

Transit Fare Policy

An International Best Practices Review for Metro Vancouver



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Abstract

Both the Transportation 2040 report and the Mayors Transportation Plan call for the implementation of finer grained time and distance based pricing of transportation, and the launch of the Compass Card in 2015 has opened the door to new opportunities to facilitate these goals. This report consists of a review of international best practices in fare policies from cities around the world based on academic literature, publicly available transit agency information, and interviews with transit agency stakeholders. The report identifies opportunities and challenges for the Metro Vancouver Region in the following areas: distance and zone based pricing, time of day pricing, differentiation by service type, concession fares, and approaches to policy changes. Lessons are drawn from each case study with a view to informing the City of Vancouver's ongoing participation in TransLink's Fare Review process.

Acknowledgments

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Transit Fare Policy – Best Practices Review

Executive Summary

Report by Peter Lipscombe, M. Sc. Planning Candidate, UBC
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Summer 2016

Intro and Purpose

The Metro Vancouver Region has long been a leader in sustainable land use and transportation. This is reflected today in a robust public transportation network and increasing sustainable mode share. As part of the Greenest City 2020 goals, Vancouver has set a target of 50% of all trips undertaken using a sustainable transportation mode – walking, cycling or transit – and a 20% reduction in vehicle kilometers driven per person by 2020. These goals have since been achieved, though the City strives for continual improvement.

Transit fare structure is a major component of people's transportation decisions, and can help shape the way people travel and where they live. The current fare structure and zone boundaries dates back to 1984, and both job and population growth have caused considerable changes in regional travel patterns. In part to address these changes, both the Mayors' Transportation Plan and TransLink's Transportation 2040 call for a move towards mobility pricing in both transit and road usage. The launch of the new Compass Card payment system provides an opportunity to rethink the current fare structure in order to increase ridership, encourage better transportation decisions, and enhance system efficiency.

This report provides a review of fare policy best practices worldwide with a view to identifying opportunities and challenges for the Metro Vancouver Region. The report addresses the City of Vancouver's Greenest City goals and will help to inform Vancouver's participation in TransLink's ongoing Fare Review.

Methodology

The report includes a primarily qualitative, in-depth analysis of seven international cities and regions. The case studies were chosen based their diversity of transit modes, current fare policy and how well they satisfied the criteria for mobility pricing. Twelve Interviews were conducted with transit agencies, providers and academics working in the cities of interest. The case studies chosen for in depth analysis were:

- Amsterdam
- Bremen
- Dresden
- Hong Kong
- London
- Singapore
- Washington

The report is organized by research area with relevant examples are drawn from each case study. Lessons for Metro Vancouver are drawn from the case studies, and wider recommendations are outlined at the end of each research area. Finally, the last section includes a proposed transit fare structure that attempts to incorporate the recommendations and offer a starting point for discussion. The research areas include:

- Distance and Zone based Fares
- Service Type-based Fare Differentiation
- Time of Day Pricing
- Fare Media and Modal Integration
- Concession Fares and Affordability
- Approaches to Implementing Fair Changes



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Current Metro Vancouver Fares Structure

	Regular Cash Price	Compass stored Value Price	Cash and Compass Concession Pricet	Regular Monthly Pass	Concession Monthly Pass
1 Zone Single	\$2.75	\$2.10	\$1.75	\$91.00	\$52.00
2 Zone Single	\$4.00	\$3.15	\$2.75	\$124.00	\$52.00
3 Zone Single	\$5.50	\$4.20	\$3.75	\$170.00	\$52.00
3 Zones – after 6:30 weekdays, all weekend	\$2.75	\$2.10	\$1.75	N/A	N/A

Benefits and Drawbacks of the Current Metro Vancouver Fare Structure

	Benefits	Challenges
Zone System	<ul style="list-style-type: none"> » Easy to understand and display on a map » Zone boundaries follow logical geographic and municipal boundaries » Provides rough approximation of distance travelled 	<ul style="list-style-type: none"> » Zone system is subject to boundary penalty » Concentric zones do not reflect increasingly polycentric commuting patterns » Those in the more central areas receive significantly higher level of service than those in suburban areas yet pay the same fare
Fare Structure	<ul style="list-style-type: none"> » Customer friendly free transfer policy encourages efficient system usage » Affordable daily and monthly transit prices 	<ul style="list-style-type: none"> » Lack of automatic daily, weekly and monthly fare capping » Lack of time based pricing fails to encourage efficient usage of system through spreading of peak demand
Concessions	<ul style="list-style-type: none"> » Provides affordable travel to some key demographics including students and children 	<ul style="list-style-type: none"> » Some concessions (UPass, seniors) lack appropriate distance based pricing price signals » lack of targeted, needs-based concession fares
Compass Card	<ul style="list-style-type: none"> » Compass card that now accounts for over 94% of transit transactions, with over one million active cards in circulation 	<ul style="list-style-type: none"> » Tap off for bus travel was not implemented, resulting in lost revenue and incomplete origin-destination data



Overview of Best Practices Review:

City	Distance and Zone based Structure		Differentiation based on:			
	Single Journey	Pass	Service Type	Time of Day	Fare Media	Concession Fares
Amsterdam	Distance based: €0.90 Base rate, plus €0.154 per km	Mosaic Zone-based passes Frequent rider discount card: €17.50 per month for 20% off all public transport	Integrated fares	No	Smart Card with nationwide validity	Various concessions offered by individual municipalities
Dresden	Flat fare for central municipality Zone-based fares for regional travel	Honeycomb zones with premium price for central zone	Integrated fares Bike Share included in monthly transit pass	Off-peak perks for monthly pass holders	Smart Card valid region wide	Various concessions offered at municipal level
Hong Kong	Distance-based rail fares Individual private operators' bus fares vary	Various passes valid based on geography and mode	Very limited integration between modes	No	Smart Card with optional e-wallet function accepted through Hong Kong	HK\$600 (~CAD\$100) cash travel allowance for low income residents provided by central government
London	Zone-based rail fares, flat bus fares	Daily & weekly caps Zone-based monthly passes	Rail and bus fares not integrated	Significant premium for peak rail travel	Payment by Oyster smart card, contactless bank card or smart phone Cashless buses	Many concessions: free travel for <16 years old, >60 years old, and targeted needs-based passes
Singapore	Distance based charged per kilometer with decreasing marginal rate per km	Flat fare, single zone monthly pass	Integrated across modes	off-peak pass, free early morning transit, and rewards program	Smart Card integrated payment	Numerous concessions offered by central government
Washington	Distance based rail fares, flat fare buses	Monthly passes valid for unlimited single journeys up to a designated monetary value	Very limited integration	Significant premium for peak rail fares	City-wide smart card payment	Heavily subsidized bus fares offer mobility for low-income riders Concession fares

Sample Case Study: Amsterdam Distance and Zone Structure

Single Journey Fares:

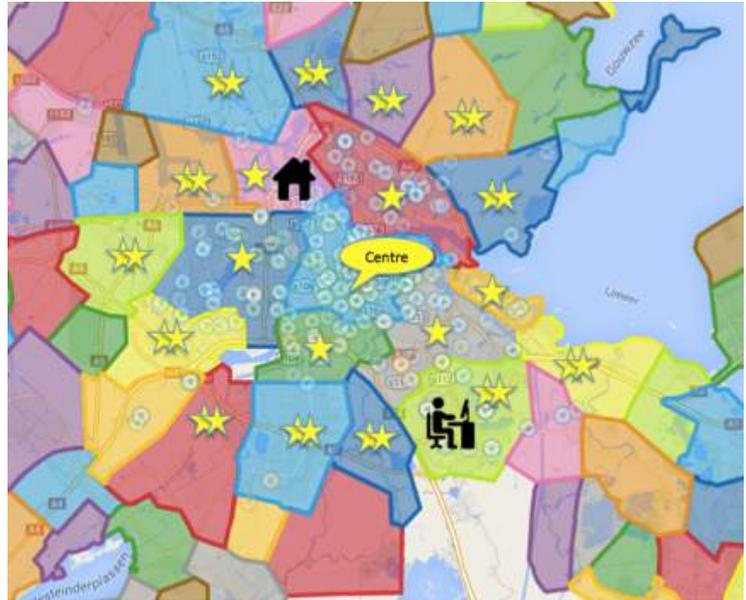
Total fare: €0.90 Base rate, plus €0.154 per km.
(~CAD \$1.31 + \$0.22/km)

Monthly Passes:

Randstad Noord Zone Monthly ticket:

1 star € 50.20	4 star € 159.10
2 star € 81.50	5 star € 197.30
3 star € 121.90	6 star € 234.2

Randstad Noord tickets are zone-based monthly passes. Validity includes the user specified central zone, in addition to as many concentric ring of zones as the user has purchased (each star = one zone in each direction). The map shows the validity of a 2-star pass.



Altijd Korting (“Save All”) Card:

The monthly purchase of the Altijd Korting, or ‘Save All’ card, entitles users to a 20% discount on all public transit nation wide.

Lessons for Metro Vancouver:

The integrated distance based fare structure for Amsterdam and the surrounding region was a significant achievement, bringing together dozens of transit operators under a single fare structure and providing customers with the convenience of one payment system. The system, however, is stuck between two eras: a distance fare for single journeys, and an antiquated zone structure for monthly passes that is difficult to understand.

The ‘Save All’ card provide an interesting example of what a future mobility pricing structure might look like. It offers both simplicity over the zone system as well as a true expression of the user pay principle by providing appropriate price signals for intensive and longer distance transit users. Professor van Oort of the Delft University, Amsterdam, sees the municipal transport agency moving away from zoned passes and towards this ‘Save All’ type passes in the future, though public acceptability of eliminating the ‘all you can eat’ transit pass has been a major hurdle.

Recommendations for the Metro Vancouver Region

Distance-Based Pricing

- Each city’s pricing structure reflects the unique context of their transit infrastructure, demographic and social profile, and political system. None of the case studies offered a ‘plug and play’ solution for Metro Vancouver
- The advantages of implementing distance-based fares should be weighed against the costs of customer comprehension, simplicity and rigidity of fare structure
- Zone based fares offer flexibility that can be harnessed to achieve related goals such as demand management and zoned peak time pricing to match system capacities

Service-type based fares

- Metro Vancouver should continue to offer integrated fares across modes given the complementarity of various modes and limited coverage of rapid transit networks (excluding West Coast Express)

Time based pricing

- Time-based peak pricing should play a role in future fare policy as it provides the opportunity to expand ridership, increase revenue, and enhance system efficiency

Fare Media and Multi-modality

- Incorporate Mobi Bikeshare in the monthly passes in order to increase cycling mode share, improve last mile options, and advance Greenest City Goals
- Consider implementation of contactless bankcards to increase customer convenience and improve operational efficiency

Concession Fares and Affordability

- Limit seniors concession prices to off-peak travel times
- Continue to improve public transit offering, while implementing targeted, needs-based concession fares in collaboration with other levels of government

Approaches to implementing fare policies

- Fare policies have a large degree of inertia, and new schemes will be more comprehensible and more publicly acceptable if they build on existing principles
- Both substantive changes and the motivations behind new fare policies, should be proactively communicated with the public to help build acceptance

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Section #1: Background Information

1.1 - Introduction and Purpose

The Metro Vancouver Region has long been a leader in sustainable land use and transportation. A pivotal moment in Vancouver's sustainable transportation trajectory occurred in the late 1960's when Vancouver rejected a downtown freeway plan. Instead, the city actively pursued transit-oriented development with very limited growth in automobile capacity. Today the region is home to a robust public transportation network with growth policies that have encouraged densification along major transit routes and facilities.

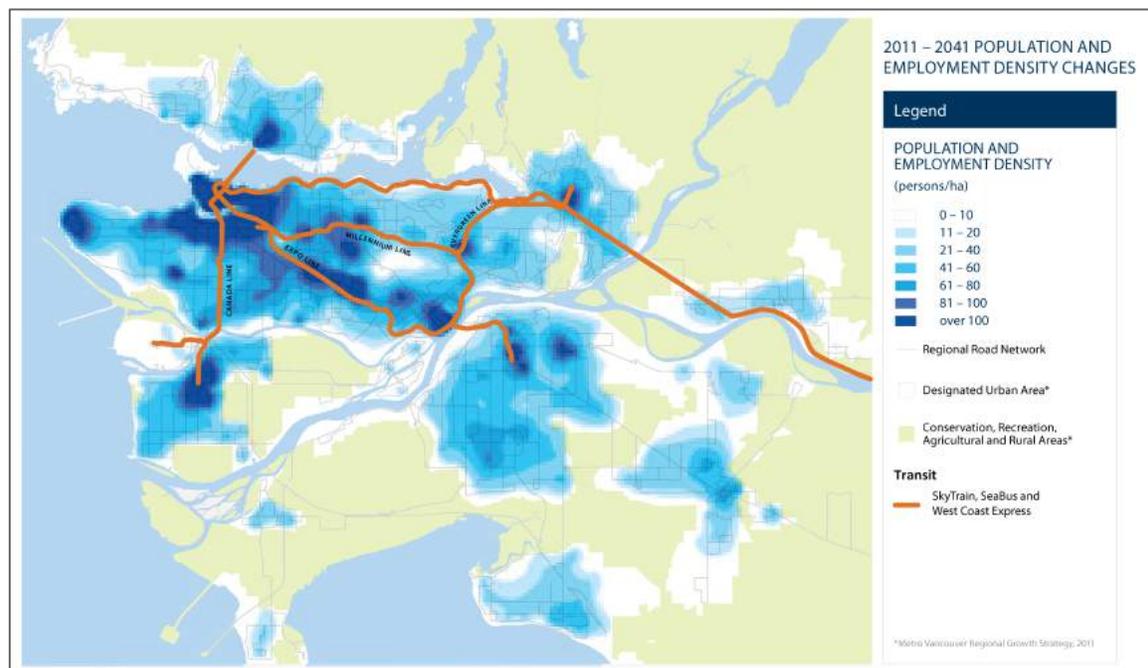


Figure 1 - Job and Population Densities (City of Vancouver 2011)

The current Metro Vancouver transit-pricing scheme has stayed largely unchanged since the current 3-zone system was introduced in 1984 (Popescu, 2015). Since then the region has experienced dramatic growth in jobs and population, expansion of the rapid transit network, and travel patterns have changed significantly. Polycentric travel patterns are emerging that are causing the three-zone system to become antiquated, and new taxes including the TransLink fuel taxes and carbon tax have helped transit to become more competitive with driving. These changes suggest that a review of the fare structure policy is long past due in order to ensure efficient use of the system and effective public transit.

In 2015 TransLink introduced the Compass Smart Card for payment of transit fares. The system has resulted in many immediate benefits including decreased fare evasion, increased passenger convenience, and decreased operational costs for TransLink. It has been widely adopted, and there are currently over one million active cards in circulation

that account for more than 94% of transit trips in the region (Translink, 2016a). As an added benefit, the Compass Card offers an opportunity to implement a new fare structure for transit in the region that will increase regional equity, improve efficiency of the system, and encourage sustainable travel decisions. The new fare structure will help accomplish the goals of both the Mayors' Transportation Plan and TransLink's transportation 2040 plan that call for a shift towards mobility pricing.

This report serves as a review of fare structures around the world and offers recommendations on how these various structures might be adapted to the Metro Vancouver Region.

1.2 - Methodology and Structure of the Report

Structure

This report begins with a review of the fare structure in Metro Vancouver, and highlights the strengths and weaknesses of the current state of affairs. The second section goes into detail on each research area of the report. Each research area begins with an overview, and is followed up by relevant case studies from around the world. Lessons from each case study are highlighted where appropriate. Each research area is concluded with recommendations for future fare policy changes in Metro Vancouver. The research areas include:

- Distance and Zone based Fare Differentiation
- Service Type-based Fare Differentiation
- Time of Day Pricing
- Fare Media and Modal Integration
- Concession Fares and Affordability
- Approaches to Implementing Fair Changes

The final section of the report outlines a proposed fare structure for the Metro Region that attempts to incorporate some of the recommendations, and offer a starting point for discussions.

HandyDart and West Coast Express

The report does not explore pricing strategies for HandyDart or the West Coast Express. HandyDart is an on-demand accessible transit service for those with specific mobility requirements. It has a separate fare policy from the rest of the system, and special consideration of HandyDart will be needed in the future. The West Coast Express is a premium commuter service that is similarly not part of the regular fare structure, and is already more advanced towards mobility pricing.

Compass Card Limitations

The report does not consider the limitations of the Compass Card and how that might impact the ability to offer various fare structures. There have been technological impediments that have thus far prevented tap outs on surface buses, and these will need to be addressed in future fare schemes. These limitations and the cost of implementing

various features will have to be weighed against the benefits offered before considering any changes.

Methodology & Best Practices City Selection

This report draws its case studies from seven international cities that were selected for in depth analysis. These cities were selected based on the range and diversity of their transit networks, novel fare products and policies, and the extent to which their current fare structure reflected a mobility-based pricing scheme.

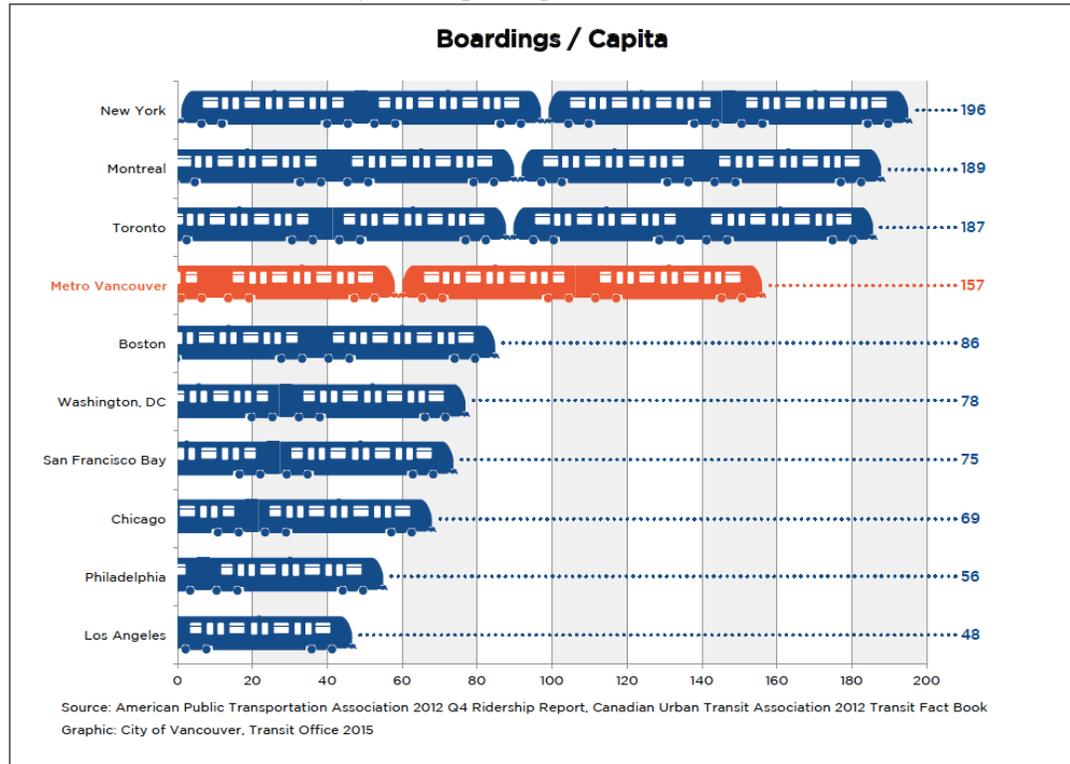


Figure 2 - Boardings per Capita of Major North American Metro Areas

Although the initial intent was to focus on North American cities, the best practices research ended up taking on a more international approach. This is in part because Metro Vancouver's public transit network is very well developed in the North American context. It has the fourth highest per capita ridership behind only New York, Montreal and Toronto, and both its governance structure and fare policy are already well advanced of many of its peers. In order to include a diversity of fare policy best practice policies, it was necessary to draw from world leading international cities.

