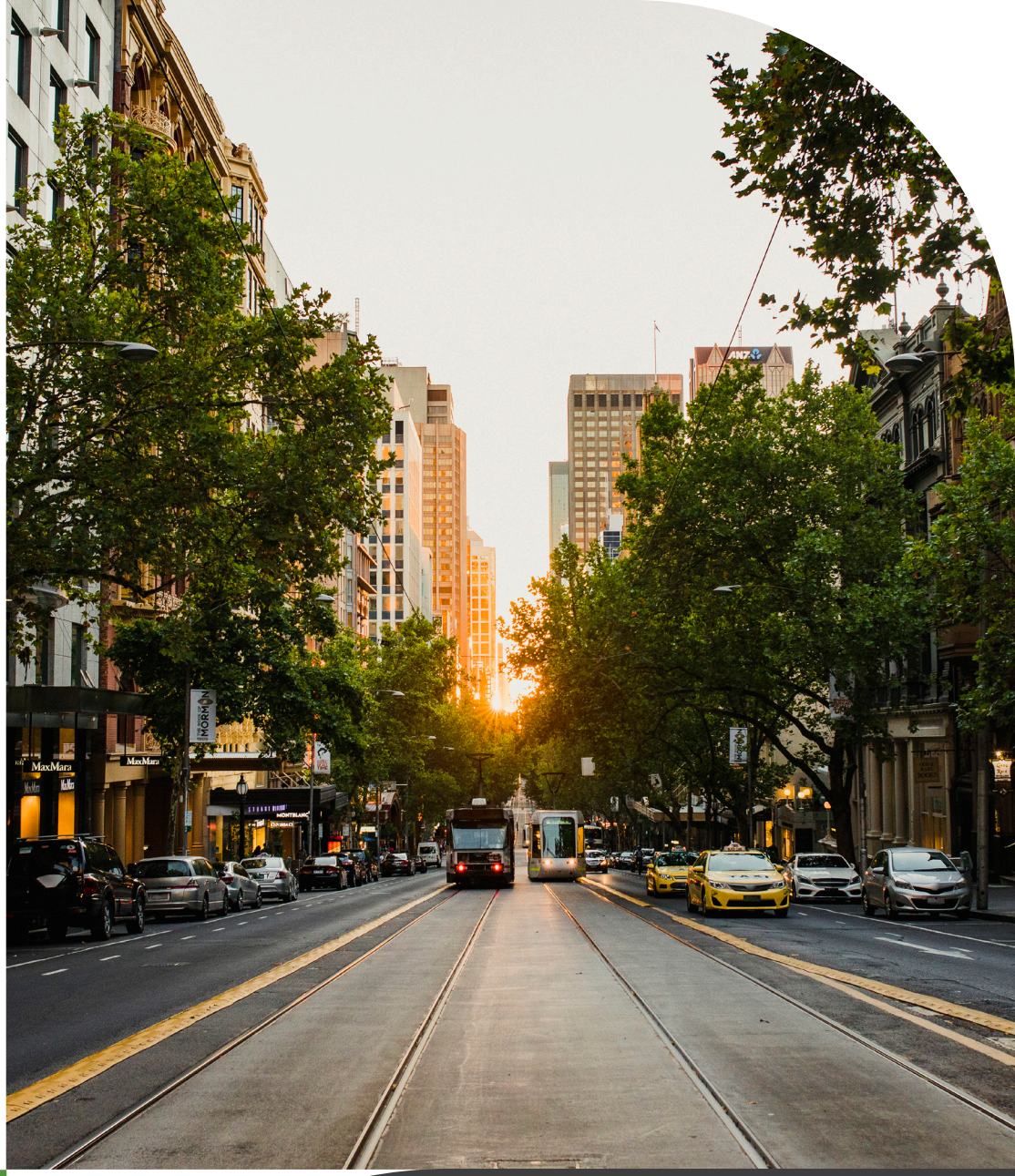
September 2020



INFRASTRUCTURE VICTORIA

Fair Move

Public Transport Fares Reform Technical Report

Aboriginal Acknowledgement

Infrastructure Victoria acknowledges the traditional owners of country in Victoria and pays respect to their elders' past, present, as well as elders of other Aboriginal communities. We recognise that the state's infrastructure is built on land that has been managed by Aboriginal people for millennia.

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1. Introduction

This paper is a complementary paper to *Fair Move: Better Public Transport Fares for Melbourne,* and does the following:

1. Presents the conceptual foundations more extensively, with more detailed analysis of the recommended fare reforms presented in *Fair Move: Better Public Transport Fares for Melbourne.*
2. Reports on the analysis of the broader set of issues in public transport fares not discussed in *Fair Move: Better Public Transport Fares for Melbourne*.

Except where necessary for continuity we do not repeat commentary presented in *Fair Move: Better Public Transport Fares for Melbourne*. For example, we do not cover problems that fare reform is required to address or review the reasons for removing the free tram zone. We just note, as documented more extensively in *Fair Move: Better Public Transport Fares for Melbourne* that public transport fares currently provide very little incentive for travellers to make choices that make best use of the public transport system.

This paper begins with a set of objectives to guide the setting of fares and a methodology that can be used to set them.

The next two sections focus on the two more important reforms (and the main recommendations in *Fair Move: Better Public Transport Fares for Melbourne*): mode-based and peak and off-peak pricing. This is followed by a set of chapters analysing the other aspects of pricing that is or could be applied to public transport – from discounts for concessions to distance-based pricing.

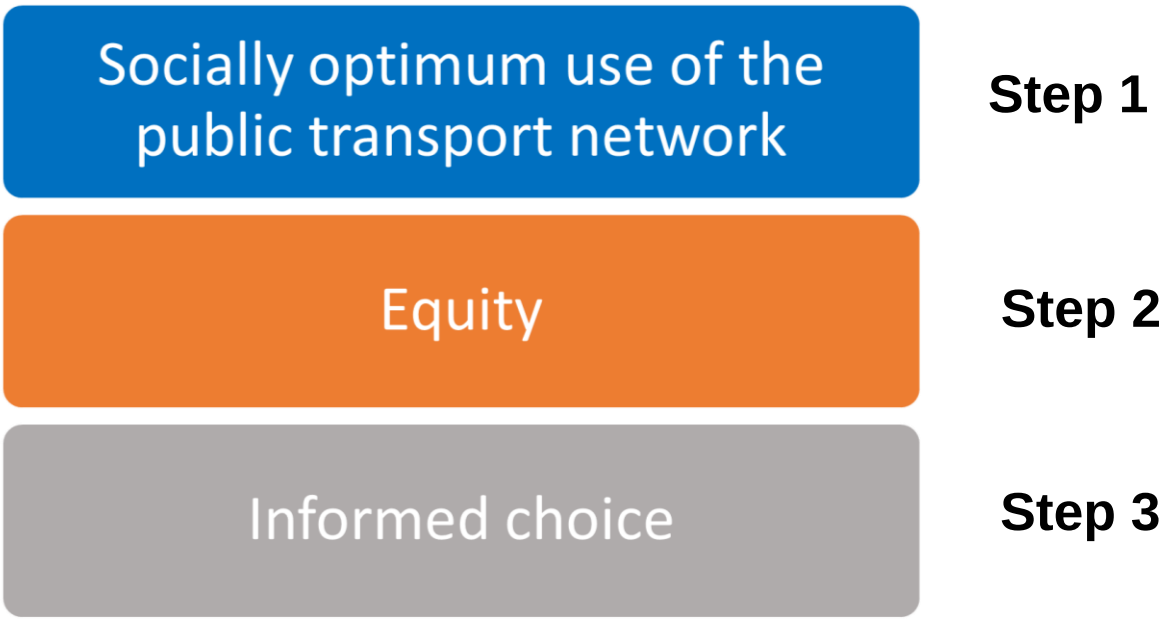
This report concludes with a technical note regarding the modelling reported in *Fair Move: Better Public Transport Fares for Melbourne*.

2. Fare setting objectives

2.1.1 Overview of objectives

Error! Reference source not found. is a representation of the three objectives that we apply in designing fares in this report, and view as central to any objectives the government would seek to specify for fare setting. Each of these objectives was developed after thorough research, and each objective has a direct relationship to fares. Further explanation for each of the objectives is provided in the following sections.

Figure 1 Objectives for setting fares



2.2 Socially optimum use

The primary objective is that fares should guide travellers to make choices that result in the socially optimum use of the public transport network. In other words, to encourage public transport use in such a way that the network provides the most benefits to all Victorians (across those using public transport, the road network or choosing active transport).

The public transport network contributes to many outcomes – it delivers benefits to travellers by providing an alternative to private transport and opens up more options to work, shop and engage with others. It also increases productivity while travelling, improves health through active transport and reduces carbon emissions, road congestion and road trauma.

Focussing on the socially optimal use of the network encompasses these outcomes and enables managing the trade-offs between them. For example, reducing public transport use results in lower network operating and future infrastructure costs while reducing public transport crowding, but also increases road congestion environmental costs.

An optimal set of prices enables people to make choices that will benefit themselves, as well as take into consideration the impacts of their journey method on society (defined as the social costs and benefits of a trip). Well-designed prices provide incentives for people to make decisions as though they had information on the social costs and benefits of their potential trips and used this information to make their decisions.

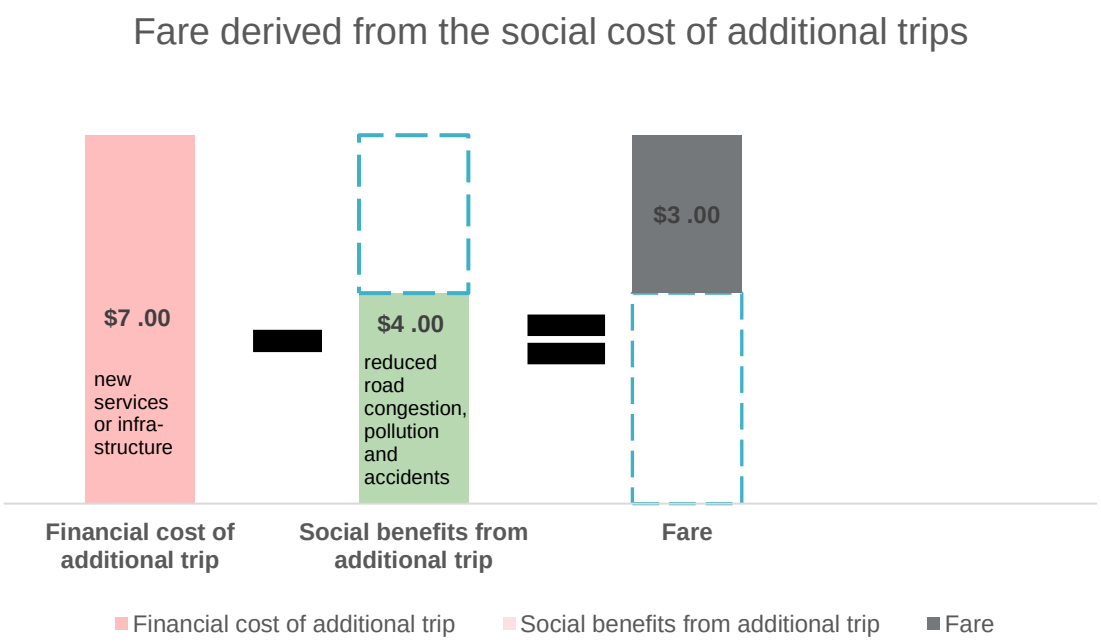
The approach we use to decide the structure and value of public transport fares is to charge people according to the cost that they impose on society when they make each public transport trip. This social cost is made up of the financial cost of providing an extra public transport trip (new services or new infrastructure needed to provide the trip) minus the benefits (including any disbenefits) to society an extra trip on the network provides. These include:

- financial costs of public transport services
- taxation costs to fund services and additional public transport infrastructure
- road congestion benefits
- environmental benefits

- road accident reduction benefits
- public transport crowding disbenefits.

The calculation is illustrated in Figure 2.

Figure 2 Illustration of social cost



We focus on the social costs and benefits of *additional trips* to the network (more technically known as the social marginal cost), rather than the average social costs for all trips. Economic theory suggests that using this pricing approach will yield the greatest social benefits from the entire network.

Our focus on the costs and benefits that come from additional trips also reflects that individuals make decisions about trips as they arise, one at a time. Society does not make a single decision about all trips at once. It is also the *change* in trips that causes additional costs and benefits in public transport and roads (the existing network is already built and paid for) and it is these changes that fares are best able to influence.

Using average costs rather than marginal ones results in very high prices for an underused train network (total social cost divided by low patronage), while an overused train network would result in very low prices (total social cost divided by high patronage), clearly neither of which would yield the best use of the train network.

The implication of pricing according to the social cost of additional public transport use is that an overused network with crowded train carriages should be priced higher to reduce over-crowding and help fund new infrastructure to be installed to allow for more trips (i.e. the social cost of adding extra trips is high), while an underused network with empty trains should be priced low to encourage greater use of the existing network (i.e. the social cost of adding extra trips is very low).

Our pricing approach ensures that maximum benefits are generated from the existing network. Road congestion and public transport crowding is balanced, society subsidises the benefits it receives from people using public transport and users pay for the remaining additional costs they impose by choosing to travel.

This approach is also the approach recommended by the NSW independent Pricing and regulatory tribunal (IPART), a process they describe as “socially optimum fares” (IPART, 2015).

Our recommendations on how various fares and elements of fares are priced are drawn from the elements that cause the costs and benefits of different journeys to increase or decrease. For example:

What kinds of things drive changes in financial costs?

- Crowding on the network means that to add more passengers’ new services or infrastructure must be provided. Empty services however can take on new trips at a very low cost.

- Some modes cost more to add service than others (for example buses are cheaper to add to the network than trains).
- Some geographic areas have high crowding and need new services to add capacity, while other areas have excess capacity so that additional trips can be added with minimal cost.
- Some times of the day are very crowded and so adding more trips is costly due to the need for new services or infrastructure to add capacity.

What kinds of things drive changes in social benefits?

- Times of the day where the road network is congested and where public transport has high benefits.
- Some modes do not use any road space and can move large numbers of people off the roads (e.g. trains), and so have higher road congestion benefits compared to other modes.
- Substantial crowding generates discomfort and unreliability for existing public transport users.

What is social marginal cost?

When we talk about the social cost of an additional trip, we are referring to the economic concept of social marginal cost, or put more simply, the social cost at the margin (where the margin refers to producing a little more or less of something).

In economic theory the production of a good or service is optimal when the marginal revenue (which is equal to the fare in this case) is equal to the marginal cost. When the quantity of a good or service is equal to the point at which the marginal revenue is equal to marginal cost of the good or service it will produce the greatest overall welfare.

Where externalities (such as congestion, pollution, noise etc.) are present these need to be accounted for, resulting in the "social" marginal cost.

Setting price equal to the social cost of producing the efficient marginal trip means that the entire network is being best utilised, providing the greatest benefits to society for the cost.

In this report Infrastructure Victoria has used the model developed by CIE (CIE, 2019) for estimating the social marginal costs of public transport. Rather than using point estimates, Infrastructure Victoria has charted a range of possible values from the model. We have done this because point estimates are built on a range of assumptions with which there is uncertainty, data is imperfect, and values are sensitive to issues in modelling.

Parameters used within the CIE model for estimates displayed in this report:

- Exclude "other revenue impacts" from marginal excess burden for taxation (MEBT) calculations, which would have included the costs of raising additional taxes for revenue lost outside of public transport due to an increase in public transport use (e.g. reduced tax revenue from fuel excise due to a switch from private to public transport).
- Applied a factor of 0.6, 1.4 and 1.0 to the proportion of infrastructure costs related to capacity (CIE ascribing 50% of most new infrastructure to capacity, and this factorisation brings the range to 30%, 50% and 70%).
- Included a MEBT of 25% and 40% (the values for the weighted average of state revenue and the weighted average of state own-source revenue).
- Discount rate of 7%.

The resulting set of prices are also consistent with the standard set of economic principles for pricing public transport as summarised in the paper *Good Move: Fixing Transport Congestion*.

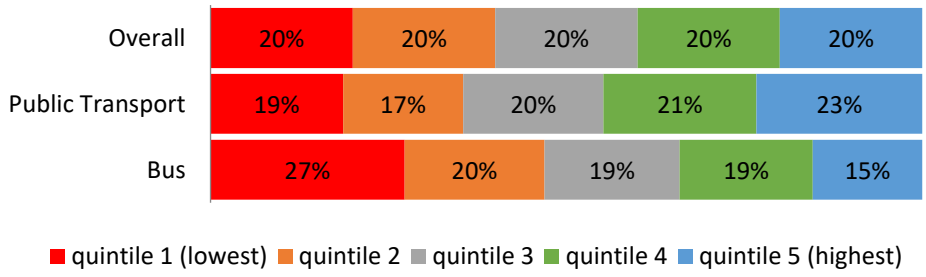
2.3 Equity

While the first aim is to price the network in such a way that it encourages public transport use that provides the most benefits to all Victorians, there are equity implications that must be considered. If the overall benefit comes at a high cost to groups who are already more vulnerable, then the change becomes inequitable. To avoid this the second objective is that changes to fares should not be inequitable.

To achieve this, each proposed change in fares undergoes analysis which shows which groups of people, by income, are most affected from reductions and increases in fares. We have done this by relying on the Victorian Integrated Survey of Travel Activity (VISTA), which provides a survey on what trips people are taking, as well as their household characteristics. We have used the information in the data to place people into equivalised household income groups (quintiles or fifths). We are primarily looking at how changes in fares are affecting the bottom 40% of households (bottom two quintiles).

For example, Figure 3 features a chart showing that overall public transport use is disproportionally lower for those on low incomes (less than 20% for low income quintiles) and higher for those on high incomes (over 20%). Bus use, however, is disproportionally higher for those on low incomes and disproportionally lower for those on high incomes. This analysis tells us that for equity reasons, care should be taken when changing bus fares in particular.

Figure 3 Public transport use by equivalised household income



Source: VISTA 2018, Infrastructure Victoria analysis

2.4 Informed choice

The final objective is ensuring that users have an informed choice. It ensures the way Victorians pay for public transport remains logical and user-friendly, promoting genuine informed travel choice.

Our first objective aims to make better use of the transport network. To rigidly apply this approach to all trips would result in an extremely complex set of fares which would be unlikely to be effective in practice. Prices are only as good as people's ability to understand and use them for decision making. Fares should be set in such a way that they provide an informed choice to users, and not create confusion. This means logical and user-friendly pricing.

Our approach to public transport fare reform aims to provide users with the option to make an informed choice about how and when they wish to travel. In order to achieve this a fare structure is needed that promotes the best use of a large and complex transport network but is simple enough to be understood and acted upon by users in their travel choices. Our public transport fare reform research includes both the specific pricing components (e.g. peak/ off-peak, mode, zones) and user experience (e.g. fare integration, ticketing systems) as part of reforming Victoria's public transport system.

In addition to empirical data and modelling, surveys and experiments are another way to collect vital data around how users may react to sophisticated fares, and how, or if, they are able to make a more *informed choice* around how they travel.

To understand this behavioural influence in detail, SGS Economics & Planning and The Behavioural Insights Team (BIT) conducted a study to examine how people responded to complexity in public transport fares (SGS-BIT, 2020). An online experiment designed to test public transport user types across society attracted 2,011 participants and identified a wide distribution of how users made choices. The experiment asked participants to choose the cheapest public transport fare, based on a defined pricing structure provided in four scenarios. Table 1 shows the components of each of the four scenarios plus a fifth scenario used in a more detailed analysis.

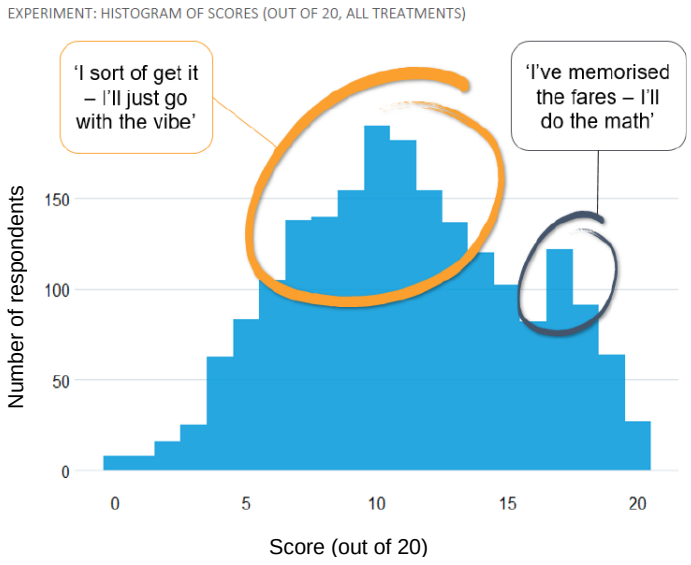
Table 1 Scenarios analysed in SGS-BIT (2020)

	Peak and off-peak pricing	Distance-based pricing	Mode-based pricing	Multimodal journey
Scenario 1	✓	×	×	×
Scenario 2	✓	×	✓	×
Scenario 3	✓	✓	×	×
Scenario 4	✓	✓	✓	×
Scenario 5	✓	✓	✓	✓

In choosing the cheapest fare for the first four scenarios, researches noted that there were different styles of fare calculation being used. While some people were keen problem solvers, attempting to work out exact fares, others were motivated by logic and feeling, approximating the total fare based on what they felt would be cheapest. There were also calculation styles that were motivated by a single fare element (often ignoring other elements) as well as others who ignored elements that were difficult to calculate (such as distance-based pricing).

The histogram of scores from the experiment identifies two clear peaks (Figure 4), and SGS explain that the left peak likely represents the “intuits” while the right peak represents the ‘problem-solvers’.

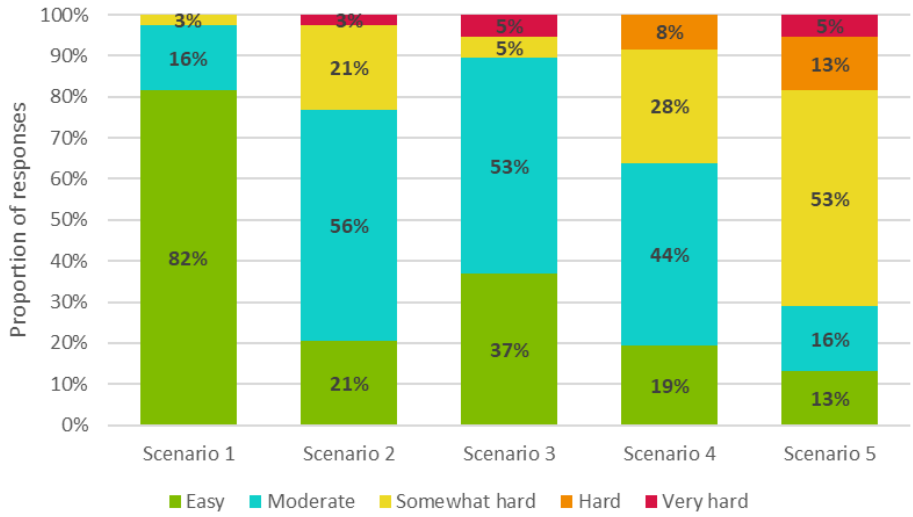
Figure 4 Histogram of scores from SGS-BIT experiment



From the highest peak, it appears that the majority of respondents fall into the category guided by logic and feeling – those that take an approximate calculated approach and rely on mental shortcuts or heuristics. This means that when we approach designing our proposed fare structure, we aim to make things easy to learn and follow, relying on rules of thumb that are intuitive. For example, fares could be more expensive when its busy or cheaper if you were to take a short trip. Ultimately, these heuristics and problem-solving approaches need to be incorporated into the proposed fare structure to ensure that understanding of the fare system is intuitive for an average user.

SGS-BIT also did a more detailed analysis of 39 participants’ responses to all five fare structures in Table 1. This is shown in Figure 5. By following the same scenarios as shown in the earlier table, it was clear that increased fare complexity resulted in greater difficulty calculating fares. Results also suggested that distance-based pricing was one of the most difficult pricing elements to understand and calculate. This shows that the more elements there are in a fare structure, the more disengaged people are likely to become.

Figure 5 Responses regarding difficulty of fare structures in SGS-BIT experiments



In order for users to make an informed choice, the presentation, promotion and supporting information about a fare structure is vital. Put simply, intuitive and logical fare structures will be less effective if they are not *presented* intuitively. A good example of successful presentation is Melbourne's free tram zone (noting Infrastructure Victoria considers the free tram zone should be removed for other reasons explained in this report and *Fair Move: Better Public Transport Fares for Melbourne*). The free tram zone is essentially a zone-based fare element – one that provides free travel to those that use trams solely within the zone. While poorly designed to be incompatible with the myki system, this fare element is well presented with clear signals to users including on-trip announcements and signage on platforms and in trams. All these visual and audio clues provide especially relevant information for intuitors that use the system.

Our approach to informed choice may focus on the solutions that exist currently but should also consider the role of technology in overcoming complexity. With new initiatives such as Mobile myki and dual screen passenger information displays being rolled out on select low-floor trams[1], technology is making it easier than ever to provide Victorians the information they need to make informed choices on how they use their transport network.

2.5 The next steps

These objectives not only guide how we analyse what is and isn't included in a fare structure (and the associated values), they also shape the order of the steps in which our analysis will take place. First, fares are evaluated on how they can encourage the best use of the network, then equity is evaluated to see what effects the proposed fares have (and what changes need to be made on an equity basis) and finally we ask whether these fares provide people with an informed choice.

[1] https://yarratrams.com.au/news/improving-passenger-information-on-melbournes-trams

3. Mode-based pricing

Conclusion: Metropolitan fares should vary by mode of transportation, such that trains are more expensive than trams and buses.

