IT'S TIME

Moving around Metro Vancouver:

EXPLORING NEW APPROACHES TO REDUCING CONGESTION

An exploration of the regional baseline, and implications for mobility pricing

mobility pricing
INDEPENDENT COMMISSION

OCTOBER 2017

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1. INTRODUCTION

The Mobility Pricing Independent Commission

The Mobility Pricing Independent Commission is an initiative of the Mayors' Council on Regional Transportation and the TransLink Board of Directors. Comprised of 14 community leaders from across Metro Vancouver, the Commission will engage with the diverse users of Metro Vancouver's road system in a fair and transparent process.

The Commission is leading *It's Time*, a public engagement and research project designed to provide recommendations on how to reduce congestion and improve the way transportation is priced in Metro Vancouver. It is the first step in creating a 'made-in-Metro-Vancouver' approach that fits the unique needs of the region. This work will explore decongestion charging, where users pay for the road services they use, and how different scenarios might impact existing forms of mobility pricing.

The Commission's recommendations are being guided by three key objectives:

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

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

Metro Vancouver residents are already paying for mobility in different ways, such as transit fares, gas taxes, parking charges, and taxi fares. The current approach to pricing, however, is not helping to reduce traffic congestion, and previous approaches to road-use charging – where some bridges were tolled and not others – may have created an unfair burden on residents in certain areas of the region. Furthermore, with declining revenues from the gas tax, and the removal of tolls, the region needs other sources of revenue to ensure there is adequate funding to build and maintain transportation infrastructure. It's time for a new approach to mobility pricing.

Mobility pricing, and decongestion charging more specifically, is already in place in major cities around the world, including London, Stockholm, Singapore and Milan. It is also being explored by cities across North America. The Commission will explore these international best practices, and will utilise local research and analysis and public feedback. It will also consider regional planning and policy objectives, as well as the provincial government's role in funding and managing aspects of the regional road network. These sources will form the basis of recommendations presented to the Mayors' Council and TransLink Board of Directors.

The Commission will summarize its work and recommendations in a final report at the end of April 2018, which will include:

- Recommendations on a number of detailed community-based principles for designing a decongestion charging policy, including: policy design, privacy and affordability considerations, the need for transportation alternatives, and next steps in the process.
- Illustrative scenarios of mobility pricing for Metro Vancouver describing how key principles and objectives might be achieved.

The purpose and content of this report

This report examines information on congestion, fairness and supporting investment to provide a baseline for the first phase of the Commission's engagement in the fall of 2017. It is not a comprehensive study of these complex and multi-dimensional issues; rather, the intention is to provide a starting point for public discussion with Metro Vancouver residents, business and stakeholders. The outcome of that engagement will be a more comprehensive understanding of these – and other – issues, which will form part of the assessment of possible future scenarios in early 2018.

This report has been prepared by Commission secretariat staff with research and other contributions from expert consultants engaged in the *It's Time* project.

The next section explores the regional context in terms of recent and forecasted growth, and some of the transportation and mobility-related challenges that are anticipated with this growth. This is followed by an examination and discussion of existing and future congestion, fairness, and the need for transportation investment and revenue available to support that investment. Each section concludes by outlining the implications for the work of the Commission.

For ease of viewing and interpretation, data in the maps in figures 2.1, 2.2, 2.4 and 4.3 is only shown for areas within the Urban Containment Boundary. The full versions of these figures are included in the appendix.

2. REGIONAL CONTEXT

The population of Metro Vancouver will continue to grow rapidly

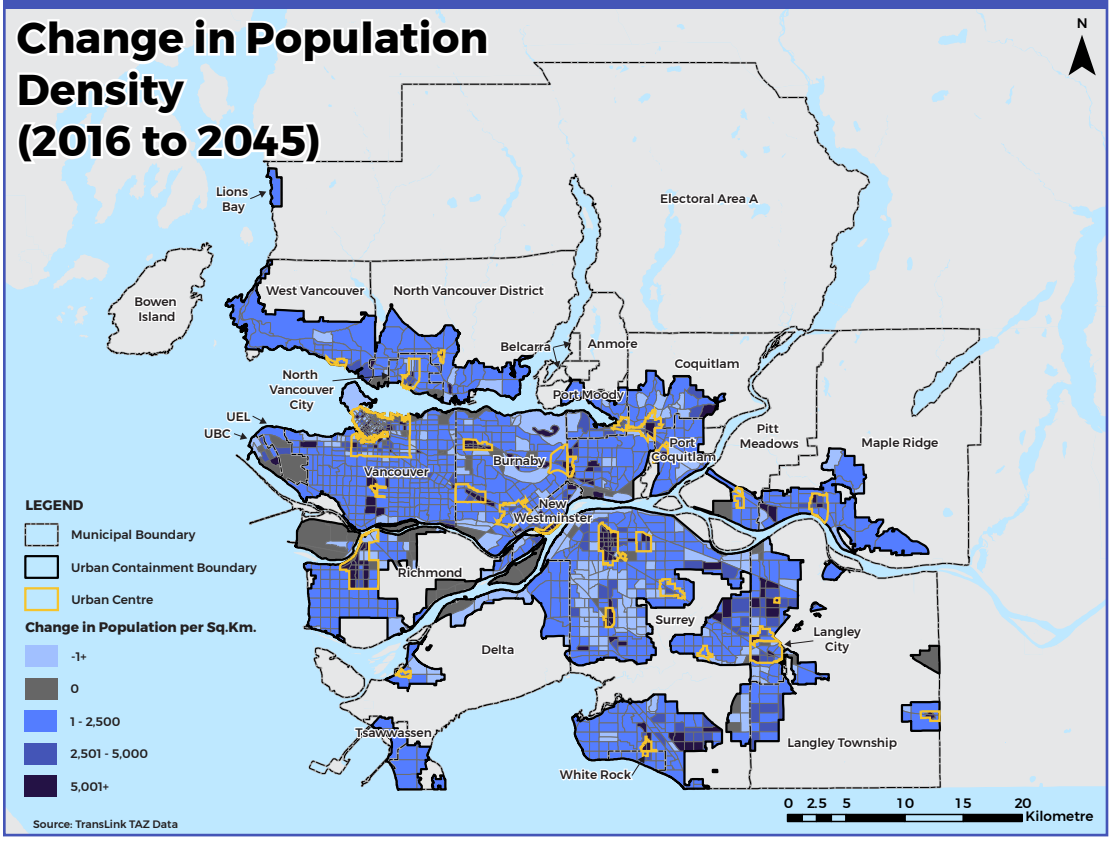
In 2016 there were approximately 2.5 million people living in Metro Vancouver (Statistics Canada, 2017), which is an increase of around half a million people since 2001. Forecasts indicate the region's population will increase by more than 40 percent by 2045, meaning that Metro Vancouver will welcome more than 1 million new residents. That's the equivalent of the population of the City of Edmonton, or to put it another way – one packed city bus every day from now until 2045.

More people means more economic activity and thus more jobs. Employment in the region will also continue to grow, with another 400,000 jobs expected to be added by 2045, which is an increase of about 30 percent[1].

Growth will be accommodated by increasing density

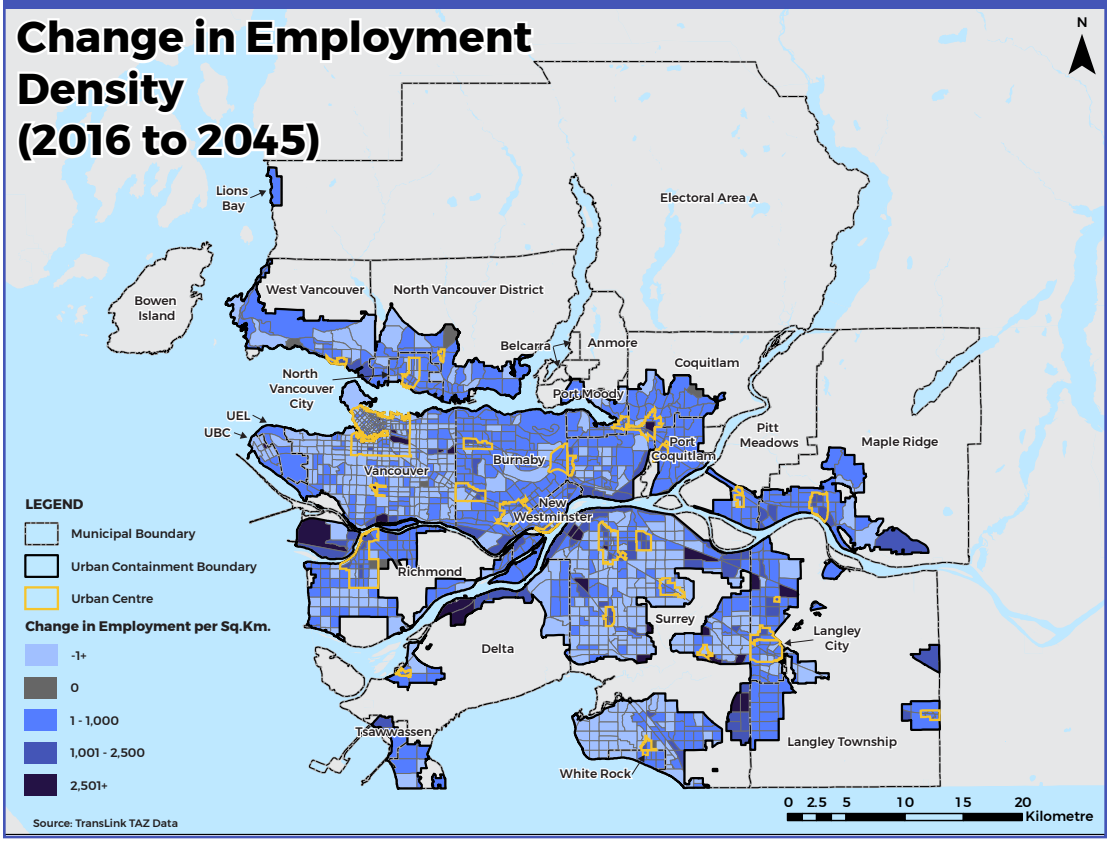
The Regional Growth Strategy (Metro Vancouver, 2017) describes how growth will be accommodated in the region over a 30-year period. The strategy continues to support an urban structure with many thriving city and town centres, which has been guiding regional growth since the *Livable Region Plan* was first adopted in the 1970s (GVRD, 1972). Approximately two-thirds of new housing needed and more than three quarters of new jobs will be located in urban centres like Surrey City Centre, Metrotown and Richmond, as well as the metropolitan core around Downtown Vancouver and other locations close to the frequent transit network (FTN). Figures 2.1 and 2.2 reveal how the growth in population and employment density will be distributed throughout the region.

Figure 2.1: Forecasted growth in population density: 2016 – 2045



[1] These estimates were compiled by Metro Vancouver using baseline data from the 2016 Census and the Regional Transportation Model.

Figure 2.2: Forecasted growth in employment density: 2016 – 2045



Increasing density enables people to live closer to jobs, schools and services

Cities are founded, grow and develop by providing accessibility, or "closeness". The more people that are concentrated in a small area, and are therefore able to meet each other quickly and at little cost, the greater the opportunities for exchanging ideas, goods, services, and culture. Increasing our access to other people – either by increasing the number of people close by, or by decreasing the costs in time and money of getting to other people – can bring benefits to us as individuals, and to society as a whole.

For example, the more job opportunities a person has access to, the greater the chance they have of finding employment that matches their skills. That both increases their earning potential – and thus their contribution to the economy – and gives employers a greater pool from which to find the skills they need. Increased opportunities for exchange can also improve everyone's quality of life by giving greater access to cultural and other leisure activities and to other people who share our interests.