List of In-depth City Studies

- Hong Kong
- Singapore
- Amsterdam
- Dresden
- Bremen
- London
- Washington

Following a thorough literature review and background research, 13 interviews were conducted with stakeholders in the selected cities. Interviewees were selected through a mix of purposive sampling (through internet searching), convenience sampling (through personal and collective social networks) and snowballing (asking participants to refer other potential interviewees). The interviewees included transit agency staff, oversight bodies, academics, and private transit operators. A list of interviews conducted is available in the appendix.

Interviews lasted between 30 and 60 minutes and included such questions as:

- How successful do you think your city's fare pricing is in terms of equity, revenue?
- What are the major benefits/deficiencies of the fare structure?
- What would you change?
- What is the public perception?

Other contextual questions were added for each city, and questions were asked in an open-ended fashion to encourage discussion.

1.3 - Current Metro Vancouver Transit Context

Fare Structure

Zones and Fares

Metro Vancouver's fare structure has oscillated between flat fares and more defined zone fare systems for the last 40 years. The number of zones peaked at 5 zones in 1974 and was subject to a regional flat fare for a short period in 1981 (Popescu, 2015). The current 3-fare zone was introduced in 1984 and has remained virtually the same ever since.



Figure 3 TransLink Fare Zones Map (Translink, 2013)

Metro Vancouver Single Journey Fares

	Regular Cash Price	Compass stored Value Price	Cash and Compass Concession Price
1 Zone Single	\$2.75	\$2.10	\$1.75
2 Zone Single	\$4.00	\$3.15	\$2.75
3 Zone Single	\$5.50	\$4.20	\$3.75
3 Zones – after 6:30 weekdays, all weekend	\$2.75	\$2.10	\$1.75
Surcharge when leaving YVR	\$5.00	\$5.00	\$5.00

Table 1 – TransLink Single Journey Fares (Translink, 2016b)

NOTE: All bus-only travel is one zone

Compass Cards can be obtained for a \$6 refundable deposit

Concession prices apply to:

- Children 5-13 years old
- Secondary students 14-19 years old with a GoCard
- Seniors 65+ years of age

Metro Vancouver Transit Pass Prices

	Regular Adult Price	Concession Price
Day Pass	\$9.75	\$7.50
1-Zone Monthly Pass	\$91	\$52
2-Zone Monthly Pass	\$124	\$52
3-Zone Monthly Pass	\$170	\$52

Table 2 – TransLink Monthly Pass Prices (Translink, 2016b)

Note: All Passes, except the day pass, must be loaded onto a Compass Card

Other Fare Products:

Name	Cost	Eligibility
U-pass	\$40/month	Mandatory group enrollment by post-secondary institution, initiated by student referendum.
BC Government Bus Pass	\$52/month	Registered disabled transit users can apply to BC government for annual pass
BC Bus Pass for Seniors	\$45/year	Low income seniors, disabled residents and other designated groups according to guidelines (British Columbia Ministry of Transportation, 2016)

Table 3 - TransLink Special Monthly Pass Prices (Translink, 2016b)

Time of Day Pricing

TransLink offers a coarse time-of-day discount by allowing 3-zone travel with the purchase of a one-zone fare after 6:30pm on weekdays and all day on weekends.

Current Transit Patterns

Transit mode share has been increasing in Vancouver over the last two decades, while car usage has been declining. This has been driven by strong investments in transit infrastructure and a limited supply of new roads in the Vancouver Region.

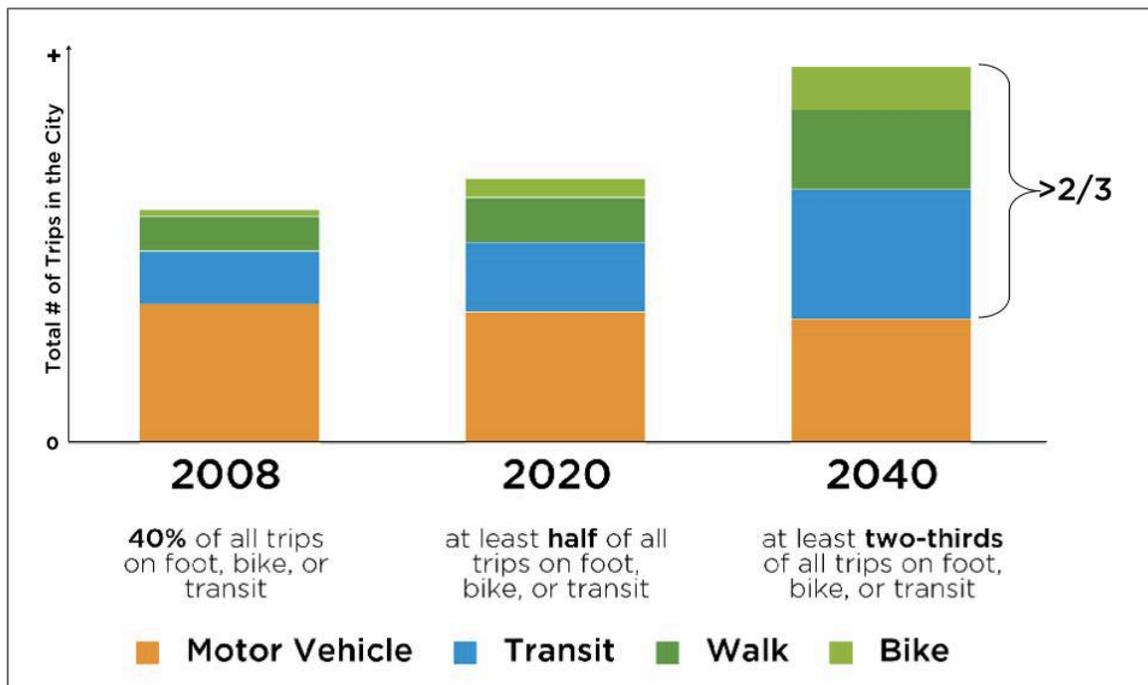


Figure 4 – Transit Mode Share for City of Vancouver (City of Vancouver, 2013, p. 34)

Time of Day

Transit trips in Metro Vancouver experience two major peaks during the morning and evening commutes. These peaks became more pronounced upon the elimination of the off-peak discount in 1997 (Popescu, 2015, p. 2).

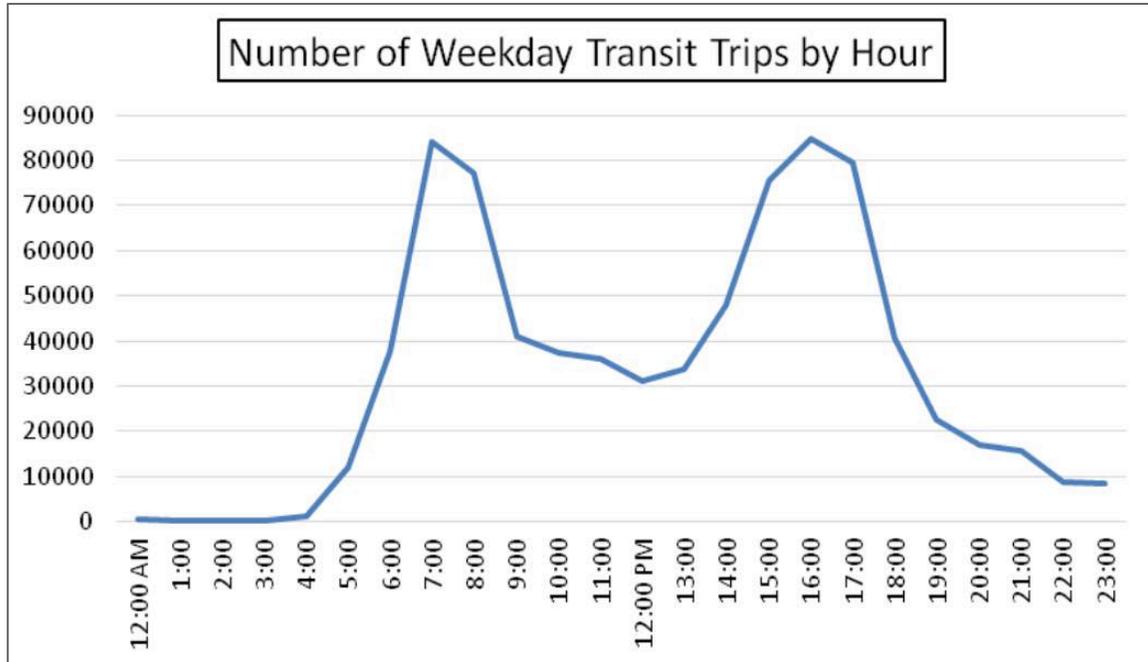
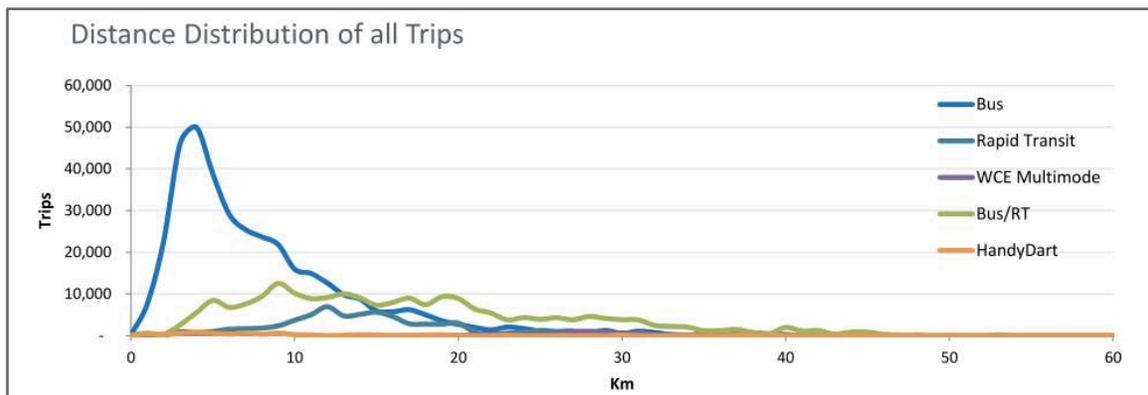


Figure 5 – Weekday Transit Trips by Hour (Tawfik, 2014, p. 32)

Distance Travelled

The distance travelled by transit passengers in the Vancouver Region is highly variable given its large service area. Bus-only passengers have a fairly low mean and mode distance, with a long tail skewing to longer distances. Multimodal bus and rail passengers as well as those taking rail only journeys have a higher mean and mode, with a greater variance in trip lengths.



Distribution of Trips by Distance - Figure 6 (Steer Davies Gleave, 2016, p. 10)

Analysis performed by Tawfik (2015) indicates that fares per unit distance decline the farther passengers are traveling on the system. The figure below shows the average fare per kilometer travelled by distance travelled. The other interesting takeaway from this

figure is that some short distance trips are over charged for the length of trip (those paying a 2-zone fare for 0-5 and 5-10km trips) and some are undercharged (those taking 10-15 and 15-20km trips on a one zone fare, as well as over 30km trips on a 2-zone fare). It is likely that there are further impacts of these pricing anomalies not represented in the ridership data. Some passengers are likely not taking transit because of the pricing structure, or finding ways to circumvent the price differential (i.e. walking or biking to the zone boundary to avoid the extra fare). These effects are very difficult to measure, as the trips are not taken and therefor impossible to count.

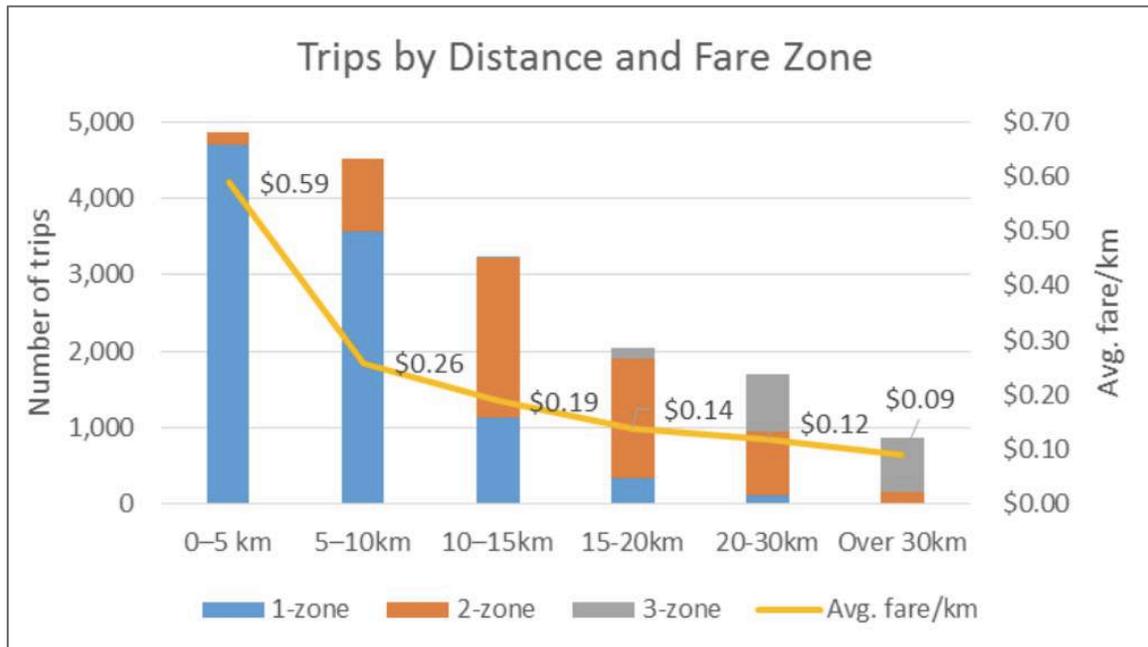


Figure 7 – Number of trips by Distance and Fare Zone (Tawfik, 2014, p. 32)

Benefits and Drawbacks of the Current Vancouver Fare Structure

	Benefits	Drawbacks
Zone System	<ul style="list-style-type: none"> - Easy to understand and display on a map - Zone boundaries follow logical geographic and municipal boundaries - Provides rough approximation of distance travelled 	<ul style="list-style-type: none"> - Zone system is subject to boundary penalty in which those making short trips across a zone boundary pay a relatively high fare - Antiquated concentric zones do not reflect more recent polycentric commuting patterns - Those in the City of Vancouver receive a significantly higher level of service than those paying the same 1-zone price in outlying areas
Fare Structure	<ul style="list-style-type: none"> - Customer friendly free transfer 	<ul style="list-style-type: none"> - Lack of automatic daily,

	<p>policy encourages efficient system usage</p> <ul style="list-style-type: none"> - Affordable daily and monthly transit prices 	<p>weekly and monthly fare capping</p> <ul style="list-style-type: none"> - Lack of time of day pricing fails to encourage efficient usage of system peak spreading
Concessions	<ul style="list-style-type: none"> - Provides affordable travel to some key demographics including students and children 	<ul style="list-style-type: none"> - Some concessions (UPass, seniors) lack appropriate distance based pricing price signals
Compass Card	<ul style="list-style-type: none"> - Excellent uptake and utilization of the compass card, accounting for over 94% of transactions as of July 2016, and over one million active cards in circulation 	<ul style="list-style-type: none"> - Tap off for bus travel was not implemented, resulting in lost revenue and incomplete origin-destination data

Table 4 – Benefits and Drawbacks of Current Fare Structure

Regional Strategies and Policy Contexts

Regional transportation strategies suggest that future transit pricing policies should move towards finer grained distance-based mobility pricing. The Mayors’ Vision states, “More refined time-and distance-based pricing for both transit and roads would greatly enhance system efficiency and fairness”. Similar language is used in the Regional Transportation Strategy, with Strategy 2.4 stating “As a priority, consistently apply mobility pricing to the transit system and to the road system to allow for more fine-grained variation in prices based on time, distance travelled or location.” (Cross, 2015).

1.4 - Generalized Cost of Travel

The generalized cost of travel is an economic concept that relates to the sum of the monetary and non-monetary costs of travel. This theory can be used to model which mode people are likely to take. It effectively takes all the different aspects of the decision to travel and converts them into dollar values in order to compare different options.

The concept of generalized cost of travel has important implications for decisions related transit pricing. Distance fares may at first glance seem like a fair way to approach pricing, however, as demonstrated below, there are many other aspects to travel decisions. Should a passenger that is traveling on a crowded, un-air-conditioned bus travelling in heavy traffic that comes once every 45 minutes be charged the same amount as a commuter travelling on a comfortable, half empty SkyTrain that is unaffected by congestion levels? The generalized cost of travel helps make explicit some of the other factors around commuters’ mode choice decisions.