3.1 The issue

Victoria's metropolitan fare system currently charges the same fare regardless of which public transport mode a person chooses to travel on. Tickets are time based and cover all modes for the two-hour time period. This system is simple to understand, provides certainty on cost to users and encourages multimode travel.

Similar to Victoria's metropolitan fares, international cities that have made moves to a single price for all modes (including free transfers between modes) include New York,[2] Auckland,[3] Singapore[4] and Paris.[5] Domestically, Adelaide, Brisbane and Perth all feature a single price across all modes.[6]

This trend towards simpler fares and the preference by consumers for simple price signals (Reeson and Dunstall, 2009) questions whether the benefits from different pricing for each mode justify the additional complexity. Our research suggests that there is merit to this, as the costs and benefits provided by each mode of transport are very different, and that the types of trips and users of each mode are also not the same.

There are indeed other major cities that follow this rationale and change separate fees based on which mode you travel. Such cities include London[7] and Hong Kong[8] as well as Sydney[9], all utilising mode-based prices as part of their fare structures.

3.2 Social cost and benefit

The social costs and benefits of public transport use vary significantly by mode. A wide range of estimates under different assumptions consistently show that the cost for additional train use to society are consistently higher than bus and tram. This is a combination of the varying financial costs and external benefits of each mode.

CIE estimate that an additional passenger trip on a metro train in the peak has a financial cost of $13.80, $3.90 for tram, $4.16 for express bus[10] and $2.60 for metropolitan bus. These are point estimates from a wide range of potential costs, but the hierarchy that train is more expensive than tram, which is more expensive than metropolitan bus, remains constant, regardless of where the estimates are within the range (Figure 6).

The reason for the higher express bus costs than other bus costs is because many suburban bus routes do not require additional services to accommodate extra passenger trips as the services are not full, while express bus services would generally require new services as they are already at capacity in peak periods.

The cost analysis is consistent with analysis by IPART, which also shows higher costs for trains over bus (IPART, 2015a).

[2] http://web.mta.info/metrocard/mcgtreng.htm#payper *(excludes express bus)*

[3] https://at.govt.nz/bus-train-ferry/fares-discounts/how-simpler-fares-work/

[4] https://www.sbstransit.com.sg/fares-and-concessions

[5] https://www.ratp.fr/en/titres-et-tarifs/t-tickets

[6] https://www.transperth.wa.gov.au/tickets-fares/fares, https://www.transperth.wa.gov.au/tickets-fares/fares, https://translink.com.au/tickets-and-fares/fares-and-zones/current-fares,

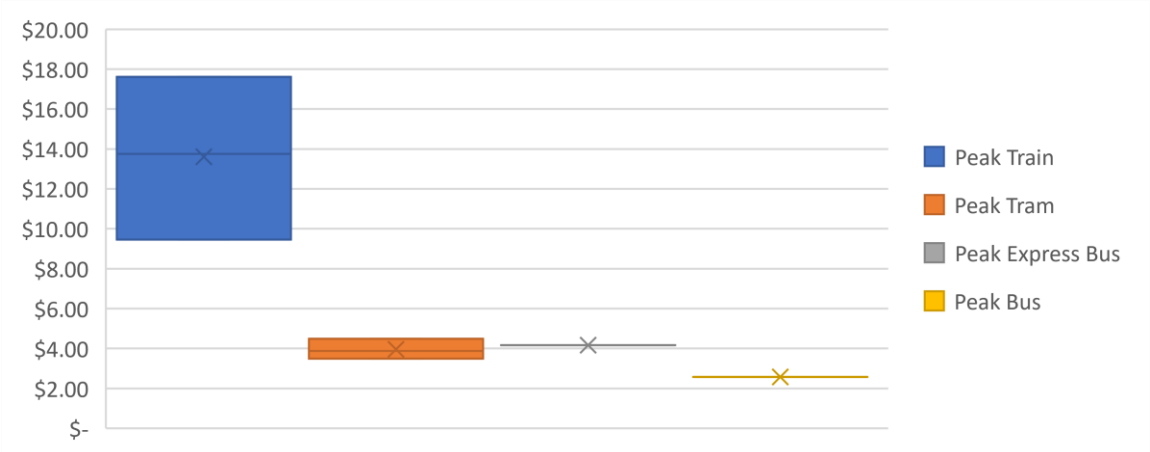
[7] https://tfl.gov.uk/fares/find-fares

[8] https://www.discoverhongkong.com/au/plan-your-trip/traveller-info/transport/getting-around/index.jsp

[9] https://transportnsw.info/tickets-opal/opal/fares-payments/adult-fares

[10] *Express buses are those that run direct CBD services and a selection of higher frequency and higher patronage services consisting of routes 302, 303, 304, 305, 309, 318, 905, 906, 907, 908, 200 and 207.*

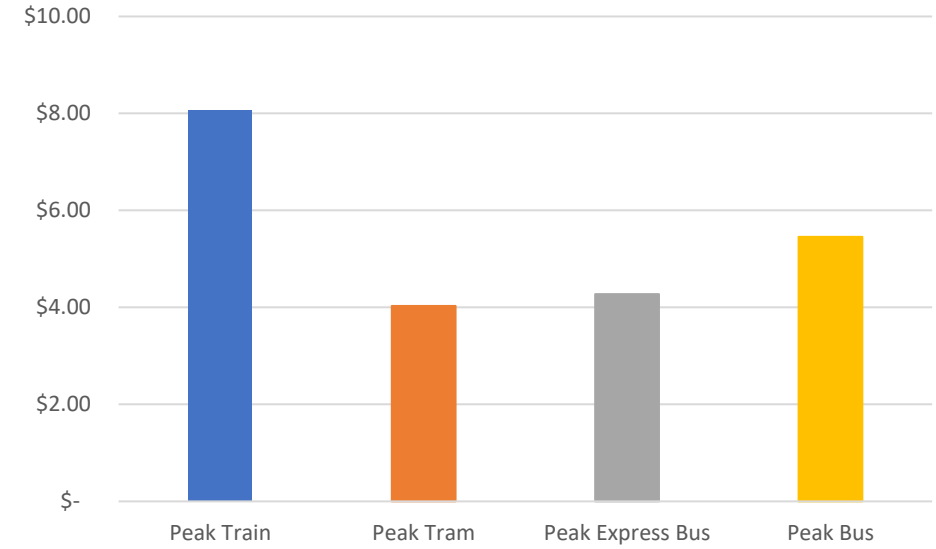
Figure 6 Financial cost of additional public service trips, by mode, during the peak



Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost. See breakout box in section 2.2 for details.

On the other side of the equation are the social benefits of additional public transport use, which also vary by mode, depicted in Figure 7. While trains cost significantly more than other modes per trip, they also generate greater benefits, driven both by longer average trip length and the fact that trains are not running on the road network like trams and buses.

Figure 7 Social benefits of additional public transport trips, by mode



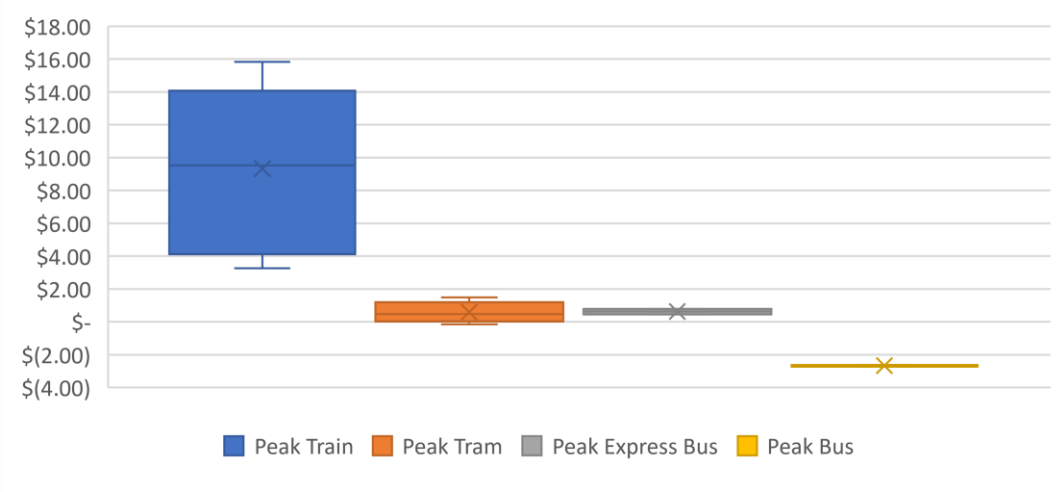
Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost. See breakout box in section 2.2 for details.

Note: The peak express bus result is somewhat surprising, given that express bus trips are longer than bus or tram trips, and we would expect them to remove car trips that would cause significant congestion (trips to the CBD). The result is likely due to VITM's limited ability to model the express bus services separately, as the VITM results suggest that express bus trips are replacing fewer car trips compared to tram and bus, which seems very unlikely. CIE note that the results for the decrease in car trips due to additional express bus trips is within the convergence error of VIMT.

While the benefits for train are greater than all other modes, the size of the differences isn't enough to overcome the significantly larger financial costs for additional train travel.

Combining the costs and benefits, and also accounting for the social cost of raising taxation revenue in order to provide the fare subsidies, generates the overall social cost estimates for additional public transport trips by mode, as illustrated in Figure 8.

Figure 8 Social cost of additional public transport trips, by mode, during the peak



Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost See breakout box in section 2.2 for details.

It is clear to see that even with a range of estimates under varying assumptions the social costs of additional peak trips vary by mode. Fares for peak trains should be higher than trams and buses, in line with their higher social costs. Express buses and trams have similar social costs, while negative fares are implied for bus trips.

The social costs for additional metropolitan bus trips are so low because there is excess capacity on these bus services. Modelling undertaken for Infrastructure Victoria estimates that 70% of bus routes run at below a third of their capacity during the AM peak.[11] It may be better for society from a cost perspective to cancel some of these services, rather than pricing them so low. However, these services are provided on the basis of other public transport considerations (such as equity of access) and so we take them as given. Since these services are being offered, the best outcome for society is that they are priced low so that people use them.

While some bus services are running well under capacity, other are not. There are also particular times of day when the bus system is under strain, particularly around school times. Beginning with a significant reduction in bus fares should be a first step, before more research and analysis is completed to see if further reductions (or even increases in some areas) are warranted, and whether these further reductions should apply across the network or only on specific routes or times of day.

Using our pricing principle that all modes should be priced, and due to uncertainty around the numbers provided by the CIE modelling, a low fare is recommended for buses, rather than a free (or even negative) fare, as some of the data may suggest.

The outcome of our social cost analysis is clear. Fares should be higher for trains than trams, and buses should be the lowest priced mode. In descending order of value fares should be:

1. Train
2. Peak Tram
3. Express Bus
4. Metropolitan Bus

The current flat fare is particularly affecting short trip bus fares and usage. A short bus trip costs $4.50 in Melbourne compared to as low as $2.24 in Sydney, $2.80AUD in London, $1.00AUD in Hong Kong and $3.40AUD in Chicago and Paris.[12]

The benefits of moving to a mode-based fare system is that it provides opportunities for travellers to trade off price, convenience and quality which will leave them better off. It also enables government to incentivise the use of underutilised bus services without then causing higher demand on train lines that are at capacity.

[11] *See CIE (2020) for discussion of the results and Jacobs (2020) for a description of the modelling.*

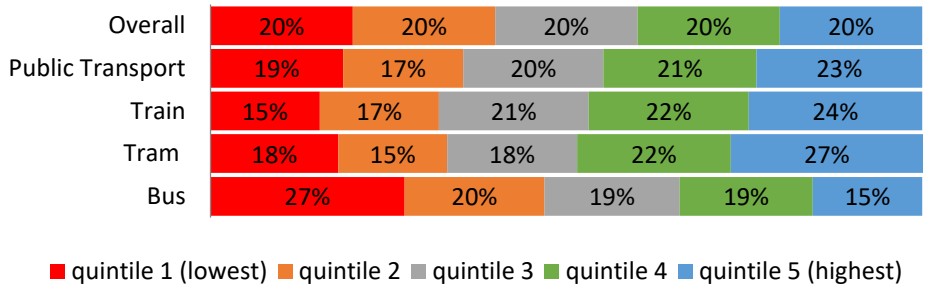
[12] *Approximations as at 19 May 2020, $1.50AUD = $1.00 USD*

The cost of continuing to provide a flat fare is that it encourages too much train travel while discouraging tram and bus travel. The current fare system results in poor use of Melbourne's public transport network and would be improved with fares which vary by mode.

3.3 Equity

The equity implications of a fare structure that is priced highest for trains and lowest for buses are positive. Using data for trips at all times of the day we can see in Figure 9 that buses are disproportionally used by those on lower incomes, while trains and trams are used disproportionally by people on higher incomes.

Figure 9 Public transport users by equivalised household income quintiles



Source: VISTA data 2018, Infrastructure Victoria analysis

In this instance promoting socially optimum use also aligns well with equity objectives and will on average make those on low incomes better off.

3.4 Informed choice

While varying fares by mode may be the best use of the public transport network and have equity improvements, there is a cost in simplicity.

However, in our opinion this trade-off is not a significant one. Research shows that people often use rules of thumb to make decisions, rather than thinking through all the options in depth, and by calculating all costs and benefits of each option (Reeson and Dunstall, 2009). Further, it is found while people may prefer simple pricing options, they are able to respond to quite complex price structures so long as they are clear and follow a logical structure (Bonsall et al., 2007).

Different prices for varying modes of public transport is intuitive. It is easy to remember, and quite logical that a train will cost more than a tram, and that buses are the cheapest form of public transport. Express buses are special services and it is also easy to understand and recall that they will be priced higher than typical suburban buses.

This is consistent with the finding from SGS-BIT (2020), which found that modal and peak charges were relatively easy to understand for participants in both the experiment and user consultation. So intuitive was mode-based pricing that it scored no higher in difficulty by users in the SGS-BIT report when combined with peak fares than a peak-fares-only structure, and users scored higher on accuracy with mode-based pricing combined with peak pricing than in peak pricing alone.

SGS ascribe part of the relative ease with which people could use mode-based prices: "the differences between the modes was large and salient. For example, a bus was always cheaper than a train, even with the peak surcharge." These large and salient differences between modes are similar to that modelled by Infrastructure Victoria, retaining very easy to understand rules where a suburban bus is always cheaper than a train, regardless of time period.

Visual cues also help people create and recall rules of thumb, and pricing differently by physical modes that vary greatly in appearance makes for a very easy rule of thumb to recall and rely upon. People struggle more with less physical concepts, such as distance and time of day pricing.

In summary, fares that vary by mode are intuitive and offer significant advantages in better managing the public transport network.

4. Peak pricing

Conclusion: Melbourne's public transport network should adopt peak and off-peak pricing for train, tram and express bus services in congested parts of the network.

4.1 The issue

Melbourne's use of the overall transport network is highly dependent on the time of day. As Figure 10 clearly shows, both public transport and roads have a "peak" period of usage that ranges from around 7:30am to 9:30am and then a double peak in the afternoon, likely attributed to school pickups and returning from work trips.

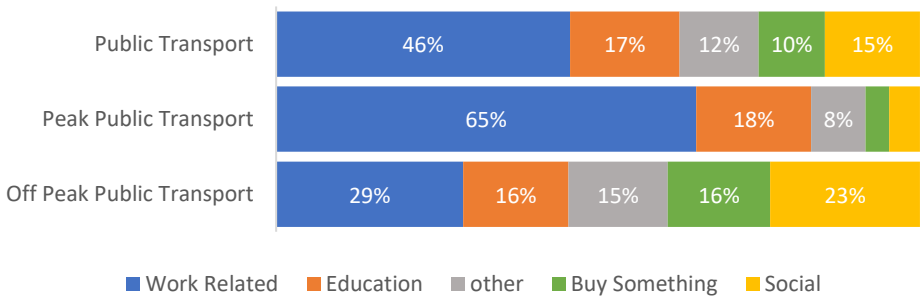
The peak is even more pronounced for public transport, as the use in the off-peak periods falls much more heavily than road use. This underutilisation of the network during the off-peak and highly congested periods in the peak is the main contributor to our conclusion that the network is unbalanced.

Figure 10 Road and public transport use by time of day, average weekday

Source: VISTA 2018

Analysis of trip purpose, represented in Figure 11 shows that the majority of trips during the peak are for work and education, while there are still a proportion of trips taking place at this time for social, shopping or other purposes.

Figure 11 Share of public transport trips, by purpose, during the peak



Source: VISTA 2018

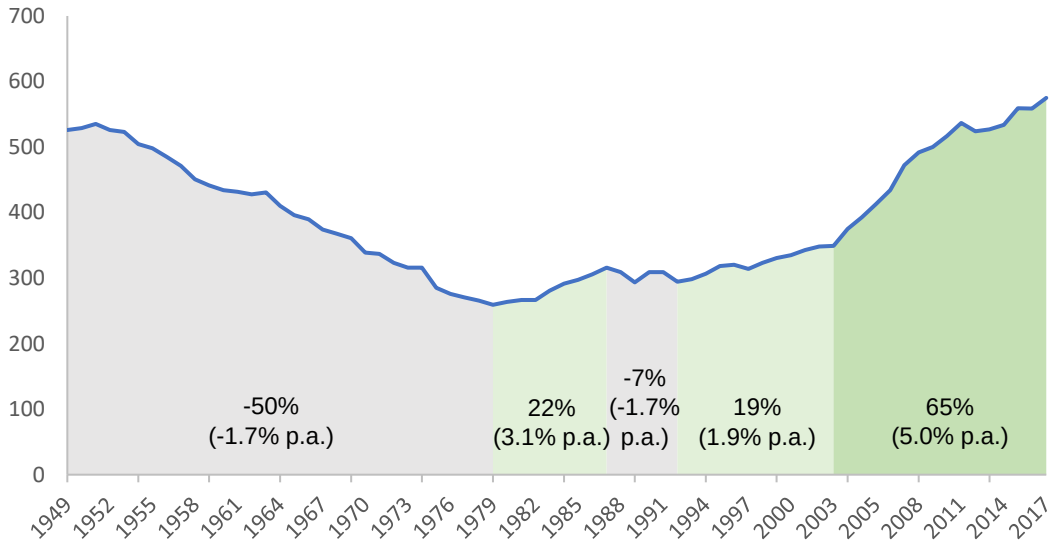
Economic theory suggests that the network could be more balanced if pricing incentivised travel on public transport in the off-peak periods to make better use of the existing network, while also sending a price signal for the peak period that balances the benefits of removing road congestion with the costs of making room for additional trips on the public transport network during busy periods.

4.2 Peak pricing in Victoria

Public transport pricing based on the time of day in which travel occurs has a long history in Victoria. Before the late 1970s, Melbourne train fares included peak and off-peak fares and were set according to a detailed schedule based on distance. In under ten years this was all replaced with the much simpler Metro card system, which evolved into today's zonal system (Infrastructure Victoria, 2020).

A full understanding of the rationale behind the move away from peak and off-peak fares is not readily available, but annual reports for the Victorian Railways Board and Melbourne and Metropolitan Tramways Board (MMTB) suggest they were in part a response to declining patronage and a way to support the introduction of ticket machines (Infrastructure Victoria, 2020). The rise of the automobile had significant effects on public transport patronage, resulting in broad underutilisation of the network. However, these issues no longer exist with public transport usage surging in the first part of the century as shown in Figure 12,[13] and with the introduction of smartcard ticketing technology. Interestingly however, peak prices have not resurfaced for Melbourne's metropolitan fares.

Figure 12 Metropolitan Melbourne public transport usage, 1949-2017



Source: PTV, Melbourne Public Transport Patronage Long Run Series 1945-46 to 2010-11 and Budget Paper 3 patronage numbers from various state budgets.

Somewhat at odds with metro fares, regional services do attract a peak surcharge, but only when travelling across three or more zones and arriving or departing inner Melbourne (Zone 1) during the AM or PM peak.[14] However, those travelling from the peri-urban fringe of Melbourne do not pay peak prices for their transport, as despite being outside the metropolitan area these are treated like Zone 2 metropolitan services, and are classified as Zone 2/3 and even Zone 2/3/4 overlap stations.

Those travelling from further out do pay a peak surcharge, which may be avoided by swapping to a metro train once reaching a Zone 2 station.[15] It is an anomaly that, as shown in Figure 13, those boarding at the critical overcrowding point on regional services (peri-urban and western Melbourne travellers)[16] do not receive a peak hour fare, while those coming from regional areas boarding much less crowded services do.

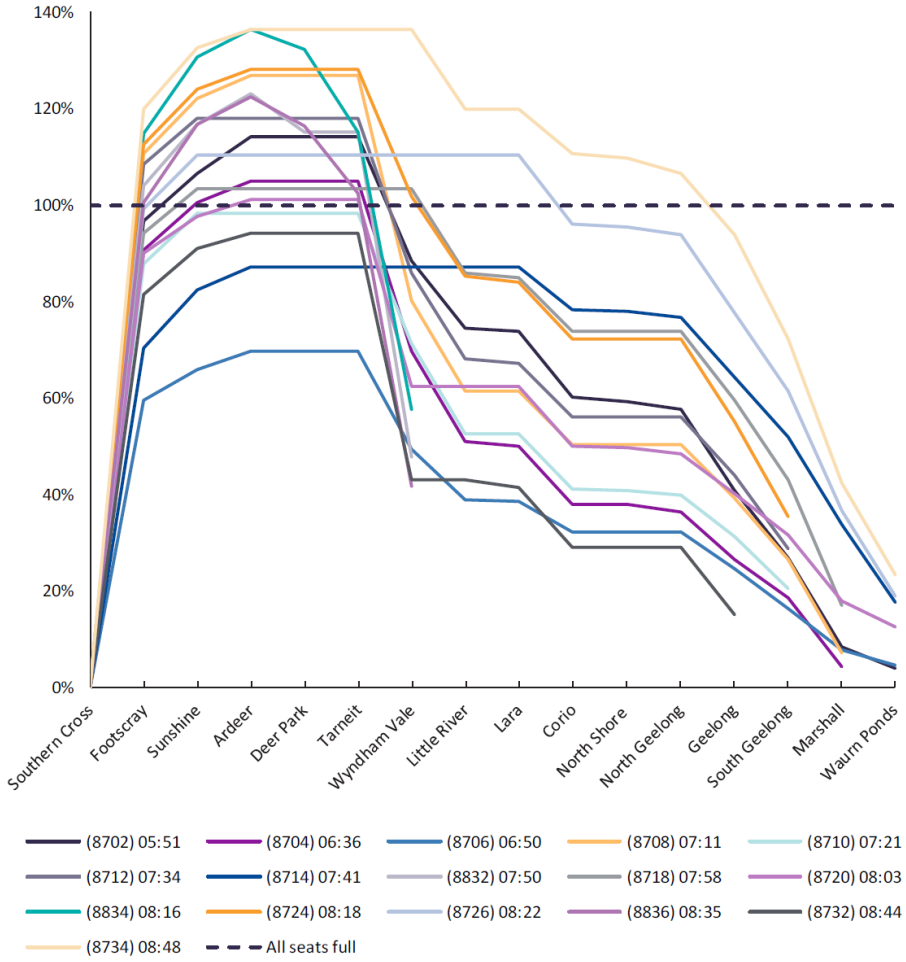
[13] *Melbourne Public Transport Patronage Long Run Series 1945-46 to 2010-11*

[14] https://www.ptv.vic.gov.au/tickets/fares/regional-fares/

[15] *For all V/Line pick up and set down restrictions, see Victorian Fares and Ticketing Manual:* https://static.ptv.vic.gov.au/PTV/PTV%20docs/Ticketing/1546213888/Final-Fares-and-Ticketing-Manual-2019-accessible-version-amended.pdf

[16] https://www.audit.vic.gov.au/sites/default/files/2017-08/20170809-VLine-Passenger-Services.pdf *Appendix D*

Figure 13 Average passenger loads between stations, inbound morning peak to Southern Cross station, March 2017



Source: VAGO - V/Line Passenger Services Figure D2, August 2017

Across the country there is a variety of public transport systems that feature peak fares, including Sydney, Brisbane and Adelaide. Internationally the use of peak fares is also mixed with peak fares being a feature in the public transport systems of London, Tokyo and Berlin while it is absent from cities such as Auckland, New York, Madrid and Paris.

In Melbourne the lived experience of commuters has been high levels of congestion and crowding on public transport services at peak times, and low frequency of services in off-peak times. The current metropolitan fare system treats both periods in the same way.

The concept of charging more in times of high demand is fairly widely accepted in society, and can be seen in many other industries, including air travel, accommodation, rideshare and petrol prices.

We find that the use of the public transport network can be significantly improved by a move to peak pricing on some modes of public transport, but not all.

Because fares affect the use of the public transport and road networks in the short term, fare policy must change with the situations to which it applies. Not all modes are in need of additional patronage generation at all times of the day, like they may have been in the 80s and even 90s. We find that peak charges should apply to train and express bus services in particular, and probably to trams. Buses are still underutilised overall, and so peak fares are not recommended at this stage.