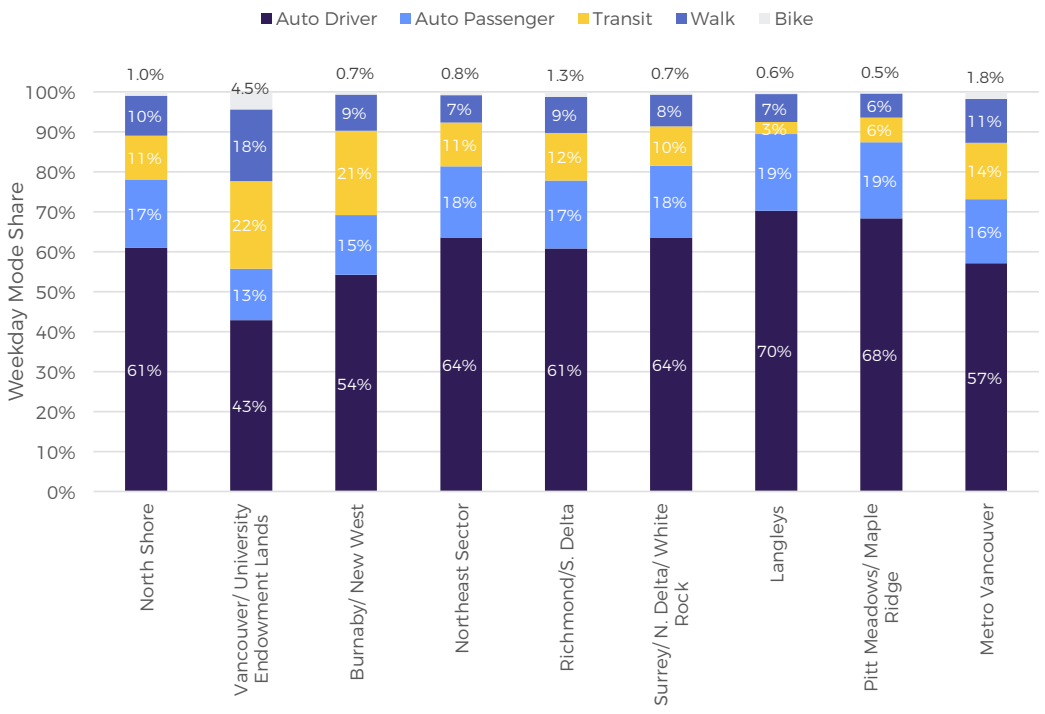
Generally, people living in dense, mixed-use neighbourhoods don't need to travel as far in their daily lives

The majority of trips are usually not made for their own sake; they are made with an objective in mind, such as getting to work, going shopping, delivering goods, or visiting friends and relatives. Whether or not a person decides to make a trip, as well as how and when they choose to make it, is largely a function of two things:

1. Where things are located in relation to one another – where do people live, work, shop, spend leisure time; and
2. The relative costs in money and time of accessing these things using different modes – how long does it take to walk or drive, what is the cost of transit, fuel, parking, etc.

People who live in dense, mixed-use neighbourhoods, where more of the things they need on a daily basis – shops, schools, healthcare – are close by, maybe within walking distance, won't need to travel as much, on average, as people who live in a less dense neighbourhood where facilities are further away. For longer trips, for example to and from work, dense neighbourhoods are generally better served by frequent, high capacity transit, making that a good alternative for many people. In neighbourhoods with less frequent transit, driving may be the only alternative available for many trips. This is revealed by data from the 2011 Metro Vancouver Regional Trip Diary (TransLink, 2013) presented in Figure 2.3, which displays transportation mode share by sub-region. People living in more densely populated communities – like in Vancouver, Burnaby and New Westminster – typically make a smaller share of their trips by car than people living in less densely populated communities – such as Langley.

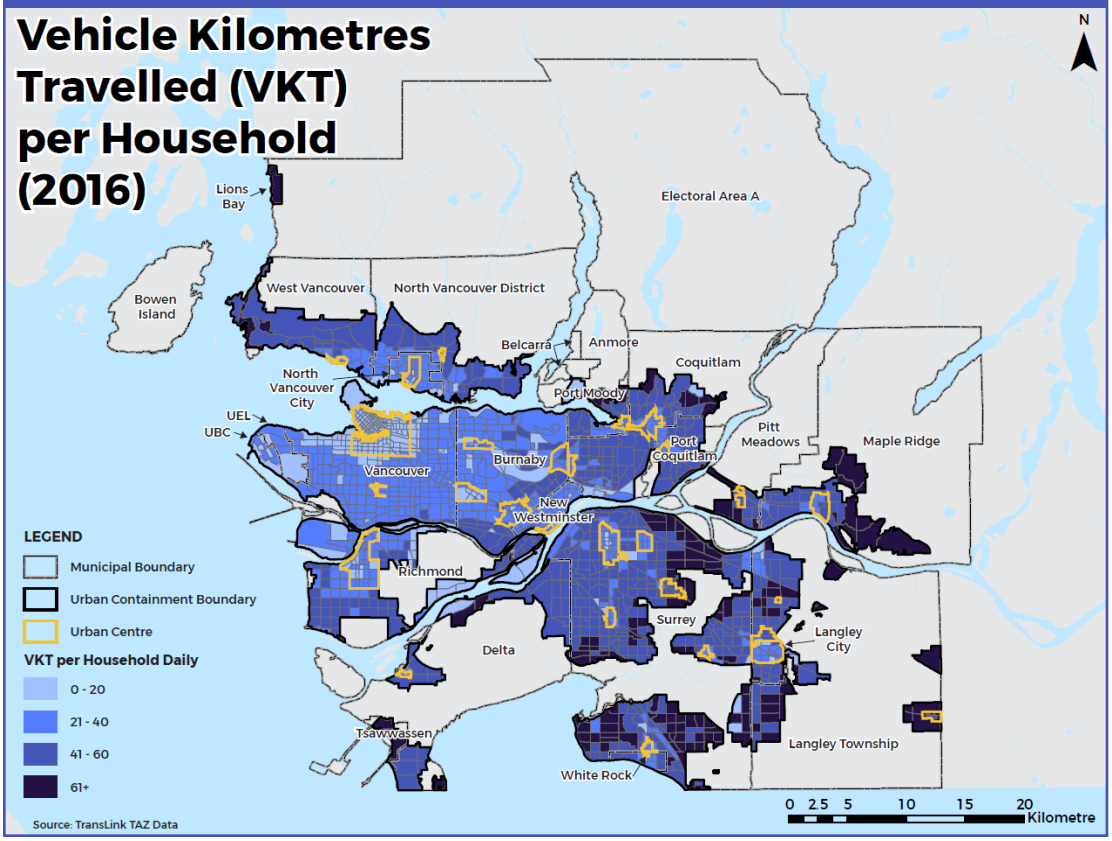
Figure 2.3: 2011 Mode Share by Sub-Region



How much Metro Vancouverites travel – and how often they choose to drive, use transit, walk or cycle – is a function of where within the region they live geographically, and perhaps more significantly, whether they live in a dense urban core or a less dense area of primarily single-family housing.

The average daily vehicle kilometres travelled (VKT) per household by Traffic Analysis Zone (TAZ)[2] is displayed in Figure 2.4. It shows that the distance travelled by car decreases along with the increasing density of the locality, i.e. more densely populated neighbourhoods are associated with lower VKT, and vice versa.

Figure 2.4: Average daily Vehicle Kilometres Travelled per Household by TAZ: 2016

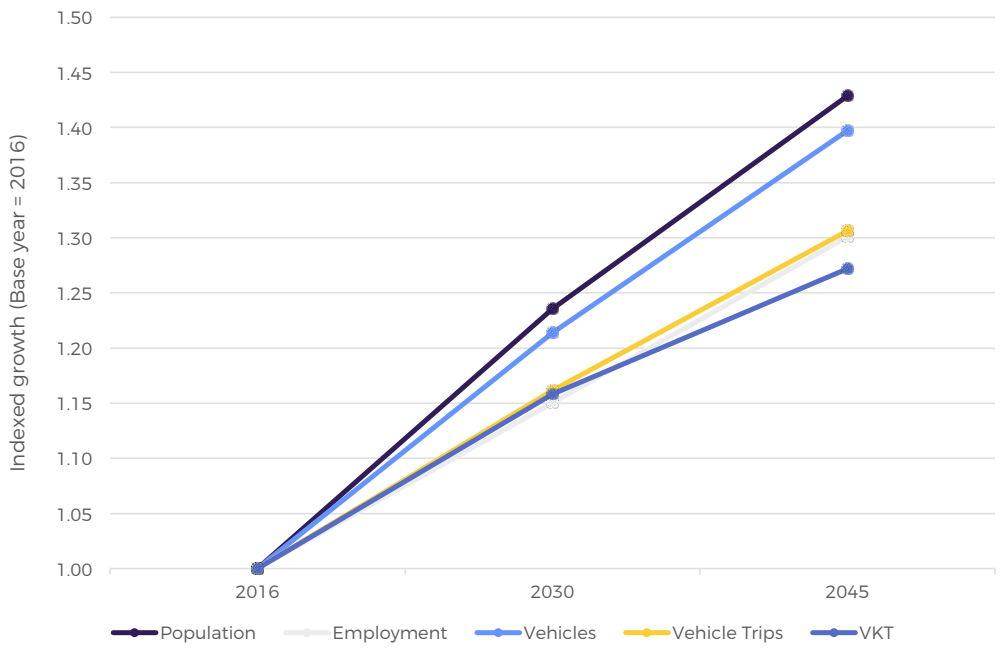


Density brings many advantages, but also some challenges

'Closeness' is the reason we live in cities and it brings many advantages, but it also brings challenges. Among those challenges is congestion and crowding on transit and other transportation systems due to high demand at certain times. Although there are economies of scale, more people living and working in a region generally means more vehicles, which make more trips (including more goods being delivered), impacting the total distance driven on the roads. The forecasted indexed growth of these factors is displayed in Figure 2.5 from 2016 to 2045, using 2016 as a baseline. The next section explores what this growth means for congestion in Metro Vancouver both today and in the future.

[2] A Traffic Analysis Zone (TAZ) is the unit of geography most commonly used in conventional transportation planning models. The size of a zone varies throughout the region. The Regional Transportation Model (RTM) contains approximately 1,700 TAZs for the region of Metro Vancouver..

Figure 2.5: Indexed growth of population, employment, vehicles, vehicle trips, and Vehicle Kilometres Travelled (VKT): 2016 – 2045



Considerations for the Mobility Pricing Independent Commission

- **Growth of population and employment in Metro Vancouver looks set to continue**
  - *Growth will put increasing pressure on the regional transportation system, creating a need to use transportation resources more efficiently and economically.*
- **Population growth is strong all over the region, but is concentrated in and around the urban centres and other locations where transit is already good or is expected to improve**
  - *Population densities are increasing in many parts of the region, but the increase is especially strong in urban centres outside downtown Vancouver. This is creating multiple regional centres and a need for efficient linkages between them.*
- **Employment growth is strong all over the region, including within the urban centres, but the pattern is less distinct than for population**
  - *Employment densities are increasing in all areas, even in locations without good access to transit.*
- **Some population growth is also occurring in areas where people may have to travel further**
  - *People living outside city centres travel more per day compared to people in more urbanized areas.*
- **Population and employment growth will generate more travel by all modes**
  - *Despite a projected decline in per capita vehicle ownership, trips, and vehicle kilometres, Metro Vancouver's anticipated growth in population and employment will still lead to more transit trips and more cars, with the risk of more congestion.*

3. CONGESTION

We know it when we see it, but congestion is hard to define

In simple terms, congestion on the road network occurs when the volume of traffic exceeds the capacity of a road, causing traffic speeds to drop. The capacity of road space is fixed in the short term – there are only so many kilometres of road space or traffic lanes upon which vehicles can travel. However, traffic volume can vary significantly throughout the day, week, and year. It is this fluctuation in traffic volumes that results in congestion on the road network. This is most visible to road users during the AM and PM peak periods on weekdays, when many people are travelling to and from work leading to a situation where demand exceeds supply on the road network. During these times, the number of cars on the road network exceeds the road's capacity, resulting in delayed and unreliable travel times, which impact the efficient movement of people and goods throughout the region.