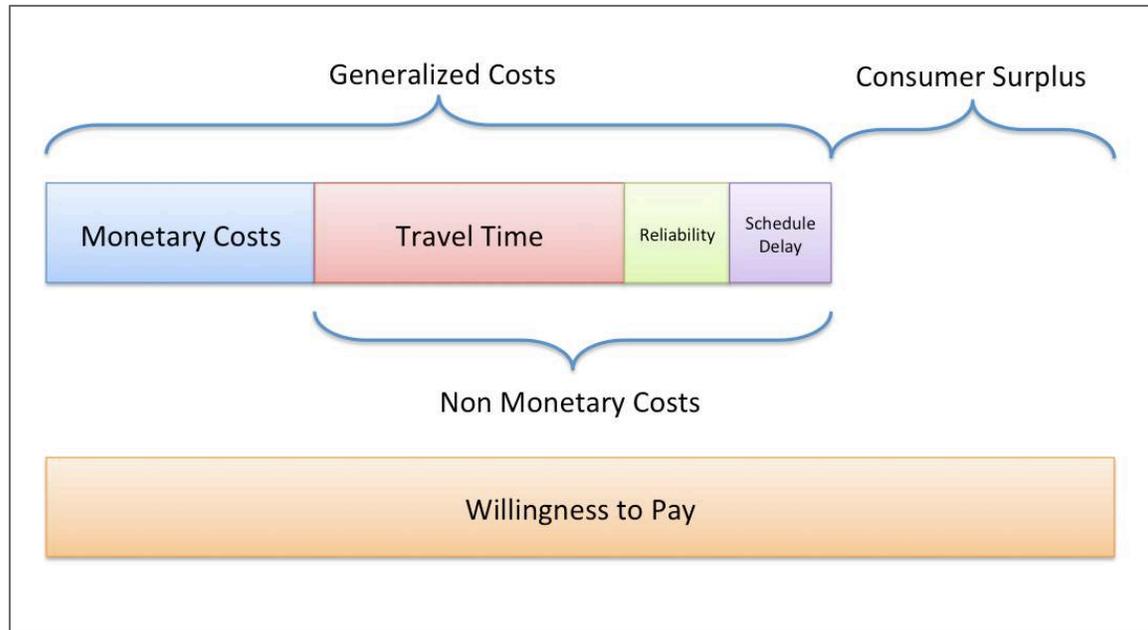


Figure 8 – Generalized Cost of Travel Description

Monetary Costs:

The monetary cost is the cash that an individual has to pay for travel. In public transport, the monetary costs are easily measurable as they are generally limited to the cost of the fare. For automobile travel, the costs become less straightforward as each trip includes a variable portion of gas, depreciation on the vehicle, insurance, road tolls, etc. Monetary costs are generally measurable and do not change based on the attributes of the traveller (the same trip taken in the same minivan would have the same monetary costs regardless of who is taking the trip).

Nonmonetary Costs

Travel time

Travel time is the cost of time expended during transit. Although travel time is measurable, it is different for each traveller as each individual values his or her time differently. For example, a father rushing to the hospital to attend his daughter's birth likely has a higher value of time than a retired person walking to the coffee shop. Also, even individuals' value time differently depending on the type of travel or purpose of the trip. The same individual may choose to take a 20 minute bus ride in which she can sit down over a 10 minute bus ride in which she is forced to stand, and these decisions relate to how individuals value their time for different trips.

Value of Reliability

If a trip time is unreliable, that imposes a cost on the user, and it will be factored into the travel decision. For example, if a bus is delayed by 20 minutes once per week because of bridge traffic, this added cost of travel may cause the bus passengers to seek alternative modes. This cost is different for different individuals, as some people have more tolerance for unreliability.

Schedule Delay

This is the cost of not being able to travel at the ideal time. If an individual wants to leave for their soccer game at 6pm, but the bus only leave at 5:45 and 6:15, this imposes a schedule delay cost on the user. This cost is specific to the individual as well.

Willingness to Pay & Consumer Surplus

This is absolute maximum that an individual is willing to pay to take a given trip, and the amount is specific to the individual. If the willingness to pay is greater than the generalized cost of travel then the difference is perceived as consumer surplus to the individual.

Travel Choice

Individuals will choose to travel if the generalized cost of one of their given travel options is less than their willingness to pay for the trip. If there are multiple options that are less than their willingness to pay, they will choose the travel mode with the lowest generalized cost.

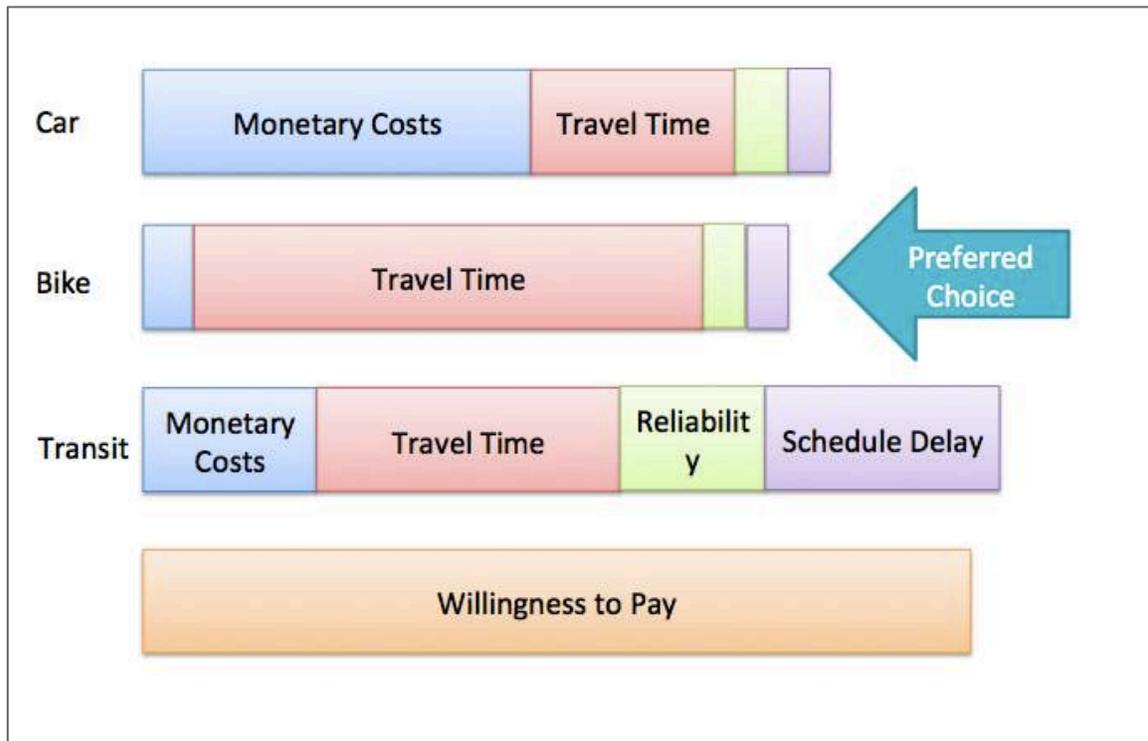


Figure 9 – Generalized Cost of Travel Comparison

Section #2: Research Areas

2.1 - Distance & Zone-based Fares

Distance is a key metric in transit networks, and many larger networks price their fares based on the distance travelled or some proxy thereof. The most commonly used proxy is zone-based fares where passengers are charged based on the number of zones boundaries they cross. In general, individuals have a higher willingness to pay for a longer distance trip, and distance based pricing allows transit agencies to capture more of the consumer surplus from each trip. It is therefore generally possible to achieve a higher revenue stream than would otherwise be possible than with a flat fare. The table below details some key benefits and drawbacks of zones and distance based fares.

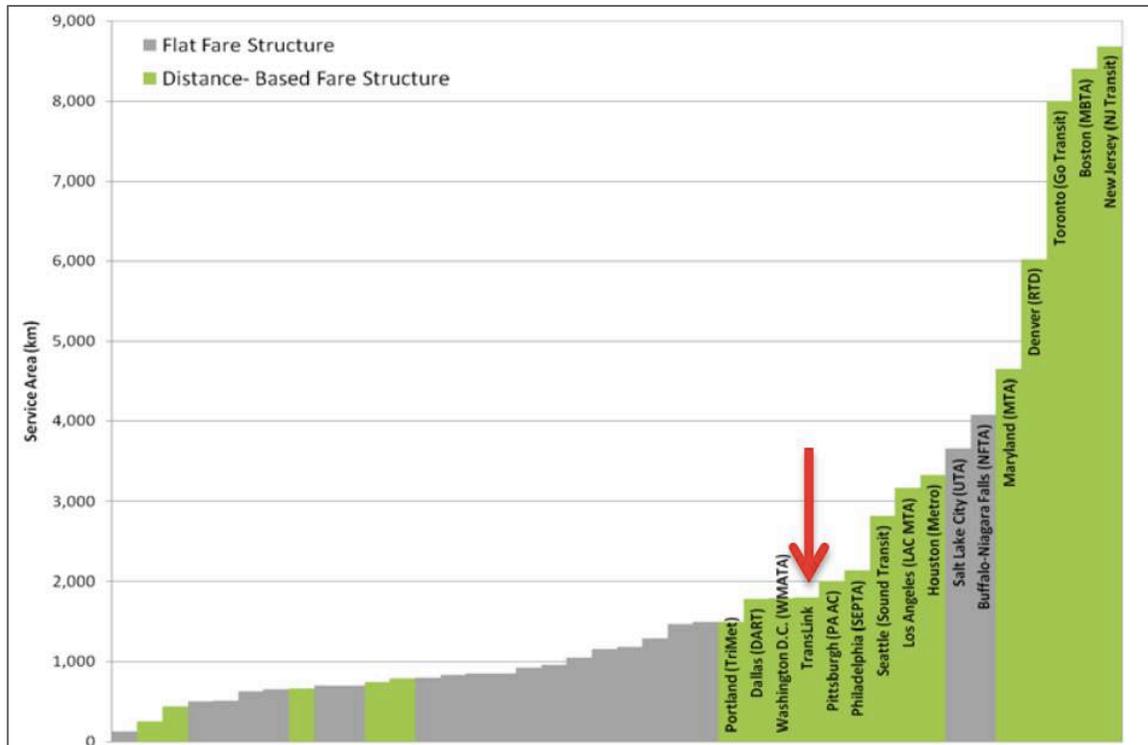


Figure 10 – Service versus fare structure of North American transit agencies (Popescu, 2015)

	Benefits	Drawbacks
Flat Fare	<ul style="list-style-type: none"> - Easy to understand and administer - Low technological requirements 	<ul style="list-style-type: none"> - Does not maximize revenue based on different passengers' willingness to pay - Lacks appropriate price signals that encourage efficient land-use and travel patterns
Zone Fares	<ul style="list-style-type: none"> - Provides some relationship between distance travelled and fares - Relatively easy to understand and depict on a map, resulting in price certainty for passenger - Can vary the zones size to compensate for level of service in areas where transit provision is more sparse 	<ul style="list-style-type: none"> - Subject to the 'boundary penalty' whereby those making a short trip across a zone boundary are charged more than those travelling a long distance within one zone - Zone boundaries can be difficult to establish and subject to political pressure - More difficult to administer, requires more advanced technology
Distance Fares	<ul style="list-style-type: none"> - Price and distance travelled can be precisely linked - Provides good price feedback for efficient travel choices 	<ul style="list-style-type: none"> - Very complex to administer, requiring sophisticated technology - Difficult to convey prices to customers for potential trips - Cannot be easily displays on a map - Uncertainty over cost for passengers for unfamiliar trips

Table 5 – Benefits and Drawbacks of various distance-based fare structures

Distance-based Fares:

Distance-based fares appear at first glance to offer a very efficient and fair way to collect fare revenue. However, there are several hurdles that quickly become apparent. Distance is only one metric upon which to measure the quantity of transit service being provided, as was discussed in the generalized cost of transit section. It is not obvious that a passenger receiving a high level of service to travel 10km in the core should pay the same amount as a passenger subject to a lower level of service in the urban periphery.

The generalized cost of travel for the passenger on public transit in a region with a lower level of service is likely much higher, while the generalized costs of auto transport would be lower due to reduced congestion, parking, and operating costs. This accounts in large part for the higher mode share of vehicles in more suburban areas. A uniform distance-based fare would likely benefit downtown residents who are already more regular users of transit while penalizing those places where level of service is lower.

In the Metro Vancouver context, the impact may be mixed on the Greenest City Goals of increasing sustainable mode share. Careful considering is needed when setting the base fare, per kilometer charge, and whether a uniform rate is charged per kilometer versus a decreasing rate. Those in downtown who already ride transit for short trips may end up paying less for a short trip for which they were willing to pay more, whereas those who previously biked and walked for short distances may end up shifting their trips to transit trips if the base fare is set very low. Conversely, those in the more suburban areas who could travel over long distances for a relatively low fare under the current zone fare may end up with higher fares, causing them to seek alternatives to transit. It is unclear how distance based fares might impact mode share, and a uniform distance pricing would likely have widely different effects based on the types of trips taken in various parts of the transit network.

One option may be to have differential per kilometer rates depending on where in the network passengers are travelling, but this runs into the problem of complexity and comprehension of the network. The case studies did not turn up any examples of distance-based fares that varied by place and, given the complexity, this would not be a recommended course of action.

How to calculate Distance Travelled

Singapore calculates the fare based on the straight-line distance between the start and end point of the trip (also known as the distance ‘as the crow flies’). This results in a fare that is the same from one point to another, regardless of the route or mode chosen. One challenge with this type of calculation is passengers that take circuitous routes to their destination in order to accomplish tasks en route during their free transfers. This would be less of a problem in Metro Vancouver given that the time-based fare allows passengers the flexibility to accomplish tasks en route.

Amsterdam, on the other hand, calculates the distance based on the route the passenger takes along the transit network. This means that a fare can be different from one place to another depending on the route and modes taken. This has resulted in complications whereby passengers were overcharged for detours taken by the vehicle due to road works or events, and may lead to confusion over the exact price of different journeys.

Washington takes a hybrid approach, charging based on the average between the crow flies distance and the route network.

Zone based Fares

Zone based fares are often used as a proxy for distance because they are easier to administer, and because they are more readily understood by transit users. Depending on the geography and the nature of the transit system, zones can be organized based on service areas of different agencies (Toronto – not studied), in concentric circles around the downtown core (London), or in a honeycomb or grid pattern of approximately equal areas (Dresden, Amsterdam).

Zones offer the added advantage of being variable in size. In many regions with zone-based fares, zones are larger in more suburban areas where level of service may be lower. This effectively decreases the rate at which passengers are charged per kilometer, and this flexibility can be a useful tool with which to help achieve transit goals.

Border Penalty

Zone based fares can create geographic inequities based on the delineation of zones. In Vancouver, those making a short trip across the Vancouver-Burnaby border are charged a two-zone fare, whereas those taking much longer trips within the city limits of Vancouver are charged a lower fare. Similar examples exist across the network.

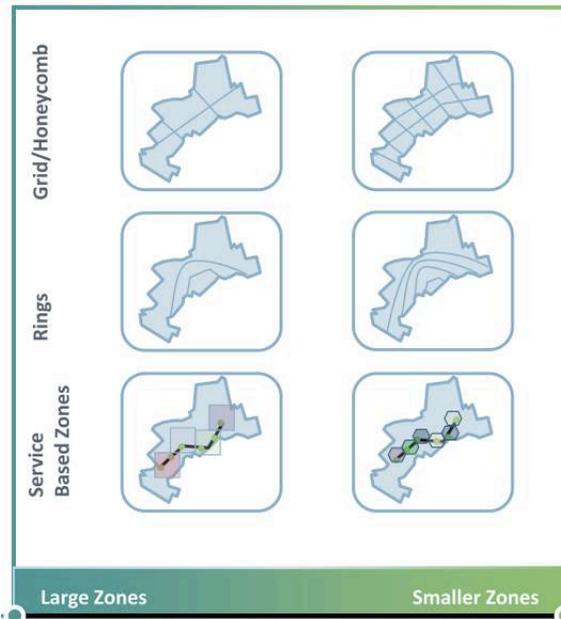


Figure 11 - Zone-based fares (Steer Davies Gleave, 2015, p 21)

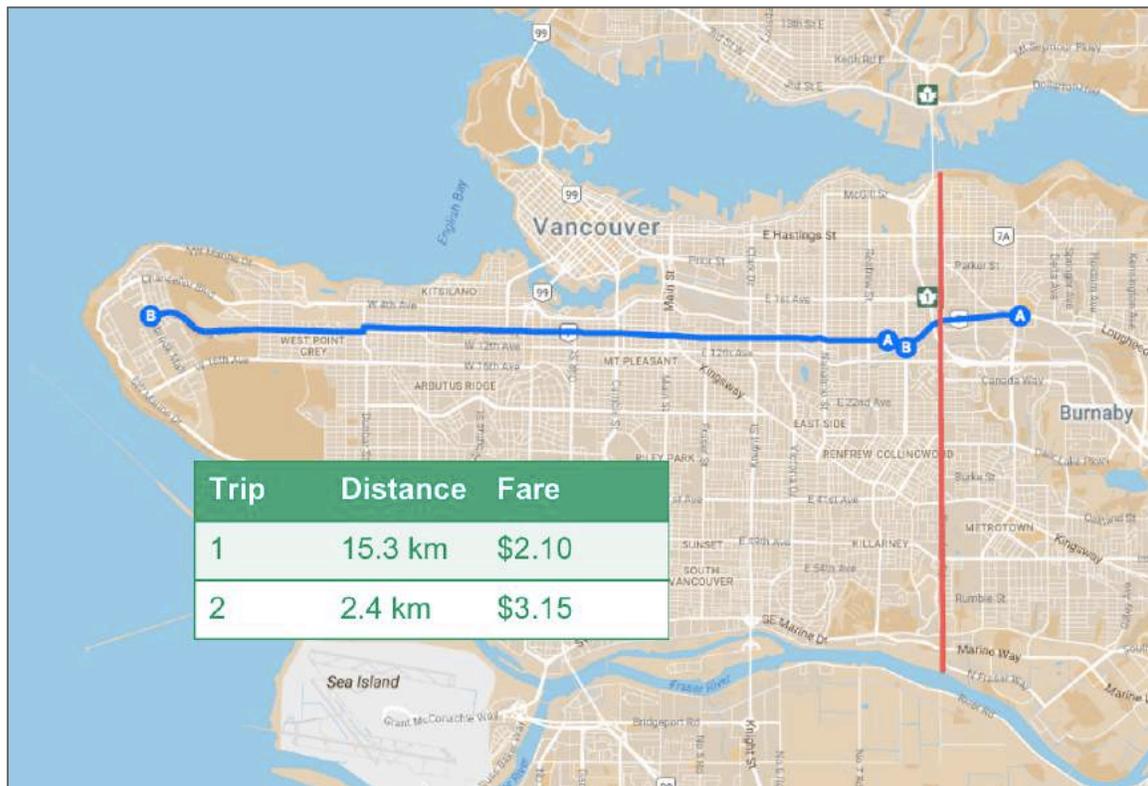


Figure 12 - Example of Border Penalty (red line represents zone boundary)

Transit agencies have various methods for reducing the border penalty. Some cities have created transition zones at the boundary where you can travel for one fare, while in other cities the cheapest transit fare includes a minimum of two zones, thus preventing a very

short trip from being charged a higher fare. This does not solve the boundary problem altogether, but reduces the effects.

Case Studies

London – Zoned Based Fares

- Concentric zone system with pricing driven both by distance and demand management considerations
- Premium pricing for relatively large zone one

London moved from a mish-mash of zones and point-to-point fares that varied between rail lines to a uniform zone based system in 2007. Most rail services in London now operate under the zone system, though some suburban services run by the National Rail services still exist outside the zone system. Bus passengers are charged a flat rate that is not integrated with the rail and tube fares. The most recent simplification of zone fares in 2007 led to an almost immediate increase in ridership of about 5% over and above what might otherwise have been expected from the change in fares (Bellenger, 2016).