4.3 Social cost and benefit

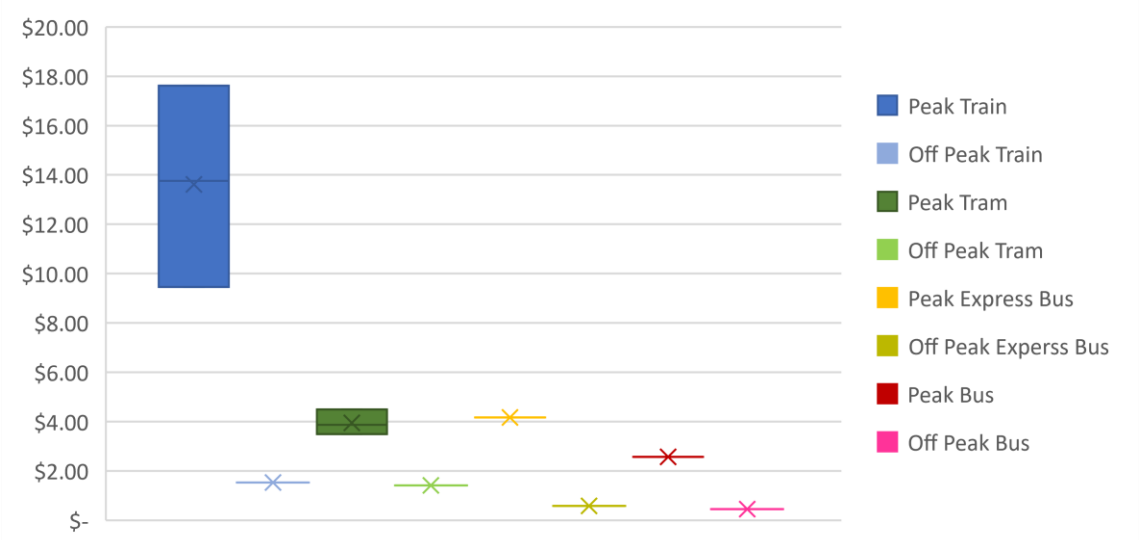
The social costs of public transport use vary significantly by time. The social costs move with the time of day primarily due to differences in the capacity available for new trips by time, and the higher levels of road congestion during peak periods.

4.3.1 Financial costs by time of day

Because services are generally not overcrowded in off-peak periods, the costs of adding additional public transport trips is relatively low. Excess capacity exists on most services such that any increase in trips can be accommodated by the current level of service. There may be increases in cost from energy use and wear and tear, and in some locations new services may be required, but there will be no need for new infrastructure or rolling stock. In peak periods the network is under significant strain, with services and infrastructure both reaching, and in some cases exceeding, capacity.

Figure 14 shows a range of estimates on the different costs of adding additional trips between peak and off-peak services. It is clear that despite the large range of peak financial cost estimates, these are always higher than their off-peak equivalent.

Figure 14 Financial costs of additional public transport trips, by mode and time of day



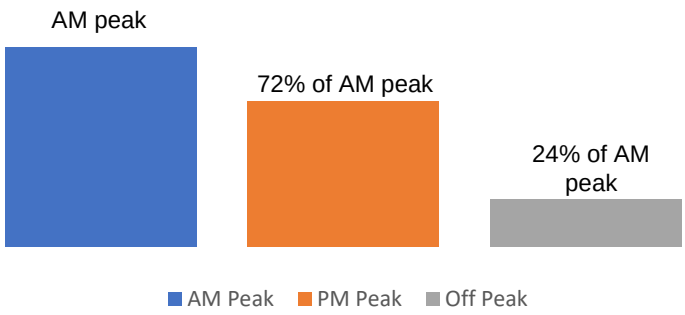
Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost. See breakout box in section 2.2 for details

4.3.2 Social benefits by time of day

Countering these high costs are the high social benefits. As shown in Figure 15, the social benefits of public transport use are much higher in peak periods. This is mainly due to the fact that at peak public transport periods, roads are also highly congested (see Figure 10). Moving a trip from the road to public transport in the peak provides huge congestion benefits to road users, benefits that are not nearly as pronounced in non-peak periods.

While CIE modelling for Infrastructure Victoria assumed no congestion benefits in the off-peak, this was recognised as understating the true social benefit for this period (CIE, 2020). While the congestion benefits are much lower in the off-peak, there are still likely to be benefits in some locations. Work conducted for the Department of Transport in 2015 by the Sapere Research Group estimated that the congestion benefits for a trip in the off-peak was around 24% of the benefit in the morning peak (Sapere Research Group, 2017).

Figure 15 Relative social benefits of additional public transport use, by time of day



Source: External benefits of public transport, Sapere for the Department of Transport, 2015

4.3.3 Overall social cost by time of day

The net outcome of the financial costs and social benefits, plus accounting for the extra cost that comes from additional taxation to subsidise extra public transport trips, varies by mode. We find that trains undoubtably have a higher social cost to provide additional services in the peak periods, while the evidence for trams and buses is mixed.

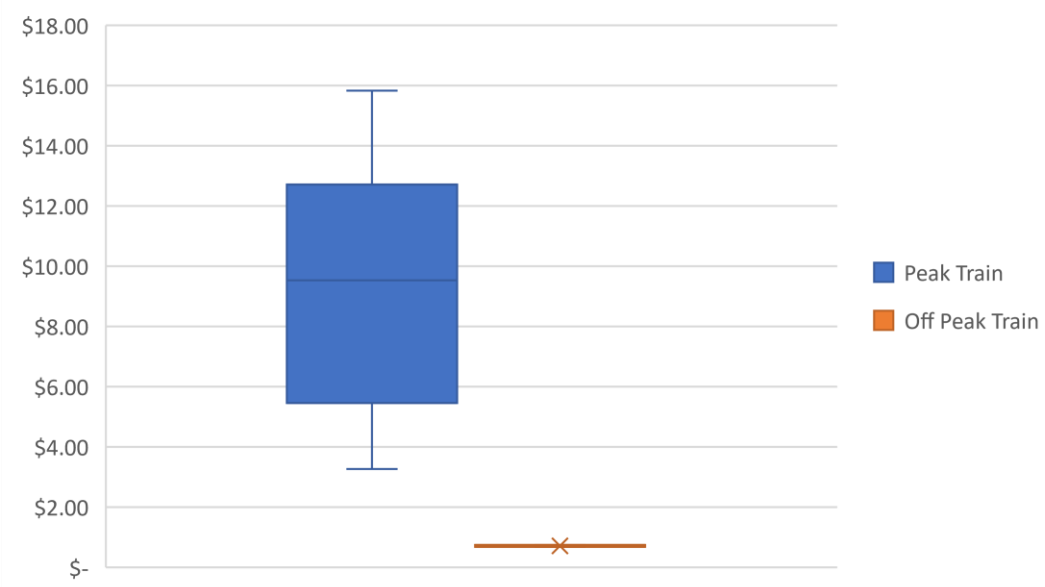
Train

CIE estimate that an additional train trip costs around $14 in the peak, while only costing around fraction of that in the off-peak ($1.50) (CIE). While the congestion benefits are significantly higher in the peak period, these benefits are outnumbered by the costs of adding additional capacity to the rail network.

As evidence in section 6 (Zones), congestion increases on the rail network the closer services get to the city, which makes adding additional capacity very costly due to the limited options available for new infrastructure, usually involving signalling upgrades and tunnelling.

Estimates produced from the CIE model provided to infrastructure Victoria show that in the peak the social cost of adding additional passengers to the train network is significantly higher than in the off-peak periods (Figure 16).

Figure 16 Social cost of additional public transport use for metropolitan trains



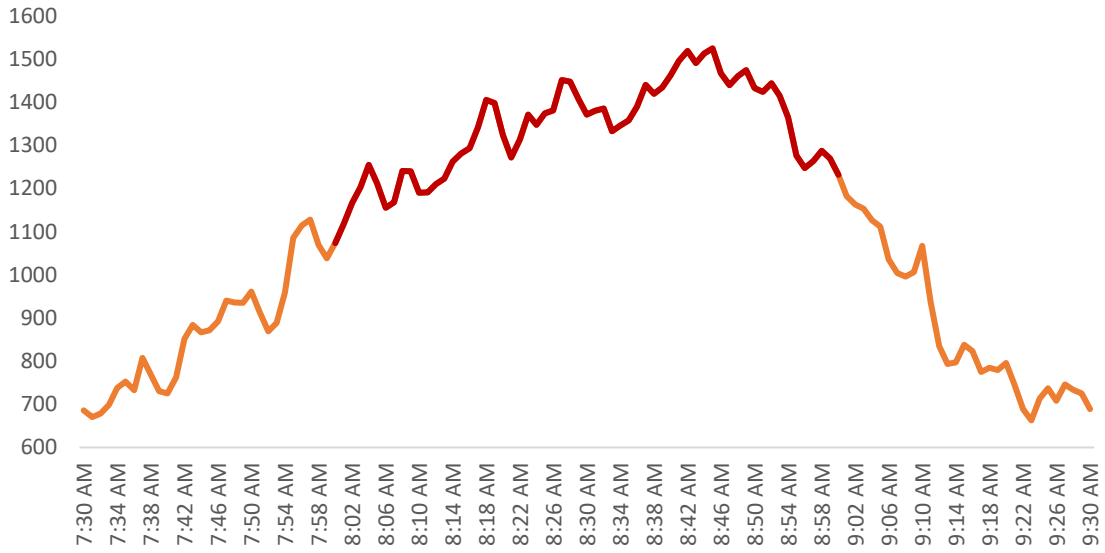
Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost. See breakout box in section 2.2 for details

This analysis suggests there are clear benefits from having peak pricing for trains, as the current fare discourages travel on the network when it is most cheap to provide and encourages it when the social costs of additional trips are their highest.

In section 6 (Zones) the capacity constraints for the inner Melbourne area for train are discussed in detail, and a new zone for train is proposed that includes city loop stations and Melbourne Metro Tunnel stations (City Zone).

Looking at city loop touch off data in the AM peak, represented in Figure 17, it is clear there is a significant peak within the peak period in CBD (highlighted in red).

Figure 17 Average touch off transactions per minute in the city loop during AM peak

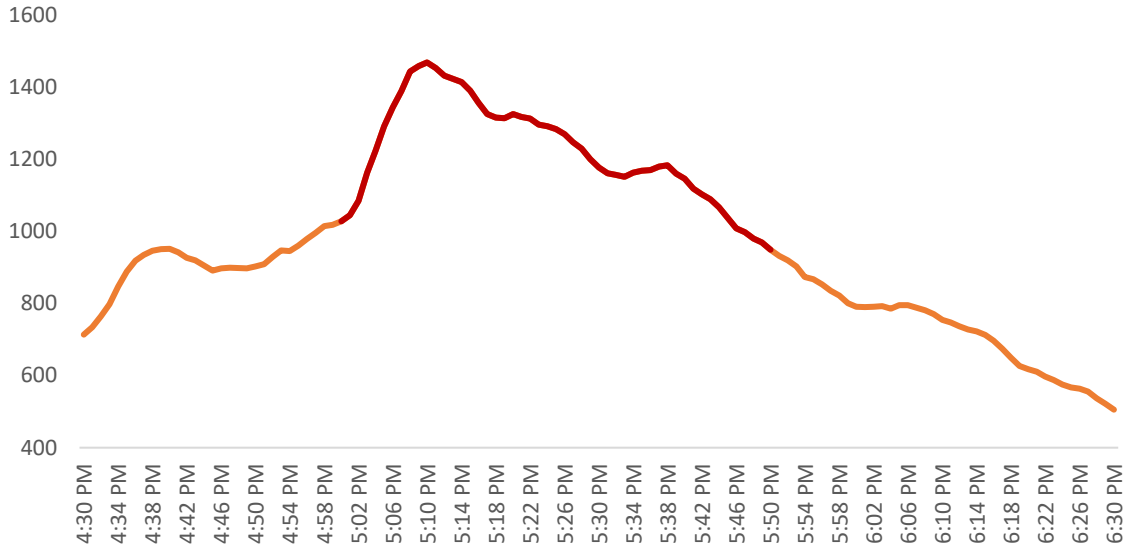


Source: Source: myki touch on/off data, 2019

Note: the darker red section of the line highlights the "peak within a peak period" for the CBD

This essentially shows that there is a peak within the peak period, and that there are benefits from moving people in these times to the edges of the peak. There is a similar peak within the PM peak, as represented in **Error! Not a valid bookmark self-reference.**.

Figure 18 Average touch on transactions per minute in the city loop during the PM peak



Source: Source: myki touch on/off data, 2019

Note: the darker red section of the line highlights the "peak within a peak period" for the CBD

Infrastructure Victoria analysis using Department of Transport (DoT) survey data has found that even for work trips, over half of people said that they are able to shift their time of travel. 54% of those able to shift their time of travel were able to shift their trip by up to 15 minutes, 38% up to half an hour, 24% up to an hour and 13% more than one hour.[17]

Given most people who can shift are able to do so by less than an hour, there will be few people able to shift from a 9:00 am arrival to a pre-peak arrival (e.g. 7:25am) simply for a fare change.

[17] *Dot Survey data analysed by Infrastructure Victoria*

Given this information it may be possible to impose an extra surcharge for travel to the CBD (City Zone) during the peak of the peak period (8-9am in the AM and 5-6pm in the PM). This would incentivise people arriving at these times to shift away from the height of the peak to the other peak times, and those in the remainder of the peak times will be incentivised to shift into the non-peak, having the effect of flattening the curve.

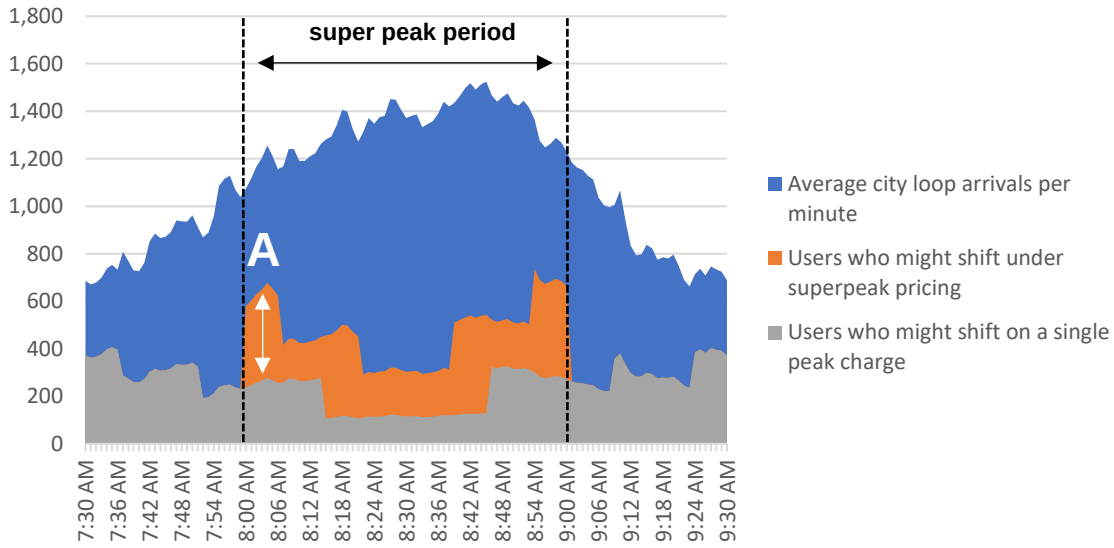
By introducing a super peak charge between 8am and 9am, those in the height of the peak would have a reason to move outside the super peak (for example from 8:20am to 7:55am) and those in the normal peak have reason to move to the off-peak, and would make room for the super peak users in the peak period (for example by moving from 7:55am to 7:25am).

Using people's stated ability to move their work trips (see DoT survey results above) as a rough proxy for their willingness to shift their time of travel in the peak, we have done analysis to see how many people might be willing to shift *and* who will also face a price incentive to shift under peak and super peak fares.

Each time period was divided into the four groups of people based on the survey results: those who would not shift, those who would shift up to 15min (7min was used as the midpoint value), 15-30min (22min midpoint), 30min-1hr (45min midpoint) and more than one hour (61min). We then analysed how many of those people who were willing to shift would face an incentive to do so under the peak and super peak pricing.

The analysis shows having super peak fares results in more than a 50% increase in the number of City Loop travellers in the peak period who are willing *and* incentivised to shift their time of travel (from 30,000 to 47,000 - Figure 19). We have highlighted Peak A in Figure 19 to help explain this difference. If the super peak charge was implemented, those who are willing to shift relatively small amounts and currently travel close to the 8am and 9am super peak start and cut-off times face an incentive to shift travel time that they previously did not have, resulting in a significant increase in people willing *and* incentivised to shift.

Figure 19 City Loop trips in the AM peak and incentives to shift under peak and super peak prices



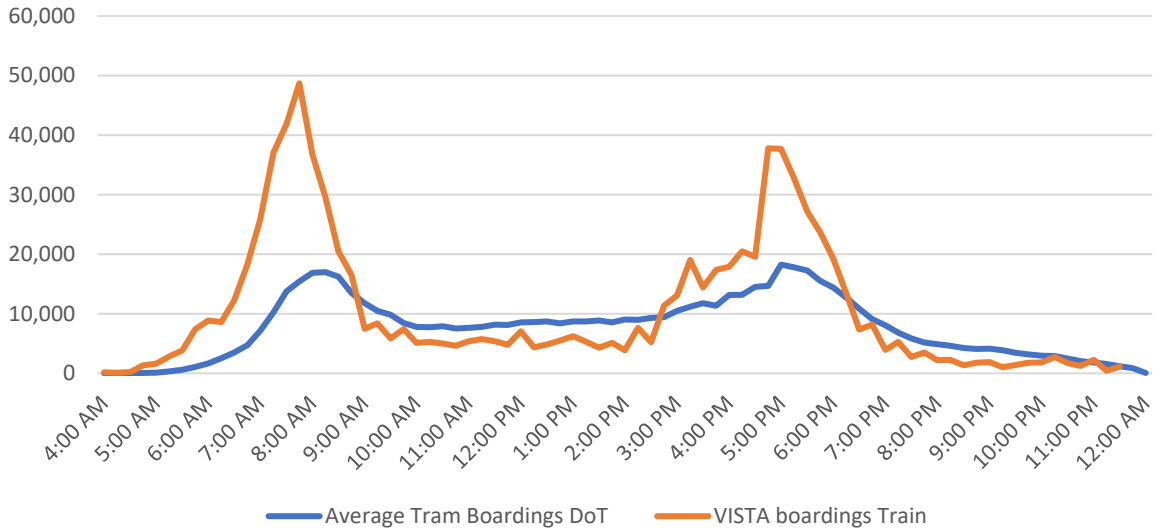
Source: Analysis performed by Infrastructure Victoria using Department of Transport survey data and myki touch off data.

However, despite the potential behavioural benefits of this approach, it must be weighed against the complexity of implementation and the ease with which people will be able to understand the additional peak fare. This is discussed in detail in section 2.4 (Informed choice), with the conclusion that super peak pricing faces practical barriers that are likely too great to recommend this particular pricing approach in the short term.

Trams

Tram services also vary by capacity with time; however, the differences are less distinct when compared with trains. While train usage falls almost 13 times lower between the height of the peak period and inter-peak periods, tram patronage only falls around 2.2 times, as demonstrated in Figure 20.[18]

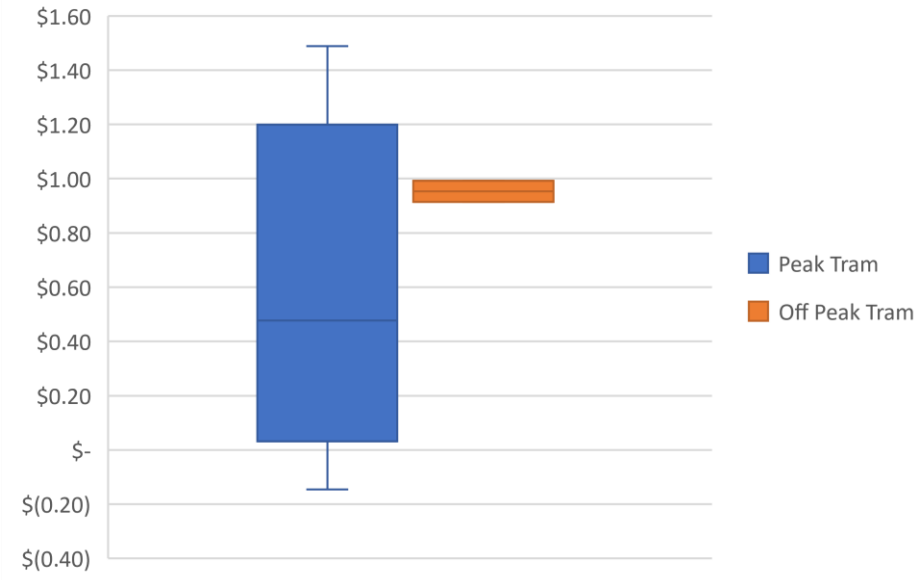
Figure 20 Train and tram boardings, average weekday



Source: VISTA 2018 and DoT data

The financial costs for trams are estimated by CIE to be around $3.90 per additional trip in the peak, and $1.40 in the off-peak (CIE). The congestion benefits are similarly varied however, resulting in a social cost of additional tram travel (after accounting for the effects of increase taxation) that is similar between the peak and the off-peak as represented in Figure 21.

Figure 21 Social cost of additional public transport use for metropolitan tram



[18] *VISTA 2018 and DoT patronage data*

Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost. See breakout box in section 2.2 for details

These estimates make arguing for peak pricing on tram lines difficult, however they do not reveal the full picture. The CIE estimates did not account for the additional cost of housing larger trams in depots, or address that for some lines adding trams is very difficult, or simply not possible.

The St Kilda Road and Swanston Street (CBD) tram corridor, which carries 10 of the 24 tram lines in Melbourne, is particularly problematic as peak frequencies cannot be increased on any of the routes in the corridor (there is a tram every minute in both directions for much of the day) as safety regulations permit only 60 trams per hour. Run times become slow, unreliable and inefficient as trams queue at signals and behind other trams when trying to access tram stops. Additionally, any incidents on the corridor can affect one third of Melbourne's tram network (Langdon and Degnan, 2017). This is also one of the busiest tram corridors in the world.

This can be managed in the short to medium term by increasing the capacity and size of the trams themselves but may require network reconfigurations in the longer term.

It is also true that overcrowded trams during the peak hour are a lived experience for many Melbournians, particularly those travelling into, out of or within the CBD.

All this makes for some uncertainty in determining whether or not a peak fare should apply to trams, or whether they should be the same price at all times of the day.

Given our recommendation that trams be priced lower than trains, it would be prudent to include peak pricing for trams as a first step in fare reform, as modelling the reforms did show an increase in tram use from the lower tram fare, even in times of peak pricing.[19] This would enable policy makers to observe the change in tram use behaviour from a change in fares during the peak, and perform more quantitative analysis on the social costs of additional tram patronage before contemplating a flat fare for trams.

Buses

While there is crowding on some bus services in the peak, additional services are relatively inexpensive to put on, and in many cases no additional services are required due to the excess capacity that already exists on many bus services, even during peak times. On average CIE estimate the additional financial costs for an additional peak bus trip to be around $2.50, and only $0.50 in the off-peak.

While the additional financial costs are low, the benefits from reduced road congestion from additional trips is still significant. This leads the net effect that the social costs for bus services is estimated to be negative by CIE, across both peak and off-peak periods, which suggests a negative fare. As discussed in the section 3 (Mode-based pricing), this leads us to the conclusion that bus fares should be priced low, but not free.

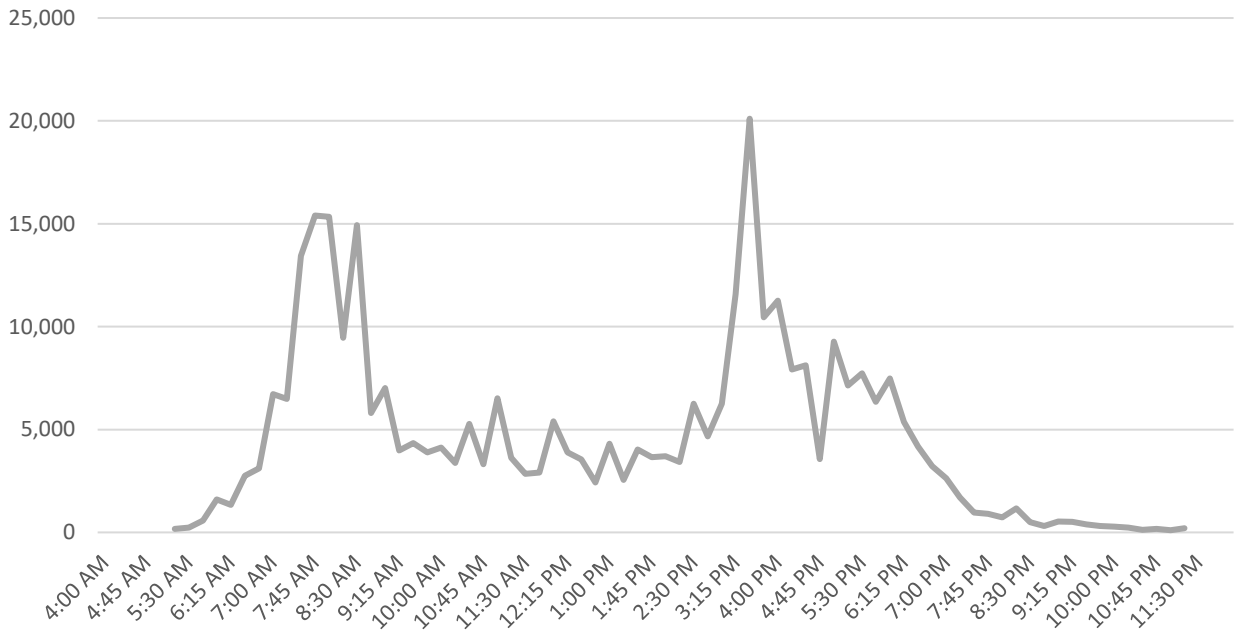
Given that both peak and off-peak social costs are estimated to be approximately negative for additional bust trips, we have concluded there is little merit in peak and off-peak charging across most of the metropolitan bus network.