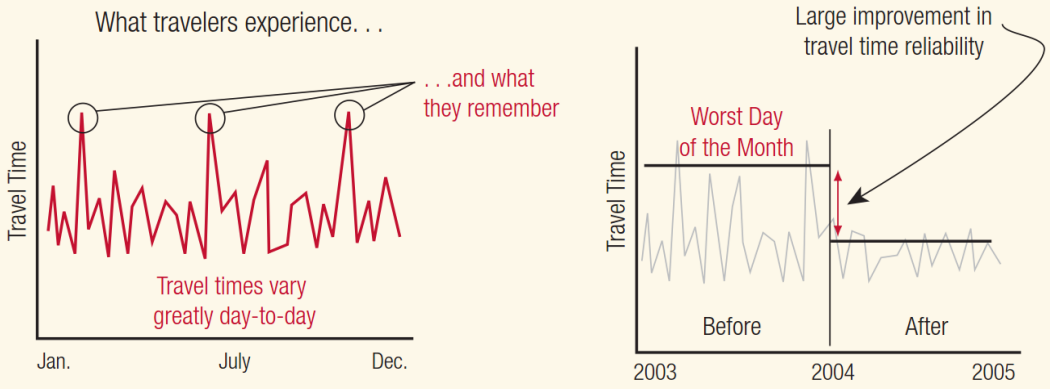
In reality, congestion is rarely a function of capacity on a given road link, rather it is the result of known bottlenecks, or pinch points in the road network, often at busy, complex junctions, bridges and tunnels or around other geographical features like lakes and mountains. These cause what can be called "recurring congestion" – delays that occur in the same place and at the same time on given days. Others – "non-recurring congestion" – are caused by temporary reductions in capacity on the road network. These can either be planned occurrences, like road works or events, or unplanned, like crashes and breakdowns, or impacts from weather-related issues. The effects of non-recurring congestion are much harder to identify and quantify.

The relationship between traffic volume and congestion is complex and non-linear. If a road is operating close to its capacity, every extra vehicle that is added will have an impact on every other vehicle's travel speed. So while a ten percent increase in the number of vehicles on an empty road will have negligible effects on congestion, the same is not true if the same number of vehicles is added to a road that is already congested. The converse is also true: it is not necessary to reduce the number of vehicles on a congested road by half in order to reduce congestion by half.

Reliable travel times can be more important than congestion delays

Urban areas will always experience a certain degree of congestion. That the demand for transportation exceeds capacity and delays occur is part of life in a major city, and must be accepted to a certain degree. However, there comes a point at which the length and in particular the unreliability of travel times becomes a major burden to individuals and businesses. Many people may accept a certain level of 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 when journey times vary so much that we are unable to reliably predict when we will arrive. Given this situation, individuals tend to remember the worst delays, and often adjust their travel times to account for them. This leads to loss in other productive time, family time, or recreation time because they are accounting for variances which only occur sporadically. Therefore, reducing the variance of travel times can have the effect of improving average journey times, with only small reductions in total journey times. Figure 3.1 illustrates how this works.

Figure 3.1: Impacts of improvements in travel time reliability



Source: U.S. Federal Highway Administration

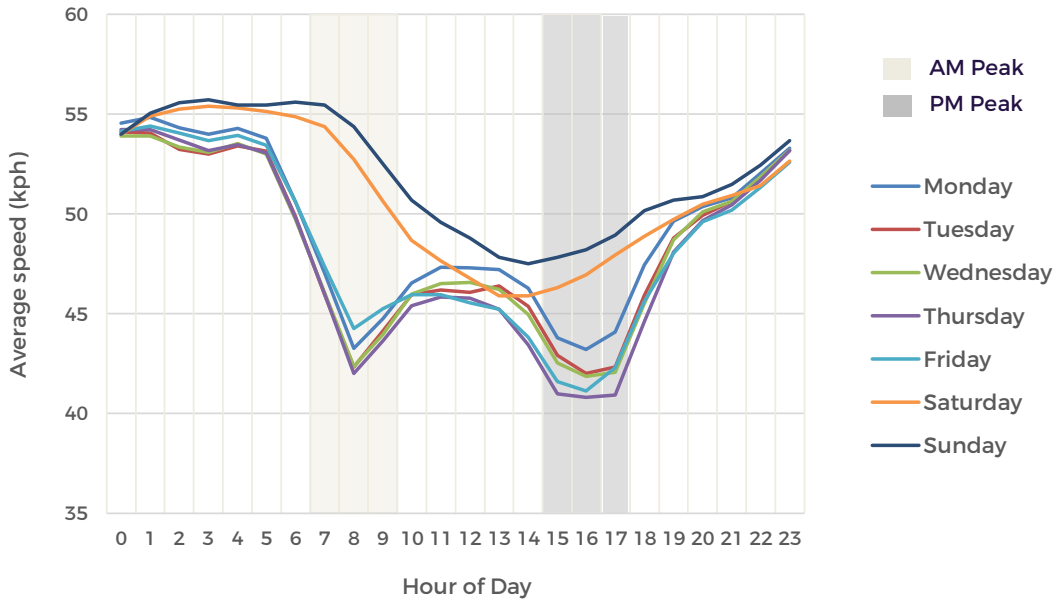
When does congestion occur and how long does it last?

There are many different aspects to congestion, such as the time of day that it occurs, the locations and road types at which it occurs, and the intensity and variability of the delays that are experienced by road users. It should be no surprise that some of the worst traffic congestion coincides with the times that most people want to travel – during the AM and PM peak periods from Monday to Friday. Figure 3.2, shows the average driving speed by time of day from mid-September to mid-October in 2017 for Metro Vancouver. Average speeds decrease during the AM peak on weekdays, increasing during the middle of the day, and decreasing again during the PM peak.

Speeds are typically lower during the PM peak than for the AM peak, and the duration of these lower speeds is more prolonged than during the AM peak. The time at which most people need to arrive at their destination in the morning – typically work or school – is often inflexible. Whereas the time we leave work or school is much more variable and flexible. Also, morning trips tend to be directly from home to work or school, maybe stopping to drop someone off along the way. Evening trip patterns are often more complex, including stops for shopping, visiting relatives or beginning evening activities.

Trips on weekends often start later but can still result in a drop in average speeds. There can be significant congestion delays at certain times and locations on weekends. Congestion on Mondays as well as Friday mornings is typically less intense than on other weekdays, as a small number of people choose to extend their weekend taking some or all of the day off. This is a good illustration of how a relatively small change in the number of vehicles on the road can have a surprisingly large impact on vehicle speeds.

Figure 3.2: Network-wide average speeds: mid-September to mid-October, 2017



Source: TransLink analysis of Google Maps API data (Fall, 2017)

Where does congestion occur in Metro Vancouver today?

While Figure 3.2 sheds some light on the speed profile throughout the day for the entire network, sometimes these morning and afternoon peaks can be experienced at different times for different parts of the region. This means that the illustration of the congestion problems on a static map for Metro Vancouver is no trivial task. Identifying or defining the AM peak alone is a perfect example of this challenge – where, the morning peak time will usually start at different times for different parts of the region, where areas that are further away from a city centre will typically have an earlier AM peak than areas that lie closer to a city centre. In addition, there are also many ways in which congestion can be defined or measured.

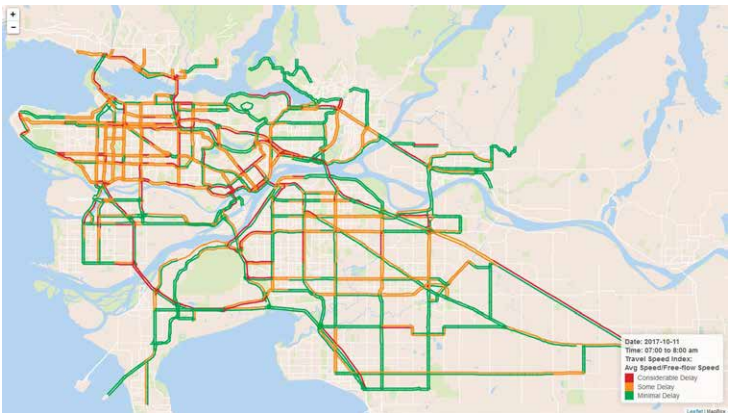
Figure 3.3 illustrates this, where the Travel Time Speed (TTI)[3] is displayed across the region for two different times in the AM peak (7:00am – 8:00am and 8:00am – 9:00am), and two different times in the PM peak (4:00pm – 5:00pm and 5:00pm – 6:00pm)[4].

[3] The TTI in this case compares the actual travel speed to the speed that can be achieved during 'optimal efficient' conditions. That's something slightly lower than a "free-flow" speed, which is unrealistic in many urban environments, and does not represent the most efficient use of the road network in terms of the number of people who can be transported.

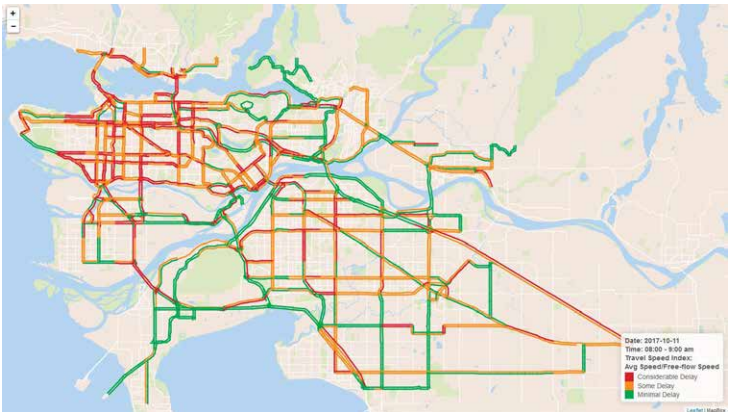
[4] This data was generated using Google Maps API for a typical weekday in the fall of 2017 (October 11th, 2017).

Figure 3.3: AM and PM network speeds

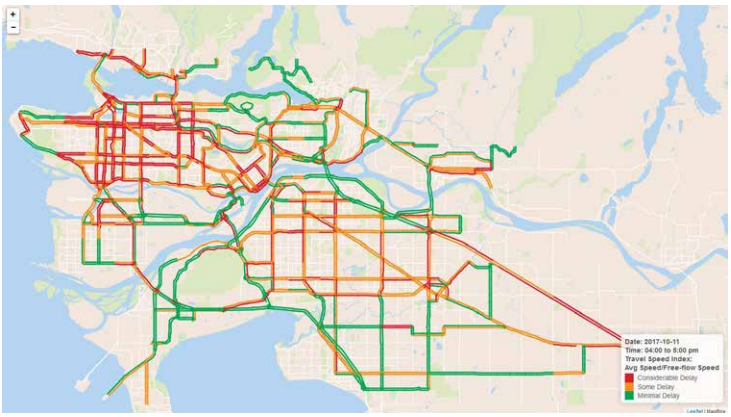
7:00am – 8:00am



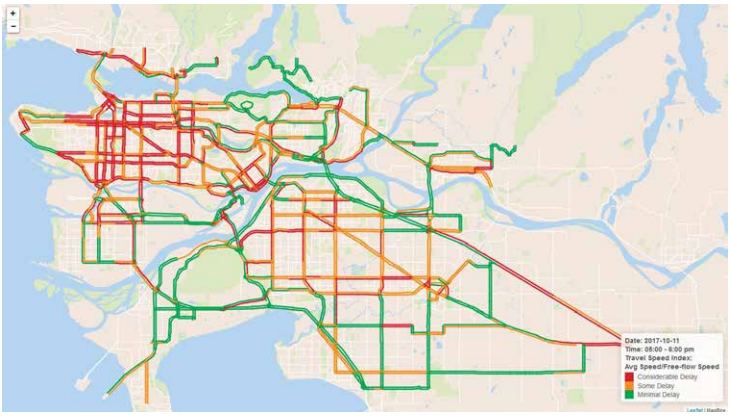
8:00am – 9:00am



4:00pm – 5:00pm



5:00pm – 6:00pm

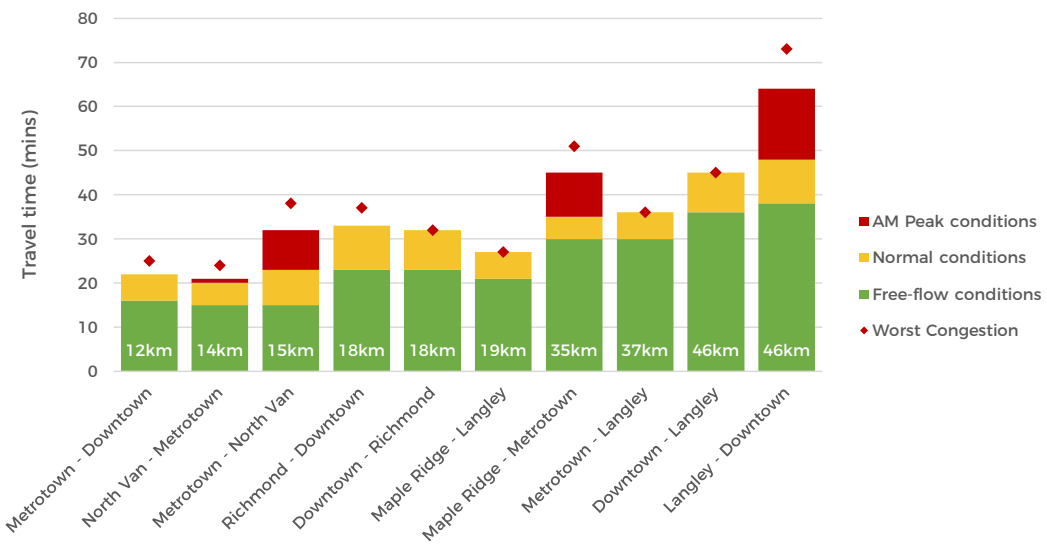


While these images help to reveal where and when congestion is experienced throughout the region, they do not reveal the variability in congestion from day to day, where, as described above – it is often the 'worst day of the month' that many people remember, and which informs their perception of congestion.