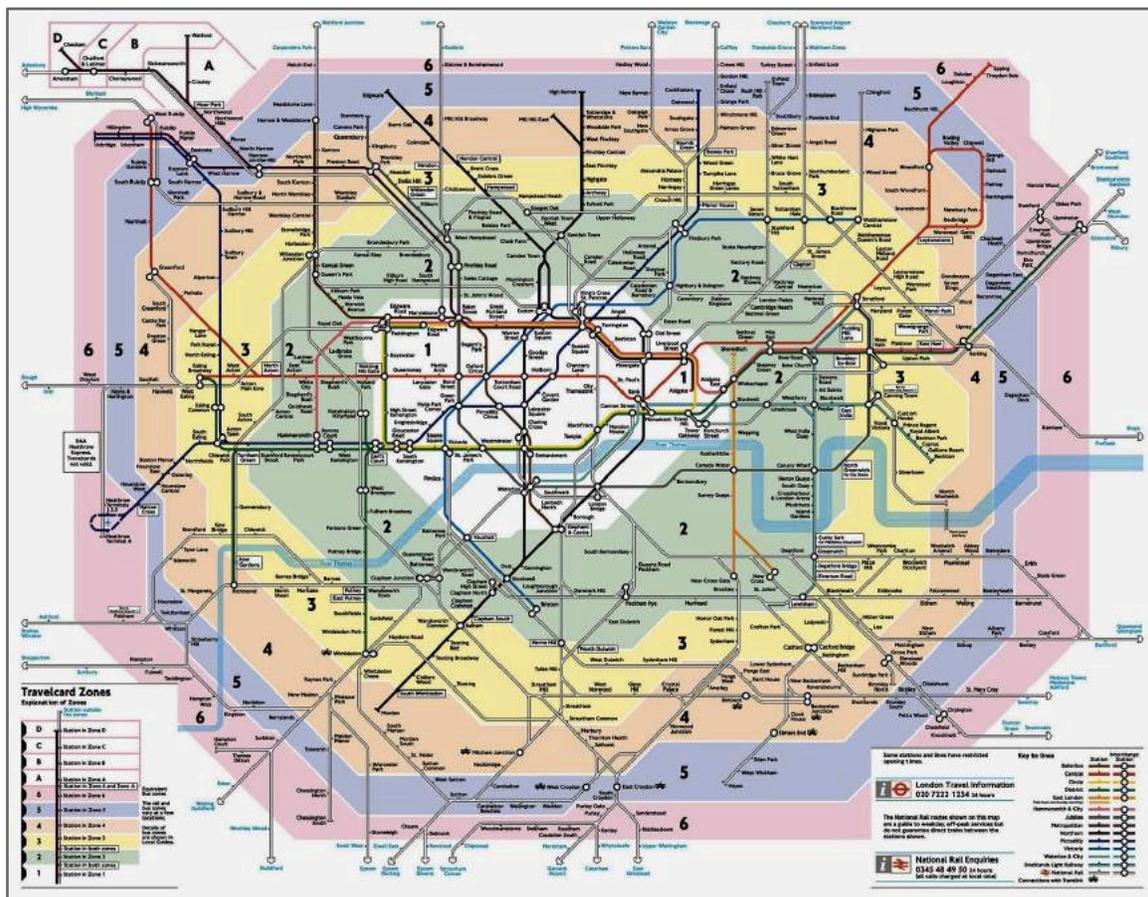


Figure 13 – London Transport Zone Map (Transport for London, 2016a)

The zone fares have been devised in such a way so as to provide a combination of travel demand management as well as pseudo-distance based fares. The travel demand management function is necessitated by the fact that the central zone one is very

crowded, particularly so during peak travel times. The large central zone is priced at a premium compared to the outer zones, as can be seen from the chart below.

Peak London Transport Rail Fares (£)

Zone	1	2	3	4	5	6
1	2.40	2.90	3.30	3.80	4.60	5.00
2		1.60	1.60	2.30	2.70	2.70
3			1.60	1.60	2.30	2.70
4				1.60	1.60	2.30
5					1.60	1.60
6						1.60

Table 6 – London Peak Rail Fares by Zone (Transport for London, 2016b)

When travelling from a one extent of an outer zone to the other extent, significantly cheaper fares are offered if the trip can be made without traversing the central zone in order to decrease ridership through the most congested part of the network. Transport for London Pricing and Forecasting Manager Adrian McMullan remarks that “the more congested central area is priced at a premium in order to even out valuable capacity, and people understand the demand management needs behind that” (McMullan, 2016).

Example Demand Management motivated Zone Fares

Journey	Distance	Price through Central London	Price avoiding Central London
Willesden Junction to Camden Town	7.6km	£2.90	£1.70
Willesden Junction to Paddington	5.2km	£2.90	N/A

Table 7 – Example of London’s Demand Management Fare Zone Pricing

For a discussion of bus fares in London, see the London case study in “Fare differentiation by service type” section.

Lessons for Metro Vancouver

Much of London’s peak hour commuting consists of suburban dwellers travelling to their jobs downtown, and the largely radial structure of the rail network is reflective of this. Given that much of the rapid transit is oriented radially, the concentric zone structure oriented around central London provides a relatively good proxy of distance travelled.

In downtown London, very high costs of ownership of personal vehicles combined with a peak congestion charge for vehicles encourage high sustainable mode share in spite of very high transportation costs. Although Metro Vancouver lacks the congestion charge and has lower vehicle costs, public transit is reasonably competitive in the core given high parking costs and congestion levels. There may be an opportunity to follow London’s lead with a high charge for the central area without losing significant ridership in order to

increase overall revenues. A higher fare would also be reflective of the higher level of service that downtown public transit users are afforded.

The zone system in London provides a good model for Metro Vancouver to follow, and the incremental pricing of the zones reflects the level of service in the zones. Further, non-peak, non-central rail trips are priced quite low to encourage travel by transit in areas and times when private vehicles are likely to be a more competitive option. This increases overall ridership and increases sustainable mode share while collecting sufficient revenue to cover costs.

Amsterdam

- Distance based fares for single journeys
- Complex honeycomb zone based system for monthly pass holders
- Monthly discount card for frequent transit users

Amsterdam implemented the OV-Chipkaart beginning in 2007, and the card is now valid nationwide across Holland. It replaced the antiquated Stripkaart system in which passengers were required to validate the required number of tickets for their journey upon boarding. The OV-chipkaart is accepted on all modes of public transport, though each municipality is subject to its own fare structure.

Amsterdam Single Journey Fares:

Total fare: €0.90 Base rate, plus €0.154 per km. (~CAD \$1.31 + \$0.22/km)

The single journey fares are distance-based with a uniform fare structure across the region. The fares are integrated with no transfer penalty for switching modes or service provider. Passengers are required to tap on and off each mode travelled, with a 30-minute window allowed for transfers. Distance is calculated along the path travelled by the transit vehicle rather than as the crow flies distance.

Period passes

GVB-Only Monthly Passes: €91 per month (~ CAD \$ 132)

GVB is the municipal transit service provider in the City of Amsterdam. The GVB-only pass is valid for all services run by GVB including buses, trams, and subways. It does not include travel on regional trains or other service providers.

Randstad Noord Zone Monthly ticket:

- 1 star monthly € 50.20
- 2 star monthly € 81.50
- 3 star monthly € 121.90
- 4 star monthly € 159.10
- 5 star monthly € 197.30
- 6 star monthly € 234.20

The Randstad Noord tickets are valid based on the number of zones a passenger travels through. The least expensive ticket is the one-star ticket that is valid for the user designated central zone plus one zone in each direction around the central zone. A two star ticket is valid within a radius of two stars around the central zone, and so on.

In the example below, an individual's home and workplace are separated by 3 zone boundaries. In order to choose a pass that would accommodate her work commute, the passenger would choose an intermediate zone as the central zone, and purchase a two star ticket in order to include both her home and workplace in the area of validity. The two-star pass would be valid in all zones marked with either one or two stars.

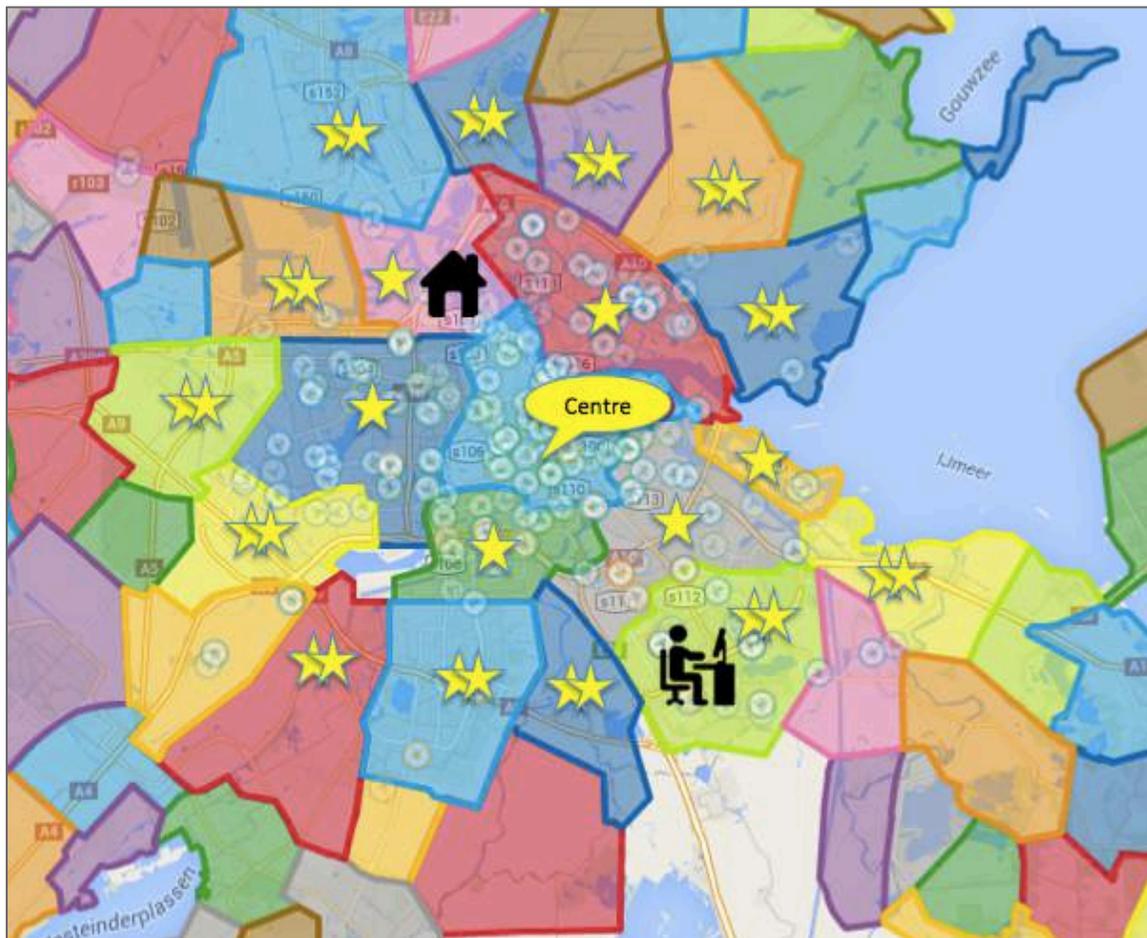


Figure 14 – Amsterdam Zone Map with Monthly Pass Validity (Adapted from GVB website: <http://maps.gvb.nl/nl/zones>)

Professor Niels van Oort, a professor of transportation engineering at Delft University, Netherlands, remarks that “most Dutch people don’t understand the system even”, while the head of the urban planning program at the University of Amsterdam notes that “As a very infrequent user I can only say it is on one hand easy (paying is by means of transit smart card valid in all of the Netherlands including the national railway network), but what and why is exactly detracted each time is much of a black box.” (Oort, 2016)

Altijd Korting (National “Save All” Card) - €17.50 per month

The Altijd Korting, or ‘Save All’ card, is another form of monthly discount in which users buy a monthly pass that entitles them to a 20% discount on all public transit nationwide. Professor van Oort sees the municipal transport agency moving towards this type of monthly pass in the future, and away from the zones. It offers both simplicity over the zone system as well as appropriate price signals for intensive and longer distance transit users.

Lessons for Metro Vancouver

The integrated fare structure for Amsterdam and the surrounding region was a significant achievement, bringing together dozens of transit operators under a single fare structure and providing customers with the convenience of one payment system. The system, however, is stuck between two eras, a mobility-based distance fare for single journeys, and an antiquated zone structure for monthly passes that is difficult to understand. Vancouver is fortunate to have achieved an integrated regional fare structure under a single agency, and has the opportunity to leapfrog ahead of this complicated dual system.

The “Save All” card provides an interesting example of what a true mobility pricing future might look like. An unlimited monthly pass provides no price signals to pass holders given the zero marginal cost of each additional trip. A ‘Save All’-like card, on the other hand, could strike a balance between rewarding regular passengers and providing appropriate incentives to passengers. Regular passengers could purchase a loyalty card in order to gain varying levels of discount for transit trips. This would encourage transit use while at the same time provide effective incentives to discourage marginal trips.

Advantages of the ‘Save All’ type card:

- Inherent price signals for marginal trips
- Rewards regular transit users
- Relatively easy to understand

Drawbacks

- Price uncertainty for individual trips as well as monthly budgeting
- Public acceptance may be challenging
- Precedent for ‘all you can eat’ passes in Metro Vancouver

Finally, Amsterdam is in an enviable position of having an incredibly high mode share. Public transportation improvements and policy changes are generally aimed at decreasing the mode share of cars; however, improvements often come at the expense of walking and cycling mode share (Oort, 2016). Careful attention should be given in Metro Vancouver as to how transit improvements and fare policy is affecting sustainable mode share, particularly in those neighborhoods that already have a high walking and cycling mode share. Analysis and modeling needs to be completed at the micro level with neighborhood specific parameters in order to provide meaningful results.

Dresden

- Single fare zone inside relatively small central municipal boundary
- Honeycomb zone-based fare for suburban and regional travel, with premium pricing for central zone

Dresden public transit operates within the context of a larger region that has many different service providers. The fares media and pricing policy are integrated into a region-wide smart card system. The City of Dresden operates under a single zone, with a mosaic of honeycomb shaped zones radiating from the central municipal zone.

	<p>Preisstufe A 1 Tarifzone (gemäß Fahrausweisdruck) außer Tarifzone Dresden</p>
	<p>Preisstufe A Grenzraum (gemäß Fahrausweisdruck) Der Grenzraum erweitert nicht die Gültigkeit der Tarifzone.</p>
	<p>Preisstufe A.1 Tarifzone Dresden</p>
	<p>Preisstufe B 2 benachbarte Tarifzonen (gemäß Fahrausweisdruck)</p>
	<p>Preisstufe C 1 Tarifzone und alle umliegenden Tarifzonen (gemäß Fahrausweisdruck)</p>
	<p>Preisstufe D Verbundraum</p>

Figure 15 – Dresden Fare descriptions (in German) (Deutsche Bahn Ag, 2015)

The Table below shows a simplified fare structure for the city of Dresden. The higher monthly pass prices for the city of Dresden reflects the higher level of service provided to the urban area than in the more suburban outlying areas. Some towns outside Dresden offer other fare products, and a number of other tickets exist for bikes, dogs, night services, and various concessions. The full regional fare policy as well as detailed zone

maps can be found in a 64 page German only PDF document on the DVB website (Dresdner Verkehrsbetriebe AG, 2015).

Fare Structure

Fare Type	Single Fare	Monthly Pass
A1 – Dresden Only	€2.30	€59
A – Any one zone outside of Dresden	€2.30	€49
B – Any two zones	€4.10	€86
C – Dresden and all adjacent zones	N/A	€129
D – Valid across all zones in the region	€8.20	€170.50

Table 8 – Dresden Transit Fares (Deutsche Bahn Ag, 2015)

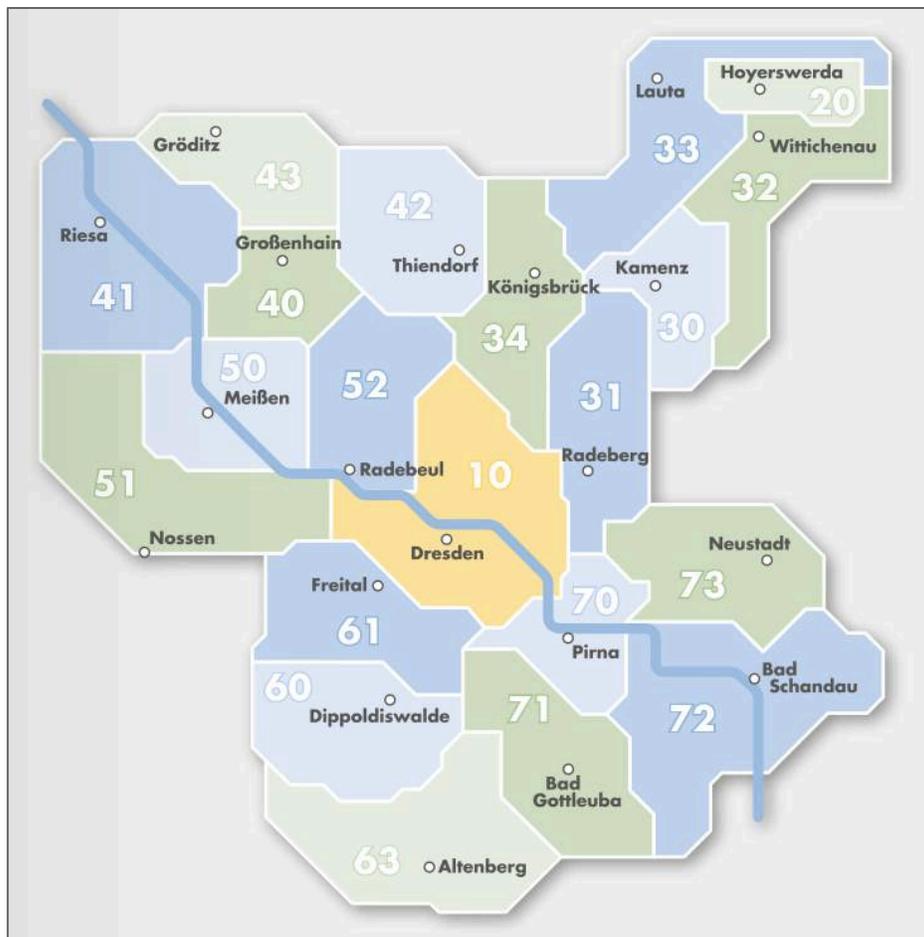


Figure 16 – Dresden Transit Zone Map (Dresdner Verkehrsbetriebe AG, 2015)

Dresden's zone structure is subject to the boundary penalty problem, and a 'Grenzraum' transition between each zone has been created in order to decrease the severity of this penalty. Transit trips that are completed entirely in the transition zones are only subject to a one-zone fare. The transition zones can be found by visiting the DVB website and using the fare finder tool. The diagram below gives an example of how the Grenzraum transition zones.