However, some further thought and analysis should be given to how a dramatic reduction in bus fares might affect the PM school peak. As Figure 22 shows, the largest peak for bus services occurs at 3:00-3:30pm and is very sharp. In this 30-minute period around 50,000 bus boardings occur, which is by far the most significant peak of the day for buses.[20] Notably around 70% of these are educational trips and are likely to be on concessional tickets. While the CIE data suggests that even free fares would be optimal across the bus network due to spare capacity and high congestion benefits, it may be that the social costs of adding additional bus trips at school time may vary from peak and off-peak estimates provided by CIE.

[19] *Good move: Better public transport fares for Melbourne*

[20] *VISTA 2018*

Figure 22 Weekday bus boardings



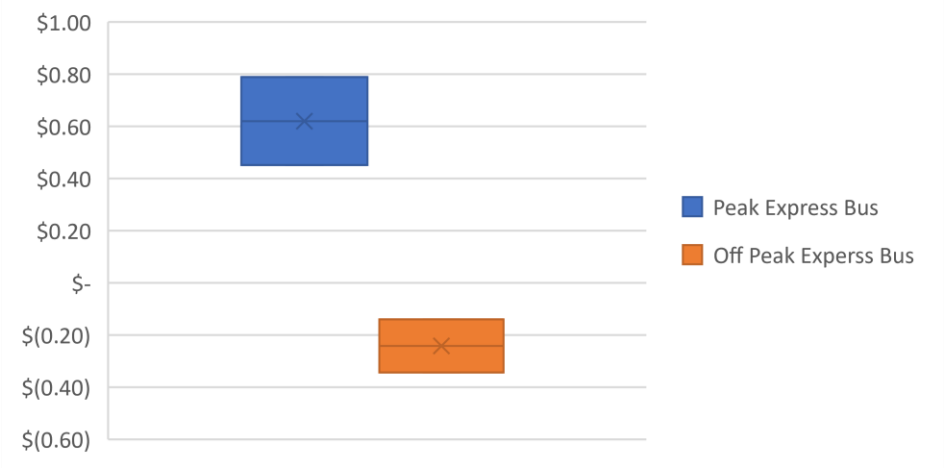
Source: VISTA 2018

Express city-bound buses

While the majority of bus services have excess capacity, this is not true for all bus services. One particular class of bus service has significant congestion on its services. CIE selected a range of “express bus” services and modelled their financial costs to be over $4.00 in the peak, significantly higher than the average for buses ($2.50).

The social cost of an additional passenger journey via express bus, as represented in Figure 233, shows a small difference between the peak and off-peak journeys, suggesting there is some room for peak and off-peak pricing.

Figure 23 Social cost of additional public transport use for express bus services



Source: estimates produced by Infrastructure Victoria using the CIE model for social marginal cost. See breakout box in section 2.2 for details

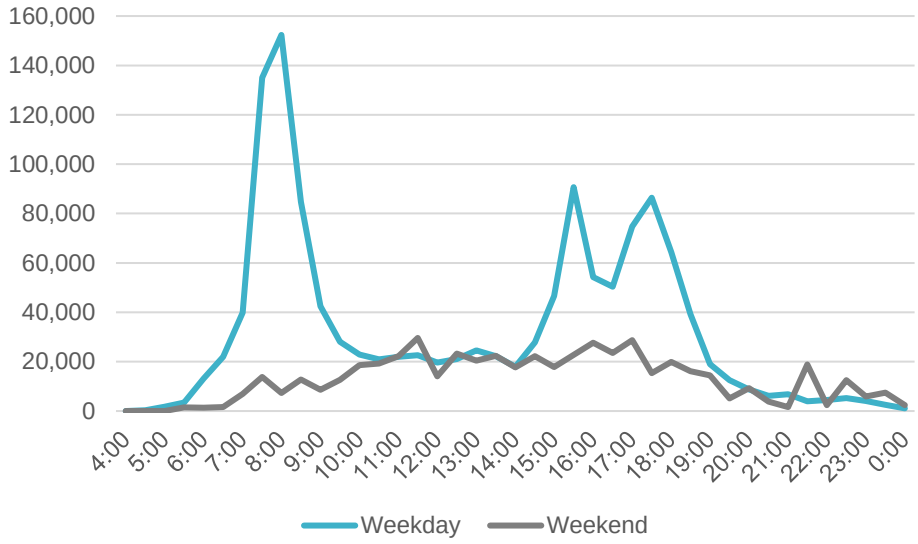
The CIE estimates for the social cost of express bus services are very low, and this implies that more services should simply be put on to offset crowding. However, the historical high levels of crowding on express bus services at current fare levels would suggest that these new services have not materialised in practice, and so peak and off-peak prices to help spread the load would be beneficial. While only one in three additional bus trips would board already crowded services from a 30% fare reduction, this increases to 85% of additional bus trips for express bus services (CIE).

It can also be argued that these services act more like trains than your average bus, with high proportions of the trip at high speed on dedicated freeway bus lanes and providing high levels of service to users.

Weekends

Weekends present a significant opportunity to get more out of the public transport network. Currently public transport is very underutilised on the weekends, which can be seen by comparing public transport usage on the average weekday to weekend in Figure 244.

Figure 24 Public transport use, weekdays and weekends

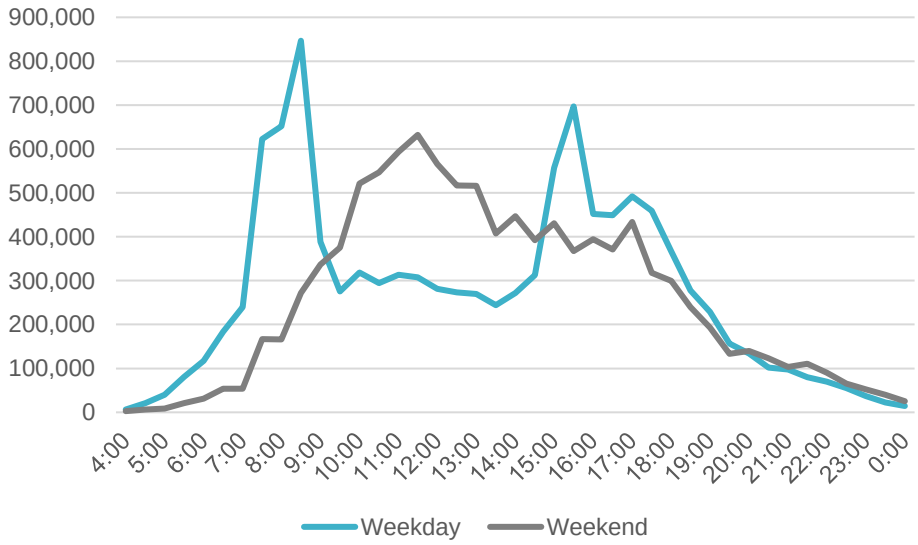


Source: VISTA 2018

It is clear that there is huge capacity on the public transport network on the weekends that goes unused, and so additional public transport travel could be provided for very little expense.

While the financial costs of adding more passengers on the weekend are low, the benefits are high. While public transport is underutilised on the weekends, the same cannot be said for roads, which experience about the same number of trips on a weekday as weekend, with a longer peak period during the middle of the day as depicted in Figure 255.

Figure 25 Private vehicle use, weekday and weekend



Source: VISTA 2018

This means that congestion benefits are significant on the weekend, while the social cost of providing additional public transport travel is very low due to all the unused capacity on the network. This implies fares should be lowest on weekends.

Currently myki offers a daily cap discount of around 30% for weekend travel, however the two-hour fare remains unchanged. More can be done using fares to encourage weekend travel, particularly for bus fares which are still relatively expensive when compared to bus fares around the world (*Better public transport fares for Melbourne*).

4.4 Equity

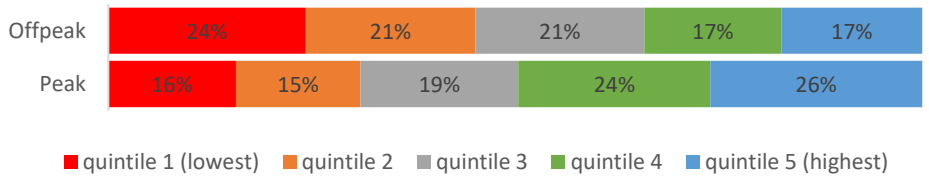
Public transport use by those on different income levels also varies by the time of day as demonstrated in ***Figure 26***6. In peak times 54% of public transport use is made by those in the top 40% of household incomes, while only 27% is made by those on the lowest 40% of household incomes. In the off-peak the situation reverses, with only 34% of all trips being made by those in top 40% of household incomes, and 45% being made by those in the lowest 40%.

This suggests that those with higher incomes will bear most of the burden from higher peak prices, and that those on lower incomes will gain the most from off-peak discounts. This should have the overall effect of improving equity.

With peak fares those on low incomes may also choose to move their trip to off-peak periods and gain a lower fare, which at the moment they do not have the option to do.

While some low-income earners may still need to travel in peak periods, they will still be eligible for concession fares at 50% off the full fare price.

Figure 26 Weekly equivalised household income quintiles for public transport users by peak and off-peak

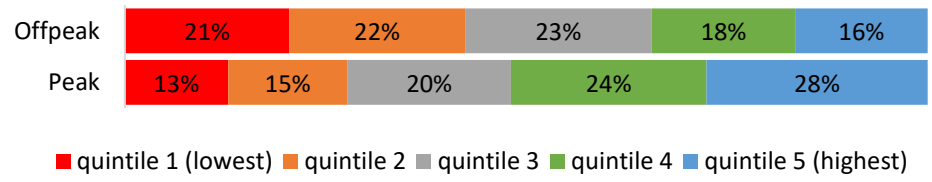


Source: VISTA 2018, Infrastructure Victoria analysis

Peak and off-peak usage also varies by mode as represented in Figure 277, Figure 288 and Figure 299. While peak usage is lower than the off-peak for those on low incomes for all modes, the difference varies substantially. Buses are still disproportionally used by those on lower incomes in the peak, while for trains peak usage by those on low incomes is very low.

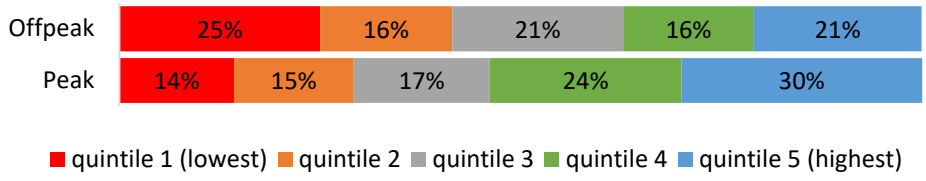
Having no peak fares for buses is likely a better option for equity, compared to a peak fare across all modes, and is likely to still make the best use of the network.

Figure 27 Train users - weekly equivalised household income quintiles by peak and off-peak.



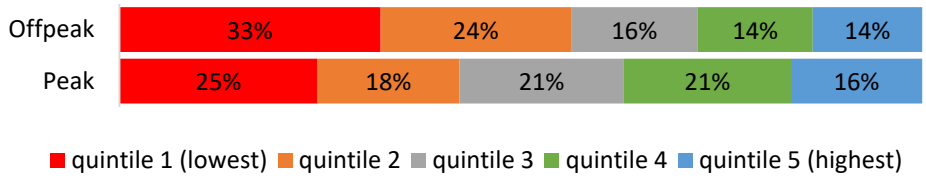
Source: VISTA 2018, Infrastructure Victoria analysis

Figure 28 Tram users - weekly equivalised household income quintiles by peak and off-peak



Source: VISTA 2018, Infrastructure Victoria analysis

Figure 29 Bus users - weekly equivalised household income quintiles by peak and off-peak



Source: VISTA 2018, Infrastructure Victoria analysis

4.5 Informed choice

As discussed in the opening section of this chapter, consumers have long understood that there are higher prices in times of high demand, and lower prices when there is less demand. Peak and off-peak prices exist in the market for airfares, accommodation, commercial passenger vehicles, electricity, internet data usage and many more.

It is intuitive that during very busy times people may pay more, and it is highly likely that users of the public transport network can adapt to peak fares quickly and without significant levels of confusion.

SGS found that peak charges are relatively easy to understand. Their experiment and consultation found that the concept of a peak charge is largely well understood by the general population, and that respondents to the experiment moved through scenarios faster under a peak-only fare structure compared to the more complex fare structures.

SGS found that the main source of confusion for peak charges appeared to be around uncertainty on what times peak charges applied. The response to various scenarios suggested that while respondents understood the structures, and absorbed the concept of a peak charge, some respondents did not recall the precise start and end times and struggled where a journey straddled peak and off-peak times.

SGS conclude that this feedback highlights the importance of framing and presentation of fare structures – in the real world, the understanding of a peak charge will likely be tied closely to how well it is explained, presented and reinforced by the system.

Challenges in user behaviour and understanding for peak pricing

How peak pricing is designed and implemented is going to be important. People will understand peak times better if there is only one set of times for all locations, and peak services are determined by what time *you touch on*. This works well for the PM peak, as the touch-on point is aligned with the location and time for congestion. For example, those touching on at the end of the day from the CBD will touch on at the congested location, and the congested portion of the trip occurs close in time to when they touch on.

However, in the AM peak the time and location of congestion may be far removed from the time and location of the touch on. For example, someone who touches on at the far end of the network and travels into the CBD will touch on at a point in time well before they cause congestion, while someone in the inner part of the network will touch on closer to the time in which they cause congestion.

In the AM peak period touch off is the far more accurate and reliable measure, as people are travelling into congested areas, and their touch off time will be very closely aligned to the time at which they are causing the greatest congestion. This is the current method used for regional trips and for Early Bird.

However, there may be some practical issues with using touch off data across the whole network. Firstly, some services may run late, which means that non-peak services may result in a touch off during the peak, adding significant cost to an already late trip. There may also be a rush to touch off before the end of the off-peak period(s), which may decrease safety. Early Bird services have a 15 minute grace period to allow for late running, such that the 7am Early Bird fare

actually ends at 7:15am. Regional services apply to all services arriving before 9am, so late running, and a rush to touch off is not an issue (there is no early morning off-peak period).

Touch on data can be used as a proxy for AM congestion, but will not be as accurate as touch off data, particularly if a single time period is used for the entire network. It is simple for people to recall however and has the added benefit of having the same definition in the AM and PM, regardless of touch on location. While not very elegant this is the system used in London. Sydney's public transport ticketing uses a system in which location and touch on data is used, such that the peak periods start at different times in different locations. This is quite effective but adds to complexity and confusion for users whose peak times will vary by which region/zone their station is in. It should be noted, however, that regular commuters will quickly learn the times for their typical services, and journey planners can be used when there is uncertainty.

Adding a peak designation to the scheduled train services themselves would also be very effective and have the benefit of being simple for users to understand and visually identify. The current ticketing system doesn't readily support this level of complexity as people touch on and off at station locations, and not individual services or platforms. However, a clever use of ticketing algorithms could be used to match a person's touch on location and time, as well as and touch off location and time, and match the service they were using.

These issues are challenging in the implementation of peak pricing, but there are viable pathways available to resolve them, and this can be evidenced by the success of peak and off-peak pricing in other jurisdictions. However, in order to implement a super peak surcharge, the issues are doubled, as there are essentially two peak periods with two transitions. Further, SGS noted that the main difficulty with peak pricing wasn't conceptual, but the ability for people to recall the times of the peak periods. Having two peak periods would increase the complexity significantly for users, and much more so should different times be used for different locations.

For this reason, we have not recommended super peak pricing at this time. It may be possible that in the future ticketing reform and changes in the way users access transport services will make this option more viable, when the complexity trade-offs are lower.

One option available to help move users away from the peak of the peak is to shrink the hours of the peak periods, say from 7:45am to 9:15am for the AM peak, or an even shorter period. This would mean that those using a train that arrives at 8:30am (for example) would only have to shift 45min, rather than an hour. This would have revenue implications and may potentially under-price some services that are already at capacity, and so specific analysis for varying time periods would be required.

5. Multimode trips

Conclusion: Fares for multimode trips should reflect the social cost of the mode(s) chosen for a journey, in line with the recommendation for mode specific fares.

Possible options include summing the fares for each mode in a journey, summing the mode-based fares with a transfer discount (as per NSW), or simply charging the fare for the highest cost mode used as part of a journey. We prefer the additive methods and suggest a combination of the maximum and additive methods in practice to account for free feeder bus trips to train stations.

5.1 The issue

The concept of integrated fares is made up of two parts, ticketing integration and fare integration.

Ticketing integration offers users the opportunity to travel across multiple modes of public transport using a single form of payment/ticketing (increasingly a form of smartcard). The benefits of this level of integration are significant, as there are costs in time and mental effort to users in managing multiple different ticket arrangements. Ticketing integration can be extended to go beyond supporting a single payment/ticketing system for all modes, to providing access to all modes through multiple platforms that users can pick and choose from, such as those described in *Better public transport fares for Melbourne* related to Mobility as a Service (MaaS) platforms.

Fare integration can be viewed on a spectrum. At one end of the spectrum is a non-integrated fare structure in which users are charged a separate fare for each mode they use. Each leg of the journey would be charged as a separate fare regardless of whether it is made on the same or different mode. At the other end, there is full fare integration, where the same fare schedule applies to all modes and there is only one price for all journeys. Individual legs as part of the same journey are charged for only once based on the origin and destination of the journey, regardless of the number of legs and by which mode the legs are made. In the middle, a range of options exist including charging for each mode individually (but not each leg), discounting the cost of additional modes and charging the highest mode fare for a multimode journey.

The level of fare integration varies by jurisdiction and is tied to the level of mode-based pricing in each jurisdiction. In Australia, Sydney is the only city to price modes separately. However, there is still a level of fare integration in the way fares are calculated. For public transport trips in Sydney a $2 credit is applied each time you switch modes ($1 for concessional fares), such that the cost of a journey is still made up as a function of the types of modes used, but not simply a sum of the modal fares.[21]

Many international cities have separate mode prices including Tokyo, New York and London. Others use a single distance-based charge across all modes, for example Brisbane, Perth, Paris and Auckland. Melbourne, Adelaide and Berlin are somewhat rare cases in that they have one price for all modes regardless of distance (for travel in the metropolitan area), representing the extreme end of the integrated spectrum.

Proponents of full integration argue that the fares should be set such that the technical details of the route and vehicle don't affect what one is charged.[22] This seems fair from the perspective that everyone is charged the same to access the public transport network.

However, the downside to this is that the *level* of access is not the same. This is shown by the differences in use across modes by quintile. We have argued that a more equitable fare system would charge less for buses than trains, because additional bus trips have a lower social cost to provide. They also provide services to people who have lower incomes on average, and they provide a service that is demonstrably inferior to trains in comfort and in speed. Furthermore, trips on buses are typically much shorter than trains.

Holding cost recovery constant, charging a single price for all modes therefore averages fares between the modes, meaning fares are too high for bus trips and too low for trains. This benefits relatively high-income commuters to the detriment of relatively low-income bus users.

In practice the Victorian fully integrated fare system has resulted in a short trip on an underutilised local bus to the shops costing as much as a highly crowded long-distance train trip to high income employment.

A balance must be struck along the spectrum that makes the best use of Melbourne's public transport and road network, while also being equitable.

5.2 Social cost and benefit

Currently there is no evidence that the social cost of additional public transport travel for each leg of a journey changes depending on the combination of legs used within a particular journey.

The financial costs of an additional passenger for a particular mode are not directly related to the mode of choice used by the additional passenger to access the mode. For example, the financial cost of adding a passenger to a train are unlikely to vary depending on whether the passenger has accessed this train by bus, tram or even car.

Similarly, there is no reason to expect the external benefits from reduced road congestion or environmental benefits for a particular leg of a public transport journey would change depending on what mode is used before or after the public transport leg in question. For example, the congestion benefits of a train trip to the CBD are the same regardless of whether the train is accessed by car, bus, tram or cycling.

[21] https://transportnsw.info/tickets-opal/opal/opal-benefits

[22] https://www.ptua.org.au/2020/03/27/iv-transport-pricing/

On this basis the most economically efficient way to charge for journeys and maximise the benefits to society would be to simply sum the fare for each leg for each mode to get the final fare.

However, this is somewhat oversimplified. The true social cost of additional travel would vary by route, mode and time of day. Conceptually if someone was on a busy bus service, got off halfway along the route and boarded a mostly empty bus, they would likely be generating less social cost than if they had stayed on the busy bus route. Because we are using estimates of social costs (and not actuals) averaged across entire networks (and not specific routes and times of day), the findings must be used as a guide only. It makes sense to charge one price for a bus journey, regardless of whether one or two buses were used as part of the journey. This is also fair, as otherwise people would be financially better or worse off based solely on how well the service routes matched their travel need.

Further, as per our discussion in 4.3.3, the social marginal cost for buses has been estimated to be potentially negative. While there are caveats around this conclusion, it is clear the social costs are lower for additional bus travel than other modes. Further, because roads and train station car parking are currently uncharged in Victoria, there is an over-reliance on driving to train stations over bus use, resulting in greater congestion, carbon emissions and air and noise pollution.

The low social costs of suburban buses and the lack of pricing for road or parking provide grounds from a social cost basis to provide free feeder services to train stations. This also helps provide more equal access to the transport network for everyone, regardless of how close to a station they reside.

We believe the most pragmatic option to reflect the social costs of additional public transport travel while retaining fairness and simplicity is to sum the fares for all modes used in a journey (but not the fares for each individual leg), and to allow free feeder buses to train stations. For practical purposes our modelling in *Better public transport fares for Melbourne* did not charge extra for bus-tram journeys, as these are rare (around 1.4% of trips) and were not considered worth the added complexity.

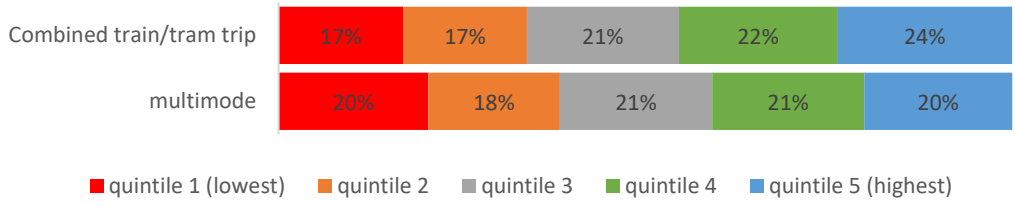
5.3 Equity

Given the evidence already presented in this paper that varying fares by mode could have a positive equity effect (see section 3.3), there is a case on equity grounds for allowing a lower level of integration than currently exists in Victoria to allow for modal and peak pricing.

Overall, those using buses have lower incomes than those using trains and are also receiving a lower level of service. Analysis on household income by multimodal use presented in Figure 30 shows that multimode journeys are evenly distributed across incomes, almost perfectly aligned with the general population.

However multimode trips that involve a train and a tram are used by relatively well-off individuals when compared to the overall population. In our modelling of fare reform, we chose to only charge a multimode fee for train/tram combinations, which is used by a disproportionate number of people on higher incomes.

Figure 30 Train/tram and multimode users - weekly equivalised household income quintiles by peak and off-peak



Source: VISTA 2018, Infrastructure Victoria analysis

5.4 Informed choice

As presented in the chapter on modes (see section 3), there is a clear trade-off in simplicity when implementing fares that vary by mode, however it is our opinion that the benefits are worth the small trade-off and that pricing by mode is fairly intuitive.

This does have a greater effect when users are taking multimode journeys. Instead of focussing on a single price that varies by mode and time of day, multimodal users are faced with multiple modes that vary in price by mode and time of day.

As pointed out in SGS-BIT(2020), the current literature supports the idea that consumers do not deal with complexity well, and typically do not choose the best prices when faced with more complex pricing structures. The experiment and

user consultation performed by SGS and BIT confirmed the literature. Comprehension was lower and there were slower reactions times for the more complex fare structures.

Given this, the aim should be to keep complexity down while incorporating the benefits that come from prices that reflect the social costs of additional travel.

While there are a very large range of possible ways to deal with multimode trips, we discuss four:

- flat fare
- maximum mode fare
- transfer credits
- the sum of fares.

Flat fares are clearly preferable from a simplicity perspective but give up the equity benefits of mode-based fares as well as the ability to get the best use from the network by varying fares with social cost. This trade-off seems unnecessary given people's ability to deal with some complexity.

A fare based on the maximum fare charges a single fare based on the highest cost mode used. This is very simple for users to understand and recall and retains a significant amount of the benefits of having different mode prices. What it loses, however, is the incentive based on the relationship between the social cost of additional public transport use and consuming more of transport network services. For example, someone taking a train to the CBD and then a tram to their workplace will not face a price for the tram segment of their trip. This provides them no incentive to use other modes of transport (e.g. active transport) and they also do not provide a contribution to the social costs of providing the extra tram trip.

Summing individual fares provides a relatively simple solution. As mentioned, fares could be charged for each leg, or just for each mode used as part of a journey. We feel the right solution would be to focus on each mode used, rather than each leg. This simple addition would not be hard for people to understand, as it is a simple addition of mode-based fares. When using zones and time of day in combination with mode the calculation does become more complicated, increasing the potential for confusion.

Finally, there is the discount method used in Sydney. Here a discount is applied for each transfer. In Sydney this is $2 per transfer.[23] This has the benefit of including a cost for each leg of a trip, while still reducing the fare for people who use multimode trips. It is not particularly intuitive or straight forward to calculate, however, and users may find it confusing.

5.5 Conclusion

As we concluded above (see section 5.2), we believe the most pragmatic option to reflect the social costs of additional public transport travel while retaining fairness and simplicity is to sum the fares for all modes used in a journey (but not the fares for each individual leg), and to allow free feeder buses to train stations.