How unreliable are travel times?

Figures 3.4 and 3.5 illustrate travel times between a number of locations around the region, during the AM and PM peaks in the fall of 2017, respectively[5]. The bars indicate the difference between "free-flow" travel times (what you might expect to experience in the middle of the night), travel times in "normal" conditions (during the off-peak periods), and during the AM or PM peaks. They also reveal what some of the longest travel times can be as a result of the unpredictability of congestion. The upper point in the figures represents the worst travel time that a person commuting daily could expect to experience once every two weeks, which relates to the variance or reliability of travel times previously discussed (and similar to that shown in Figure 3.1).

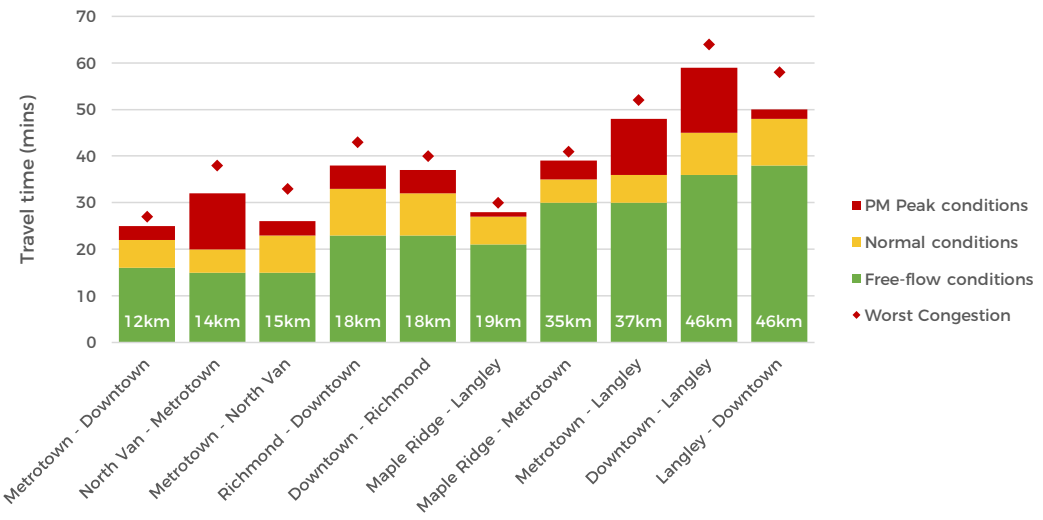
Figure 3.4: Travel times between key regional origins and destinations during the AM peak



Source: TransLink analysis of Google Maps API data (Fall, 2017)

[5] For simplicity and consistency across the origins and destinations, we have defined the AM Peak here as 7:30-8:30am, while the PM Peak is defined from 4:40-5:30pm.

Figure 3.5: Travel times between key regional origins and destinations during the PM peak



Source: TransLink analysis of Google Maps API data (Fall, 2017)

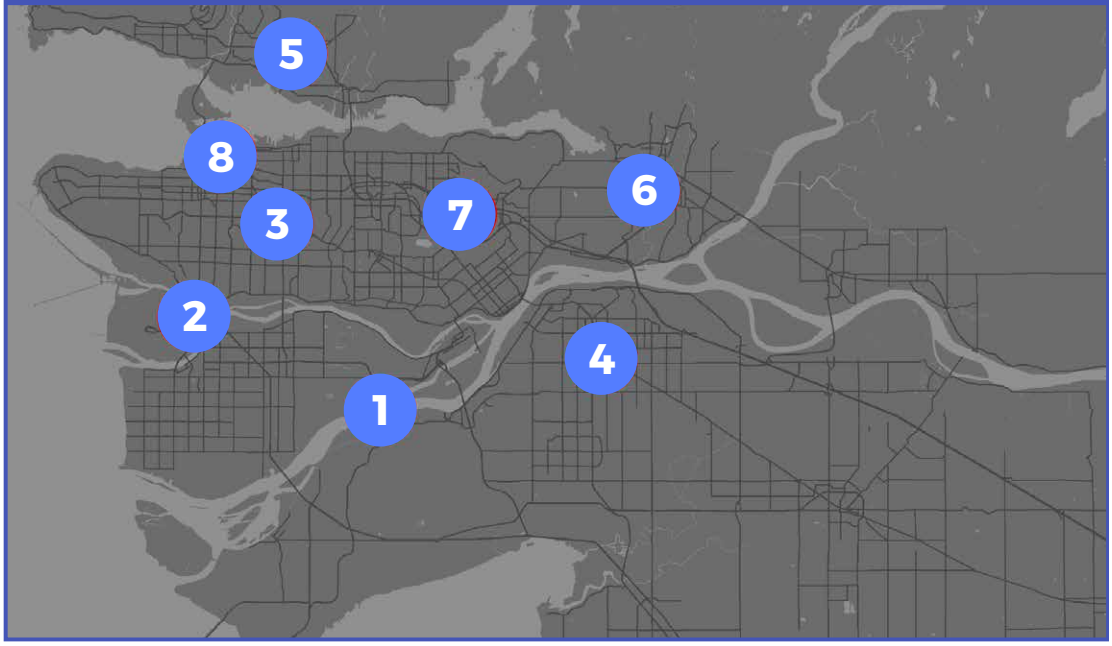
Typical congestion issues facing the region today

Through an analysis of available data[6] and from modelling the region's traffic system, Figure 3.6 identifies some of the worst congestion 'hot spots' in and around Metro Vancouver. This is neither a definitive nor an exhaustive list – there may be many congestion issues faced by people on their daily trips around the region that do not appear here, and those should not be considered any less important. This list is provided as a starting point for a discussion with the public, businesses and stakeholders around the region about what they consider to be the most urgent congestion issues.

Furthermore, to help quantify some of these issues, it is estimated from the RTM that while only about 5-6% of the total road network is congested during the morning and afternoon peaks, this results in over 30% of total travel time being congested during these times.

[6] Source: TransLink analysis of Google Maps API data (Fall, 2017)

Figure 3.6: Some of the worst congestion hot spots in Metro Vancouver today



The traffic hot spots presented in Figure 3.6 are described below in no particular order.

1. **On and around bridges and tunnels crossing the Fraser River – especially northbound in the morning and southbound in the evening.** This includes the Golden Ears Bridge, the Port Mann Bridge, the Pattullo Bridge, the Alex Fraser-Queensborough bridge corridor and the Massey Tunnel. Often traffic can flow well once it is on the bridge or in the tunnel, but traffic on roads and streets leading to the approaches to the bridge or tunnel experience delays.
2. **On and around bridges between Richmond, the airport and Vancouver – bidirectional in the morning and evening.** While issues described on and around the bridges above tend to have a directional flow dependent on time of day, the issues on bridges between Richmond, the airport and Vancouver tend to be in both directions in the morning and evening, due to significant commuter flows between the two cities, and to and from the airport from all parts of the region.
3. **Major arterials in Vancouver and western parts of Burnaby – having a particular impact on busy bus corridors.** Some congestion is to be expected on busy city streets, with many traffic signals controlling the points where two major roads meet. Many of these streets are also places with significant commercial activity, with lots of people walking and cycling, as well as using on-street parking, and are a positive sign of vibrant city life. However, this can also cause extra friction for traffic, which significantly impacts the reliability of buses on some of the region's busiest bus routes.
4. **Travel to, from and around urban centres – for example New Westminster, Metrotown, Surrey City Centre, and Richmond City Centre.** As the region's urban centres continue to grow, congestion to, from and within these areas is causing problems for drivers and bus passengers.
5. **Travel to, from and around the North Shore – in every direction.** Geographical features like water and mountains impose constraints on all parts of our region, but especially on the North Shore. Constrained capacity on the two bridges linking to the rest of the region, and a limited number of opportunities for east-west travel is a problem.

6. **Travel to and from the northeast part of the region – Coquitlam, Port Coquitlam, and Port Moody.** Some of the geographical constraints in the region are immediately apparent, like the Fraser River and Burrard Inlet. Others are less obvious, like the constraints caused by the terrain, parks and smaller rivers that limit the number of roads between the northeast part of the region and the Highway 1 corridor.
7. **Travel on regional highways during peak periods – for example Highway 1 and Highway 91.** Vancouver has fewer highways than many other cities in North America. That has helped to preserve some of Metro Vancouverites' favourite neighbourhoods. However, the highways we do have are carrying a large amount of the region's traffic, including truck traffic to and from the ports and airport. Congestion on the highways can spread quickly to city streets.
8. **Travel to, from and around the Metropolitan Core of Downtown Vancouver.** Metro Vancouver is an increasingly polycentric region (with many town and city centres), but 20 percent of all employment in the region, as well regional cultural and sporting arenas, are located in the metropolitan core (the Downtown peninsula, plus areas to the south of False Creek around Broadway). Many journeys to and from the North Shore also need to pass through downtown.

Even with significant transportation investments, congestion could get worse over the next 30 years

As discussed above, the region is expected to welcome a million more people and over 400,000 new jobs over the next 30 years. Most of this will be in dense, mixed-use areas with good access to frequent transit. Significant investments are planned in new transit, including the Broadway extension of the Millennium Line, new light rail transit (LRT) in Surrey and Langley, new B-line bus services across the region, a new SeaBus and new SkyTrain cars, as well as ongoing reviews of transit services in response to demand. Reinvestments are also planned in the major road network, as well as ongoing revisions of traffic management and signals to improve traffic on municipal roads, and improvements for bus priority, walking and cycling. All of these changes will have an impact on congestion. New transit and road improvements could lead to decongestion in some locations and at certain times, while increasing population could lead to worsening congestion at other locations and times.

With the help of traffic models, we can try to understand how the relationships between planned changes in land-use and transportation infrastructure, and other factors we can't control – like inflation, the cost of fuel, wages, etc. – might change patterns of travel and congestion. Making projections about the future is not an exact science; it builds on assumptions regarding which trends will continue and which will change, and how. The Regional Transportation Model[7] has proved to be a reliable tool to understand these trends, and in particular to compare the relative impacts of the different courses of action. Given the growth in population and employment, as well as the developments in transportation infrastructure and behavioural patterns, the model has been used to estimate what the future may hold for congestion across Metro Vancouver by 2045[8] compared to 2016. Table 3.1 reveals the proportion of congested lane kilometres, and journey time that is congested, for the AM and PM peaks for 2016 and 2045.

[7] The Regional Transportation Model (RTM) is a four-step travel demand forecasting tool developed and maintained by TransLink. The RTM produces estimates from numerous data sources including TransLink's regional trip diary and the regional screenline survey. The RTM produces regional travel demand estimates from demographic inputs (population and employment) developed from the Canadian census and refined by Metro Vancouver, and transportation network data developed by TransLink and external consultants.

[8] Note that the 2045 scenarios include the decision made by the previous provincial government to replace the Massey tunnel with a bridge.

Table 3.1: AM and PM peak congested lanes and journey time: 2016 and 2045

	2016		2045	
	AM Peak	**PM Peak**	**AM Peak**	**PM Peak**
Total lane kilometres	13,034km	13,034km	13,349km	13,349km
Congested lane kilometres	653km	806km	1,116km	1,497km
% Congested lane kilometres	**5%**	**6%**	**8%**	**11%**
Total Journey time	115,596 hours	132,730 hours	157,985 hours	190,223 hours
Congested Journey time	37,105 hours	44,968 hours	64,331 hours	87,147 hours
% journey time that is congested	**32%**	**34%**	**41%**	**46%**

The key takeaway from this table is that while only 5-6% of the entire road network is congested during peak times in 2016 (which is expected to rise to 8-11% by 2045), over 30% of our travel time during peak hours is spent in congestion today, and this is set to increase to over 40% by 2045.