Figure 17 – Dresden Boundary Tariff Description (Dresdner Verkehrsbetriebe AG, 2015)

Lessons for Metro Vancouver

The Dresden public transit has gone to great lengths to make transit pricing fair for all, but this has often come at the expense of simplicity and legibility. The extensive 64-page fare guide is indicative of the complexity of the fare structure, and the 'Grenzraum' transitional zones are difficult to communicate to users absent a complex online trip planner.

Nonetheless, there are some interesting takeaways from the Dresden zone system. The differential pricing between the suburban and urban areas offers a potential model for Metro Vancouver to follow, and it may help to grow ridership in areas less well served by transit. The honeycomb fare structure ensures that those users making high-value long distance trips within the suburban areas and charged appropriately.

Singapore

- Distance-based fares for single journeys, integrated across modes
- Single zone monthly pass

Singapore has a very well developed public transit system and strong demand management programs to limit personal automobile usage. Its metro system has always had distance based pricing, and non-integrated bus fares were charged in stages. In 2010 Singapore moved to complete integration of fares in which passengers paid the same price for a given distance travelled regardless of the mode or number of transfers made. This allowed for more flexibility and greater choice in how customers can plan their journeys (Public Transport Council of Singapore, 2016).

Single Fares:

The base minimum fare of SGD \$0.79 (~ CAD \$ 0.77) is charged for any distance up to 3.3km, with an additional distance portion charged in one-kilometer increments. There is a decreasing marginal cost per kilometer with increasing distance, and this effectively subsidizes longer distance riders. Some express services are subject to a higher distance based fares that are not detailed here.



Figure 18 – Singapore Integrated Transit Fares (Singapore Land Travel Authority, 2016)

Monthly Passes – SGD \$120 (~ CAD \$117)

Singapore's Monthly Travel Passes operate under a single zone, and are valid for all modes of transport in Singapore. The monthly pass, therefore, does not provide any price signals to consumers that would encourage efficient transportation patterns or efficient work-home locational decisions.

Lessons for Metro Vancouver:

Singapore's integrated distance-based fares create a convenient and efficient public transit system. The cost of transit is relatively cheap in Singapore, whereas personal automobile usage is very expensive. Given the cheap cost of transit, most passengers are not particularly concerned if they do not know the exact price of each trip prior to taking it (Jain, 2016). In Vancouver where transportation is comparatively more expensive and relatively less competitive with driving, price certainty of public transit likely takes on greater importance.

The decreasing marginal cost per kilometer in Singapore could be an effective way to increase the attractiveness of longer transit trips that are typically more competitive by personal vehicle. This is already the case with the current fare structure, and should be encouraged in any future fare structure (see Distance Travelled figure in the Current Transit Patterns section). However, whereas in Singapore there is a relatively good level of public transit across the entire city-state, the level of service varies widely in Vancouver. A uniform fare structure for Vancouver would likely not lend itself to maximum mode shift towards transit given the varying conditions in Metro Vancouver. Finally, the single zone monthly pass would be a shift away from mobility pricing and contrary to the aspirations of the city and regional plans.

Washington DC

Washington's regional transit authority charges a combination of flat and distance based fares. The relatively extensive rail system is charged based on distance and time of day, whereas the bus fares are charged based on a flat fare and do not change throughout the day. For a discussion of fare differentiation based on time of day and service types in Washington, see the appropriate sections of this report.

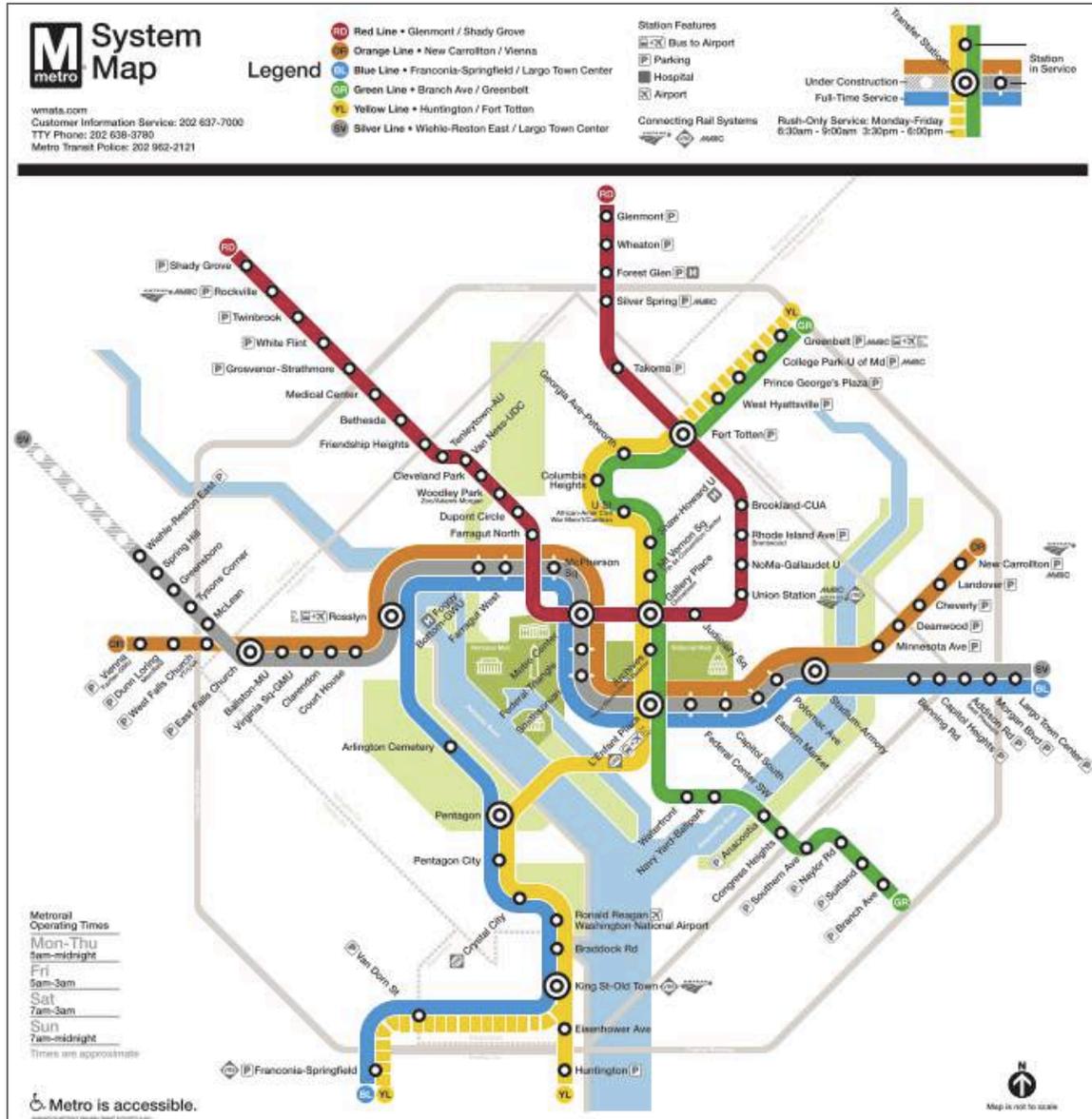


Figure 19 – Washington DC MetroRail Map (Washington Metropolitan Area Transit Authority, 2016a)

Single Journey Fares

(US\$)	MetroRail		MetroBus
	Peak	Off-Peak	All times
Boarding Charge (includes first 3 miles)	\$2.15	\$1.75	1.75 Flat Fare
Per mile (for miles 3-6)	\$0.32	\$0.24	N/A
Per Mile (for miles 6 to max fare)	\$0.28	\$0.21	N/A
Max Fare	\$5.90	\$3.60	N/A

Figure 20 – Washington DC Transit Fares (Washington Metropolitan Area Transit Authority, 2016c)

Notes:

- Bus to bus transfers are free within 2 hours
- Bus to rail and rail to bus transfers receive a \$0.50 discount on the otherwise un-integrated fare
- No transfer penalty for rail fares, and distance is calculated based on the average between the straight line distance and distance travelled along the transit network.

Monthly Passes

The Washington Metrorail avoids the use of Zones by offering passes that are valid for trips up to a certain monetary value. Each pass is valid for specific service types up to the maximum monetary value of the single journey fare as indicated. The distance covered by the pass depends on the time of day, as during off-peak hours both the boarding charge and per mile charge decreases. This allows pass holders to travel farther with the same pass during off-peak hours.

Name of Pass	Length of Validity	Validity on Rail	Validity on Bus	Price
One Day Pass	1 day	Unlimited	Yes	\$14.50
7-Day Fast Pass	7 days	Unlimited	No	\$59.25
7-Day Short Trip	7 Days	Trips up to \$3.60 in value	No	\$36
7-Day Regional Bus	7 Days	No	Yes	\$17.50
28-Day Fast Pass	28 Days	Unlimited	No	\$237
Metro SelectPass	One Calendar Month	Trips up to \$3.75 in value	Yes	\$180
Metro SelectPass	One Calendar Month	Trips up to \$2.25 in value	Yes	\$126
Metro SelectPass	One Calendar Month	Trips up to \$3.75 in value	No	\$135
Metro SelectPass	One Calendar Month	Trips up to \$2.25 in value	No	\$81

Table 9 – Washington Transit Pass Prices (Washington Metropolitan Area Transit Authority, 2016c)

Lessons for Metro Vancouver

The Washington Transit passes offers a compelling example of how period transit passes might work under a distance-based fare system.

Advantages:

- Zone of validity expands outside of peak hours given lower fares
- No need to choose zone of validity
- In case of travel beyond the validity, only marginal per distance fare is charged
- No need for complicated zone map

- No zone boundary penalties

Disadvantages:

- Would not work in tandem with existing 2 hour free transfer policy
- Need to have relatively complete understanding of distances to understand zone of validity

Recommendations on Distance-Based Pricing for Metro Vancouver

1. Each city's pricing structure reflects the unique nature of their particular transit infrastructure, demographic and social profile, and political system. None of the case studies offer a 'plug and play' solution for Metro Vancouver
2. The advantages of implementing distance-based fares should be weighed against the costs of customer comprehension, simplicity, and flexibility offered by zone-based fares.
 - a. A uniform fare per distance does not reflect the varying levels of service over TransLink's service area, and may not result to greatest transit mode share.
 - b. Distance-based fares present barriers to passengers' certainty over fares prior to riding, and this uncertainty creates a barrier to using public transportation in the general public as well as equity implications for low-income riders
 - c. Moving to distance-based fares needs to be considered in tandem with monthly pass structure, as some fare structures are not compatible with all-you-can-ride passes
 - d. If implemented, distance fares should have decreasing marginal cost per kilometer in order to reflect current system trends and to encourage longer distance trips by transit
 - e. Careful consideration should be given to the level of base fare in order to balance the attraction of public transit with walking and cycling
3. Zone-based Fares:
 - a. Rapid transit services are oriented radially and, as such, a concentric zone system may be a good way to match fare with level of service provided
 - b. There are many options for compensating for the boundary penalty, most involve a tradeoff with simplicity and legibility of the system

2.2 - Service Type

Some transit agencies worldwide differentiate fares based on service types. There is no definitive list of service types, and all modes exist on a messy continuum that has general tendencies. For example, some LRT's like Toronto's streetcar network provide slower more local service in mixed traffic, whereas Calgary's LRT operates on a dedicated right of way and would likely be considered more on par with rapid transit.

Type of Service	Distance	Characteristics	Market
	20 + km	High speed between urban centers	Long distance Commuters
	5-25 km	Dedicated right of way, High speed & reliability	Medium to Long distance trips
	2-12 km	Express Buses, LRT, Streetcar, Prepaid fares	Medium trips
	0-5km	Local service	Local trips and connections to rapid transit

Figure 21 – Service Type Description

There are various motivations for charging based on type of service including:

- Increased cost of providing higher level of service
- Increased willingness to pay, and potential for higher revenue
- Subsidize more local service in order to provide a minimum level of service at affordable rates to disadvantaged and lower income passengers

Metro Vancouver has chosen not to pursue service based fare differentiation in large part, though there are nonetheless several examples. The West Coast Express provides a premium service for rush hour commuters at a higher cost than the equivalent trip on local and rapid transit. Somewhat unintended fare differentiation by service type was created through the move to one-zone buses. In response to the difference in price between the two zone SeaBus and the equivalent one zone bus journey, ridership on the SeaBus dropped as passengers shifted to the more economical bus service (Mui, 2016).

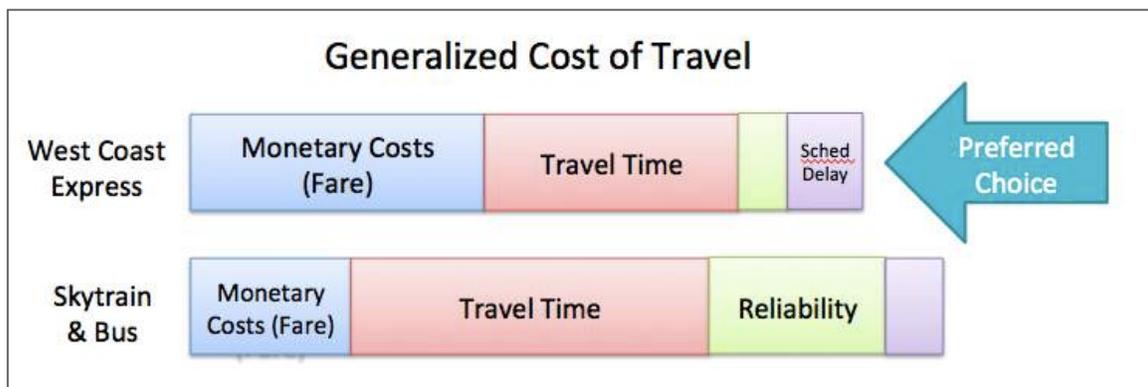


Figure 22 – Service type – generalized cost comparison example

Case Studies

London

- Integrated distance based pricing across rail services
- Single flat fare on buses, with no free transfers
- Bus travel generally used for short journeys primarily because of longer travel time compared to rail

Mode	Bus	Rail
Fare	£1.50	£1.60-£5.00
Type of Fare	Flat	Zone
Integration	No – pay for each bus taken	Yes – free transfers between lines

Table 10 – London transit fares by mode (Transport for London, 2016b)

London has integrated zone fares for most rail services (see Zone and Distance based Fares section). The buses, on the other hand, have a flat fare structure that is separate from rail fares. There are several reasons for this discrepancy:

- The low flat fare encourages public transit users to take the bus for short trips that are best served by bus. The differential fare, therefore, is in part a demand management strategy to divert users away from the congested tube network (Metz, 2016)
- The entry and egress to tube stations on escalators and stairs can be very congested, particularly in older stations. Bus travel can be competitive for short journeys when considering the vertical travel time within stations, and cheaper flat fare buses help the transport authority save the entry-egress capacity for higher value, longer distance travellers (Allsop, 2016)
- The busy network of double decker buses with high turnover do not lend themselves well to tapping off that would be required for distance-based travel (Allsop, 2016)
- The buses serve as an alternative for low income travellers who may find tube fares unaffordable (Bellenger, 2016)
- Buses are mostly used for short journeys because it is much slower than rail-based journeys, and the rail network is sufficiently extensive to provide good service to most parts of London
- Professor Peter White notes that “the case for price differentiation is weak given that trip length distribution is highly skewed with low mode and mean averages” (White, 2016)

Several stakeholders acknowledged, however, that those bus users who take more than one bus to their destination were disadvantaged by the requirement to pay additional flat fares for each bus used. London’s new mayor has recently committed to the implementation of a timed bus fare with free transfers to eliminate this inequity.

Lessons for Metro Vancouver

The London example of fare differentiation on service type is particular to its context, and in many ways is not applicable to the Metro Vancouver situation. In London, buses provide a cheap and easy substitute for short rail journeys, whereas for longer journeys the bus is not a competitive substitute for rail travel. In Metro Vancouver the bus network is an integral part of the network that compliments rather than substitutes for rail transit. Given the limited rapid transit network, buses are the only option for many places inaccessible by rapid transit. Finally, there is a significant convenience factor to be gained through integrated rail and bus fares in Metro Vancouver given the complementarity of the system.

Hong Kong

- Distance-based, integrated fares for rail journeys
- Non-integrated fares for bus services driven primarily by commercial considerations of the private bus franchises
- Bus fare structure varies depending on which private service provider, type of service, and type of users

Hong Kong has distance-based fares for its rail network. The non-integrated bus network is franchised to several private bus companies, each with their own fare structures. The fare structures vary by company and by route, and include flat fares, zone fares, and time based fares.

The fare differentiation based on service type in Hong Kong is an artifact of a long history of private transportation. Bus fares reflect the willingness to pay of the passengers more so than the actual cost to provide the service or the length of service provided. Urban routes that have a slower average speed, higher turnover of passengers and a lower average distance travelled have a lower fare than bus routes longer distance, more express type buses (Tsang, 2016).

Lessons for Metro Vancouver

The Hong Kong transit system is primarily driven by private capital and profit maximization. The high mode share of public transit (over 90%) allows the system can run very efficiently and affordably while providing reasonable profits for operators (Jain, 2016). Passengers are used to transfer penalties for changing modes and buses, but the cost of transportation is so low overall that little importance is placed on it. It is fundamentally different from the Vancouver situation, and lessons are difficult to apply in the Vancouver context.

Washington DC

- Partially-integrated bus fares provide minimum level of service at affordable prices
- Integrated rail fares provide premium service for higher income commuters

Washington Single Journey Fares

Mode	Bus	Rail
Fare	\$1.60	\$1.70-5.75
Type of Fare	Flat	Distance
Integration	Free timed transfer between buses, partial integration with rail	Yes – free transfers between lines
Time of Day Pricing	No	Yes
Farebox Recovery Ratio	24.9%	67.7%

Table 11 – Washington Transit Fare Prices by mode (Washington Metropolitan Area Transit Authority, 2016c)

Washington has distance-based rail fares and separate flat rate bus fares. The rail network is reasonably large and has a high Farebox Recovery Ratio versus the low rate of the bus.

Bus fares in Washington have been kept low as an intentional policy decision to provide mobility to low income residents (Tawfik, 2014). When the metro system was expanded to new stations, special transfer discounts were afforded to residents of the area to compensate for the replacement of low-cost bus service with higher cost rail service.

The Washington transit system provides an interesting hybrid trying to capture two distinct markets for public transport. In the USA, transit systems are often seen as a public service and as a transportation option of last resort for those who have no other option. This social purpose is fulfilled by the bus system whose prices are kept very low through high subsidies. By contrast, the rail system provides a higher quality service for a premium price. The 2006 Washington ridership survey showed that 80% of rail riders had access to a car, indicating that rail attracts choice riders. 44 of the 91 Washington Metro stations host park and ride facilities, further contributing to the distinction between lower income bus ridership and premium rail service (Washington Metropolitan Area Transit Authority, 2016b).