For our modelling in *Better public transport fares for Melbourne*, we have chosen a combination of the maximum fare and additive methods. For all trips the maximum fare is charged, except those involving a train and a tram, in which case a fee is charged for tram use (equal to the off-peak tram price).

The reason for this is that we wanted to preserve the price incentive for people to consider other transport modes for different parts of their journeys (active modes in particular). This meant that we leant towards the additive method.

In order to implement free feeder services to trains we priced bus/train combinations using the maximum fare approach. Tram and bus combinations were found to be rare (only 1.4%of public transport journeys), and rare enough that we thought it unnecessary to price them separately given the low social cost for additional bus use, meaning that for these journeys the maximum cost method was also used.

This left us with a system which charges the maximum fare for all trips except for train/tram combinations, which are charged a fee to cover the social costs of providing additional tram journeys and to encourage active transport where possible.

[23] https://transportnsw.info/tickets-opal/opal/opal-benefits

6. Zones

Conclusion: The Victorian government should retain Zone 1 and 2 for train and express bus services (possibly with some tweaking of borders), while adding in an additional zone for CBD stations, which represents some of the most congested parts of the rail network. There appears little merit in zones for bus and tram services.

Directional pricing on trains should be introduced so that travel in non-peak directions is discounted at the same rate as off-peak train fares.

6.1 The issue

Fare zones are a pricing element that charge users of a transport network based on spatial boundaries, known as zones. Typical fare zone systems charge based on how many zones are travelled through, or the origin and destination zones of a journey. Melbourne's metropolitan zones determine the appropriate myki fares for our metro trains, trams and buses. The current zones include Zone 1, Zone 2, the Zone 1/2 boundary overlap and the free tram zone.

Zones are a popular element amongst domestic and international public transport networks. In Australia, Perth, Melbourne and Brisbane use zones while internationally they are incorporated into the public transport systems of Auckland, Madrid, Paris and London. Other cities that price on spatial characteristics but that do not have zones, but favour pure distance charges include Sydney, Hong Kong, Tokyo and Singapore.

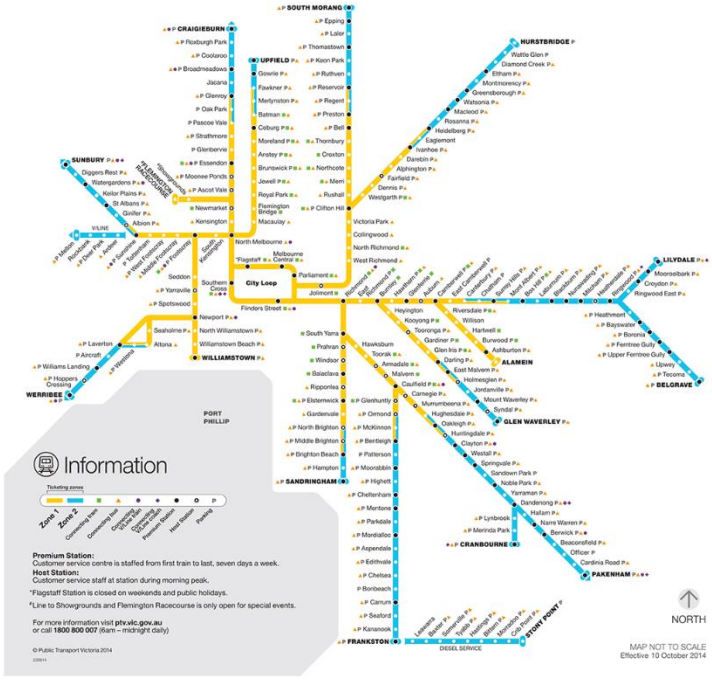
myki fares are $4.50 for a full fare for two-hour travel in Zone 1 or Zone 1+2 (listed as at January 2020), while travel exclusively in Zone 2 is discounted at $3.00 for a full fare two-hour ticket. Figure 3131 shows the full extent of metropolitan Zones 1 and 2 (white background), along with regional myki fare Zones 3-13 (grey background).

Figure 31 Victorian train network

Source: PTV, Victorian Train Network - https://www.ptv.vic.gov.au/assets/PDFs/Maps/Network-maps/91ec3c5794/PTVH5027_Network_Victorian_Train_Map_A4L_Digital_v1_FA.pdf

The metropolitan Zone 1 and 2 boundaries are represented in Figure 32, from 2014. PTV do not currently provide a zone map for metropolitan Melbourne, and only line maps are available from Metro trains clearly showing the Zone 1, 2 and overlap boundaries.

Figure 32 Archived 2014 PTV Metro trains map



Source: The Age, 2014: https://www.theage.com.au/national/victoria/melbournes-future-train-maps-compared-to-new-york-london-and-paris-20150618-ghqzin.html

Victoria was operating on a zone-based fare system long before the introduction of myki, and one that was more complex (see section 6.4). We believe there is scope for improvements to the current zone system, enhancing an underutilised element of Melbourne's fares structure.

Zones can function as a proxy for distance-based pricing, for location-based pricing, or a combination of the two. We discuss distance at length in section 7 (Distance) and instead focus here on how zones can be structured as a form of location-based pricing – setting prices based on the infrastructure, capacity and crowding context of the areas a user travels through.

There are two issues with the way that the current metropolitan zone system is structured. Firstly, having only two zones provides only a coarse resolution of congestion that may not be adequate in capturing the variation in the social costs of additional public transport travel across Melbourne. The second issue is that peak travel on the network is not just a factor of time, but also of direction. Services that are heading towards the city in the morning, or away from the city in the afternoon, are highly crowded, while travel in the non-peak direction is underutilised.

6.2 Social cost and benefit

As outlined in section 2.2 (Socially optimum use), we focus on the social costs and benefits of *extra trips* to the network – based on individuals' decisions about the trips they wish to take. This means that we take the existing network as already built and paid for and look at how zones can help influence decision making on how to make the best use of the network, balancing crowding, road congestion and infrastructure costs.

In section 4 (Peak pricing), we explained how the social costs of adding additional passengers to the network vary by time.

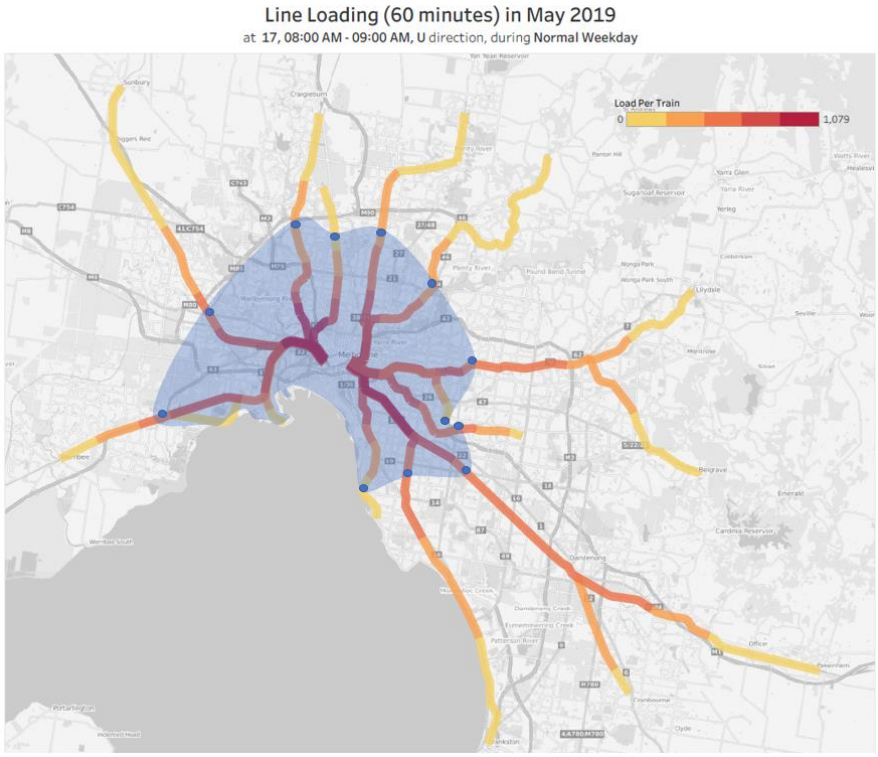
Just as this concept holds for time (peak and non-peak), it is also extremely relevant to **location**. Just as capacity varies with time (and with it the social costs of additional public transport use), so it varies by location. We know this to be intuitively true. Trains, trams and buses are all much less full in the outer parts of the metropolitan network than they are towards the inner parts. This is where location-based zones can be a useful fare setting parameter.

The Melbourne context presents a situation where levels of congestion and crowding are higher within the inner city than the outer suburbs. The cost of expanding infrastructure in the dense inner areas of Melbourne is also generally far higher than expanding infrastructure in low density suburbs, where land is less utilised and valuable (and in many cases, capacity already exists and there is no need to further expand). For example, while a train with spare capacity may accommodate additional users within the Zone 2 station of Belgrave, the costs of capacity expansion of the network especially as the train approaches the CBD and City Loop would be significantly higher as additional tunnelling and track would most likely be required – due to the current City Loop being at capacity.

The best way to do zone analysis would be to investigate the varying social costs of additional public transport travel by location. However, this analysis is yet to be performed. To assist with assigning zones and the appropriate fare, we can develop a simple principle that acts as a rough proxy for the social costs approach, and will result in more equitable and efficient zones: *the fare applied to a zone should reflect the amount of crowding, congestion and capacity of the zone area.* This means that as the network begins to inch closer to capacity, so the fare for entering and travelling through that congested area should reflect this.

Figure 33 shows the spare capacity at even the busiest times in the extremities of the network, and an approximation of the boundary for Zone 2 (blue). While not perfect, the existing Zone 2 boundary does correlate strongly with the spare capacity on the network during the morning peak.

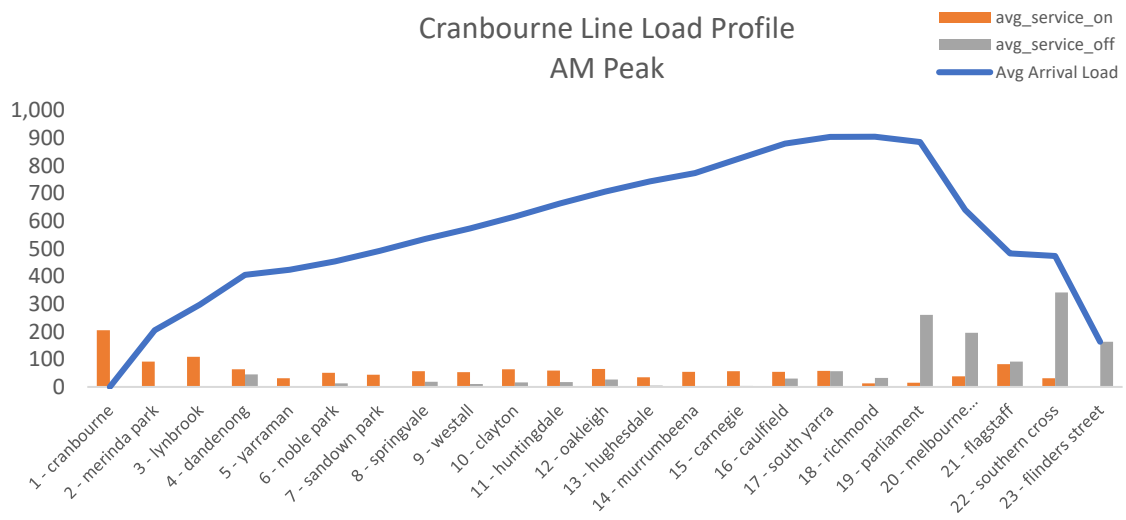
Figure 33 Line loadings, AM peak, May 2019



Source: Maps and analysis provided by Department of Transport

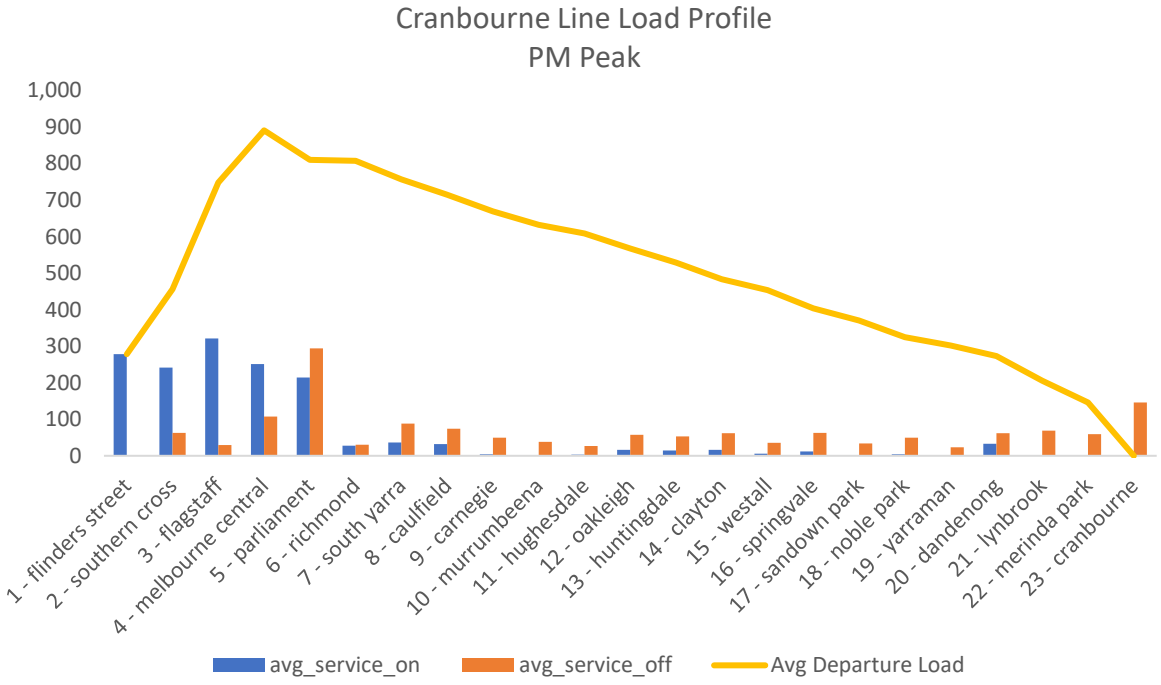
Crowding continues up until services reach the CBD, and up until this point more people board trains than alight. An example of this is contained in the line load profile for Cranbourne in Figure 34. A gradual passenger volume decline when exiting the CBD occurs in the PM peak Cranbourne loading profile shown in Figure 35.

Figure 34 Loading profile for Cranbourne line during AM peak[24]



Source: Data and analysis provided by Department of Transport – weekday trips in May 2019

Figure 35 Loading profile for Cranbourne line during PM peak[25]



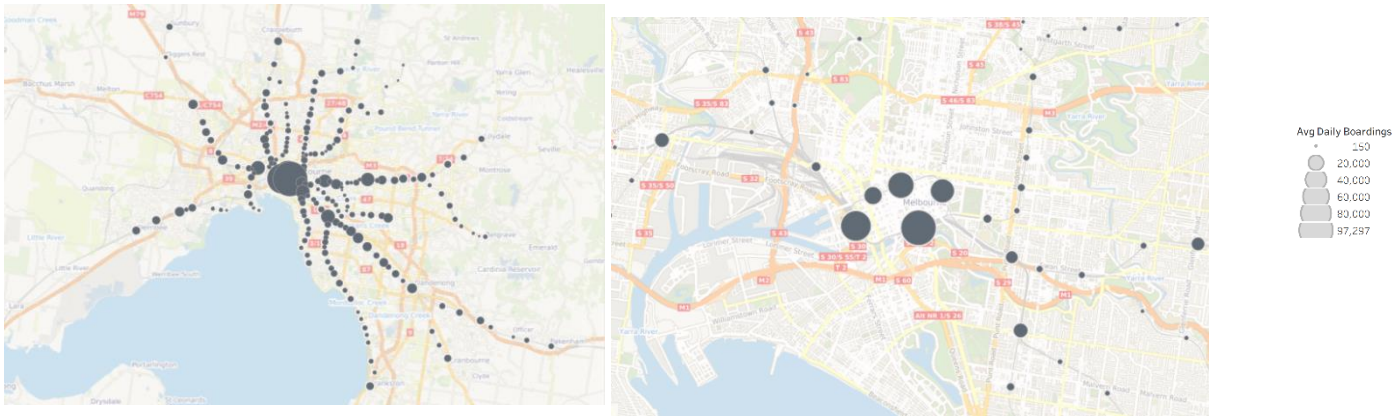
Source: Data and analysis provided by Department of Transport – weekday trips in May 2019

Origin and destination data confirm that the majority of trips around the inner of Melbourne are terminating in the City Loop stations as depicted in Figure 36.

[24] *AM peak defined by service operating between 7.30am – 9am*

[25] *PM peak defined by services operating between 4pm – 7pm*

Figure 36 Destination data of inner-Melbourne train stations (overall and zoomed view)



Source: Maps and analysis provided by Department of Transport - average destination data of weekday trips in May and August 2019

This means that anyone getting off before Richmond (from the example of Cranbourne) is freeing up space for others to get on, and this is a benefit. Those travelling in all the way to the city are inflicting the greatest capacity issues.

Taking this analysis into account, one refinement to the location-based zone system is the introduction of an additional zone, a “City Zone”. The rationale of the additional City Zone is to further refine the existing Melbourne metropolitan rail zone system with one that captures the areas with the highest levels of congestion – Melbourne’s rail lines as they approach and tunnel through the city.

The City Zone is proposed to include the existing City Loop service stations (Parliament, Melbourne Central, Flagstaff, Southern Cross and Flinders Street) and the new Metro Tunnel stations (Anzac, Town Hall, State Library, Parkville and Arden). This means that the metropolitan rail network will now have three zones: The City Zone (Melbourne city), Zone 1 (inner Melbourne) and Zone 2 (outer Melbourne).

In line with the zone-setting principle outlined above, travel that crosses from Zone 1 to the City Zone should be the most expensive, as this is the point at which the network is under the greatest capacity strain. Zone 1 (or travel that crosses into Zone 1) should be the next highest priced zone, while travel solely within Zone 2 should be the cheapest. A lower fare should be applied for users travelling exclusively within Zone 1 or the City Zone as these people are not contributing to the main bottleneck in the system, which is travel crossing from Zone 1 to the City Zone (or from the City Zone to Zone 1 in the PM peak). Passengers travelling solely within a single zone free up capacity on services before they reach the most congested points of the metropolitan train network.

We also propose the introduction of cheaper non-peak directional fares. Just like the proposed zone principle applies cheaper fares that reflect the cheaper infrastructure cost of capacity expansion in the outer zones, so too should trips that occur on parts of the network that are under capacity, even within congested zones. These are typically the trips that are heading out of the city when everyone else is heading in (AM) or heading into the city when everyone else is heading out (PM).

The typical travel patterns of Melbournians leads to high levels of congestion in a specific direction, linked closely with the time of day. During the morning peak, services heading into the city are far more crowded than those heading out of the city. The opposite applies for the evening peak.

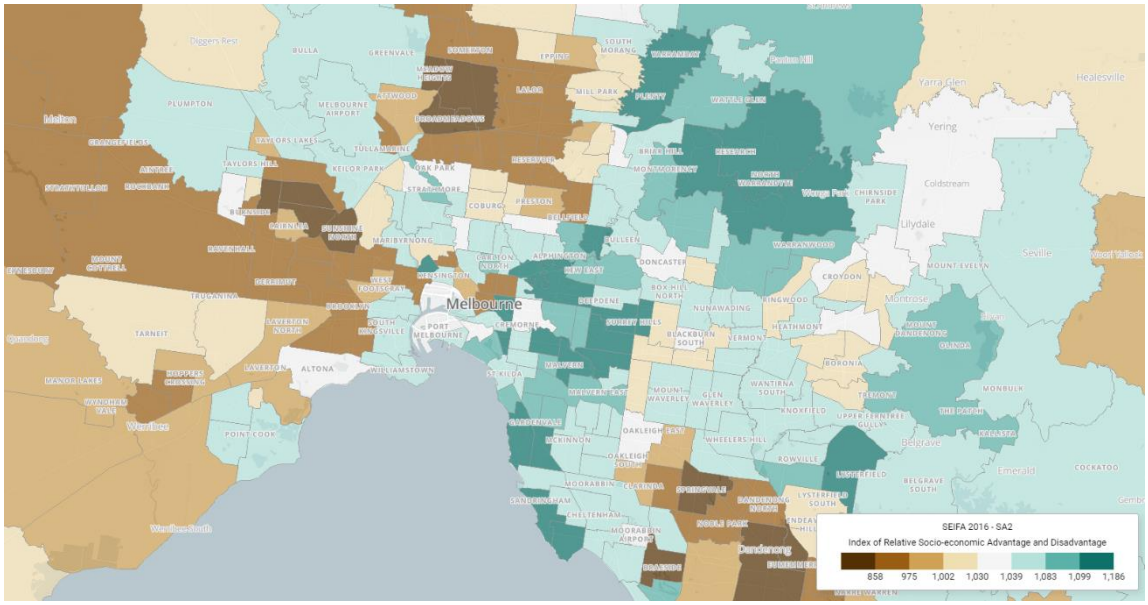
Our discussion has been focussed on trains. This is because of the nature of train travel where congestion builds up along a line and where many people share the same destination, so bottlenecks occur in an orderly and predictable fashion. However, for bus and tram, average trip distances are much shorter, and the distribution of origins and destinations larger. Large spatial zones are less likely to be effective here, and more analysis is required on the benefits of zones for tram and bus. While crowding is higher in the inner areas, so are benefits. As we have already seen in section 4 (Peak pricing), the financial costs of adding additional passengers is much smaller for these modes, and it is possible the congestion benefits outweigh the additional crowding costs.

In our modelling for *Fair Move: Better Public Transport Fares for Melbourne*, we have simplified the zone system for buses (except for Express Bus) and trams so that there is only a single zone, effectively removing zones for these modes.

6.3 Equity

The current distribution of socio-economic advantage and disadvantage (SEIFA 2016) categorised by SA2 is shown spatially in Figure 37.

Figure 37 Index of relative socio-economic advantage and disadvantage

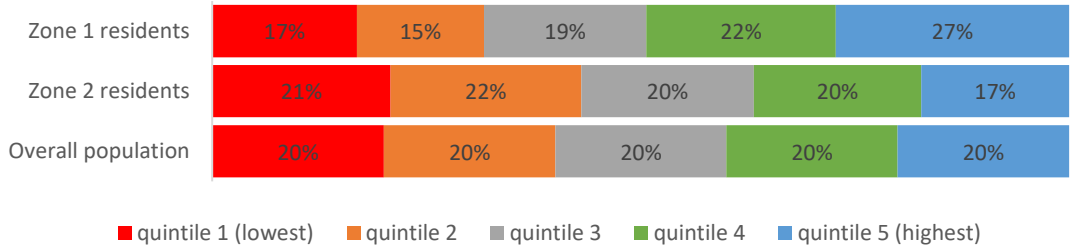


Source: SEIFA 2016, mapped using Plan Wisely

Upon first glance, it is clear that the suburbs of the inner areas tend have a higher socio-economic index, compared to outer areas and that eastern suburbs have higher incomes compared to areas in the north and west.

Figure 38 shown below illustrates how equivalised household income is distributed across Melbourne's current metropolitan zones.

Figure 38 Zone residency and equivalised household incomes



Source: VISTA data 2018, Infrastructure Victoria analysis

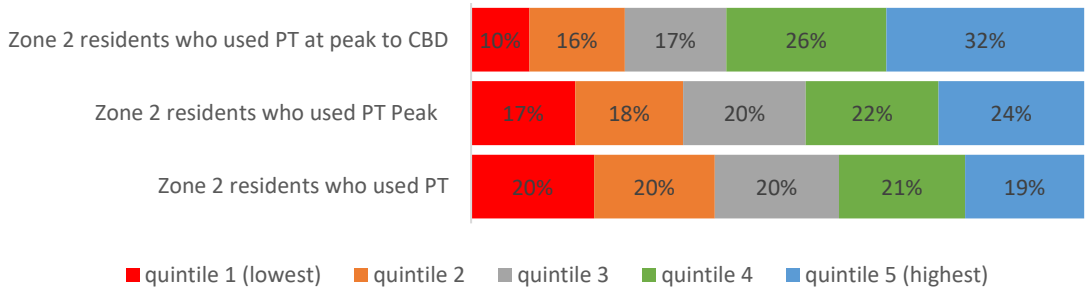
From Figure 38, we see that there are more Zone 2 residents in the three lower quintiles compared to Zone 1. Of all residents who reside in Zone 2, 21% of those are in the lowest quintile, compared to 17% of residents who reside in Zone 1. At the other end of the scale, a much larger percentage of Zone 1 residents are in the highest quintile (27%), compared to the percentage of Zone 2 residents in the highest quintile (17%).

It is important to note that zones do not charge fares based on where you live, but on what zones you start, end and travel through during a trip. More important than how zones overlap with low income areas is how they affect low income travellers.

Focussing on Zone 2 residents who use public transport shows a clearer picture of equity for public transport fares. Figure 39 below shows incremental refinements to our distribution criteria of Zone 2 residents who use public transport. Zone 2 residents who use public transport can be seen to be very close to the distribution of the overall population, with around 20% in each household income quintile. This shows that Zone 2 *users* of public transport are similar in household income to the average for Victoria.

Refining the scope again to only include Zone 2 residents who use PT *during the peak periods* shows that this group of people is more wealthy than the general population, and in line with Zone 1 residents. A further refinement of scope to only include Zone 2 residents who use public transport during the peak *to travel to the CBD* shows a further shift resulting in over 30% of users being part of the highest income quintile, compared to just 10% in the lowest income quintile.