Mobility innovations could make future predictions more challenging

The transportation sector is, like many others, in a period of rapid change as a result of the electrification and anticipated automation of the vehicle fleet. In addition, the application of digital services is allowing new types of shared mobility and data analysis. These changes are still in development and there is continuing uncertainty about the longer-term impacts:

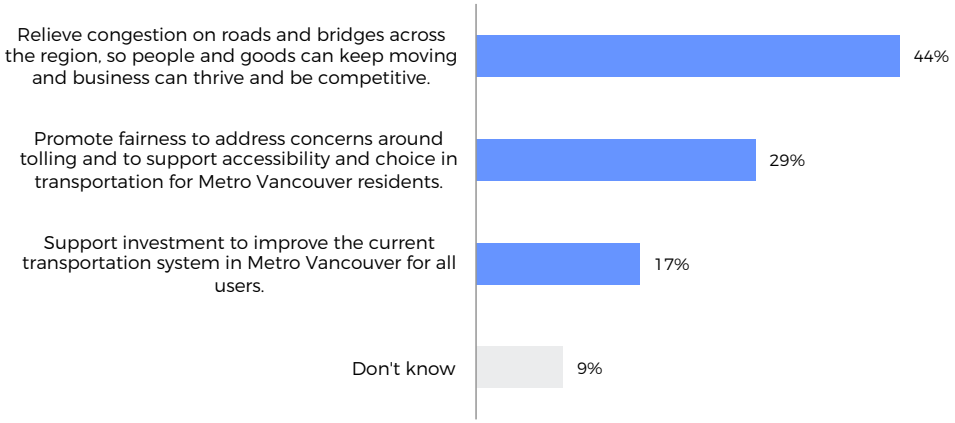
- Purchase prices for **electric vehicles** are dropping and the operating costs are low compared to gasoline or diesel. Electric vehicles can have significant environmental benefits, but low operating costs could lead to more travel and increasing congestion.
- **Autonomous and semi-autonomous driving capabilitie**s could reduce collisions and congestion as well as enabling new infrastructure and on-demand mobility without the need for ownership. They could equally have rebound effects such as increased vehicle dependency, competition for public transit, and increased privatization.
- **Emerging technology-enabled models** as well as the **sharing economy and shared-use mobility** (e.g. ride-hailing and car-sharing services), taxi services, and public transit open the possibility of *Mobility as a Service*, reducing car ownership and use.
- **Data and analysis capabilities** are delivering new possibilities for parking management and urban congestion relief as well as enhanced traveler information and incentives (use of interactive maps like Waze as well as incentives such as insurance reduction).
- **Technology affecting freight and urban goods movement** including the impacts of mobile apps and new service models and even things like drones and 3D printing.

What do Metro Vancouverites think about congestion in the region?

The Mobility Pricing Independent Commission conducted an opinion poll to understand what Metro Vancouverites think about various aspects of the project. One thousand people across the region were polled by Ipsos from September 12 – 19, 2017.

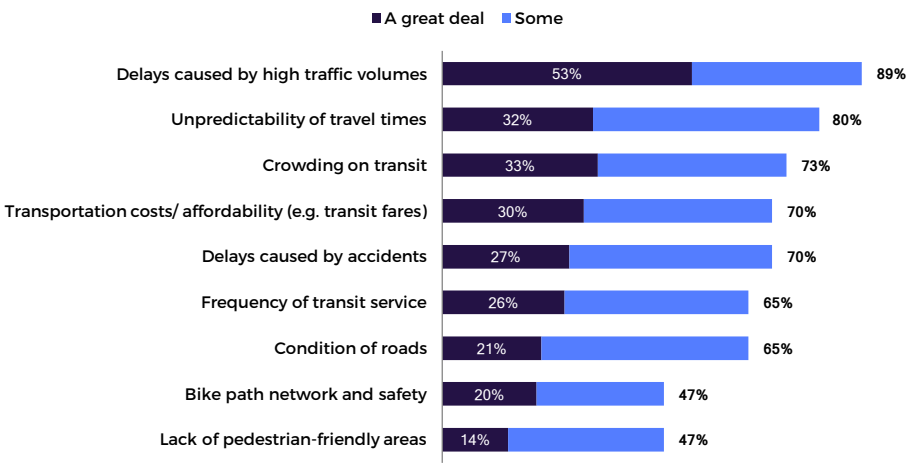
Metro Vancouver residents rate all three of the Commission's objectives as important ('very' or 'somewhat'). Nearly nine-in-ten (86%) say it is important to them to 'relieve congestion on roads and bridges across the region, so people and goods can keep moving and business can thrive and be competitive.' Asked to select the single most important objective, 44% of respondents (the largest number) chose relieving congestion.

Figure 3.7: Most important Commission objective



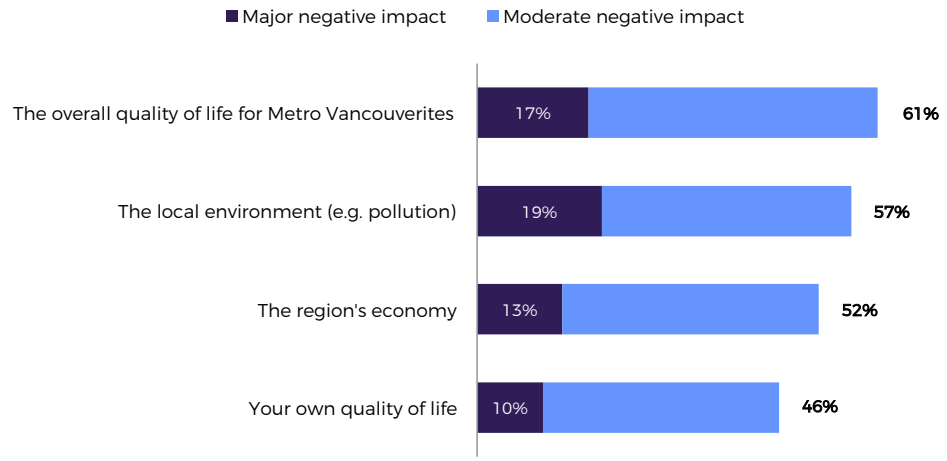
Congestion and unpredictability are the two biggest frustrations of moving around in Metro Vancouver. Nine-in-ten residents (89%) say 'delays caused by high traffic volumes' make them feel 'a great deal' or 'some' frustration. Eight-in-ten (80%) are frustrated by 'unpredictability of travel times'. Other higher rated frustrations include 'crowding on transit' (73%), 'transportation costs/affordability' (70%) and 'delays caused by accidents' (70%).

Figure 3.8: Frustrations moving around Metro Vancouver



Almost half of residents (46%) say that their transportation frustrations have either a 'major' (10%) or 'moderate' (36%) 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' (61% negative), 'the local environment' (57% negative) and 'the region's economy' (52% negative).

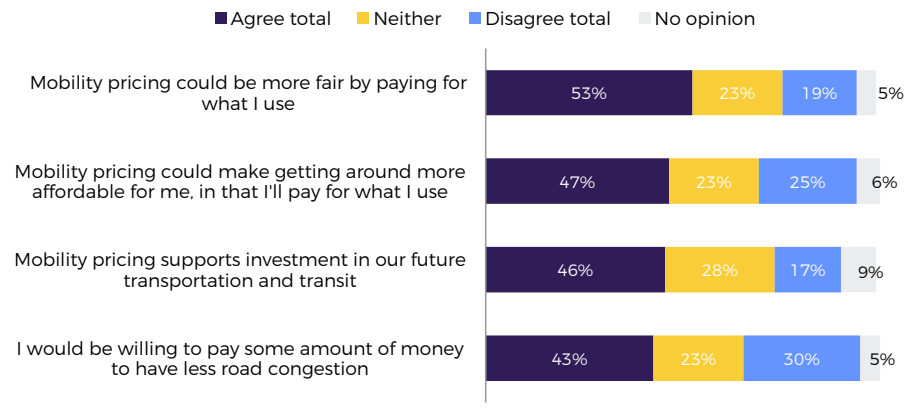
Figure 3.9: Negative impacts associated with transportation frustrations



Younger residents (55%) and North Shore residents (52%) are the most likely to say their transportation frustrations have a negative impact on their 'own quality of life'. South of Fraser residents (57%) are the most likely to say their transportation frustrations have a negative impact on 'the region's economy'. Older residents (62%) are the most likely to say their transportation frustrations have a negative impact on 'the local environment'.

Survey respondents were asked to agree or disagree with several statements about mobility pricing. 43% agree that 'I would be willing to pay some amount of money to have less road congestion' (30% disagree, 28% neutral/no opinion). Agreement is higher among North Shore residents (51%) and younger residents (48%).

Figure 3.10: Agreement with mobility pricing statements



Considerations for the Mobility Pricing Independent Commission

- **Defining congestion is important**
  - *Congestion should be considered as incremental travel time increases relative to an 'efficient' use of roadway capacity as opposed to free-flow travel time. We also need to take into account the way congestion shifts in geography and in time. Reliability of travel times also need to be considered.*
- **There are peak congestion times**
  - *Congestion is a particular issue during the AM and PM peaks, but reasonable during the midday. There may be other locations and times, for example on weekends, where congestion is an issue.*
- **Congestion is widespread throughout the region**
  - *Congestion is having an impact on accessibility for businesses and residents across many parts of the region, primarily during the morning and evening peaks.*
- **Transit is impacted by traffic congestion**
  - *Congestion on roads impacts the efficient movement of transit, such as buses, which many people use and rely upon. The delay of one bus alone could impact more than 100 people travelling on the larger buses operating in the region.*
- **Metro Vancouverites think congestion is a problem**
  - *A clear majority of people in the region experience road congestion to be a problem with implications for quality of life and the regional economy. There is particular concern around travel time delays and unpredictability.*
- **Autonomous vehicles are a wild card for congestion and mobility pricing**
  - *The implications of autonomous vehicles on congestion are not fully understood, but consideration should be made to provide mobility pricing which is flexible enough to adapt to autonomous vehicles.*
- **Shared use mobility is changing expectations and attitudes towards mobility pricing**
  - *Shifting the economy towards shared-use mobility (e.g. taxis and other ride-hailing services, Car2Go, Evo, etc.) may impact the consideration of pricing options. Shared services are creating new expectations around the price of mobility.*

4. FAIRNESS

Fairness means different things to different people

There are many aspects to fairness relating to the transportation system, and to mobility pricing specifically, and these aspects will have a different level of importance for different people and in different circumstances. Because of this, it is not possible to define what "fairness" means or what is "fair". We can only seek to understand what information people need in order to make their own judgement about the relative fairness of different options or ways forward.

The Commission will be engaging with Metro Vancouver residents and stakeholders to understand what information will be important to determining whether different mobility pricing scenarios – including the status quo – are considered fair.

An analysis of congestion pricing systems in California, Norway and France (Raux and Souche, 2004) identifies the following examples of considerations in understanding the equity of implementing decongestion charging:

- Whether charging is perceived to deny individuals "basic rights" such as "freedom of movement".
- If it takes more from people on lower incomes than people on higher incomes (in proportion to income) – i.e. is it a progressive or regressive redistribution?
- The extent to which different groups have different opportunities to adapt – that might, for example, include geographical differences, access to services, availability of transit, other travel choices, etc.

Mobility as a basic right

It could be argued that mobility is a basic right, and that charging to use the roads is an infringement of this basic right. This needs to be considered in the context of the other significant barriers that already exist to using a motor vehicle on the road, including:

- the cost and complication of obtaining a driver's licence
- the cost of owning and maintaining a vehicle
- the cost of vehicle insurance
- the cost of fuel including taxes
- the cost of parking

We can also compare to the barriers of using other forms of mobility – in particular public transit, where there are no basic rights of having free access to transit, and the costs of using transit impose a certain barrier on some individuals.

Another aspect of basic rights that will need to be considered in the context of mobility pricing is privacy. The Mobility Pricing Independent Commission will not be making detailed recommendations as to technology choices or other aspects of implementation with an impact on privacy. It may wish, however, to establish some basic principles as to how privacy would need to be handled if a new form of mobility pricing, such as decongestion charging, were to be implemented.