Lessons for Metro Vancouver

The Washington model is less applicable to the Metro Vancouver context as the bus and rail system work as a complimentary system rather than competing services. Busses in Vancouver often act feeder services to the more trunk rapid transit lines, and intermodal travel on bus and rail is common. There is also less of a dichotomy between income levels between bus and rapid transit usage, suggesting that a cheaper bus fare would be an ineffective means to target low-income transit users, one of the chief goals of cheap bus fares in Washington.

Dresden

- Bike Share integration

Dresden has an enhanced Monthly Pass for passengers that subscribe to autoloading their passes through their bank account or credit card. These “Monthly Pass Plus” members

are offered a free subscription to the regional Bike Share program. As the transit agency already has users' bank account or credit card for annual subscription payments, security deposits and payments for additional bike share usage are easily automated online through a user agreement upon activation.

The regional DVB transport agency is a partner with the local SZ Bike Share program and sees partnership both as added value for Monthly Pass Plus holders as well as a public relations initiative to encourage sustainable mode share. The DVB pays a fixed partner fee in exchange for bike share usage by Monthly Pass Plus holders (Christian, 2016).

Lessons for Metro Vancouver

With the integration bike share and discounts on car shares, Dresden has made a noteworthy shift from transit pass to mobility pass. This provides an excellent model for Metro Vancouver to follow, and integration of the City of Vancouver's new Mobi Bikeshare would further support Greenest City Goals of increasing walking and cycling. Including Bike Share in the monthly pass introduces more people to cycling, and could potentially shift short, slow downtown transit trips that are expensive on a per kilometer basis to low cost Bike Share rides.

Passes that require annual subscriptions based on credit card or direct debit payments may run into equity and privacy concerns in the Canadian context, and these issues should be dealt with in tandem with discussions over premium passes.

Recommendations for Metro Vancouver

1. TransLink's intermodal system with free transfers provides robust system and high levels of customer convenience.
2. Fare differentiation based on service type is not appropriate for the Vancouver region given the complementarity of various modes and limited coverage of rapid transit networks (excluding West Coast Express).
3. Mobi Bikeshare memberships should be included in monthly transit passes in order to increase physical activity, improve last-mile transportation options, and increase cycling mode share.

2.3 - Fare Differentiation by Time of Day

There are two peak travel periods in Metro Vancouver corresponding to the morning and evening commutes. This peak travel places significant strains on the system and pass-ups have become a regular occurrence on some bus routes. There are costs to the system in terms of both passengers who forgo transit in response to the conditions as well as for those passengers who ride in crowded conditions.

Although peak pricing is often viewed as inequitable, academic research and analysis of the Metro Vancouver Trip diary suggest that peak pricing would lessen the cost burden on lower income riders overall. As can be seen from the following graph, lower income users tend to have a much more even distribution of trips throughout the day, versus higher income riders whose trips are most concentrated during peak periods (Tawfik,

2014). This result is consistent with wider academic studies that suggest that peak fares “could help eliminate socially regressive aspects of transit fare policies such as those that result from flat fare regimes where off-peak users cross-subsidize the rush hour commuters” (Gwee & Currie, 2013, p. 61).

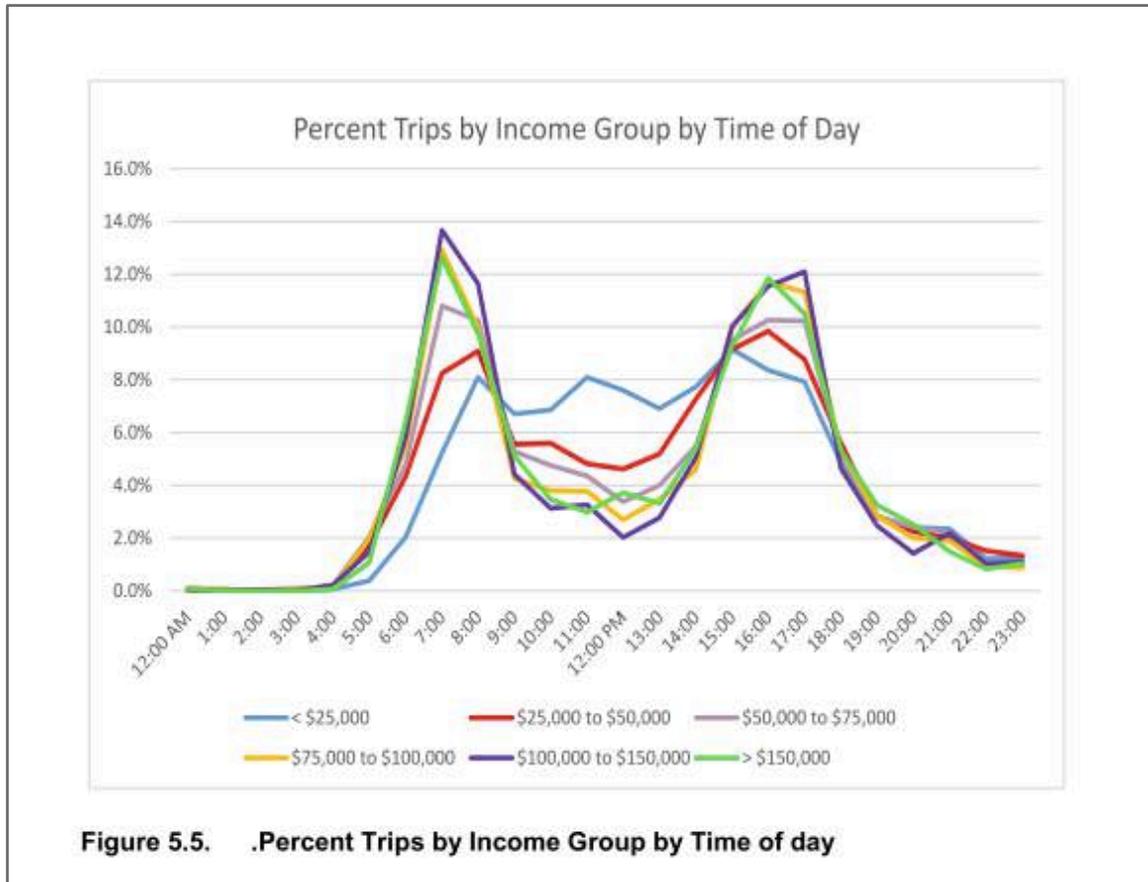


Figure 23 – Metro Vancouver trips by time of day by income level (Tawfik, 2014)

Elasticity of Peak Demand

Price elasticity for transit trips is a key factor in fare pricing policy, and specific values are context and city dependent. Nonetheless, elasticity of peak demand with respect to price has consistently been shown to be smaller in magnitude than off-peak travel, meaning that peak travellers are less price sensitive than off-peak travellers. This suggests that differential increases in fare levels for peak and off-peak will likely have less loss of ridership than across the board increases in fares. The chart below shows some median values from academic research.

Time period	Elasticity
Peak Hour	-0.18
Off-peak	-0.39
Average for all travel	-0.36

Table 12 – Elasticity by time of travel (Litman, 2004)

Infrastructure Costs and Peak Travel

Peak travel also presents infrastructure and financial demands for the system. Studies from other cities show that transit agencies' costs can be 30-50% higher to transport users during the peak versus the off-peak (Daniels & Mulley, 2013). In Australia, 80% of their recent \$7 billion dollar investment was spent to address peak ridership capacity, and a similar story rings true in Vancouver. Stations upgrades at Commercial Broadway, Joyce Subway station, are primarily being undertaken in order to increase capacity to accommodate peak demand, as well as future ridership growth. In spite of research suggesting that peak riders are often the least flexible, de Palma notes that “only a modest fraction of users may need to shift in order to obtain appreciable congestion relief” (de Palma, Kilani, & Proost, 2015).

Metro Vancouver had a mid-day discount until 1997. When the discount was removed it resulted in more pronounced peaks and lower demand in the off-peak; subsequently leading to lower utilization levels and lost revenues (Popescu, 2015). There is a strong case for more refined peak pricing in Metro Vancouver in order to increase revenue, manage demand, and utilize system resources more efficiently. Below is a diagram of various peak pricing policy options:

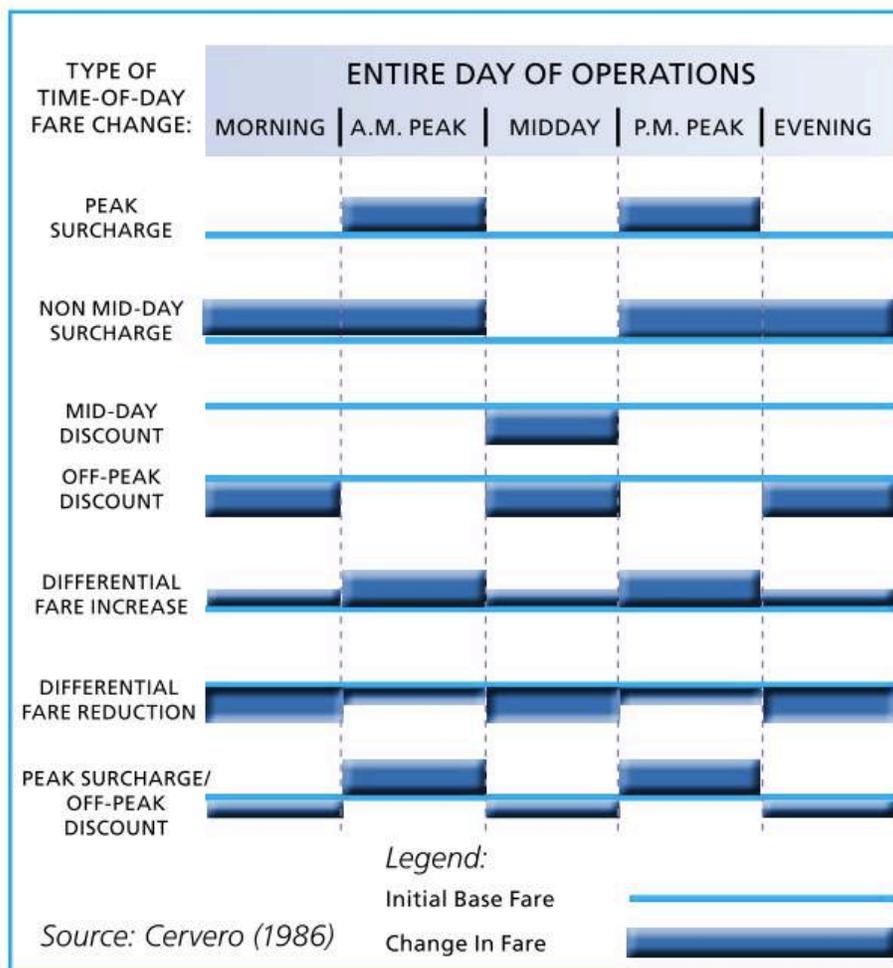


Figure 24 – Time of Day pricing examples (Gwee & Currie, 2013, p. 60)

Communications around Peak Pricing

Messaging around peak travel is very important for customer acceptance. Peak pricing premiums are much more palatable when accompanied by specific investments for increased capacity and comfort to meet peak demand. TransLink is already making many investments to enhance peak capacity including the Commercial-Broadway station upgrades, purchasing of new Canada Line trains, among other investments. These should be promoted and the link between increased costs during the peak and a peak surcharge made clear.

Case Studies

Singapore

- Several demand management strategies driven primarily by efficiency considerations
- Off-peak discounts implemented to lure passengers out of the peak periods

Free Travel before 7:45am

Singapore has several time of day pricing incentives. The most significant was a pilot project in which commuters who exited at 1 of 18 congested downtown stations before 7:45am received their journey for free (Singapore Land Transport Authority, 2016). The first year of the scheme was funded through a SGD \$10 million grant from the central government (Chew, 2015). Significant peak shifts resulted, with a decrease of 7-8% in the number of peak commuters, and the ratio of morning peak (8am-9am) to pre-peak (7am-8am) riders exiting at target stations decreasing from 2.7 to 2.1 (Singapore Land Transport Authority, 2015a).

Travel Smart Rewards

The Singapore Land Transport Authority hosts a rewards program called Travel Smart Rewards that specifically targets passengers who are already travelling during the peak and encourages a shift to off-peak periods. Passengers enroll their EZ-link smart card with the program, and their travel history is analyzed to determine the level of rewards they are eligible for. Passengers who completed regular trips during the peak periods are eligible for the most rewards (platinum members in the diagram below), whereas passengers who travel infrequently during the peak may be ineligible for the program (Singapore Land Transport Authority, 2015b).

	 Bronze	 Silver	 Gold	 Platinum
Monday - Friday				
Before 6:15am off-peak	1x	1x	1x	1x
6:15 - 7:15am decongesting	3x	4x	5x	6x
7:15 - 8:45am peak	1x	1x	1x	1x
8:45 - 9:45am decongesting	3x	4x	5x	6x
After 9:45am off-peak	1x	1x	1x	1x

Figure 25 – Singapore Travel Smarts Rewards Program (Singapore Land Transport Authority, 2015b)

Passengers accrue points for every trip they shift from peak to non-peak periods. Participants are entered into a draw based on the number of points they have to win cash prizes and can also redeem points for future travel. In this way the rewards program provides a targeted incentive to a captive audience that leads to significant peak spreading. The program also takes advantage of behavioral economics and consumer's propensity to overvalue the expected value of the prizes (Kahneman, Slovic, & Tversky, 1993). This leverages the funds invested into the system into more demand shift than would be possible with straightforward cash incentives.

Off-peak Pass

Singapore residents are eligible for monthly travel passes, and have the option to choose between unlimited monthly travel pass and the Off-peak pass (Singapore Land Travel Authority, 2016). If passengers holding the off-peak pass wish to travel at peak times, they pay the full applicable fare. This provides effective demand management for those who are able to travel outside of peak periods.

Pass	Eligibility	Price
Adult Monthly Travel Pass	All basic train and bus services	\$120
Off-Peak Pass	All basic services for trips that do not begin between 6:29am to 9:01am, and between 4:59am to 7:31am Monday to Friday	\$80

Table 13 – Singapore Off-peak Monthly Pass Prices (Singapore Land Transport Authority, 2015a)

The image is a promotional graphic for the Singapore Off-peak Monthly Pass (OPP). At the top left, a circular badge says 'STARTS 5 JULY 2015'. The main title is 'After 9AM SAVE with the NEW Off-Peak Pass!'. To the right, it says 'CONCESSIONS ON PUBLIC TRANSPORT' with icons for a bus, train, and person in a wheelchair. Below the title, a box titled 'What is the Off-Peak Pass (OPP)?' lists prices: Adults \$80/mth, Persons with Disabilities \$40/mth, and Senior Citizens \$40/mth. It also states 'UNLIMITED RIDES on basic bus services & trains ALL DAY on weekends, public holidays & weekdays, except:'. Two clock icons indicate 'Weekday AM Peak 6.30am to 9.00am' and 'Weekday PM Peak 5.00pm to 7.30pm'. A section titled 'How can I SAVE?' shows a timeline from 6:30am to 7:30pm with 'Off-Peak' and 'Peak' periods. It includes two scenarios: 'Scenario 1: Starts off-peak, Ends off-peak' and 'Scenario 2: Starts off-peak, Ends during peak'. A yellow callout box says 'Simply START your journey during off-peak!'. The background features illustrations of people walking and a person in a wheelchair.

Figure 26 Singapore Off-peak Monthly Pass Promotion (Singapore Land Transport Authority, 2015b)

Lessons for Metro Vancouver

Singapore has been a leader in peak travel demand spreading, and their programs should strongly be considered for implementation in Vancouver. Offering an off-peak pass could help spread peak travellers and attract new ridership to off-peak periods.

The challenge with the free off-peak travel, on the other hand, is that it is provided indiscriminately to all passengers traveling before 7:45am, including those who would otherwise have travelled at that time without the discount. This results in a significant loss of revenue, and a more expensive peak-spreading program than other more targeted approaches. Nonetheless, transit authorities in Singapore found the peak demand shift significant enough to call the pilot a success and extend the program for second year.

The travel rewards program offers an interesting model that provides targeted incentives at a very reasonable cost per passenger. The perception of fairness among those who already travel during the off-peak and are ineligible for enrolment in the program would be a challenge to implementation in Metro Vancouver.

London

- Premium pricing for peak rail travel motivated by efficiency, demand management and revenue generation

London has relatively straightforward peak pricing on rail services. As can be seen from the table below, zone 1 is priced at a premium at all times and remains competitive with automobile travel both because of significant traffic in the downtown zone and because of the congestion zone charge (Allsop, 2016).

Travel between zone 1 and other zones is priced higher during the peak, with the peak surcharge increasing with the number of zones travelled. This reflects the lower elasticity of longer distance riders, and their willingness to pay a higher fare during peak periods when roads are most congested. Travel that avoids zone 1 in the less central areas of London is very affordably priced in the off peak, and this in turn helps rail fares to be competitive with car travel during less congested periods.

Travel Zone	Peak Fare	Off-peak Fare	Peak Price Premium	Cash Fare
Zone 1 only	2.40	2.40	0%	4.90
Zone 1-2	2.90	2.40	21%	4.90
Zone 1-3	3.30	2.70	22%	4.90
Zone 1-4	3.90	2.80	39%	5.90
Zone 1-5	4.70	3.10	65%	6.00
Zone 1-6	5.10	3.10	65%	6.00
Zone 2 only	1.70	1.50	13%	4.90
Zone 2-3	1.70	1.50	13%	4.90
Zone 2-4	2.40	1.50	60%	4.90
Zone 2-5	2.40	1.50	60%	4.90
Zone 2-6	2.80	1.50	87%	4.90

Table 14 – London Peak Rail Fare comparison (Transport for London, 2016b)

Lessons for Metro Vancouver

London charges a significant peak period fare premium that has resulted in higher revenues for transit and helped shift demand away from the peaks. Vancouver should strongly consider peak pricing, particularly in parts of the network that are capacity constrained at peak travel periods.

Washington DC

- Premium pricing for peak travel, driven in large part by revenue generation concerns

Washington began implemented a time of day pricing scheme in 2003. It was initiated in part due to unstable funding agreements and a push to increase fare box recovery ratios (Gwee & Currie, 2013, p. 64). The peak rail prices have increased relatively faster than the off-peak prices, while bus fares have stayed relatively stable. There has been sustained growth in ridership throughout this period, in spite of very little appreciable increases in service delivery. Washington provides a compelling example of how peak price differential can increase both revenue and ridership.