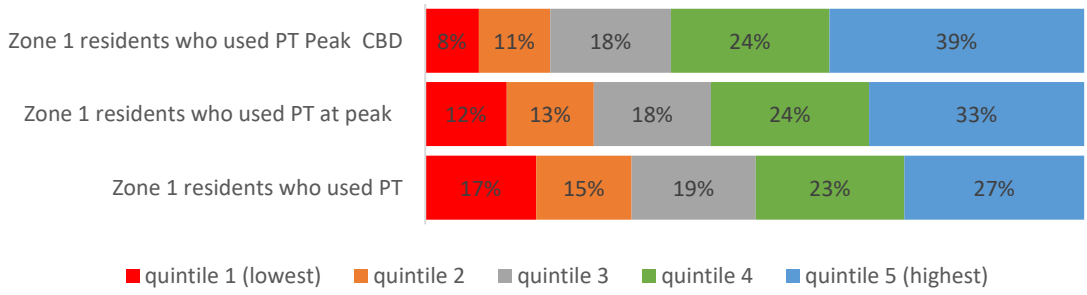
Figure 39 Public transport users in Zone 2 - equivalised household incomes



Source: VISTA data 2018, Infrastructure Victoria analysis

A similar pattern is followed by residents of Zone 1, shown in Figure 40. On average, Zone 1 residents who use PT during the peak to travel to the CBD tend to categorise as higher equivalised income than the rest of the residents of that zone.

Figure 40 Public transport users in Zone 1 - equivalised household incomes

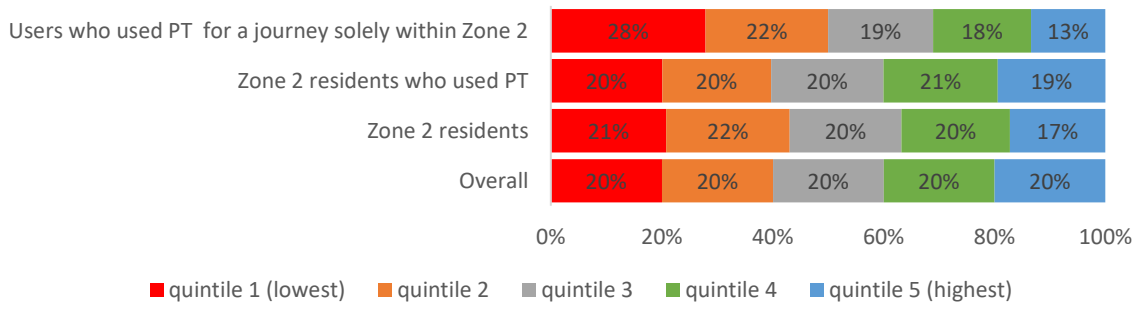


Source: VISTA data 2018, Infrastructure Victoria analysis

From these two distributions of Zone 1 and Zone 2, we can see that a proposal to introduce an additional CBD zone (City Zone) with higher fares during the peak will generally impact those on higher incomes.

Public travel taking place solely within Zone 2, as represented in Figure 41, has interesting results. The data clearly shows that Zone 2 residents who travel exclusively within Zone 2 tend to be on lower household incomes, and significantly so. This demonstrates that the low price for Zone 2 travel not only benefits the use of the public transport network, but equity as well.

Figure 41 Public transport users travelling solely in Zone 2 - household equivalised incomes



Source: VISTA data 2018, Infrastructure Victoria analysis

From an equity perspective, this data shows that on principle, the current zone system is rather well organised – those that travel within Zone 2 are generally lower income, and pay lower fares – those that cover great distances travelling through Zone 1 and 2 are generally on higher income, and pay higher fares.

6.4 Informed choice

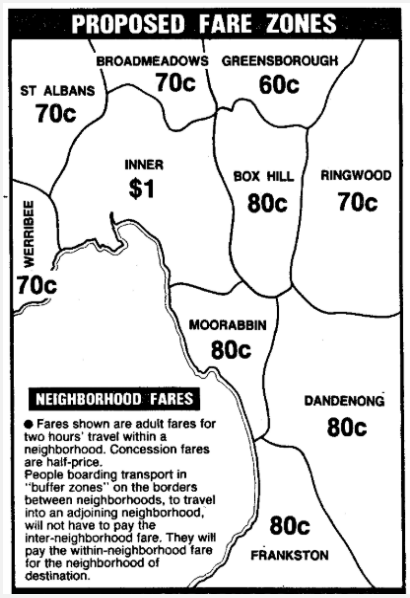
The current zone-based pricing for both Zone 1 and Zone 1/2 ensures that a significant portion of public transport users already know how much they will be paying, regardless of what zone they board/alight a service in ($4.50). Arguably, a more price-sensitive group of public transport users who travel solely within Zone 2 would also understand that their fare would be discounted at $3.00. With the help of audio and visual aids on services and clear signage – the zone system is well known and understood by Melbournians – to the extent that historically, some have gamed the system.[26] Prior to the capping of Zone 1/2 fares, anecdotal evidence and articles would report commuters living close to zone boundaries effectively driving or using active modes to travel to inner Zone 1 stations to avoid the additional surcharge for crossing a zone boundary.

Zones of the past – ticketing before Melbourne's myki

Melbourne's introduction to the zone-based fare system was in the early 1980s – a three-zone system which allowed for multimodal travel with the use of the *TravelCard*. Some of the largest savings were offered to those who used multiple modes (being able to replace single-mode tickets). Interestingly, weekly, monthly and annual tickets were unavailable. At the time, the Australian Railways Union State Secretary drew attention to the 100% increase in fares for short rail trips near Zone 1 and Zone 2 borders, rising from 35c to 70c for a single trip, arguing patronage would decrease.

This three-zone system was short lived, replaced in 1983 by the new *Neighbourhood System.* Gone were the original three metropolitan zones, replaced by dividing the metropolitan area up into 10 regionalised neighbourhood zones. Fares would be charged depending on how many neighbourhood zones were covered, trips within zones were heavily discounted while trips to neighbouring zones were more expensive. Off-peak discounts introduced in early fare reforms were maintained.

By 1989, along with commentary that the neighbourhood fare structure did not properly cater to the needs of the travelling public through overly complicated charging areas, Melbourne reverted to a zone-based system – the *Met Fare System*. The subsequent zone based automated Metcard and myki systems were developed in later years, along with adjustments, and the ultimate removal of Zone 3.



Source:
http://www.robx1.net/victkt/metcard/html/history.htm
http://www.robx1.net/victkt/zone123/images/123_9002.gif

Image: Proposed Fare Zones, The Age Thursday 22nd September 1983 (Image courtesy of Rob O' Regan, http://www.robx1.net/victkt/nhood/images/news02a.gif)

With a global fare setting trend towards simplicity, zone-based fare structures perform well when compared to the high cognitive transaction costs of calculating distance-based fares (SGS-BIT, 2020). When bounded by easily identified areas, minimal confusion should arise with zone-based charges, as is the experience with a survey of public transport users where a very large majority (93%, n=2011) correctly identify Melbourne's current zone-based charge (SGS-BIT, 2020).

No matter the sophistication of a zone-based system, SGS-BIT (2020) highlight the heavy reliance of messaging and promotion of the fare structure. While Melbourne has previously managed to operate with more than two zones in the past, balance must remain to ensure any zone-based system is still easy to communicate.

[26] https://www.heraldsun.com.au/news/victoria/fare-change-driving-commuter-surge-towards-to-outer-suburban-stations/news-story/2f99f76f44a9c4178bb0bbdb6f046300

7. Distance

Conclusion: Distance-based pricing is not recommended as a first step in metropolitan fare reform. This is due to the significant complexity it is expected to add to users and the uncertainty between the relationship between the social costs of additional public transport travel and distance in metropolitan Melbourne.

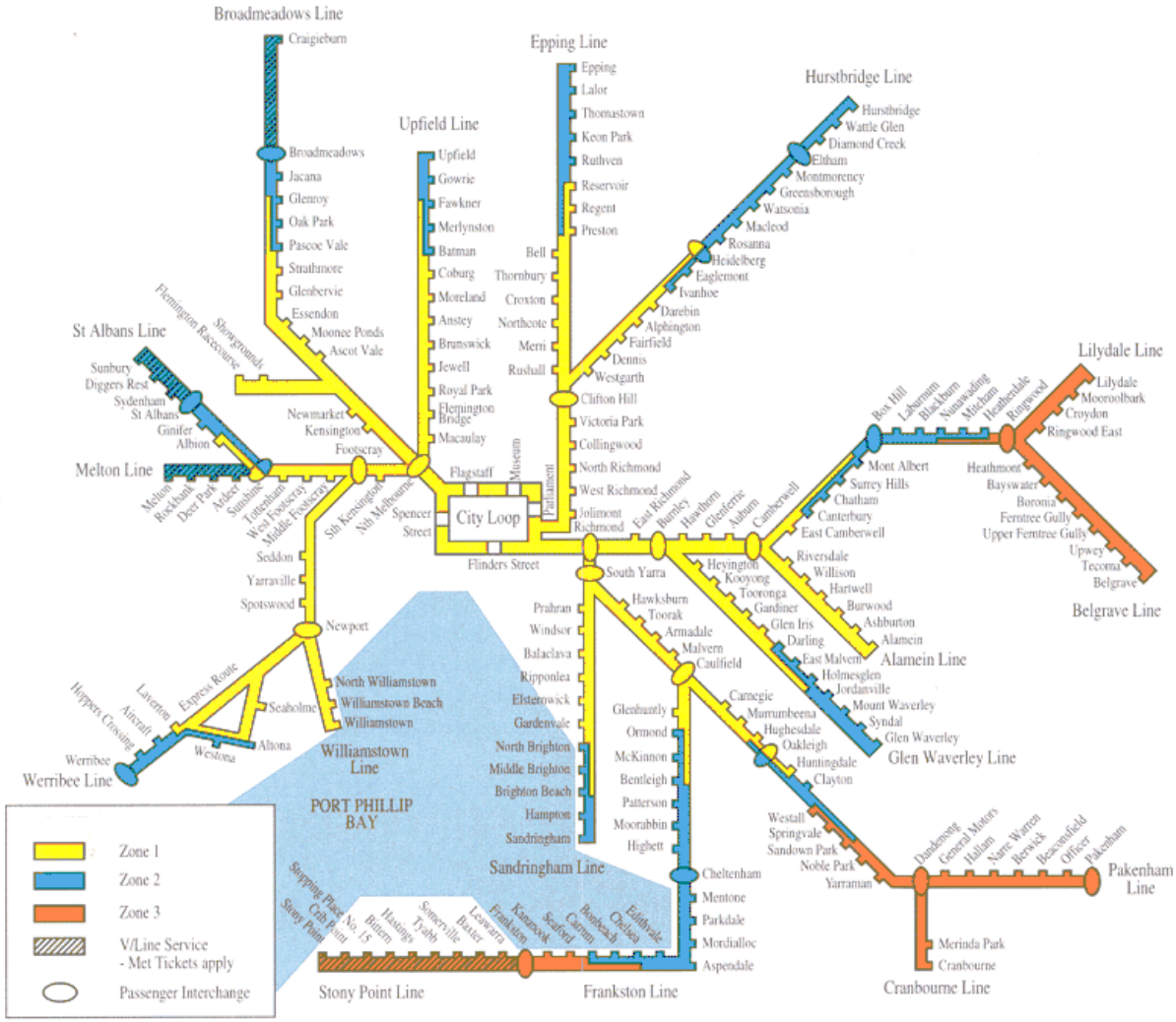
Infrastructure Victoria suggests more work be done to provide further quantitative evidence on the relationship between distance and the social costs of additional public transport use.

7.1 The issue

Few fair elements seem as natural as charging based on distance travelled. However, in practice the issue of whether or not to charge metropolitan fares based on how far someone travels is quite complex.

Victoria has a history of distance-based public transport pricing. Distance-based pricing still forms the central elements for regional public transport pricing, while in metropolitan Melbourne distance-based pricing disappeared with the removal of Zone 3 in 2007 and the removal of higher fares for trips that travel through both Zones 1 and 2 in 2015. The three-zone system that was removed in 2007 is presented in Figure 42.

Figure 42 Melbourne's three zone system (pre-2007)



Source: 1994 map from https://melbourneoldschooler.blogspot.com/p/train-history.html

These changes have had a profound impact on the cost of long distance train travel in Metropolitan Melbourne, with a current full fare daily ticket in 2020 for trips across the original three-zone system costing almost 30% *less* than in 2007, despite inflation (a three-zone daily fare cost $12.60 in 2007, compared with $9.00 in 2020).[27] Over the same period, trips within Zone 1 have *increased* by 36% ($3.30 to $4.50).[28]

The domestic approach to distance-based pricing across cities is mixed. Melbourne, Adelaide and Canberra feature flat-fare systems while Sydney, Brisbane and Perth have distance-based zonal systems.

[27] http://www.robx1.net/victkt/metcard/jpg06/lab2006a.jpg

[28] http://www.getting-around-melbourne.com.au/fares-and-travel-guide-2007.pdf

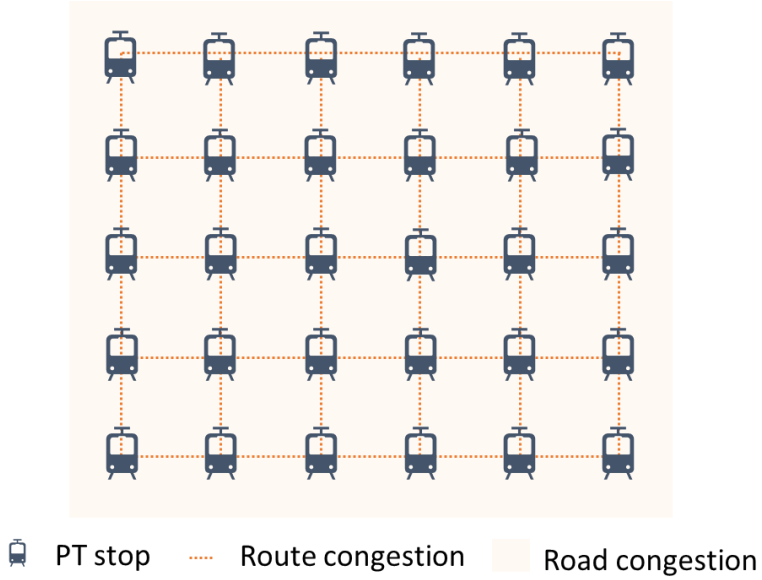
Internationally there is also a mix of approaches, with many cities still favouring a distance-based fare approach despite the move to more simple fare structures. Large cities with flat fares include New York, Chicago and Berlin,[29] while distanced-based fares feature in cities such as Tokyo and London (flat fares from tram and bus), Singapore and Hong Kong.

7.2 Social cost and benefit

The question we must ask is this: how do the social costs of additional public transport trips vary with distance travelled? The difficulty in this task arises from the overlaps between the variation of the social cost with distance, location and route.

As a simple example, consider a network that consists of evenly distributed origins and destinations, represented in Figure 433, such that the demand to get from any once place to another is the same for all origins and destinations. Additionally, the road network is evenly congested such that every kilometre moved onto public transport has the same congestion benefits.

Figure 43 Example of an evenly distributed network

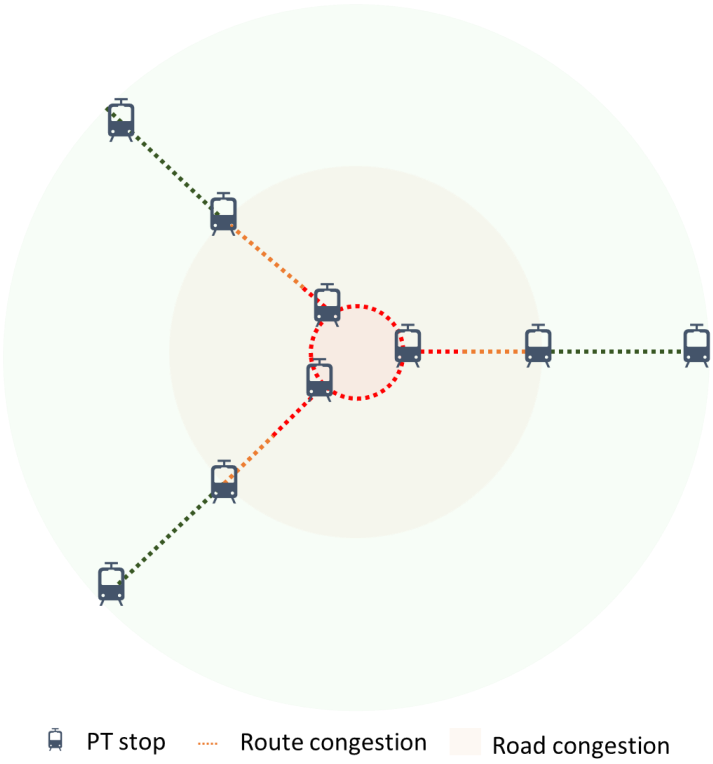


In this case distance-based pricing would be very effective, as the social cost of additional services would vary directly with the distance travelled. Those who travel for longer distances cause others to be unable to get on crowded services, while those who travel a short distance only use a small part of the network's capacity, freeing up room for others to get on. Road congestion benefits are equal for each kilometre travelled, as is the cost of adding new services.

However, the further you diverge from this evenly distributed model, the greater the difficulty in unpicking the overlap between distance, route crowding and road congestion. As an example, take the radial network in Figure 44, which is more closely related to the Melbourne metropolitan train network than the previous example.

[29] *Flat for the Berlin urban area only.*

Figure 44 Radial, unevenly distributed, network example



Here we note that road congestion varies by location, as does route congestion. In this example extra people travelling along the green section of the route can easily be accommodated, because this section of the network is uncrowded. Those travelling in the red sections are causing significant crowding, which will require new services or infrastructure to accommodate. Road congestion benefits on the other hand are greater in the inner area than in the outer areas.

In this example it is much harder to say how the social cost of additional trips changes with distance, as it really depends on where the distance travelled is taking place. Someone travelling from the uncrowded parts of the network into the congested area may not add to the social cost much more than someone travelling from the middle into the congested area. An extra passenger travelling for 10km in the highly congested area will cost a great deal more to accommodate than 10km in the outer area.

A number of approaches have been used by different reports and agencies to estimate the distance component of the trip, however these approaches vary significantly in their outcomes based on the assumptions underlying what costs are attributed to distance and under which circumstances longer trips result in the need for more capacity.

7.2.1 The IPART approach

At the time of this writing, IPART produced the most extensive publicly available estimates in Australia, and quite possibly the world, for the social cost of additional public transport travel. They conclude that distance is an important part of public transport pricing across all modes (train, tram, bus and ferry) for Sydney's public transport network (IPART, 2016).

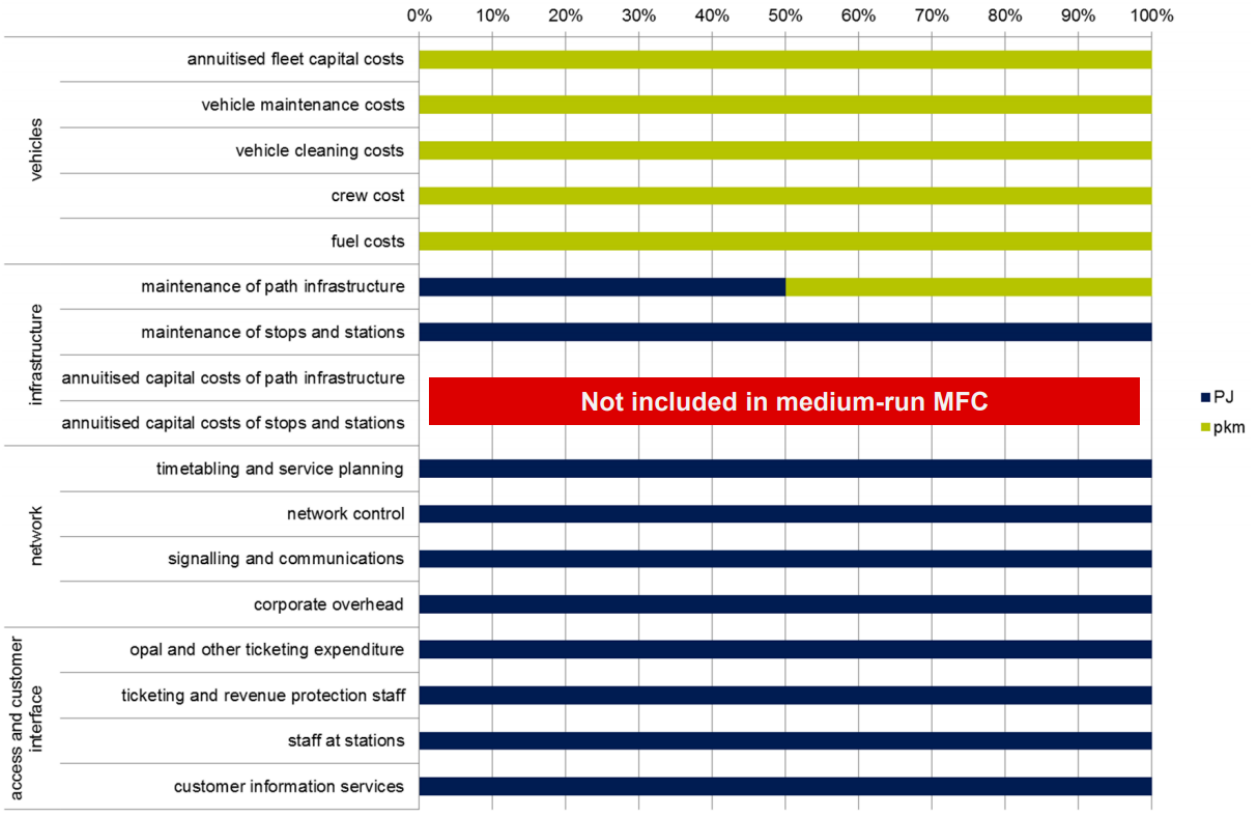
IPART's estimates suggest that the financial costs for additional public transport use vary substantially with distance. For each mode we have calculated the distance at which IPART's distance-based component exceeds the per-trip component for buses and trains (IPART, 2015a).

For trains trips greater than nine (for peak) to ten (for off-peak) kilometres long the per-kilometre component exceeds the per-trip marginal financial cost. For buses during the peak, the per-kilometre component has passed the per-journey component for any trips of 4km or more. This effect is even greater in the off-peak, where the per-kilometre component exceeds the per-journey component at a trip of 1km long.

These results are not surprising, given the chosen methodology for IPART calculations. IPART estimates do not take into account location or route capacity, assuming that every new passenger journey and additional passenger kilometre will incur new costs (IPART use a straight average cost approach in which each passenger kilometre and passenger journey incurs the same cost, regardless of location or route).

IPART's financial costs of additional public transport use are defined as the total cost of the service divided by either passenger kilometres or passenger trips, depending on whether they are deemed to be driven by a journey or distance. Their classification is illustrated in Figure 45. IPART classify rolling stock costs, fleet maintenance, vehicle operating costs, crew and driver costs as all being directly driven by distance, and 50% of track (and path) maintenance. These distance-driven categories comprise much of the total cost for running the public transport network. This approach is more aligned with the evenly distributed network example presented in Figure 43.

Figure 45 IPART allocation of costs as per km (pkm) or per journey (PJ)



Source: IPART (2015a)

7.2.2 Alternative approaches

The work conducted by CIE for Infrastructure Victoria, and the work conducted by Sapere for the Department of Transport, both focus more heavily on the effects of the Melbourne public transport network shape and design on costs, primarily around crowding on public transport.

The result is that location and capacity form a more integral part of the CIE and Sapere thinking, along the lines of the radial, unevenly distributed network shown in Figure 44.

For trains in particular, both CIE (2019) and Sapere (2017) were of the opinion that costs do vary with distance, but that this is only partial, because for established routes the social cost of additional travel is "(generally) independent of where the passenger boards".[30]

Of trains, Sapere (2017) conclude that:

"It is clear that the cost of supplying an additional service increases with the distance travelled, reflecting the additional operating costs (including labour, fuel and maintenance) and the potential to share the cost of rolling stock over more services.

[30] *Sapere (2017) Executive Summary.*

However, the relationship between cost and distance travelled is somewhat more complex particularly with regards to capacity. The number of vehicles required to service a route may be determined by the capacity in a small portion of the route (a "critical section"). For example, in an outer area heading into the city there may be negligible capacity constraints but substantial capacity constraints in an inner area. Consequently, passengers exiting (/entering) a train before (/after) the critical section do not add to the capacity constraint.

Potentially the capacity on the critical sections could be managed with shorter services focussed on those critical sections during peak times. However, this tends not to be the case. The Network Planning team within Transport for Victoria recently concluded that there was a one to one relationship between additional peak services and increases in the size of the train fleet; that is, an additional peak service requires (on average) a 1 unit increase in the fleet.

The implication is that it may be efficient to charge for capacity only those passengers who enter or exit in the critical section where capacity is constrained. For example, a passenger on an AM-peak train heading into the city will be charged less for exiting the train prior to the train entering the inner section of stations."

While there are still costs associated with distance, these are much lower than IPART estimates, and there are also benefits that offset that cost from the decreased road congestion from the longer trip. It should be noted, however, that these road congestion benefits would be significantly lower should road pricing be introduced, perhaps strengthening the case of distance-based pricing under these circumstances.

Sapere (2017) is much more supportive of distance being a driver of costs for buses, as these are driven primarily by operating costs.

