be faced with additional charges. It will be important to speak with the FNHA to coordinate travel allowances if mobility pricing were to be implemented

b) Municipal elected official workshops

Municipal Workshop Summary #1
Nine attendees
February 28, 2018
Burnaby

Distance-based charging

- Tax increases are a concern, especially because of affordability problems in the region
- If transit infrastructure is improved, there would be more willingness on behalf of the public to pay more to drive
- One zone has fairness issues, since it punishes those who have to drive the most and those who have been pushed out to the suburbs due to affordability issues
- Fairness needs to be considered for those people forced to live further out; tax credits should be part of the research when it comes to lower-income families and individuals
- Rather than focusing on big projects that require lots of time and money, it may be more effective to multiply bus routes, which takes less time and requires less revenue

- Differential charging by zone with time and location variables is one of the more fair options
- Flat rate for driving a vehicle should be considered, since a vehicle levy would eliminate privacy concerns
- The Commission should consider, in terms of fairness, charging more in areas that have better transit
- Charging those more in higher public transit areas is unfair, since those residents already pay more in property taxes
- Technology and privacy concerns with regard to distance-based charging
- Interest in understanding time spent on discretionary trips versus work

Congestion Point Charges

- A point charge around the Burrard Peninsula would mean half the population would not have to pay.
- Consider a hybrid approach that uses both a distance-based and congestion-point charge. For example, one zone that has a distance-based charge (only if you get rid of fuel tax) and some kind of congestion point charge.
- A congestion-point charge like a toll would be the least problematic in terms of privacy.
- Tolls would be unfair to regions like the North Shore that are dependent on those bridges, since there is no other way to get across.
- Congestion-charging could help nudge the region to plan more complete communities that are walkable.
- The more complex you make the decongestion charge, the harder it is to plan around and get the public to be supportive.
- Need to consider how charges impact small businesses and could lead to consequences like drivers speeding in residential areas.
- Resident versus non-resident rate should be considered.
- If businesses are charged more to get around – the cost will be passed on to the consumer.
- Need to consider how autonomous vehicles may affect any type of mobility pricing scheme.

Fuel Tax

- It is difficult to decide if the fuel tax should be maintained, eliminated or reduced if one does not know how much revenue decongestion charging could raise.
- Impact of electric vehicles – it will make the fuel tax irrelevant.
- As one ramps down on the fuel tax, one can incrementally phase in a decongestion charge. It may be beneficial to start with a lower fuel tax and lower decongestion charge, and then when the fuel tax is phased out, increase the decongestion charge.

Municipal Workshop Summary #2

Eight attendees
February 28, 2018
Burnaby

Distance-based charging

- One-zone distance based charge could be a good alternative to the fuel tax to be able to charge people for how far they drive because it captures electric vehicles.
- Multi-zone distance-based charging is too difficult, since it is hard to determine when one is in the circle or not.
- It will be difficult to agree to such a charge without understanding the full trade-offs.
- Costly to upgrade technologies for different cars.
- It will be difficult to convince people to accept a charge if the fuel tax is not reduced.
- Distance-based charging would require high administration costs to set up and maintain.

- There needs to be transparency with regard to the tiered levels of charging should there be a multi-zone distance-based charge.

Congestion Point Charges
- Equal tolling per crossing does not makes sense since some bridges are busier than others. Consistency would be easier for people to understand, however.
- Need to consider onramps to highways or bridges as well.
- You cannot build your way out of congestion. If you build more roads people will use it.
- Need to clearly define where the congestion points are; where is it higher; how many people does it affect?
- Municipalities may need more autonomy to determine where congestion hot spots are because they are the ones investing in the supporting infrastructure.
- As long as residents know what they are paying it is okay. Scaling to different times of day would also be appropriate.
- Deliveries at night would ease up daytime traffic.
- Need to consider how ride-hailing will affect any kind of mobility pricing scheme.

Fuel Tax
- Reducing the fuel tax would help with public acceptance and would mean we can put something in its place to really help reduce congestion.
- Fuel tax and mobility pricing should remain as two separate public policies.

c) Federal elected official meeting

Participants:
Liberal MP, January 31
Conservative MP, February 21
NDP MP, February 21

Discussion and Questions:

- Housing affordability is directly related to congestion and commuting times.
- Suburbs are getting more and more crowded, but jobs are all located in the downtown core.
- Lack of transit alternatives.
- Consider whether or not congestion is the primary concern of the Metro Vancouver public.
- Need to consider the effects of technology and the emergence of autonomous vehicles.
- Small businesses, trades and sales people need to work from their cars. It does not work for them to take transit.
- Need to consider blue collar workers, who have a lower income, and that must drive to their jobs.
- Distance-based charging could be fairer, since it does not punish those who need to cross a bridge to get from A to B.

d) Provincial elected official meeting

Provincial Elected Official Workshops

March 7, 2018
BC NDP – Eight attendees
BC Liberal Party – Twenty attendees
BC Green Party – Four attendees

Discussion and questions:

- Limited alternatives to driving on the North Shore
- Need to consider workers who commute who do not have any other option but to drive. Mobility pricing could potentially impact those who have scheduled shifts and no choice as to when they have to drive
- Consider making it revenue neutral or there being accountability as to where revenue from mobility pricing is going
- Fuel tax has not done enough to raise revenue for further transit alternatives
- Fairness is key; should not penalize those who cannot avoid living far from work
- Dealing with congestion requires changing the way we design cities
- Consider technology to differentiate local residents from visitors
- There should be considerations made for commercial vehicles; they have no choice but to travel by vehicle in congestion
- Consider implementing the simplest, most affordable and least intrusive solution
- Need to makes sure that not all British Columbians are paying for Metro Vancouver transportation solutions, since this is not equitable
- Tolling all bridges would be less popular than charging in the most congested areas
- People are living further out because of affordability issues, so not fair to charge those persons more
- Distance-based charging is too difficult to explain to the average person, especially those living outside the City of Vancouver who have had to do so because of affordability issues
- Point charges are more preferable and the bridge models are more understandable
- Idea of caps is appropriate, since it is an easy way not to impact businesses, taxis, commercial drivers
- Fairness is critical; people rejected sales tax proposal (2015 plebiscite) because there was no transit infrastructure available
- Important to encourage electric vehicles and discourage inefficient vehicles.
- Increased fuel tax would enable big projects to be built
- Concern about distance-based charging not having been tried elsewhere before. How would it work with the technology available?
- Consider a hybrid option of both distance and point charges
- Consideration for defining fairness – whether that means everyone has the right to drive or that everyone has the right to access transportation options
- To make life more affordable, densify along transit lines and build transit