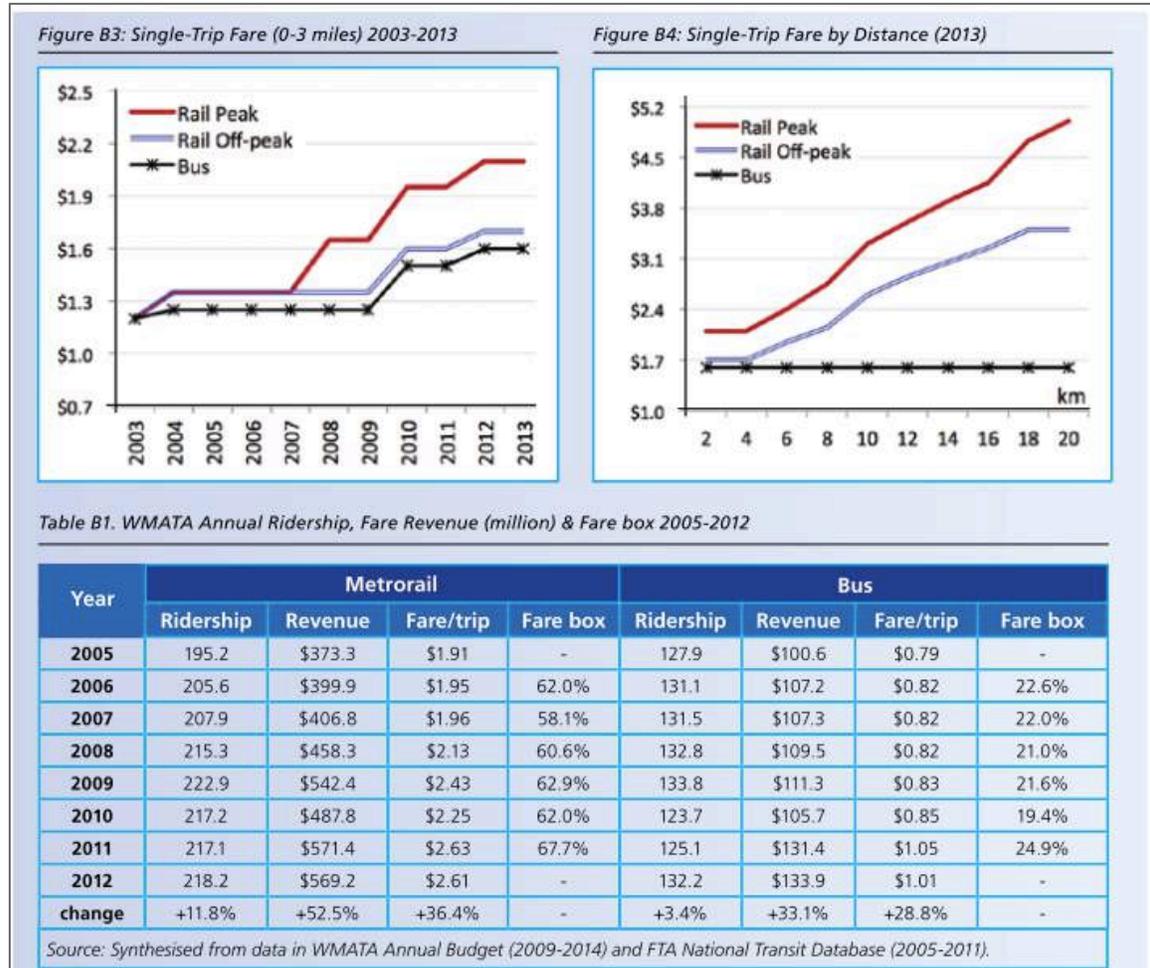


Figure 27 – Washington DC Peak Rail Fares and Ridership (Gwee & Currie, 2013)

Lessons for Metro Vancouver

Washington provides an admirable example of how peak pricing can be used to increase revenue while at the same time growing ridership. It takes advantage of differential elasticities of different riders, and has allowed the system to continue to offer quality service in spite of unstable funding arrangements.

Recommendations for Metro Vancouver

1. Implement time of day pricing in order to help manage demand and enhance system efficiency
2. Fare differentiation can be used to both raise revenue and increase ridership simultaneously if properly implemented.
3. Off-peak pass offerings can help to grow ridership, with very low incremental service delivery costs.

2.4 - Fare Media & Loyalty Programs

Most transit agencies offer differential fares based on the type of media is used to the fare. Metro Vancouver has higher prices for cash payments, and this has in part been responsible for Vancouver's tremendously successful implementation of the Compass Card. By June 2016 – less than a year after the roll out of the card – 94% of all transit transactions are completed using the Compass Card, and there are over one million active compass cards (Translink, 2016a). Fare differentiation based on Fare Media and method of payment can extend beyond use of the smart card to loyalty programs and open payments systems. This section details various options from around the world.

Case Studies

Hong Kong

- Open Payment System Integration
- Profitable smart card operations

Hong Kong launched its Octopus Smart card in 1997 and there are currently over 20 million active cards in circulation. The card is used for 95% of all trips on the transit system, and over 99% of Hong Kong residents have a Octopus card (Maggie Hiufu Wong, 2016). In addition to transit fares, Hong Kong's Octopus card is widely accepted as a method of payment outside the transit system, with a majority of the market share of non-cash transactions under \$20 (Jain, 2016). Only 25% of transactions performed on the card were transit related in 2005, and significant transaction fees are generated from usage of the Octopus Card as a digital wallet. The Octopus Card system as a whole generates \$12 million in profits each year for the transit system (Puhe, Edelmann, & Reichenbach, 2014, p. 26)

Lessons for Metro Vancouver

This example is somewhat unique to the Hong Kong context in which there is an overwhelming transit mode share and excellent market penetration of the Octopus card. Since Hong Kong's introduction of the Octopus Card in 1997, contactless bankcards have emerged as the dominant mode of non-cash payment in Canada. It is unlikely that use of Compass Card as a digital wallet would gain traction in Vancouver.

Dresden

- Rewards Program for Annual Pass purchasers
- Bike Share integration

Dresden and the surrounding region have a uniform smart card payment system that works across transit operators. There are several fare products available for the smart card, including pay-as-you-go, period passes, and annual passes.

The annual pass is available by subscription, and passengers are required to commit for a minimum year purchase of the card. This loyalty program provides a discount over the regular monthly pass, and also provides valuable benefits to the user:

Pass	Price	Validity
Monthly Pass	€ 59	Non-transferable pass, valid as group pass on evenings and weekends
Monthly Pass Plus	€ 49.70 Minimum one year purchase	Transferable pass, valid as group pass on evenings and weekends in any fare zone, free bicycle and dog transport any time, unlimited 30 minute rides on regional bike share, significant discounts to regional car share programs

Table 15 – Dresden Monthly Pass Plus Fares and Explanation (Dresdner Verkehrsunternehmen AG, 2015)

Lessons for Metro Vancouver

Annual passes and premium passes for regular users help to create a loyal passenger base with appropriate rewards. A premium pass could be considered for implementation in Vancouver.

London

- Cashless buses
- Integration of contactless bank cards and phone payments
- Daily and weekly fare caps

Transport for London has been a world leader in fare payment systems. The bus system went entirely cashless in 2014, and London was one of the first transit agencies in the world to integrate contactless bankcards into their payment system.

Cashless Buses

Given the success of the Oyster Card and other travel cards, cash payments on buses in London accounted for about 1% of all fares by 2013. Studies indicated that eliminating cash payments would result in a net savings of £24 million per year, and improve operational performance and average bus speeds (Transport for London, 2014). In addition, many of the most vulnerable users (seniors, low-income passengers, children, etc.) who might otherwise be affected by cashless buses were already using discounted Oyster cards under one of London's many concession fares (Bellenger, 2016).

In 2014, Transport for London made bus service entirely cashless. Several provisions were put in place to ease the transition to cashless buses:

- A 'last fare' on the Oyster cards allows users who have a zero or near-zero balance on their Oyster cards to use part of the deposit to make a last journey home
- Additional training for bus drivers on vulnerable passengers to help ensure they are not being stranded and in danger
- Substantive marketing exercise to educate the public (Transport for London, 2014)

Contactless Bank Cards

London introduced payment by contactless bankcards, credit cards, and smart phones in 2014. The motivations for this decision included a high number of visitors, high penetration rate of contactless bankcards, the move towards cashless buses, and high transaction fees for Oyster cards at retailers. These new payment mechanisms can now be

used for all Transport for London services, with the same price point as for Oyster smart payment cards.

The biggest hurdle to integrating these new payment forms was the transaction time, as contactless bankcards generally have a much longer authorization time than the maximum of 500ms mandated by Transport for London. Negotiations with the contactless bankcards association led to a nationwide agreement between transit agencies and bankcard operators. Instead of immediate authorization, contactless cards are reconciled periodically throughout the day, leading to a robust system with risk shared between the bankcard issuer and the transport agency.

The system has proven to be an enormous success. In less than two years, more than 500 million journeys have been made by over 13 million unique cards from over 90 countries (Hill, 2016). The unrecoverable transactions from contactless bank cards have been under 0.07%, and transport for London “strongly believe that these small costs are heavily outweighed by the savings in the cost of revenue collection brought about by contactless payments” (Hill, 2016).

Daily and Weekly Fare caps

London initiated weekly fare caps in large part to encourage the uptake of their contactless Oyster cards (Allsop, 2016). The fare caps are activated automatically when the daily cap is reached between Monday and Sunday, with further trips within the capped zones being free of charge.

In the past daily caps were much more expensive than weekly caps on a per day basis. London’s TravelWatch consumer protection agency produced studies that suggested that the increase in precarious employment and the rise of multiple part time jobs was creating two tiered system for transport (Bellenger, 2016). Weekly passes were privileging those making regular trips within the same zones, a demographic that TravelWatch research showed was largely made up of higher income white collar workers. Those who worked less than 5 days a week in part time jobs, or commuted to multiple part time jobs in various locations were not afforded the same discounts.

In response to this criticism, Transport for London lowered the daily fare cap to approximately 1/5 of the weekly fare cap rates. This has helped workers with precarious employment and encouraged workers to take up employment jobs they might not otherwise have chosen to pursue (Bellenger, 2016).

Lessons for Metro Vancouver

Cashless buses in Vancouver would likely have marginal savings compared to the London example. Cash fares in London used to be collected by the bus driver who also provided change. This resulted in both security concerns over handling cash as well as operational efficiency problems. In Vancouver the very few cash transactions that continue to occur are automated and likely produce minimal delays on bus operations.

Contactless bankcard payments are compatible with Vancouver’s new Compass Card systems. Given London’s experience with operational savings, ease of use for customers,

and precedent set by Transport for London, Metro Vancouver should consider offering contactless bank card payments in future fare payment schemes.

Day passes are offered for sale in Metro Vancouver, but the barriers to purchasing them make them difficult to use in practice. Automatic daily fare caps should be considered for implementation in Metro Vancouver in order to make day passes easier to access, and encourage transit usage.

Recommendations for Metro Vancouver

1. Consider future implementation of payment by contactless (tap) bank and credit card to increase customer convenience and improve operational efficiency.
2. Implement daily fare caps to replace current day passes, as the barriers to accessing the current day passes are considerable.

2.5 - Concession Fares and Affordability

Concession passes are a near universal feature of all transit fare policies, though different agencies offer them to different groups at varying degrees of discount. Most are based on demographic group, while some are needs based. Demographic groups are often targeted based on a perceived need, but indiscriminate concession fares for large swaths of the population may result in lost revenue for transit agencies when many passengers captured by the concession may be otherwise able and willing to pay the full fare.

Case Studies

Hong Kong

- Direct cash travel subsidy for low income residents
- Limited concession fares directly supported by government

Hong Kong's transit service operates on a commercial basis in which private operators bid on franchises for particular bus routes. The private bus fare operators generally maximize revenue within the confines of the franchise agreement. This results in very few concession fares offered by operators. In response to this, further subsidies are provided to seniors through a special Octopus smart card. When users tap their card, only the concession fare is deducted from the value on the card, while the government tops up the payment to the operator with additional funds.

Fare type	Discount	Notes
Seniors Singles Fares	50% off regular fare	Offered by bus and train operators
Elderly & Disabled Octopus Discount	HK\$ 2 flat fare on any service, non-integrated	Government issued compass card must be used. Central government pays direct subsidy to bus and rail companies to cover cost of concession
Child Fare	Approximately 50% off full adult fare	Offered by operators to all children under 12 and full time students aged 12-25

Table 16 – Hong Kong Concession Fares (Hong Kong Mass Rapid Transit, 2016)

Direct Subsidy

Hong Kong's central government provides a direct cash subsidy of HK \$600 per month (about CAD \$100) to low income individuals earning under HK \$10,000 per month (Kamp, 2012). This targeted subsidy allows residents to make efficient travel decisions for their particular circumstances, and allows bus companies to continue to offer competitive prices that are less encumbered by social goals. The subsidy is administered by the central government through its existing social services network.

Lessons for Metro Vancouver

Hong Kong has a clear delineation of responsibility whereby the transit authority is responsible for transport service delivery, efficiency and coverage, and the central government is responsible for affordability among lower income residents. In this respect, Hong Kong provides a very effective model with which to deal with affordability issues.

Metro Vancouver's TransLink Transit authority has no explicit mandate to provide special mobility accommodations for low-income residents. Neither its mission statement nor values state an obligation or goal to ensure affordability amongst low income transit users (Translink, 2016c). Nonetheless, this concern is typically top of mind for decision makers, and it often obscures decisions about efficiency and efficacy of the transit network. Rather than TransLink trying to weigh the affects of fare policy on affordability for low-income individuals based on undefined and nebulous criteria, it would likely be more effective for other levels of government to provide specific accommodations for low income residents. This would allow TransLink to make efficient decisions that serve the City of Vancouver's Greenest City Action Plan the most effectively. The BC government already has this model in place with the BC Bus Pass Program.

London

- Multitude of concession fares for many different target groups
- Historic Freedom Pass for Seniors after 9:30am

Transport for London offers a number of concession fares, some mandated by the national parliament and others mandated by the local London Council. The multitude of concession fares is driven by a number of factors in London, primarily the high cost of transport, historical precedent, and the division of powers allocated to London Council.

Transport for London's rail network has a farebox recovery rate of over 115% of operating costs, and bus fares recover 72% of operating costs (Transport for London, 2015). This results in very high proportion of income being spent on travel to work – about 7.3% of the average worker's salary, and 9.2% of lower income residents' pay (TravelWatch & Trust for London, 2015). In addition to this, the London council has minimal redistributive powers at its disposal, and transport fares are one area where the council can have the greatest impact. The local London council has often been elected with a mandate to tackle inequality, thus fare policy often finds itself the target of social equity efforts (Allsop, 2016).

Concession	Discount	Eligibility
Children	Free Travel anytime	Under 11, age 11-15 with valid Oyster Photocard
16+ Zip Oyster	Free bus and Tram travel, half price rail passes	16-18, in full time school, living in London
18+ Student Oyster	30% off period passes for bus and rail	Full time student living in London
Apprentice Oyster Photocard	30% off period passes for bus and rail	Apprentices in the first 12 months of their training, living in London
JobCentre Plus Travel Discount	Half rate pay as you go fares, half price period passes	Unemployed for between 3-12 months, on income support, or on a disability leave
Veteran Oyster	Free travel on bus, rail, and most national rail services	Receiving payments under the War Pension Scheme
Bus & Tram Discount	Half price bus and tram passes	Receiving income support or Jobseekers allowance
60+ London Oyster Photocard	Free travel on all bus and train services in London	60+ years of age and live in a London Borough
Freedom Card	Free Travel all London transport, and all buses across England	65+ and resident of London

Table 17 – London Concession Fares (Transport for London., 2016)

Most of the concessions are offered to targeted groups that have traditionally been lower income and/or those with fewer mobility options. The needs-based concession cards for lower income groups piggyback onto national programs such as Jobseekers allowance and social assistance. These concessions do not capture all low-income residents or the working poor, but Adrian McMullan, Price and Forecasting Manager at Transport for London remarks that “Once you get out of that very specific realm of people, and you want to help people who don’t have a lot of money, it becomes much more difficult. Trying to discern who is eligible means Transport for London finding out about your income, and that involves a very expensive bureaucracy and goes beyond most people’s expectations of what a transportation agency should know about you” (McMullan, 2016).

The Freedom Pass was recently extended to include all day travel; however, in 2008 the Freedom pass did not include free travel on the tube before 9:30am during peak travel times. The graph below shows how Freedom Pass holders overall usage of the tube was shaped by the pass restrictions. It suggests that travel demand of senior citizens is very elastic with respect to price, and that a high level of time shifting can be achieved through

targeted concession fares.

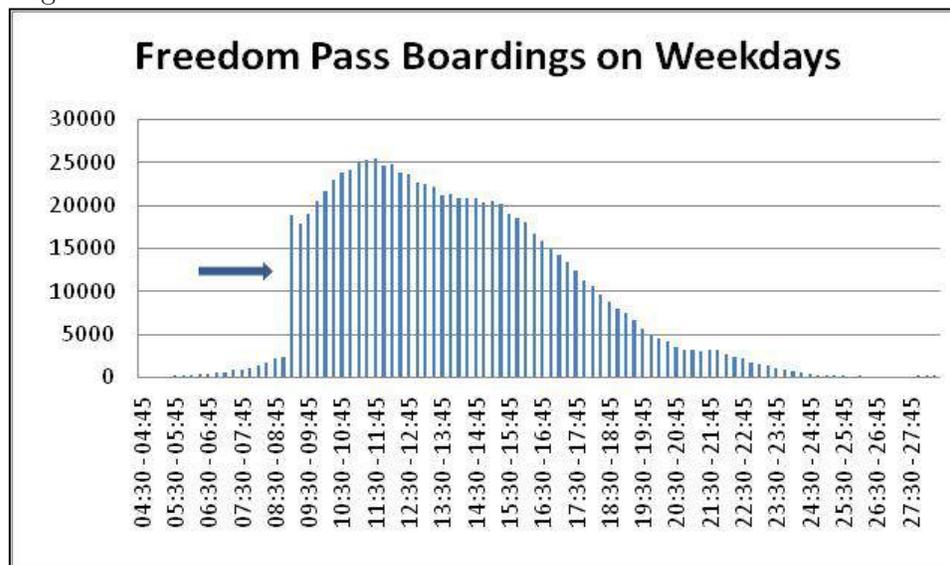


Figure 28 – London Freedom Pass Boarding by time of Day (White, 2016)

Lessons for Metro Vancouver

Transit prices are much cheaper in Vancouver in comparison to London. Nonetheless, increasing housing costs in Metro Vancouver are causing lower paid workers into longer commuters as they seek more affordable accommodations further from job centers. If transit is increasingly going to be funded through farebox revenue, Vancouver should likely consider how to provide targeted concessions to lower income residents. Coordinating administration of low-income fare support with senior levels of government that can verify eligibility through existing programs would lessen the administrative burden of such schemes.