Fuel tax costs are not being borne equally by all drivers

One of the ways car drivers are already paying to get around is through the fuel tax. How much fuel tax you pay is a product of two things – how much you drive and the fuel efficiency of the vehicle you drive. Larger vehicles and older vehicles will tend to be less fuel efficient than smaller and newer vehicles. Electric vehicles do not pay any fuel tax. This could be considered reasonable if the purpose of the tax were to encourage people to choose more efficient vehicles, which is the purpose of the carbon tax, for example. But the $0.17 per litre tax on fuel purchased in Metro Vancouver is used to finance transportation operations and investment. The fuel tax accounts for around a quarter of TransLink's budget.

So how big is the difference in fuel tax contributions across vehicle types? Consider this example with four vehicle types – a vehicle with low fuel efficiency, a vehicle with average fuel efficiency, a vehicle with high fuel efficiency and an electric vehicle. Table 4.1 outlines the contributions that these vehicles make to the fuel tax under different driving scenarios. The owner of a vehicle with low fuel efficiency – more likely to be either a larger vehicle or an older vehicle – would in these theoretical examples contribute three times as much in fuel tax as the owner of a smaller or newer fuel efficient vehicle.

Table 4.1: Fuel tax contributions from four vehicle types

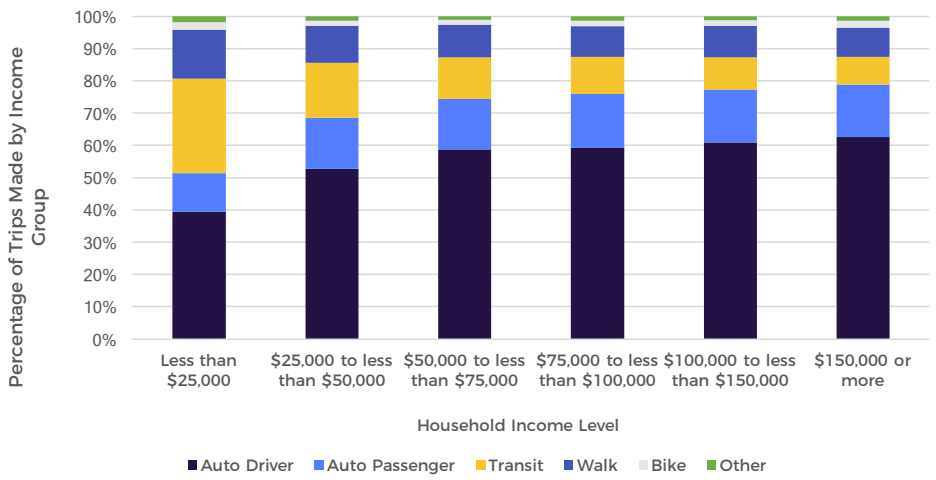
		Low fuel efficient vehicle	Medium fuel efficient vehicle	High fuel efficient vehicle	Electric vehicle
Example year, make and model		2010 Ford F150	2011 Honda Odyssey	2010 Toyota Prius	2017 Tesla Model X
Fuel efficiency		15L/100km	11L/100km	5L/100km	0L/100km
Current fuel tax ($0.17c/L) paid per km		$0.03	$0.02	$0.01	$0
Current fuel tax ($0.17c/L) paid per 100km		$2.55	$1.87	$0.85	$0
Trip type	**KM**				
Return trip to Whistler	250km	$6.38	$4.68	$2.13	$0
Low annual mileage	10,000km	$255	$187	$85	$0
Medium annual mileage	20,000km	$510	$374	$170	$0
High annual mileage	25,000km	$638	$468	$213	$0

With approximately 1.5 million vehicles registered throughout Metro Vancouver, it is likely that they range in age and size – hence in fuel efficiencies. Further work will explore these trends, and particularly how these fuel efficiencies are distributed throughout the region. It will be important to understand how contributions to fuel taxes are made throughout the region.

People living in households with low incomes are least likely to drive – and less likely to travel in the congested peak periods

Results from the 2011 Trip Diary[9] suggest that there is a relationship between household income and the share of trips made by car. This reflects both the already significant costs of driving but may also reflect lower car use in single-person households. This is shown in Figure 4.1.

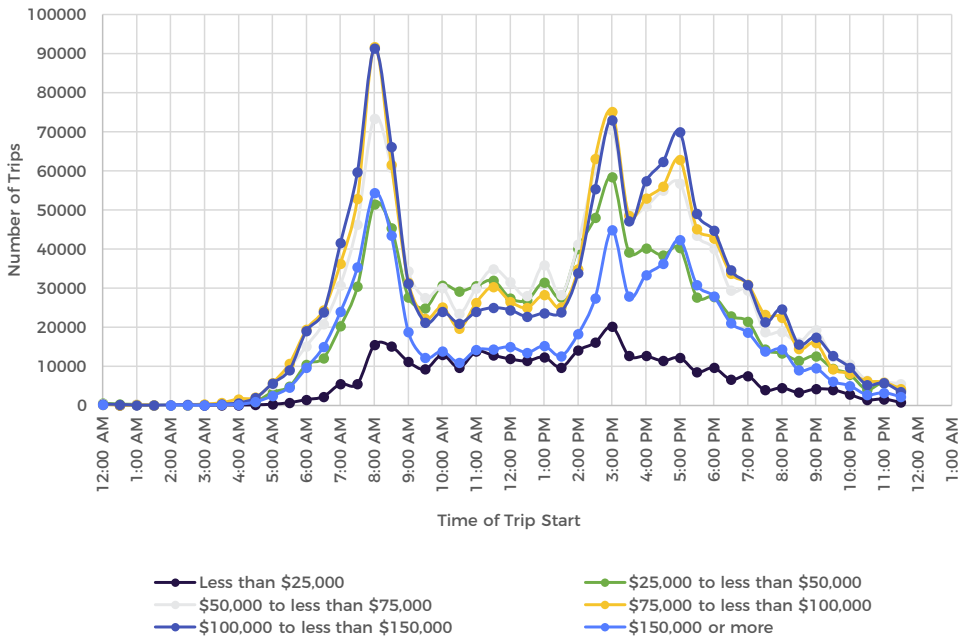
Figure 4.1: 2011 Primary trip mode by household income level



There are also some interesting differences around when trips are made by income level, as shown in Figure 4.2. People living in households with higher incomes (with the exception of the highest income category) are making a larger proportion of their trips in the congested peak period compared to the off peak. People living in lower income households are still making many of their trips in the peak, but the spread across the day is generally more even. Households with the very lowest incomes make many fewer trips, and spread them more evenly across the day.

[9] Source: TransLink (2013) 2011 Metro Vancouver Regional Trip Diary Survey: Analysis Report, February 2013

Figure 4.2: 2011 Distribution of trips across time of day by household income groups



The proportion of income spent on transportation can vary considerably – but what is causing that difference is not immediately clear

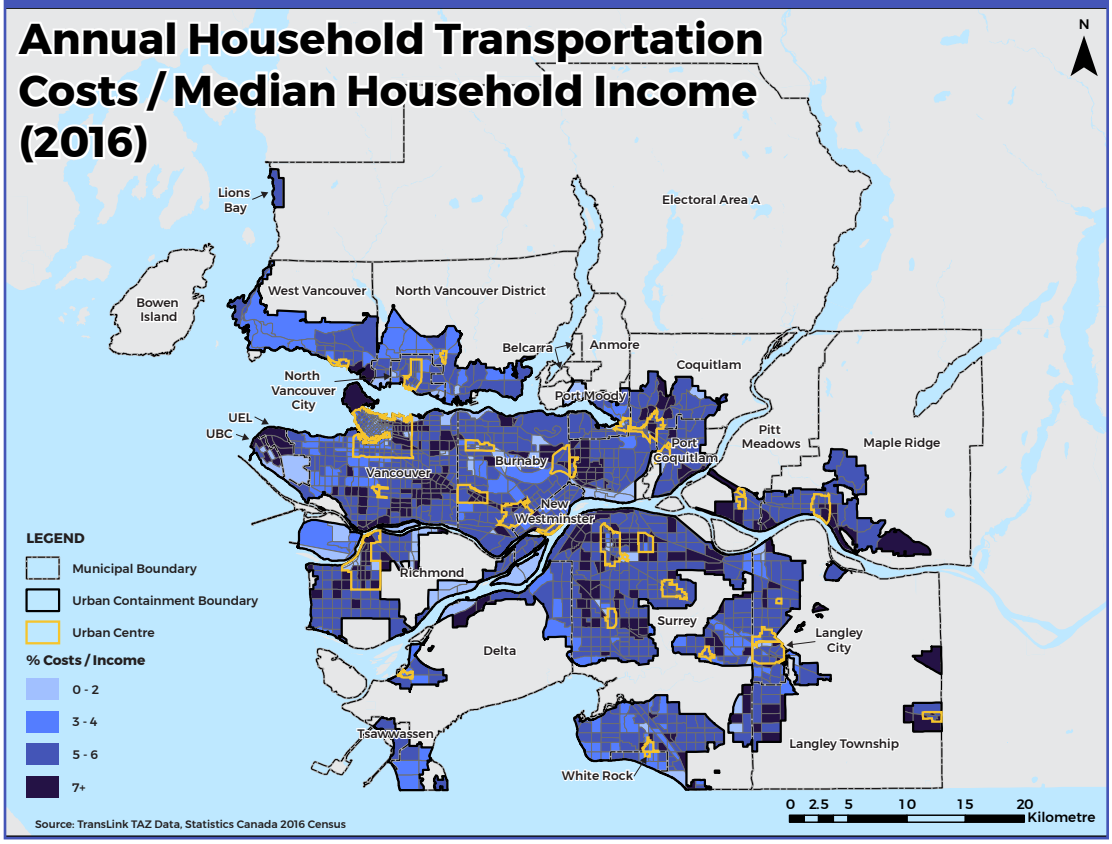
Every household is spending a proportion of its income on transportation: the two most significant elements being transit fares and the cost of owning, maintaining and operating a vehicle or vehicles. Data from the Regional Transportation Model can tell us what the distribution of these costs looks like across the region. It generally shows that out of pocket costs are lower in denser urban centres and greater in more rural areas. As discussed earlier, people living in denser urban areas generally travel less, so it is logical that their costs of travel should also be less.

Understanding what this means is more relevant if we compare it to average incomes. Figure 4.3 shows the distribution of annual transportation costs as a percentage of average household incomes obtained from census data[10]. Areas showing the highest proportional expenditure could therefore represent both areas with the lowest incomes but a normal expenditure in absolute terms, but also areas with the highest expenditure, but a close to median household income. Conversely, those with the lowest proportion of expenditure on transport represent both areas with high incomes, and areas with closer to median incomes but low transportation costs. It is also important to note that this data does not include the costs of purchasing the vehicle(s) which can be a significant proportion of household incomes.

It is difficult to discern any clear pattern from this data related to spatial distribution – there does not appear to be either one part of the region, or one type of urban form (dense, mixed use areas, less dense single-family housing or rural) that is paying a disproportionate share of income on transportation. This data will require further analysis to determine what patterns may be present. It would also be useful to add the costs of time and unreliability of transportation, to the out of pocket costs displayed in this example.

[10] Note that the transportation costs presented here do not include the costs of purchasing a vehicle.