Another key difference is that each new passenger kilometre in the IPART work is assumed to have the same cost. However, CIE's approach factors in that services are running on timetables that are set and may not change with increased travel on uncrowded portions of a journey (CIE, 2020).

For example, additional distance travelled by a passenger on a train into the outer suburbs is unlikely to result in significant additional costs, as the train is underutilised in this section of the network and is running the scheduled distance already. Significant new costs are only incurred if the train reaches capacity. This rationale is similar to the reasons why we recommend lower fares for Zone 2 only travel.

However, it must also be conceded that low levels of crowding at the extremities of the metropolitan network is not always the case. While it holds true for the established lines, the need for additional rail capacity in the outer west of Melbourne and the extension of electrified network to Melton and Wyndham Vale provides an example of where additional long trips from the extremities are costly to provide. However, location, distance and now access issues overlap in additional costs to extend the electrified network.

CIE model run for distance-related social costs

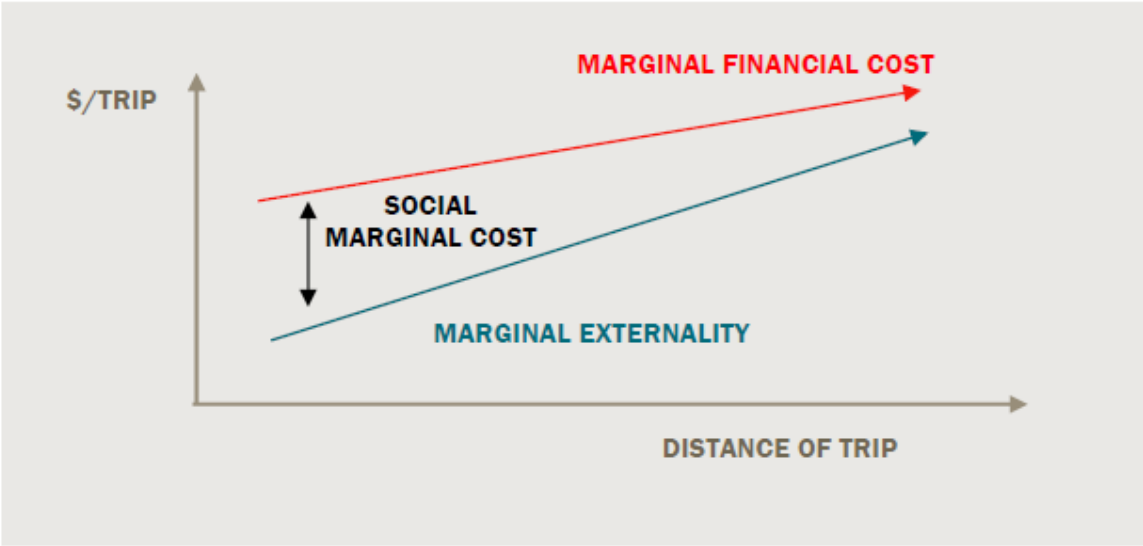
CIE performed a distance-based modelling run specifically to test the relationship between distance and the social costs of additional trips (CIE, 2019).

The results in CIE (2019) for tram and bus were not able to be relied upon due to limitations of the VITM model used in modelling short trips, primarily related to its inability to model walking as a separate mode. There were also issues with the size of the results, as the changes were not large enough to separate them from the natural variation between one model run and another in VITM.

For train, a 30% discount was provided for trips under 10km, and was compared to modelling where no discount was applied. The price decrease results in additional demand for short trips only, when compared to the no discount run. The social costs of these additional trips can be compared with the social costs for additional trips when a 30% discount is applied to all public transport journeys.

The results in CIE (2019) suggested that there was a moderate increase in the financial costs of the additional trips with distance, but that there was a larger rise in the benefits from reduced congestion and other externalities with distance, as represented in Figure 46. This is because congestion impacts are more widespread for the road network, and while public transport crowding may be lower further out in the network, congestion on the roads can still be significant. This suggested the marginal social cost may well be lower for longer trips and the CIE (2019) concludes that based on these results the case for distance-based pricing is not very strong.

Figure 46 Relationship between financial costs, externalities and trip distance



Source: CIE (2019).

The results are consistent with the assumptions of the model and analysis that costs are primarily incurred in relation to increasing network capacity, which is primarily an issue in the inner parts of the network. However, there are cases on the network, such as the western part of the rail network, where capacity is an issue in the extremities of the network, requiring electrification and new investment to increase capacity.

7.3 Conclusion

Both IPART and the alternative methods contain good arguments for why distance should and should not form a significant part of the social cost of additional public transport travel. The question is not so much whether there is a relationship with distance and social cost, but rather how large it is and how to unpick it from location and route characteristics. IPART may be relying too heavily on passenger kilometres as a driver of cost, while other methods may be underestimating their impact. This is an area that could benefit from continued research and understanding.

Sapere and IPART both agree that distance plays an important role in the social costs of additional travel for buses (IPART, 2016; Sapere, 2017). However it must also be noted that the vast majority of bus travel is for short distances, and that outside express bus services long distance travel on metropolitan buses is generally time inefficient (see 7.4 Mode price as a proxy for distance).

Given the current state of evidence and the added complexity in adding more features into the fare structure (on top of time of day, concession and mode), We have chosen not to model distance in our fare work. There are still elements of distance included in our modelled pricing due to the zone (see Section 6) and mode-specific pricing (see 7.4 and section 3). Because of the overlap with distance, mode and zone-based fares, short trips remain typically low cost, while longer trips tend to have a higher cost.

Infrastructure Victoria encourages further research to better understand the implications of distance on the social cost of additional public transport use, preferably by a Victorian independent agency set up to provide advice on fare levels, similar to the role IPART plays in NSW.

7.4 Mode price as a proxy for distance

Prices that vary by mode (section 3) also act as a rough proxy for distance through the varying usage patterns on each mode.

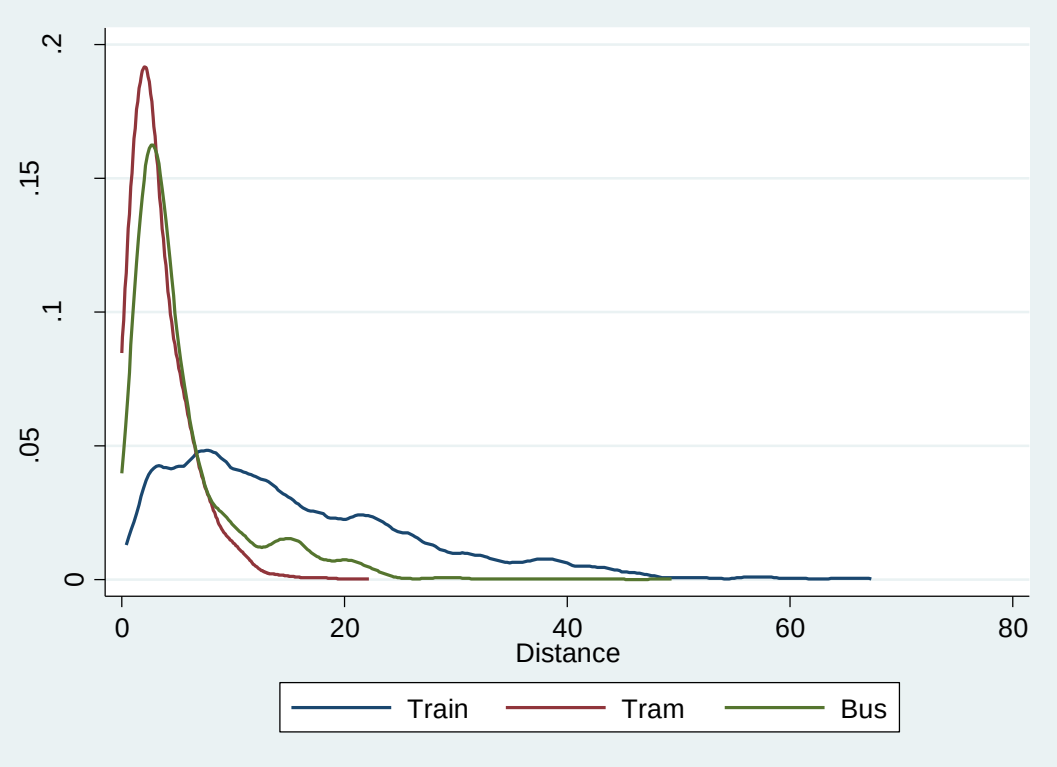
We have recommended that prices for train trips should be higher than for tram and bus. This can act as a quasi-distance charge due to the significant variation in trip length by mode. Additional trip distances, as modelled in CIE (2020) average around 12km for train, 6.5km for express bus, 4.5km for bus and 2km for tram.

Looking at the distributions, based on the 2018 VISTA, for average trips by mode, depicted in Figure 47, shows that the median train trip is 12.6km for trains, and that 90% of train trips are longer than 3.4km. 75% of train trips are greater than 7km in length.[31]

Tram on the other hand has a median trip length of just 2.6km and 90% of trips are less than 7km. This demonstrates just how little tram and train trips overlap in distance.[32]

Looking at the distributions of tram, train and bus trips, it is easy to see the huge spike in tram and bus trips for short distances, with a sharp drop off. Meanwhile trains feature few very short trips, with a large amount of medium to long trips ranging greatly in distance.

Figure 47 Distribution of trip distances by mode



Source: VISTA 2018, Infrastructure Victoria analysis

The large variation in trip distance by mode is due to the networks for tram and tram being primarily designed for shorter trips, while train travel is designed for high volume and high speed. This leads to poor performance over long distances for bus and tram, such that charging the few users who do use these services for long distance is less desirable.

Based on VITM, the average AM peak trip speed on a train is about 38km per hour. For a tram, the average speed is 15km per hour, and bus trips have a speed of around 21km per hour.[33]

[31] *VISTA 2018, IV analysis*

[32] *VISTA 2018, IV analysis*

[33] *VITM modelling for Infrastructure Victoria based on scheduled services*

Distance as substitute for mode-based pricing

Given the differences in average distance by mode, it is possible for a distance-based pricing regime to cover many of the benefits of a mode-based pricing structure. Our recommendation on mode-based pricing was that trains should be priced higher than trams and buses, and that buses should be the cheapest mode, with special fares for express bus services.

Pricing by a distance measure (that does not vary by mode) would have a similar fare variation outcome. Train trips are on average much longer than tram and bus, and express bus distances are typically higher than regular bus trips.

There are some downsides to this approach (as there are downsides to using only mode prices and not distance), as there are always trade-offs from choosing to include one element over another in fare setting.

Train travel that is short but goes through the most congested parts of the network would be under-priced under a distance-based fare system as the train network has specific points of high congestion that is location-based. This problem could be dealt with by adding congestion charges (using zones) or by having a high network access fee before applying a distance rate (e.g. $3.00 + 10c per km). However, a high enough access fee to capture the high cost of short train trips may discourage bus trips. Too low a fee with a higher per kilometre rate may discourage long trips to the CBD via train from the outer suburbs, resulting in a shift to cars that would have been best accommodated by public transport.

There would also be no price incentive to take a mode that is cheaper for society to provide, in cases where a choice between modes is available.

An optimal fare system would include factors that affect the social cost of a trip, such as mode, distance, zones and time of day. At this point in time such a system would likely be met with considerable confusion and resistance from public transport users.

As people continue to engage better with technology, the barriers to these types of complex pricing systems for public transport may be reduced. This is currently the case for commercial passenger vehicle companies, which use dynamic pricing that considers road congestion, demand for rides, location, distance, rider history and even the amount of battery remaining on your phone.[34]

7.5 Equity analysis

Melbourne's population distribution exhibits higher income earners living closer to the centre of Melbourne, where there is also a greater concentration of high paying work. Housing affordability considerations mean that those from lower socio-economic groups may reside in urban fringes and need to travel further on average.

Figure 48 shows consistently higher lifetime incomes for inner city Melburnians compared with those who live away from the centre.

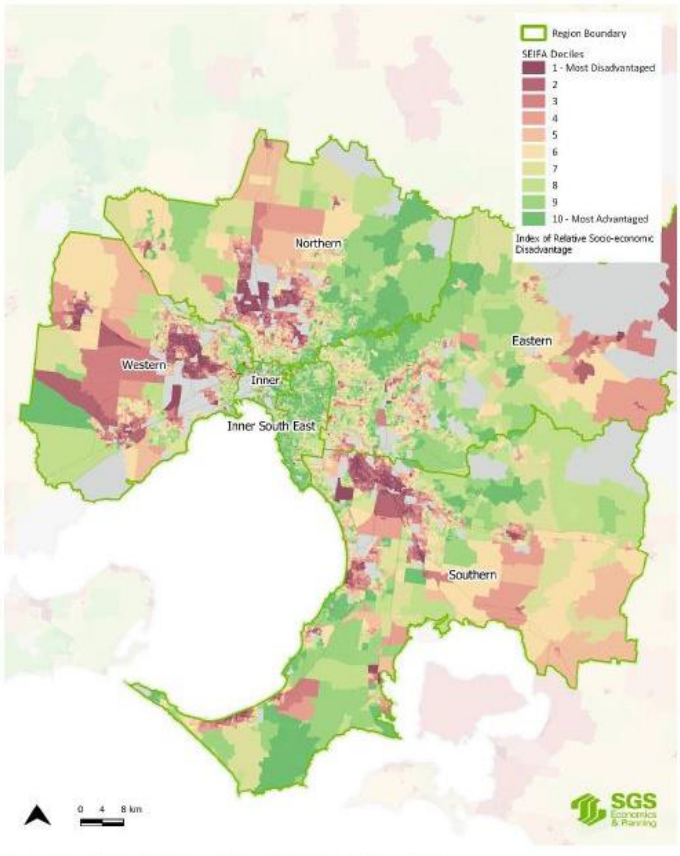
[34] https://www.forbes.com/sites/nicolemartin1/2019/03/30/uber-charges-more-if-they-think-youre-willing-to-pay-more/#5e580eea7365

Figure 48 Expected lifetime labour income per capita, by subregion (2006-2016)

Source: SGS (2019a)

Further, mapping of the index of relative socio-economic disadvantage in Figure 49 shows there is some relationship between distance from the CBD and lower income levels, however it should also be noted that the relationship is not a simple one, with pockets of disadvantage and advantage scattered throughout Melbourne.

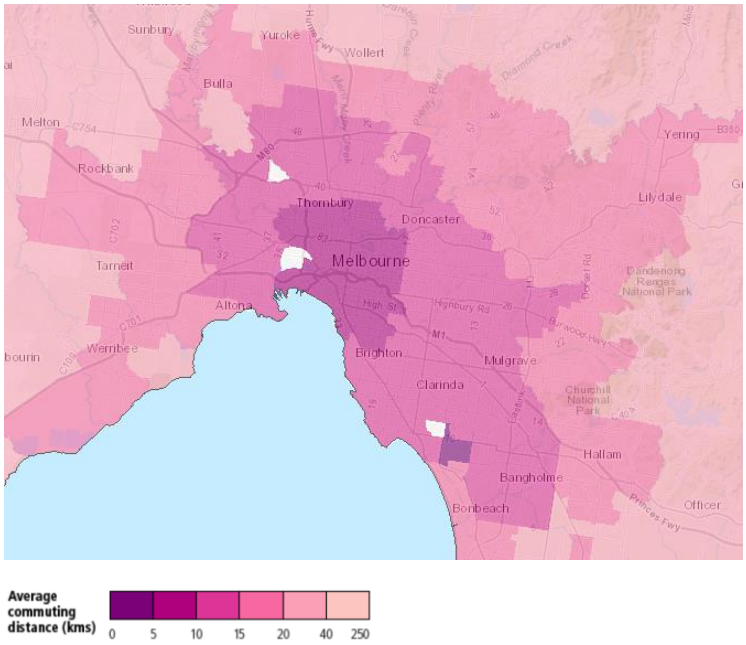
Figure 49 SEIFA index of relative disadvantage - Greater Melbourne (2016)



Source: SGS (2019b)

Due to these characteristics in population and income distribution for the Melbourne area, the argument is sometimes made that cheaper fares should be provided to those further away from the city centre, as these households are generally on lower incomes. Further, some view distance pricing as being less equitable because those on lower incomes in the outer suburbs will need to travel further to get to employment. This is supported by ABS journey to work data presented in Figure 50 which shows that the further you live from central Melbourne the further you need to travel to work.

Figure 50 Average commuting distance (kms) for Greater Melbourne



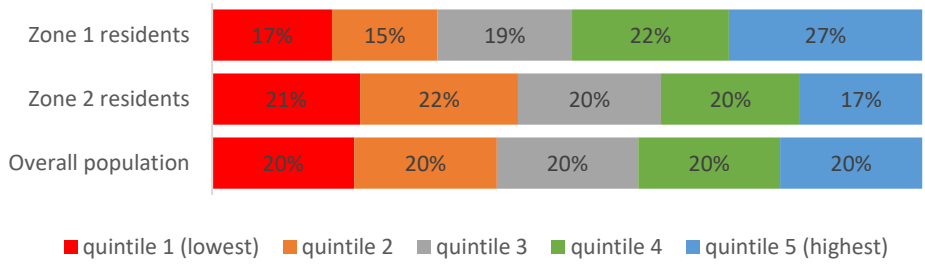
Source: ABS 2016 Census of Population and Housing : Commuting to Work
https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0.55.001~2016~Main%20Features~Commuting%20Distance%20from%20Place%20of%20Usual%20Residence~25

However, caution should be used in pursuing vertical equity by more heavily subsidising those households who are further away from the CBD for public transport. While the relationship between income and a household's location from the CBD does exist to some extent, it is not a pure relationship, and will not hold for some households.

What we do see for public transport travel is that those on higher incomes within the outer suburbs of Melbourne are using public transport. This is likely because many of those using public transport in the outer suburbs are those on higher incomes compared to their neighbours and are commuting to Melbourne for high paid employment via public transport.

Using VISTA data divided into Zone 1 and Zone 2 groups by home residence, we can see in Figure 51 that Zone 2 residents have slightly lower incomes than the general population, while Zone 1 residents have higher incomes. This is in line with what is expected.

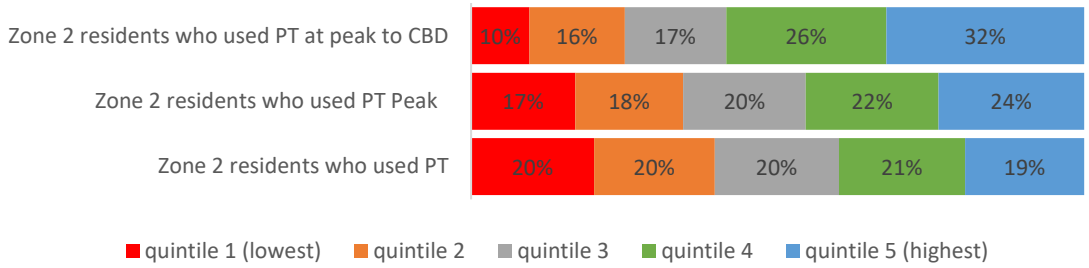
Figure 51 Zone 2 residents - household equivalised incomes



Source: VISTA 2018, Infrastructure Victoria analysis

However, looking at the distribution of incomes of *public transport users* from Zone 2 in Figure 52 shows that they are very close to the overall population. Meanwhile, those Zone 2 residents using public transport at peak are more wealthy than the overall population, and quite similar in distribution to Zone 1 residents. Zone 2 users travelling at peak to the CBD are much wealthier than the general population, or Zone 1 residents.

Figure 52 Zone 2 residents who use public transport - household equivalised incomes



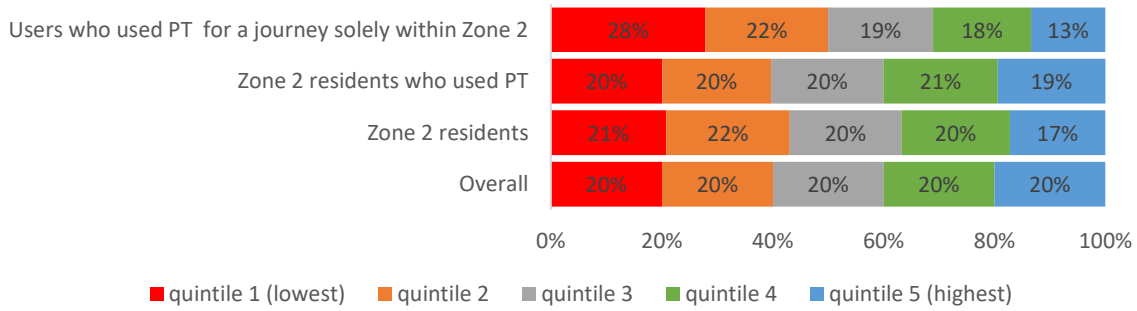
Source: VISTA data 2018, Infrastructure Victoria analysis

Given these results, equity itself is not a reason to reject distance-based pricing for public transport. Rather, continued clever use of zoning is likely a more effective equity tool.

For example, currently travel solely within Zone 2 receives a fare discount of around 30%. The reasoning behind this is likely due to the fact that people living and working in these areas tend to be on lower incomes, as was demonstrated in Figure 51 above; and perhaps lower social costs for additional trips as covered in section 6 (Zones).

Looking at the household income distribution for all people who took a trip solely in Zone 2 in Figure 53 using public transport shows that these users are indeed often on lower household incomes.

Figure 53 Public transport users who took a trip solely within Zone 2 - household equivalised incomes



Source: VISTA data 2018, Infrastructure Victoria analysis

7.6 Distance and informed choice[35]

SGS and BIT found that while modal and peak charges were relatively easy to understand and estimate fares with, distance charges were the hardest element to understand.

Kilometre-based distance charges were found to be hard to understand, and people rate fare structures with distance elements as the most difficult to understand. When asked to estimate the best journey based on varying fare elements, distance-based fares performed the worst both in terms of comprehension and response times.

It is likely that this difficulty in using distance as a fare element is driven in part by the fact that distance is simply not an instinctive way of thinking about the transport journey, as most public transport users (and people more generally) think more about journeys in terms of the time spent travelling, or the number of stations passed. Part of this is likely just unfamiliarity with distance as a pricing measure in public transport, as people are not used to receiving feedback on trips in terms of the distance travelled. This could likely be improved with familiarity and with practical use and experience, as well as help from technology that provides users information in advance of their journey.

However, the computational complexity required of distance fares means they will always be harder to accurately estimate. While modal and peak fares are simple additions or step changes, distance-based fares run on a scale, and

[35] *Derived from SGS-BIT (2020).*

usually include a flag fall component that requires a fare estimate. This includes adding and multiplication of numbers that are unlikely to be round.

SGS-BIT (2020) noted that people's overall preference for simplicity may help explain the preference for zone-based fare structures. In Otto and Boysen (2017) zone-based fares are described as essentially simplified distance-based fares with fewer increments, often bounded by easily identified areas. They can therefore be more predictable, easier to calculate, and have a lower cognitive transaction cost than distance-based fares with increments per kilometre (or other distance).

Combination of distance with other elements

Perhaps more important than how easily people are able to calculate distance-based fares is how the cumulative difficulty of fare comprehension increases as more and more fare elements are added.

Because people disengage the more elements are included, there is a trade-off in the efficiency of having many fare elements with the ability of people to respond to them.

Given the high degree of evidence around different modes and time of day pricing, and the ease with which people are familiar with them, it makes sense to prioritise these over a distance-based element should a choice need to be made. This is particularly so given the lack of evidence around more efficient use of the public transport network from a distance-based charge.

8. Discounts

Conclusion: To realise the full benefits of fare reforms the Victorian Government should simplify the fare system so that travellers face a price for each trip. This will encourage users to choose a mode, location and time of travel that supports the performance of the transport system.

Specifically, we support:

- The removal of metropolitan myki Pass tickets.
- A review into increasing the daily cap for fares.

To make the best use of discounts on public transport to improve equity we also support:

- The development of a set of principles to guide concession design.
- A review of all discounts not associated with improving equity, assessing the costs against the benefits. Those for which the social benefits do not exceed the costs should be removed.

8.1 The issue: implicit discounts

There are two methods for paying for public transport travel using myki. The first and most popular method is myki Money. Under myki Money a user pays the fare for each trip, subject to fare caps for travel within two hours (myki Money two-hour fare) and within a day (myki Money daily fare). The second method is myki Pass which enables users to pay a fixed fare for unlimited travel within a certain time period (seven days or anywhere between 28 and 365 days).

Whether or not someone is financially better off with myki Money or myki Pass tickets depends on the frequency of their travel, with myki Pass providing discounts for those who use public transport sufficiently regularly, and PTV encourages travellers to select their ticket in this way.[36] Someone consuming a small quantity of travel is encouraged to use myki Money (say travelling occasionally or 1-3 days a week), while those who travel regularly enough to pass a certain threshold can save money by purchasing a myki Pass instead. The more days a traveller uses public transport in a given period the smaller the implicit per-trip fare under myki Pass. Travellers on myki Pass can pay significantly less per trip than those using myki Money, however if they don't make a sufficient number of trips within the pass period they will end up paying a higher per-trip fare than those using myki Money.

The two-hour and daily caps applied for travellers using myki Money provide similar, though more limited, opportunities to reduce the per-trip fare. The more trips made during each time period the smaller the implicit per-trip fare.

Getting the cheapest fare requires using the right type of ticket. Although they can be placed on the same myki card, there is no automatic substitution between myki Pass and myki Money to guarantee the traveller is getting the cheapest per-trip fare. Analysis shows that users are frequently on tickets that do not give them the best financial return.

8.2 Analysis

There are two issues with myki Pass fares. The first is that these fares do not support providing incentives for travellers to make the best choices about time, mode and route for each trip they make. Secondly, there is evidence that a significant number of travellers may not be making the best choices about which type of ticket to travel with.