Metro Vancouver's seniors' passes are offered for several reasons:

- Precedent
- Because seniors have historically been perceived to be low income
- To combat social isolation amongst seniors

Several interviewees in London remarked on the phenomenon of the 'grey pound', which refers to the large minority wealthy seniors who are nonetheless provided free travel. In London, as in Vancouver, there is a minority of seniors who are living on very low incomes, and the Freedom pass end up being a very blunt instrument with which to achieve social and economic goals (Kershaw, 2016; McMullan, 2016). On the other hand, means tested passes often result in inscription processes in order to acquire the pass. This would cause a certain proportion of most vulnerable seniors to lose mobility and become susceptible to social isolation.

A compromise between offering free all day travel to seniors and a more rigorous means-tested approach would be to provide off-peak travel to seniors at a significant discount. The evidence from London's Freedom Pass above suggests that seniors are highly sensitive to price and willing to travel during off-peak if given the proper incentive. It would provide only marginally less benefit with respect to the combatting social isolation,

shift travel into less costly off-peak times, and create new revenue from those seniors willing and able to travel during peak periods.

Recommendations for Metro Vancouver

1. Limit Seniors' concession prices to off-peak travel times (after 9:30am)
2. Increasing transit mode share will be best achieved by making transit the best choice in terms of comfort and convenience. These criteria do not always lead to transit also being the cheapest option, and affordability is likely to be an increasing challenge.
3. As the region moves towards mobility pricing for both road and transit pricing, there will be an upwards pressure on transit fares from both increasing demand and expectations with respect to service levels
 - a. Efforts should be made to ensure affordability of transit for low income and transit dependent individuals through needs-based concessions
 - b. If ensuring affordability amongst low income passengers is to be included in TransLink's mandate, it should look to partner with other levels of governments and agencies that are better equipped to administer targeted needs-based concessions

2.6 - Approaches to Implementing new Fare Policies

An overwhelming theme arising from the interviews with various transit agencies and experts was the inertia of fare policies. Professor David Metz in London remarked that “My sense is that people get used to a fare structure and if you start to change it, the losers will make more noise than the gainers, and perhaps that's the reason we don't often make many changes to the fare structure. The debate tends to be over the level rather than the structure” (Metz, 2016). In Amsterdam, transit planner Neil van Oort noted that “the distance based system was objectively fairer, but the subjective reference point is the zone system, so it is always being compared back to that. It took the public 10 years to come around on distance based pricing” (Oort, 2016). This is both a challenge and an opportunity for new policy structure, and it provides a strong argument to build on existing policy both for reasons of comprehension and for public acceptability.

Case Studies

Amsterdam

- Political mandate to ensure nobody was made worse off by new fare policy
- Post-tendering changes to Smart Card implementation

Amsterdam moved from a zone-based system to a distance-based system for single journey fares in the early 2010's. The new fare policy was originally intended to be revenue neutral. In order to do so, those who were advantaged by the old system (for example, those whose travel entailed a long trip in a single zone) would be asked to pay a little more, and those who were previously disadvantaged (those who made a short trip across a zone boundary) would see a small savings (Oort, 2016).

That revenue neutrality of the new fare policy, however, was obstructed by a political promise that nobody should be made worse off by the new system (Oort, 2016). Given this promise, fares could only be reduced rather than equalized across the system. The commitment to not making anybody worse off significantly handicapped the new fare policy development, and resulted in a revenue shortfall for the agency when the policy was eventually implemented.

At the same time, the implementation of the smart card itself was also hampered by late demands on the card system for capabilities that it had not been designed for. This effect was compounded by the fact that there were multiple agencies attempting to integrate a single payment system each with their own set of criteria. Whereas the original intent had been to purchase a system that was relatively ‘off the shelf’ and already in use in Hong Kong, demands made by decision-makers for specific design elements and additional functionality made the system much more expensive than it was originally intended to be.

Singapore

- Mass educational program in conjunction with new fare policy
- Random surveying of the population that identified opportunities and helped weigh tradeoffs in fare policy

Singapore moved from non-integrated bus and rail fares to an integrated distance-based system no transfer penalty between modes. The change was intended to be revenue neutral, and there was an acknowledgement by the transit authority that some riders would end up paying more. Those who had been enjoying a transfer-free ride would see a slight increase in the price they were paying, while others who had been paying a transfer penalty would see a savings under the new system.

In spite of the relatively straightforward nature of the change, the transit authority undertook a prolonged education campaign before, during and after the change to distance fares. The campaign included radio broadcasts, road shows at bus interchanges, advertisements in newspapers, poster, and brochures, among other means (Public Transport Council of Singapore, 2016). The campaign helped people to understand the new fare structure and increased public acceptance.

Fare increases in Singapore were becoming increasing political and challenging for private operators to navigate. In response to this, a Fare Review Mechanism Committee was struck to implement a formulaic fare increase based on several factors including the consumer price index, industry costs, and other metrics. In developing the fare review, they undertook a random survey of transit users in addition to general feedback from concerned citizens. The survey indicated that there was a silent majority of passengers that were willing to pay a supplement to their fare to provide reduced rate travel for low income passengers (Singapore Fare Review Mechanism Committee, 2013). This approach helped to shape the fare increase structure and ensured an ongoing sustainable fare for the transportation industry.

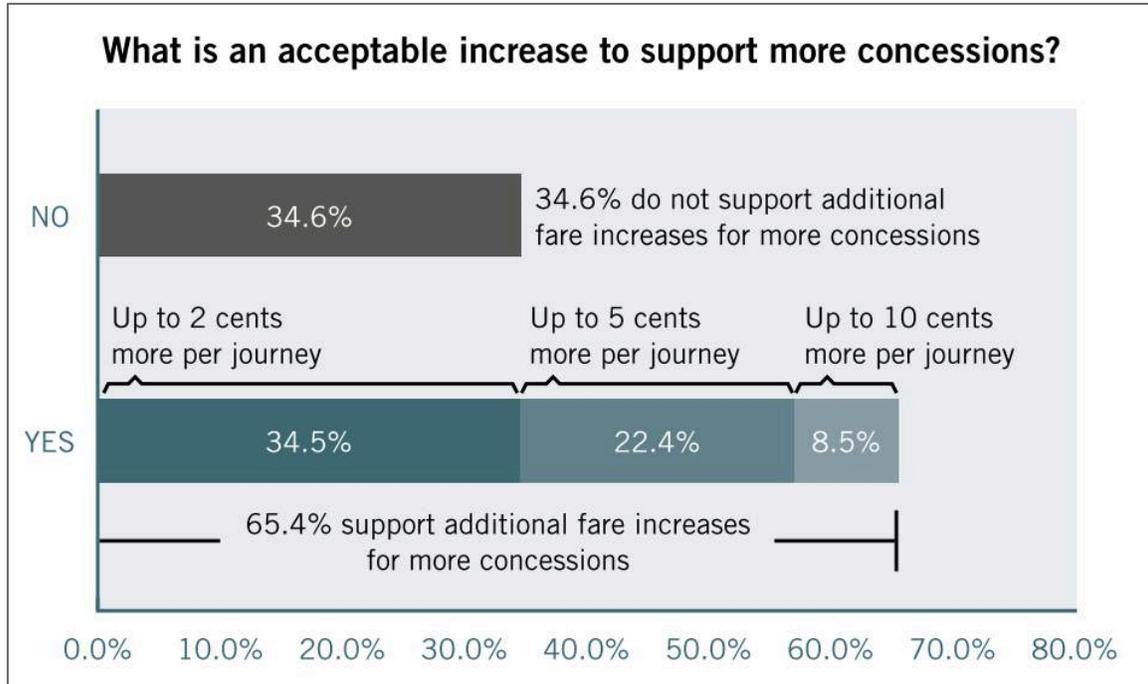


Figure 29 - Singapore public survey results on fare concessions (Singapore Fare Review Mechanism Committee, 2013)

Metro Vancouver

- Backlash over changes to BC Bus Pass Program

The BC government administers a program for disabled riders called the BC Buss Pass. In 2016, the government announced a change to the program - the BC Buss pass that was previously free with a yearly \$45 administrative fee, would cost \$55 per month as of September 2016. Concurrent with this change was an increase in the disability assistance of \$77 per month (Chan, 2016); with a subsequent announcement of the cancellation of the \$45 administrative fee.

Putting aside for a moment the debate over the absolute level of disability assistance, every recipient was made better off under the terms of the new scheme. This is particularly true for those who do not have access to or choose not to use transit. Nonetheless, those who took issue with the level of disability support took the change in policy as an opportunity to discredit decision-makers and attack the program. The objective material benefits of the program were often lost in the debate over important but unrelated debate over absolute level of aid for recipients of the program. This example illustrates one of the challenges to addressing policy inequities and inefficiencies, even those seemingly improving conditions for all users.

Lessons for Metro Vancouver

Both the motivation for fare policy changes and the changes themselves need to be clearly communicated to residents in Vancouver. The uptake of the compass card, though initially slightly delayed, has been a remarkable achievement in a relatively short timeframe when compared with the majority of systems around the world. This story could have been better communicated to the public, and celebrated as a success. An arm’s length body such as London’s TravelWatch organization may be better suited to

perform public relations activities; however, in the absence of such an organization, TransLink should proactively provide meaningful and effective communications, both to transit users and the general public.

The BC Bus Pass and Amsterdam fare policy transition illustrate the difficulty in implementing changes in transit policy, whether it is low income concessions, new pricing policies, or zone structures. Change is always going to create winners and losers, and those that stand to lose will invariably attract more attention than those who gain. Singapore's example of random sampling of the transit users provides a model of how to ensure that the will of the silent majority is included in the discussion in addition to those whose efforts attract the most attention.

Recommendations for Metro Vancouver

1. Fare policies have a large degree of inertia, and new schemes will be more comprehensible and will have an easier time gaining public acceptance if they build on the existing structure.
2. Both substantive changes and the motivations behind new fare policies should be clearly communicated with the public to help build acceptance.

Section 3

3.1 - Proposed Fare Policy for Metro Vancouver

The following fare proposal attempts to incorporate as many of the recommendations as possible into one unified fare structure. It is acknowledged, however, that this proposal is merely a starting point for a conversation and by no means adequately addresses all the challenges posed by Vancouver’s complex transit system. The proposal attempts to seek a balance between fine-grained distance based pricing and simplicity.

The absolute numbers are provided for illustration only, and would need to be adjusted based on how they are likely to affect overall revenue.

Fare Structure

1. Create new Metro core zone
 - a. New zone would be encompassed by 12th in the South, Granville in the West, Commercial in the East, and the downtown peninsula in the North

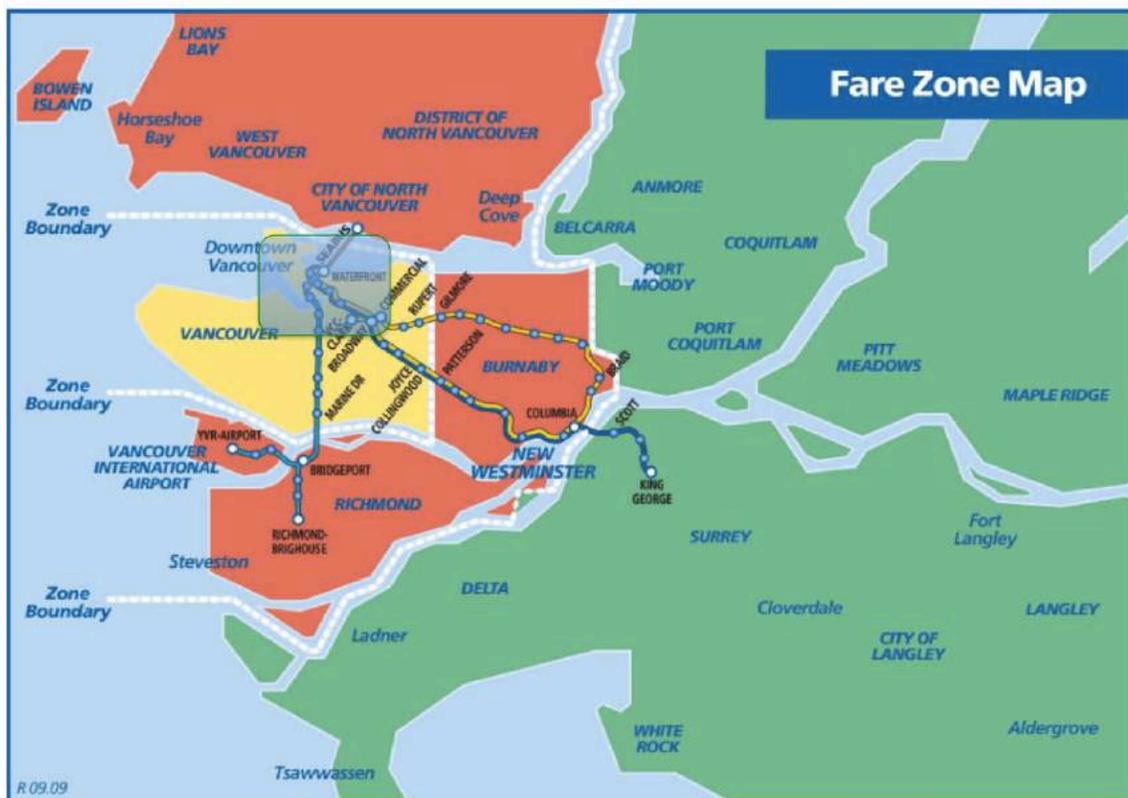


Figure 30 - Proposed new Metro Vancouver Zone Map

2. All zone fares would become valid for one additional zone
 - a. Under new system, minimum fare covers 2 zones

Old system	New System	Compass stored Value Price	Cash and Compass Concession Price (seniors concession only available after 9:30am)
1 Zone Single	2 Zone	\$2.10	\$1.75
2 Zone Single	3 Zone	\$3.15	\$2.75
3 Zone Single	4 Zone	\$4.20	\$3.75
3 Zones – after 6:30 weekdays, all weekend	4 Zones – after 6:30 weekdays, all weekend	\$2.10	\$1.75

3. Central zone is subject to \$1 surcharge during peak periods
 - a. Any passenger entering, exiting or traversing the central zone during peak periods is subject to surcharge
 - b. Peak periods are from 7:30 - 9:00am & 4:30-6:30pm Monday to Friday
4. New VIP Monthly Pass introduced

New Monthly Pass Prices:

Type of Pass	Regular Adult Price	VIP Adult Pass	Concession Price
Validity	Any zone, any time outside of Zone 1 during peak hours	Any zone, any time	Seniors pass subject to \$1 surcharge for travel between 7:30-9am in any zone
Day Pass	\$9.75	12.75	\$7.50
2-Zone Monthly Pass	\$91	\$111	\$52
3-Zone Monthly Pass	\$124	\$144	\$52
4-Zone Monthly Pass	\$170	\$190	\$52
Perks	- Valid for travel across a greater area	- Standard Mobi Bike Share membership included - Valid across all zones on evenings and weekends	

Advantages:

- Peak Spreading
 - Peak surcharge encourages demand spreading in most congested part of the network including Commercial Broadway station, Burrard Station, Broadway Corridor, Canada Line
- Border Penalty
 - Eliminates border penalty for very short rides across the a zone boundary
 - Encourages travel by transit from North Shore by reducing the fare burden, reduces strain on bridges
- Vertical Equity
 - Increase in fares occurs only during the peak when transit is used most heavily by higher income residents
- Geographical Equity
 - Reflects radial nature of rapid transit lines
 - Increases fares for those who are provided the highest level of service on downtown-centric network
 - Reduces the relative cost of transit in more suburban areas where level of service is lower, while increasing revenue from those making long-distance commutes to downtown
 - Mobi Bikeshare membership is benefitting those who live in the central zone who are most heavily impacted by increased fare
- Ridership
 - Peak riders have the lowest elasticity with respect to price, so will likely lose fewer riders than an equivalent overall fare increase
- Complexity
 - Builds on existing system, and is not exceedingly complicated
- Mobi Bikeshare
 - Creates new ridership for Mobi

Shortfalls:

- Reduces the correlation between distance and price in some cases, which does not satisfy the strategic mandate for mobility pricing
- Does not address peak pricing and spreading outside of the downtown core
- Imposes cost on reverse commute direction in despite spare capacity
- New border penalty created around central zone during peak times
- Some loss of fare revenue given the expanded zones of validity of many pass holders

Other Sub-options:

1. New zone system could be implemented for monthly passes while single journey fares could move to a distance based fare. This would better satisfy the mandate for mobility pricing on transit
 - Distance based fares should have a high base fare (~\$2.00) that includes a relatively large initial distance (first ~8-10km included in base fare). The relatively large base fare will decrease fare uncertainty for a large proportion of trips that are quite short, while at the same time encouraging walking and cycling trips for short trips.

-
- Distance based fares should have a decreasing cost per kilometer up to a maximum fare of about \$5.00
2. Peak pricing could apply throughout the network instead of just downtown
 - a. In this case, the off-peak monthly pass price could go down in price, while the VIP pass could have a higher price than current monthly passes. The offering a new pass at a reduced price would aid in public acceptability in this case.
 3. Instead of offering a VIP Pass, increase the costs for everyone to the cost of a VIP Pass, and provide a rebate of \$1 for weekday that travellers don't travel during the peak period. Prospect theory of behavioral economics suggests that passengers will place greater value on the rebate than on the extra cost of the pass overall, resulting in greater public acceptance
 4. Instead of providing all the benefits to every VIP Monthly pass holder, VIP Pass could be offered a "Choose your perk" incentive, whereby passengers choose one of the following:
 - a. Mobi Bikeshare membership
 - b. All zone validity on evenings and weekends
 - c. Group or family pass validity on evenings and weekends
 5. Could implement cheap early morning fare prices to aid in public acceptability and encourage further peak spreading
 - a. Half price (or free?) travel if finishing the trip before 7:30am
 6. Messaging is very important
 - a. Need to clearly communicate that major capital investments that are being made to specifically address peak travel periods:
 - i. Station upgrades
 - ii. New Canada Line, Expo Line and Millennium Line SkyTrains
 - iii. Expanded bus service
 - iv. Broadway improvements
 - b. Quick wins would help build confidence that peak capacity is being upgraded
 - i. Immediate increase of service on B-line if possible (for example)

Appendix

List of Interviewees

City	Name	Agency	Position
Dresden	Christian Blank	Dresdner Verkehrsbetriebe AG	Market Analyst
Bremen	Ralf Huckriede	VBN	Regional Tariff Policy Office
London	Tim Bellenger	Travel Watch - arm's length oversight body	Director of Policy and Investigation
London	Richard Allsop	University College London	Emeritus Professor, Transport Studies
London	David Metz	University College London	Honorary Professor
London	McMullan Adrian	Transport for London	Pricing and Forecasting Manager
Singapore	Agnes Ng	Singapore Public Transport Council	Director's Office
Singapore	Alok Jain	Kowloon Motor Bus Company	Deputy Operations Director
Amsterdam	Niels van Oort	Delft Technical University	Associate Professor
Hong Kong	W.H. TSANG	Hong Kong University	Associate Professor
London	Peter White	University of Westminster	Professor, Planning and Transport Studies
Hong Kong	Emmanuel Vivant	Hong Kong Tramways	Managing Director

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