Figure 4.3: Total annual transportation costs as a proportion of average household income

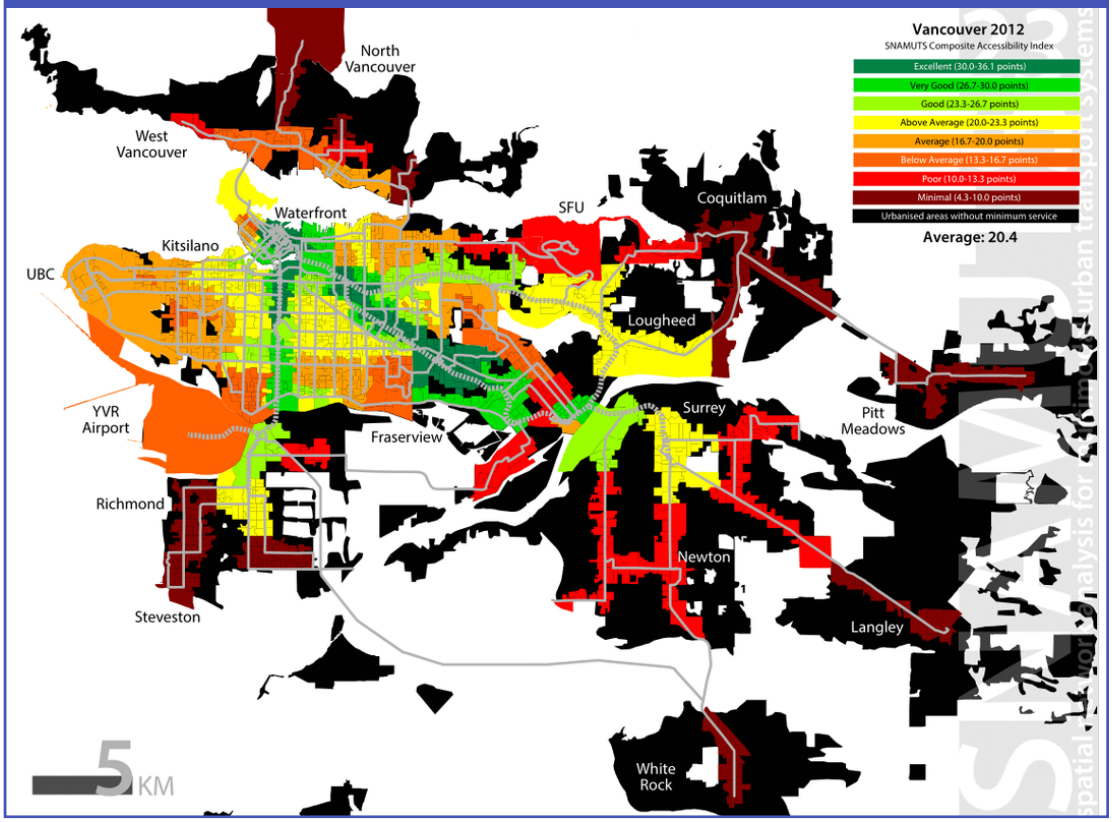


There are variations in transit accessibility across the region – but new investments are planned that will make a difference

We know that there are some big variations in transit accessibility between different parts of the region, and, therefore, the ability to choose transit for a variety of trips. Transit accessibility is a complex thing to measure and present. It is not enough to understand whether or not there is high frequency and capacity transit available for a certain location; we need to understand how easy it is to use transit to get from one part of the region to every other part of the region.

Figure 4.4 has been produced as part of a research project (Spatial Network Analysis for Multi-modal Urban Transport Systems, or SNAMUTS – www.snamuts.com) at Curtin University in Perth, Western Australia. SNAMUTS looks at a variety of indicators, including the frequency and capacity of the transit service, how long it takes to travel between transport nodes (including the need to change and average wait times), how many people and how many jobs are within walking distance of transit stops, and whether there are likely to be severe crowding issues on vehicles and stations. The map below is a composite of all these measures which is a close approximation of "how easy is it to travel from one part of the region to all the others on transit".

Figure 4.4: SNAMUTS transit accessibility map



It is important to note that this work is now several years old and does not, for example, include the Millennium Line Evergreen extension to Coquitlam, which opened in December 2016. This is likely to have made a considerable difference in accessibility for people in that part of the region, but also serves to lift scores generally by making the northeast sector of the region more accessible from everywhere else. Likewise, the planned investments in transit, including the Broadway Millennium Line extension to Arbutus, the Surrey LRT and new B-lines will lead to significant improvements in the areas directly affected, as well as lifting scores generally all around the region.

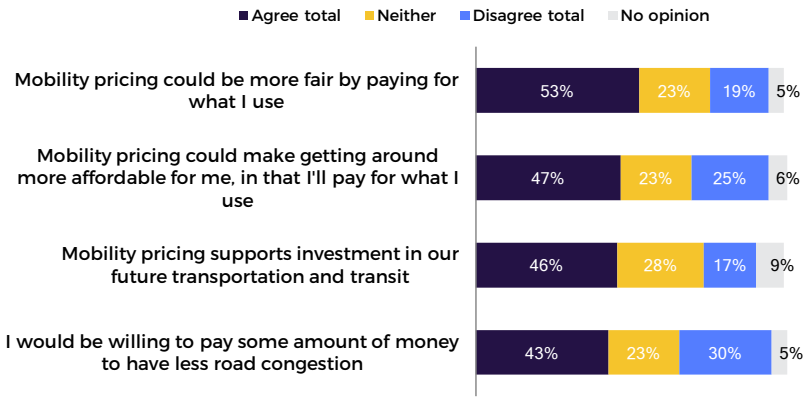
What do Metro Vancouverites think about fairness in their transportation system?

In the Ipsos survey of Metro Vancouver residents, conducted in September 2017, eight-in-ten respondents say it is important to 'promote fairness to address concerns around tolling and to support accessibility and choice in transportation for Metro Vancouver residents' (80%). Fairness was the second most important objective of the Mobility Pricing Independent Commission, identified by 30 percent of respondents, after addressing congestion.

Four-in-ten residents (40%) think our current system for paying for our road and transit system through fuel taxes, hydro fees, transit fares, parking taxes, and property taxes is fair. A similar proportion (36%) says it is unfair and one-quarter are undecided (24%). Perceived fairness is higher among Vancouver residents (46%) and younger residents (45%).

A slim majority of residents (53%) agree that 'mobility pricing could be more fair by paying for what I use' (19% disagree, 28% neutral/no opinion). Nearly half of residents (47%) agree that 'mobility pricing could make getting around more affordable for me, in that I'll pay for what I use' (25% disagree, 29% neutral/no opinion). Agreement is higher among Vancouver residents (53%) and younger residents (52%).

Figure 4.5: Agreement with mobility pricing statements



Considerations for the Mobility Pricing Independent Commission

- **Fairness has many dimensions, and will mean different things to different people**
  - *Depending on where an individual lives in the region, whether they have children or not, whether they have access to local amenities and affordable transportation choices, will all contribute to their perception of what is fair.*
- **Basic liberties related to privacy will need to be considered**
  - *The Commission won't be making recommendations on technology choices or administrative processes, but may wish to consider establishing principles around privacy.*
- **There are some questions about the fairness of the current system of fuel taxes**
  - *People with older and/or larger vehicles are paying more than people with smaller and/or newer vehicles. More analysis is needed in order to understand how these vehicles are distributed throughout the region.*
- **People living in households with the lowest incomes drive less than other groups and are less likely to be travelling in the peak**
  - *But households at or just below the median income for the region drive just as much as those with higher incomes.*
- **'Out-of-pocket' travel costs are lower in more urbanized areas**
  - *The real 'out-of-pocket' costs of using auto and transit are lower in city centres in comparison to less urbanized areas. But as a proportion of household incomes the picture is much less clear, and further analysis will be required to understand this.*
- **Access to affordable transportation choices is an important aspect of fairness**
  - *We need a clearer understanding of the quality and availability of transportation choices in different parts of the region.*
- **The benefits of decongestion charging need to be clearly communicated**
  - *Many people do not know of, or do not see any perceived benefits of, decongestion charging.*

5. INVESTMENT

Some big investments in transit and transportation are planned

In 2014, the Mayors' Council on Regional Transportation adopted a 10-Year Vision for Metro Vancouver Transit and Transportation. The 10-Year Vision[11] was developed to reduce congestion, and stimulate movement in the region after years of under-investment in the local transportation network. The Vision is the blueprint for the future of Metro Vancouver's transportation system and a comprehensive plan for urgently-needed investments. Investments are sequenced across the region in three phases, and deliver a wide range of improvements, including:

- New rapid rail transit in Vancouver, Surrey, and Langley
- 25% increase in bus service, including new B-Lines and new service areas
- Replacement of the aging Pattullo Bridge
- Upgrades and more service to the existing Expo, Millennium, and Canada Lines, and the West Coast Express
- 30% increase in HandyDART service
- New SeaBus, with service every 10 minutes
- $200 million for walking and cycling, with 2,700 kilometres of new bike lanes
- $330 million for road upgrades and seismic investments

The Phase One Plan of the 10-Year Vision was launched in January 2017, including improvements to Bus, SkyTrain, SeaBus, and West Coast Express service. The Phase Two Plan is set to launch in early 2018, with the Phase Three Plan starting in 2020.

New regional sources of revenue are required to help fund these plans

The Phase One Plan has been fully funded through partnerships with all three levels of government – Federal ($370 million), Provincial ($246 million), and Regional ($1.5 billion). Regional revenue sources for the Phase One Plan are being generated from increased transit fares, an adjustment to the property tax, a proposed new region-wide development fee for transit and transportation, and the use of TransLink's existing resources, including the sale of surplus property.

With Phase One of the 10-Year Vision now underway, the planning process for Phase Two has been launched. In March 2017, the Federal Government committed approximately $2.2 billion for Phase Two of the 10-Year Vision. However, implementation of this Plan will require further funding from the Provincial Government, as well as additional regional revenue sources. The Mayors' Council is presently seeking confirmation of a 40% capital funding contribution from the Provincial Government. If secured, this will amount to more than $2.5 billion for Phase Two from the Province. This regional funding gap for Phase Two is estimated at $60 to $80 million annually. To help address this gap, the Mayors' Council is recommending that the Province dedicate a fair share of incremental carbon tax revenues (generated by proposed carbon tax increases over the next four years from the transportation sector within Metro Vancouver) as the region's funding contribution to Phase Two investments. This would close the regional funding gap for Phase Two, and pave the way for improvements to proceed as scheduled.

Phase Three of the Vision is also not yet funded. While Federal and Provincial funding sources are anticipated, further regional funding will be required once more to help fill the gap. As outlined within the 10-Year Vision, the expectation is that remaining regional revenue sources would be generated from mobility pricing.

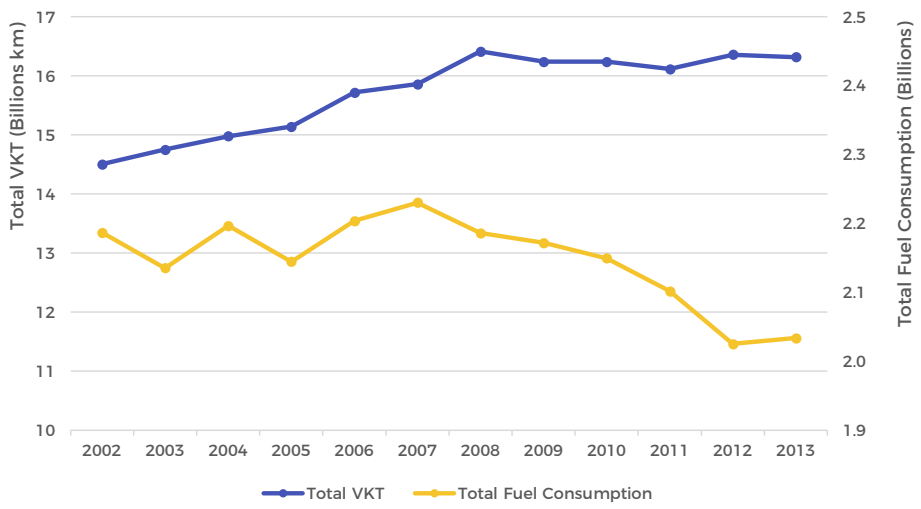
[11] More details on the 10-Year Vision, including the phased approach, can be found at: tenyearvision.translink.ca

Fuel tax revenues are in decline – and today they account for around a quarter of regional revenues

Metro Vancouver's regional fuel tax – set at $0.17/L of fuel consumed – has historically performed well as a secure form of revenue for transit and transportation investment, where it currently generates about $340 million per year. However, with recent improvements in the fuel efficiency of newer vehicles, as well as the penetration of electric vehicles into the market, there is a growing concern that this revenue source is no longer as stable as it once was. Put simply, if all the vehicles registered or passing through Metro Vancouver changed to electric vehicles, revenue from the fuel tax would be $0. Therefore, all other things being equal, a higher proportion of fuel efficient and electric vehicles amongst the fleet leads to lower revenue from the fuel tax.

Recent evidence from Metro Vancouver (King and Fox, 2015) reveals a decoupling between the usage of roads (measured by vehicle kilometres travelled, VKT) and the revenues from the fuel tax over recent years. This is illustrated in Figure 5.1. This concern has also been identified by our neighbours in the US, where currently up to 14 States from the west are researching, testing, and implementing different forms of a road usage charge (RUC) which would replace the existing gas tax[12].

Figure 5.1: Recent trends in VKT and Fuel Consumption in Metro Vancouver



Source: King and Fox (2015)

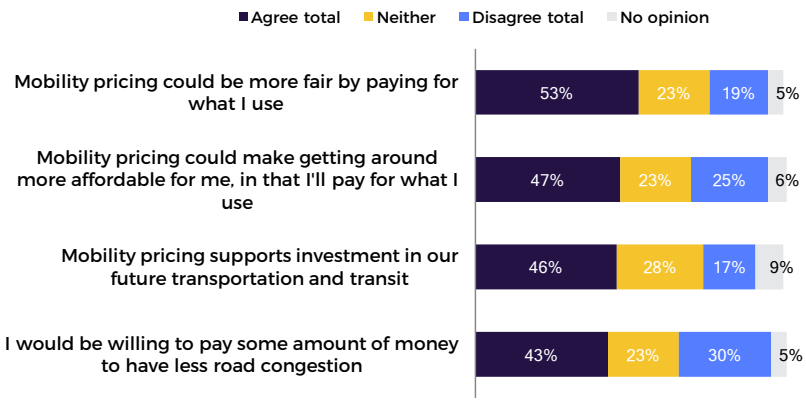
[12] More information can be found at: www.rucwest.org

What do Metro Vancouverites think about supporting investment in the transportation system?

Nearly eight out of ten (78%) respondents to the Ipsos survey agree that it is important to 'support investment to improve the current transportation system in Metro Vancouver for all users'. When asked to select a single most important of the three objectives only 17% selected supporting investment.

Nearly half (46%) of residents agree that 'mobility pricing supports investment in our future transportation and transit' (17% disagree, 37% neutral/no opinion). Agreement is higher among younger residents (53%) and residents of Vancouver (52%) and Burnaby/New Westminster (51%). Agreement is lower among Northeast region residents (40%).

Figure 5.2: Agreement with mobility pricing statements



Considerations for the Mobility Pricing Independent Commission

- **Revenue from new sources is needed to fund the 10-Year Vision**
  - *Without investment, the quality of service of all parts of the transportation system could decline.*
- **Revenue from the fuel tax is set to decline further**
  - *With increasing fuel efficiencies and electrification of the vehicle fleet, the fuel tax is no longer a sustainable source of revenue.*

6. NEXT STEPS

It's Time for a region-wide conversation about decongestion charging

This report is not intended to be a comprehensive assessment of the issues of congestion, fairness and the need to support investment in the regional transportation system. This is just the starting point for a conversation which begins in the fall of 2017, with an engagement around these three issues to understand whether we have identified the right issues, whether we have understood what the real issues are, and to hear what important pieces of the picture we are still missing.

Research on these and other questions will continue during the latter part of 2017 in order to provide more information for further rounds of engagement in early 2018. With the help of the public, businesses and stakeholders, the Mobility Pricing Independent Commission will be developing principles to be adhered to in designing a mobility pricing policy, and developing some illustrative scenarios to help us all understand what the implications of a different kind of mobility pricing might mean for Metro Vancouver.

Tell us what you think

This is an exciting time for Metro Vancouverites to join the discussion and be part of a plan that could change how transportation is used and paid for around the region for generations. Here's how to get involved:

Learn more on our website: itstimemv.ca

Follow us on Twitter: @itstimemv

Join the conversation on Facebook: It's Time, Metro Vancouver

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APPENDIX

Figure A1: Forecasted growth in population density: 2016 – 2045

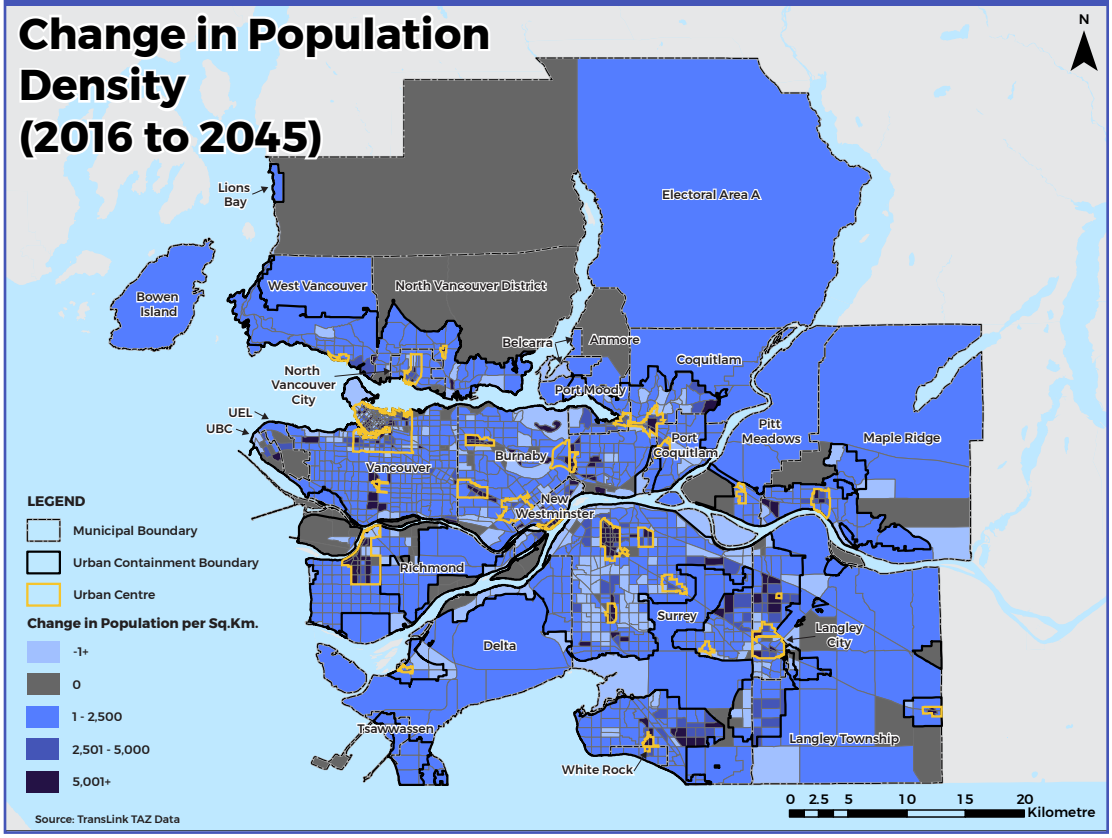

Figure A2: Forecasted growth in employment density: 2016 – 2045

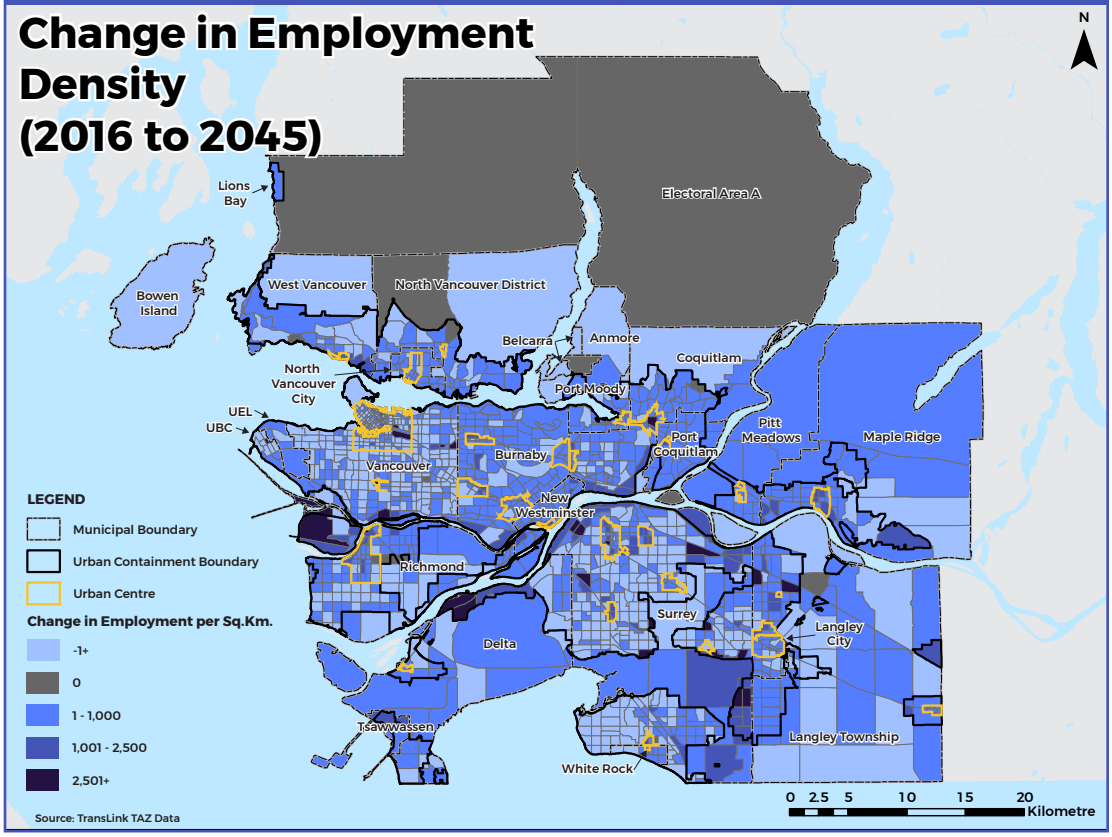

Figure A3: Average daily Vehicle Kilometres Travelled per Household by TAZ: 2016

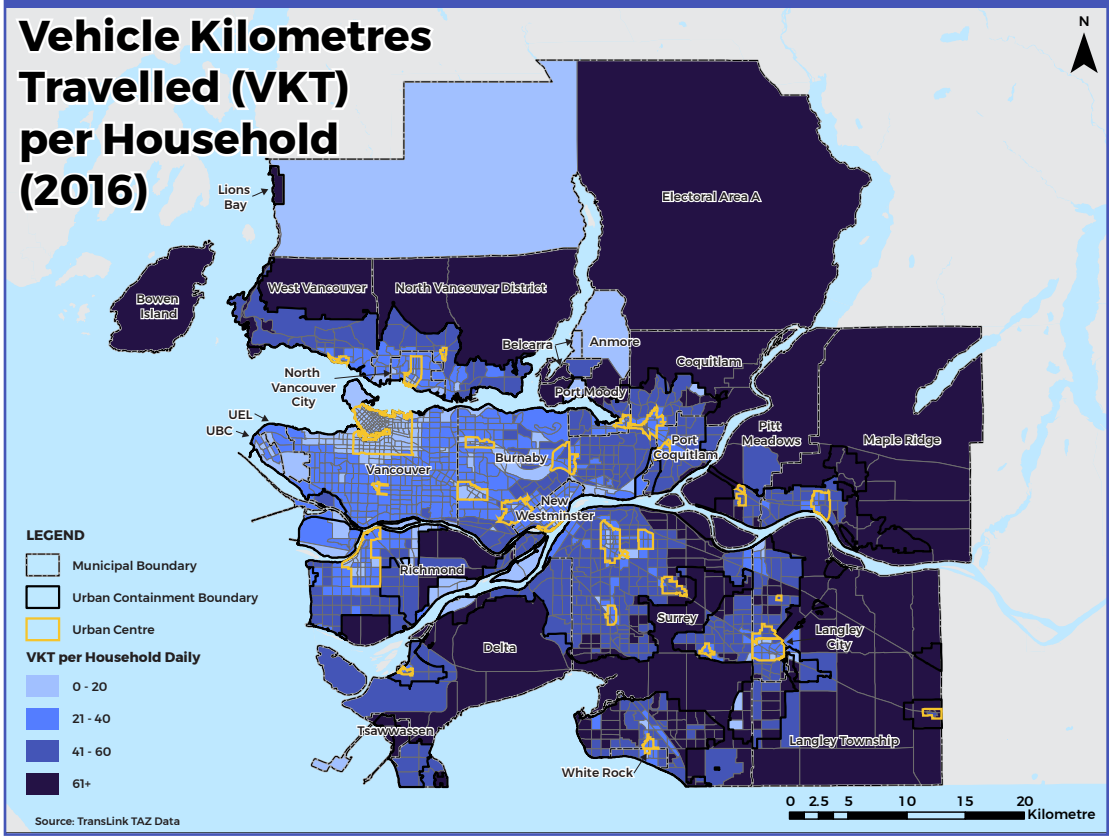

Figure A4: Total annual transportation costs as a proportion of average household income