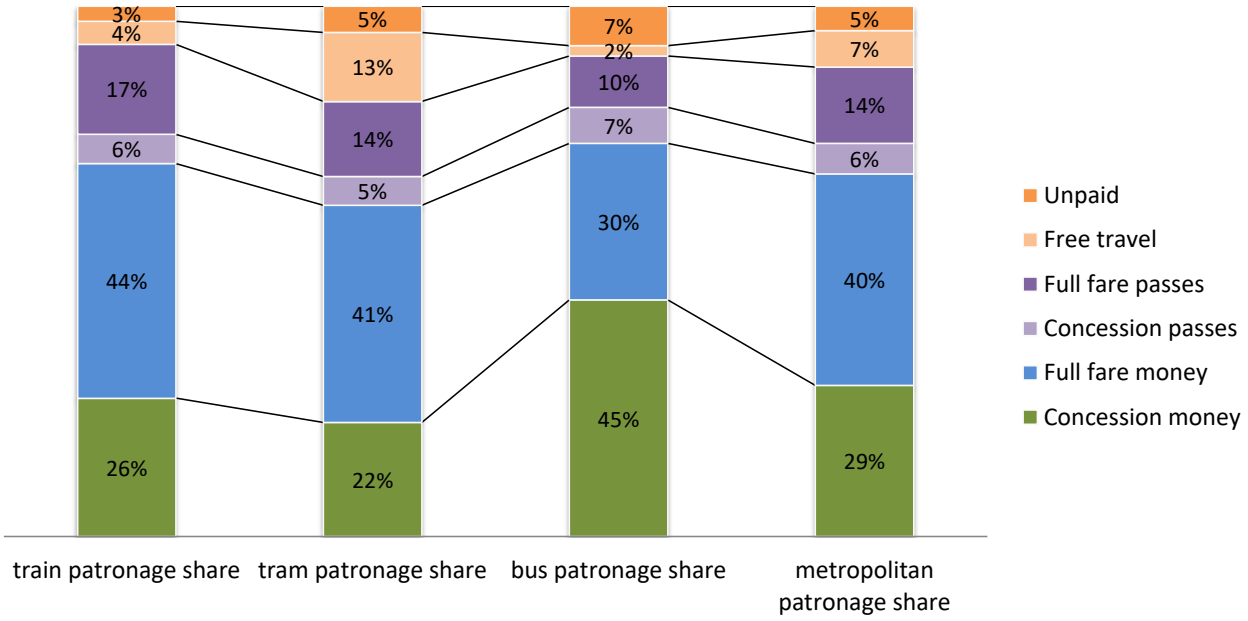
A significant share of travel is undertaken using myki Passes. While travel using myki Passes do not make up the largest share of patronage or revenue, they nevertheless make up significant shares.

Figure 54 shows that in 2015 about a fifth of patronage was completed under a myki Pass, with the greatest share on trains (23%) and the smallest share on buses (17%). In 2019 about a quarter of fare revenue came from myki Pass products (mainly the 28-325 day passes).[37]

[36] *The description for myki Money begins with "If you travel occasionally, pay as you go with myki Money" while that for myki Pass begins with "If you travel often, you can buy consecutive days with a myki Pass. Choose where you'll be travelling and how many days you need. You can buy a myki Pass for 7 days or anywhere between 28 and 365 days." A calculator comparing the fares paid under each scheme is included, complete with recommended fares. Source: https://www.ptv.vic.gov.au/tickets/fares/metropolitan-fares/, accessed 7/4/2020.*

[37] *PTV (2019).*

Figure 54 Market share of patronage by product - 2015



Source: PTV "Outcomes of the 2015 Ticket Use Survey", October 2016.

However, the significance of travel on myki Passes to the network may be understated. myki Passes provide the greatest rewards to those who make frequent regular trips, and these travellers are likely to be over-represented during the morning and evening peaks.

The primary problem with myki Pass is that it will undermine attempts to manage the demand for public transport. Introducing fares that vary by time of day and mode to improve the performance of the transport network, as described in previous chapters, will have a greater effect the greater the number of travellers who take the different fares into account when making choices about when, how and where to travel.

Travellers using myki Money will face the relevant fares each time they travel, subject to the two-hour and daily caps. Travellers using myki Pass will not, as they have paid a fixed fee for travel for a certain period. A myki Pass user's travel choices will be unaffected by incentives to contribute to reducing crowding on public transport or to support the delivery of the best services at the lowest cost (such as time of day or mode-based pricing). This undermines attempts to manage demand. If, as logic suggests, travellers using myki Pass are over-represented during the peaks because they are regular commuters, the myki Pass removes a significant set of travellers from receiving incentives to modify their behaviour at the time and locations where incentives are most needed, and from which the benefits from changing behaviour are likely to be greatest.

Daily caps also limit the impact of introducing fares to manage demand. For example, if a traveller has reached the daily cap before the evening peak, they will face no incentives not to travel during peak. Additionally, a commuter who goes in and out of the city during the peak each day will face no cost of using transport at other times, even if they are imposing a cost on society by doing so.

If public transport fares are to be reformed to provide incentives that support managing demand and making the best use of the transport network, then these reforms need to be accompanied by changes to ticketing that enable them. Metropolitan myki Pass should be removed, enabling all users of the transport network to face incentives for better use of the system, not just those who do not use it regularly. Second, the daily caps, if maintained, should be increased so people do not reach the daily cap too quickly, removing them from facing costs for future travel (alternatively discounts could be provided once you pass a certain daily threshold). These changes would support improving the economic performance of the system through changing prices.

8.3 Equity considerations

Removing the myki Pass and increasing the daily cap should not obviously worsen equity outcomes, as long as mode and peak and off-peak prices accompany it. Frequency of travel is fairly evenly distributed across the five income quintiles;[38] however myki pass is only available to those who are able to pay for travel in advance, and the larger the

[38] *DoT Survey, 2019*

amount paid in advance the greater the discount.[39] Though there is no available evidence on the income levels of different types of myki tickets, lowest income Melburnians are less likely to have the available cash to purchase a large amount of travel ahead of time via the myki Pass.

8.4 Helping commuters make informed choices

There are many reasons people may prefer myki pass over myki money, and not all them are financial. For example, it is well understood that people do not like uncertainty (Reeson and Dunstall, 2009). This and other factors lead to many people in mobile and internet markets preferring to pay too much for unlimited plans over pay-as-you-go plans (Lambrecht and Skiera, 2006). Purchasing a myki Pass means that you have full certainty about the cost of transport over that period, and do not need to dedicate any thought effort into the costs of additional public transport use for travel. Furthermore, travellers do not have to spend time checking and topping up their myki over the relevant period. Daily caps provide similar certainty for those travelling using myki Money regarding what is it is going to cost to use public transport for a day, as an upper maximum has been set.

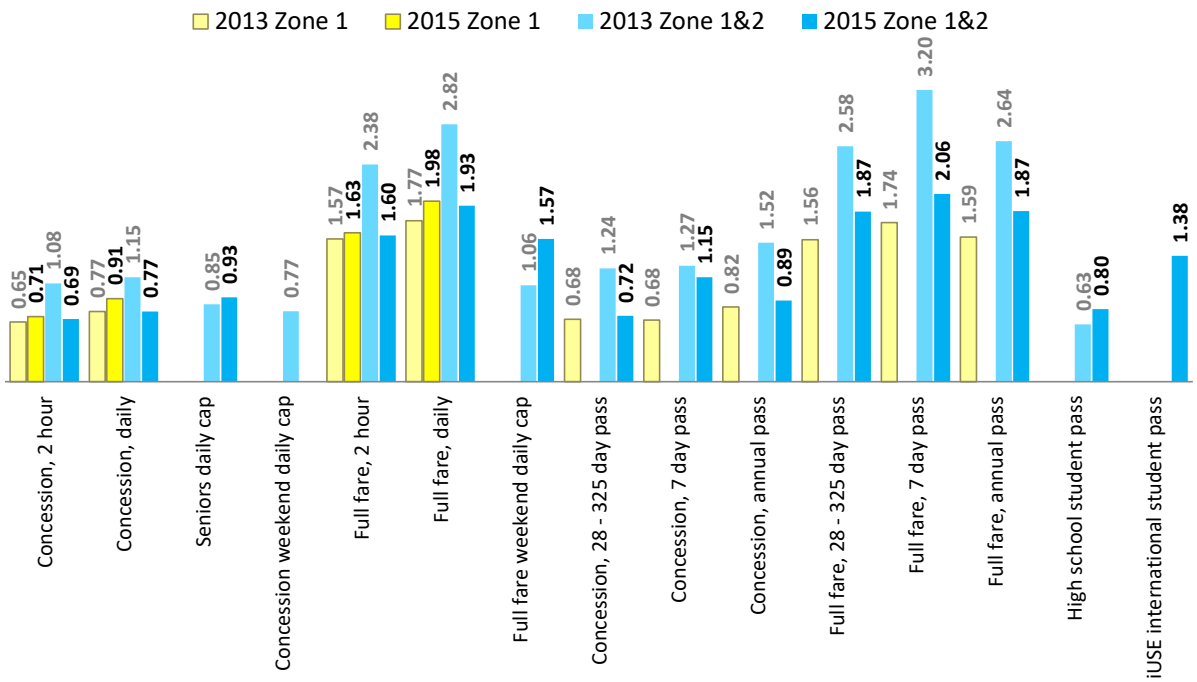
Removing myki Pass and increasing the caps could therefore make the transport system a little less easy to use, and possibly less attractive. However, this assumes that each traveller is fully informed about which type of ticket is best for them.

Three sets of evidence raise questions about this assumption. First, a 2017 PTV survey of travellers found 42% of travellers who solely used myki Money were unaware that myki Passes existed.[40] Furthermore, of those that travelled at least five days in a week, 65% were using myki Money when it would have been cheaper to use a myki Pass. Finally, the 2015 Ticket Use Survey reports, as summarised in Figure 55, that those who did purchase a seven day Zone 1&2 myki Pass were paying on average nearly 7% more than if they had used myki Money. Some of this inconsistency can be explained by people paying for certainty and convenience, but much of it also points to a poor understanding of the pros and cons of two ticketing options.

The 2015 Ticket Use Survey also showed, in Figure 55, that despite the inconsistency, those who bought passes for longer periods of time were on average receiving discounts.

Figure 55 Trip yield by fare product

Average trip yield by fare product type (ex GST) – Zone 1 and Zone 1&2 fare products



Based on 2013 and 2015 annual sales

[39] *Seven-day myki pass compared to monthly myki pass and 365-day pass.*

[40] *Quantum Research (2017) PTV Customer Tracker, Quarter One (July to September).*

Source: PTV "Outcomes of the 2015 Ticket Use Survey", October 2016.

The results suggest that with two different types of tickets a significant share of travellers aren't necessarily making informed choices, while another set is reaping significant financial reward while insulating themselves from prices that will inform them on making the best use of the transport network. Replacing the myki Pass with a system that provides greater incentives specific to each trip, as well opportunities to trade off price, convenience and quality, may simplify ticketing choice while enabling a broader set of travellers to make more informed choices

In addition, much of the convenience of the myki Pass could be preserved by combining bulk purchases with the already available auto-top up. Travellers would not have to continually check and top up their balances of myki Money but would face different fares for different trips and receive the price signals that enable them to make choices that make better use of the transport system.

8.5 The issue: cohort concessions and free travel days

Concessions do not improve the performance of the public transport system when fares are set in line with the social costs of additional public transport travel. Where fares are above this social cost, reduced fares for low income cohorts may improve the economic performance of the system. This may be applicable to current bus or tram services – particularly off-peak services not to the CBD. However, it is unlikely that the current set of fares is above the marginal cost of providing peak train services.

If fares are below or at the social cost of additional public transport travel, then there will be excessive demand for public transport and trips will be made for which the cost exceeds the benefit. Concessions also involve foregone revenue. The difference between the fare and the financial cost of the trip will have to be covered out of general revenue. Because the taxes used to collect general revenue reduce economic activity, there are additional losses to social welfare.

The reasons government has concessions, despite their ability to reduce the performance of the transport network, is to improve equity. While there is a cost to society in providing concessions, there are also significant benefits to society and individuals that come from enabling those on low incomes to have access to the transport they need, and to make navigation of the system possible for those with a disability. Concessions are an important part of the pricing of essential services like transport, which gives people access to education, health and social engagement.

The current Victorian set of concessions and free fares benefit a range of groups within the community. These have evolved over time and were introduced in response to specific concerns. There are currently three types of concession fares in offer:

1. A 50% discount for certain cohorts.
2. Free travel for certain cohorts, including on certain days of the year.
3. Free travel for all travellers on certain days of the year.

A comprehensive list is provided below. In most cases it is clear how each concession is related to improving equity or other social objectives; however, a closer look reveals inconsistencies. Inconsistent applications of concessions runs the risk of creating confusion and inequity, resulting in individuals who could have benefitted from a concession missing out.

Developing a set of principles to guide what concessions are provided could well improve equity as well as the efficiency with which the improvements are achieved.

8.6 Analysis

To make these issues a bit more concrete, the first two types of discounts and the free travel days, as stated in PTV (2020), are listed below:

Those cohorts that receive 50% discount are:

- Asylum seekers
- Holders of a Carer's Card
- Children aged between five and 18
- Centrelink Disability Support Pensioners
- Centrelink Health Care Card holders – this includes the unemployed and low-income families i.e. those who receive the full Family Tax Benefit A and those on AbsStudy and AusStudy
- Interstate Seniors Card holders
- International students
- Pensioner Concession Card holders

- Primary or secondary school students
- Tertiary students.
- Victorian Seniors Card holders – to qualify for a Seniors Card you must be over 60 and working less than 35 hours per week
- War veterans and war widowers not covered by other concession categories.

Those cohorts that receive free travel:

- Children under five
- Free travel between two consecutive zones on weekends for: holders of a Carer's Card; Carer's Payment Recipient; Pensioner Concession Card; Disability Support Pensioners; Seniors
- Access Travel Pass (those unable to consistently touch on or off due to impairment, but who can travel independently)
- Holders of a Department of Veterans Affairs Gold Card with EPA or TPI embossed on it
- Scooter and Wheelchair Travel Pass holder (have a permanent and severe disability and depend on a scooter or wheelchair for mobility outside the home)
- Travel trainer (those who deliver travel training for those with a disability)
- Vision impaired (legally blind)
- War veterans who have served overseas
- Widow of WWI veteran
- The carer of a Companion Card holder
- Those entitled to free travel vouchers (two off-peak (metro) and four off-peak (regional)) for Centrelink Pensioner Concession Card holders; DVA Pensioner Concession Card holders; Victorian Seniors Card; Victorian Carer's Card
- 1 Day, 7 Day and 30-Day travel passes issued by authorised community service organisations.

Free travel days:

- Relevant concession holders in Seniors Week; Veterans Health Week; Carers Week
- Anzac Day, Vietnam Veterans Day and Remembrance Day: Veterans and eligible participants in the march (including school students and scouts/guides)
- Extension of the free tram zone (23/9 – 26/9) to MCG
- Christmas Day
- New Year's Eve.

Most of these concessions are associated with three overlapping groups. The first group is low income Victorians. The second group are Victorians for which travel is challenging due to disabilities. The third group are associated with veterans of wars Australia has been in. However, there are groups which are not included. The first example is widows of veterans of wars since the first world war. The second example is veterans of wars who did not serve overseas.

If these are the groups for which it is believed concessions should be granted, then a review seems in order to make sure that all relevant groups have been included.

There are also a range of concessions linked with age (such as child and senior discounts), which are not necessarily tied to income or disability. Having clearly articulated objectives for concessions would help enable greater consistency and ensure that those who need the concessions get them.

The last three cases of free travel days are not clearly associated with improving equity. These will be the focus of the next section which highlights the consequences of these concessions for the performance of the transport system.

Free travel days

We now focus on the three cases of free travel where the concession is not clearly associated with improving equity, supporting Victorians with disabilities or veterans and their close families: free travel on Christmas Day, New Year's Eve and the extension of the free tram zone around the time of the AFL Grand Final.

Free public travel on New Year's Eve may have greater social benefits from public transport due to its contribution to reducing road congestion and road trauma. One way to deliver these benefits is through discounting the fares for using public transport. The same argument could be used to provide subsidies for taxis and ride-share services; however, this is likely to be more costly. However, unless the social benefits are greater than the costs of providing the service (for which there is currently no evidence) the economic performance of the public transport system is reduced by making travel free.

Free travel on Christmas Day and the extension of the free tram zone around the AFL Grand Final appears to have no obvious economic or social benefits justifying fare discounts. There is little congestion or greater risk of road trauma (as seen in New Year's Eve) that would be addressed by making the associated travel free.

Should the Victorian Government continue to offer free travel days it would be worthwhile to formulate principles that would guide when the State should make public transport free. There are many other events and days of the year that are similar to those considered above such as extending the free tram zone to the tennis centre during the Australian Tennis Open, the Boxing Day Cricket test or the Midsumma Carnival; or providing free travel on Good Friday, Chinese New Year, Eid and for all Victorians on Anzac Day.

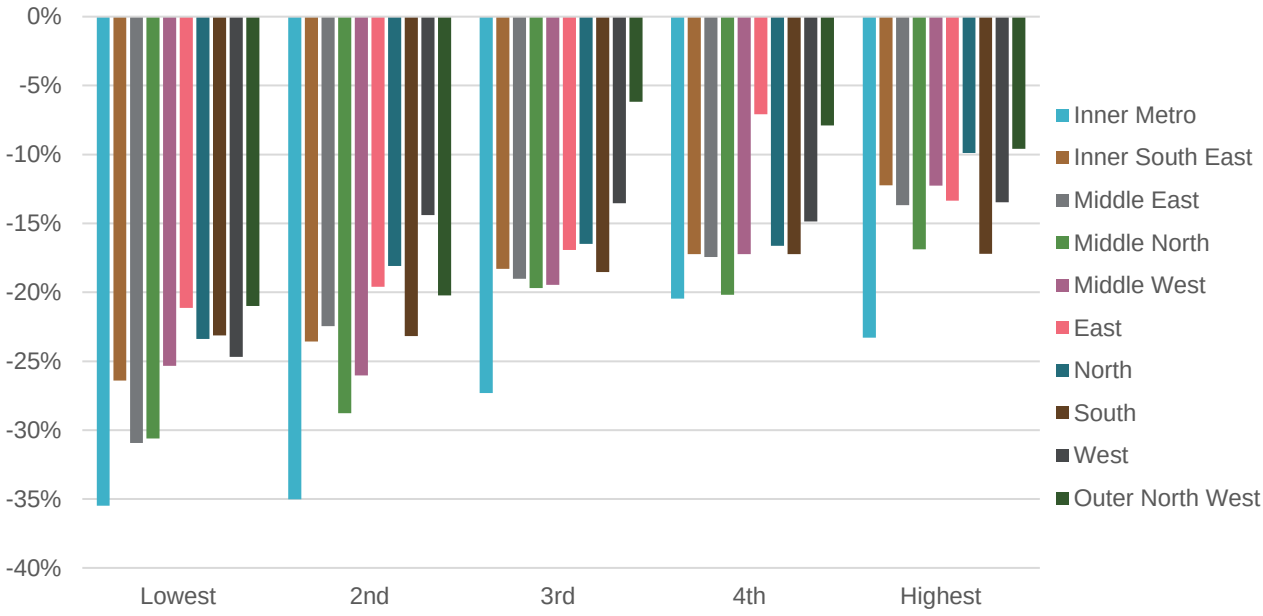
Infrastructure Victoria is not recommending that free travel be extended to all or any of these cases – rather we propose that a set of principles be developed that guide when the benefits exceed the costs of providing free travel so consistent and transparent decisions can be made.

9. Modelling appendix

As mentioned in *Fair Move: Better Public Transport Fares for Melbourne*, while VISTA data and previous modelling projects were used to estimate fare revenues in Fare Reform to be similar to what the Victorian Government would collect under the current system, modelled fare revenue value was down 14.4% under the Fare Reform scenario. In practice, the difference is expected to be smaller, as this figure does not account for lost revenue from the myki Pass product nor the Early Bird free train fare. Initial analysis controlling for Early Bird suggests that the number would be less than 11%.

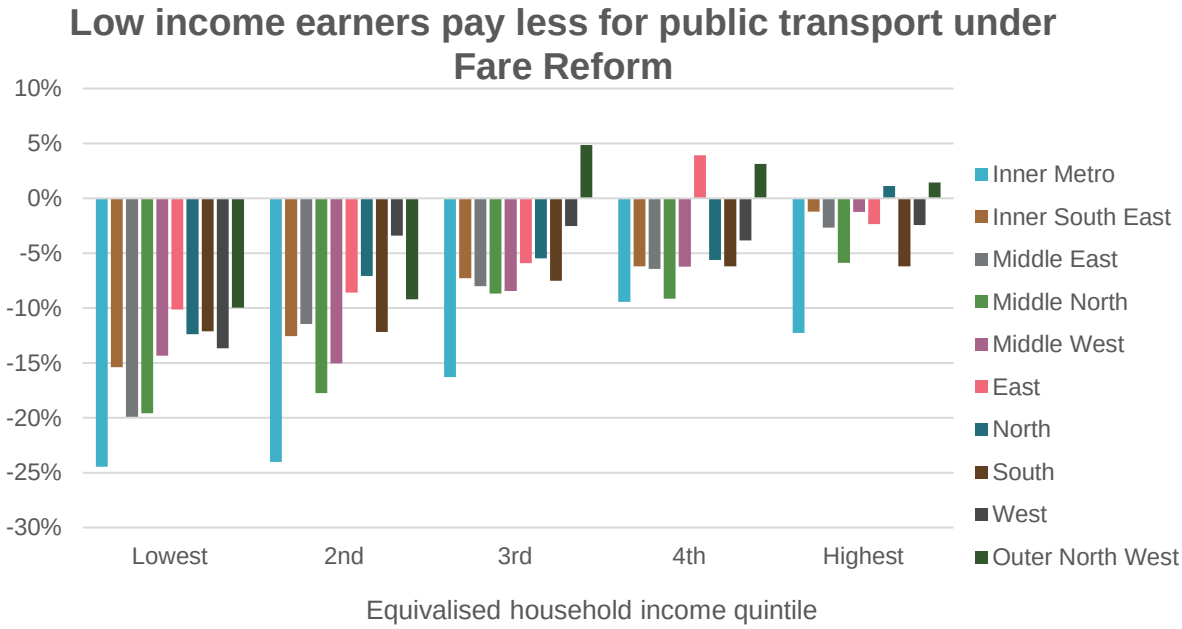
The impact of fare reform that includes this revenue shortage is presented in Figure 56.

Figure 56. Change in average daily PT fare by household income and location from Current System scenario to Fare Reform scenario



To demonstrate a scenario in which the difference between the Current System and Fare Reform scenario farebox review is revenue neutral, we adjusted these so that Victorians pay slightly more for their fare (an increase of 11% in the values represented in Figure 56), resolving the revenue gap when Early Bird is taken into account. This revision is shown in Figure 57. Note that this adjustment does not take into account any changes in travel behaviour caused by an increase in fares. Running an additional MABM scenario with such fares present would lead to a new equilibrium.

Figure 57. Change in average daily PT fare by household income and location from Current System scenario to Fare Reform scenario (with revenue adjustment)



The following section outlines all fare details, as modelled in the Fare Reform scenario using the MABM.

2031 Fare Reform scenario

Fare elements include peak and off-peak charges, mode pricing, directional discount for train and a new City Zone. City Zone stations include City Loop service stations (Flinders Street, Southern Cross, Parliament, Melbourne Central and Flagstaff) and all Metro Tunnel stations (Anzac, Town Hall, State Library, Parkville and Arden)
Express Bus routes defined: 302, 303, 304, 305, 309, 318, 905, 906, 907, 908, 200, 207

<table>
<tr><th></th><th colspan="2">Train</th><th colspan="2">Tram^</th><th colspan="2">Express Bus</th><th>Bus</th></tr>
<tr><td>City Zone + any other zone</td><td>$5.00 (peak)</td><td rowspan="3">($2.50 off-peak)*</td><td rowspan="4">$2.50 (peak)</td><td rowspan="4">$1.25 (off-peak)</td><td rowspan="3">$2.50 (peak)</td><td rowspan="3">$1.25 (off-peak)</td><td rowspan="4">$1.25 all times</td></tr>
<tr><td>City Zone only</td><td rowspan="3">$4.00 (peak)</td></tr>
<tr><td>Zone 1+2</td></tr>
<tr><td>Zone 1 only</td></tr>
<tr><td>Zone 2 only</td><td colspan="2">$2.50 all times</td><td colspan="2">$1.25 all times</td></tr>
</table>

- ***Peak fares*** apply weekdays 7.30-9.30am (AM peak) and 4.30-6.30pm (PM peak). Peak fares apply to users who *touch off during AM peak* and *touch on during PM peak*.
- ***Concession discount*** – 50% off full fare prices.
- ****Directional pricing*** – Off-peak fares are charged for train journeys that travel in *counter-peak flow direction during peak.* This means any train journey that travels *away/out from the City Zone in the AM peak* (even if you begin within the City Zone) or *towards/into the City Zone in the PM peak* (even if you end in within the City Zone) has this discount applied.
- ***^Multimodal trips*** – If a journey is multimodal, the user only pays the highest fare of any of the modes travelled. If a tram is used as part of a multimodal trip that involves a train, then an additional tram transfer fee of $1.25 is also charged. A journey is defined as complete once an agent begins a different activity. Removed all two-hour limits and daily caps.

Additional modelling notes

The following should also be noted about the MABM scenarios presented in *Fair Move*: *Better Public Transport Fares for Melbourne*:

- The MABM does not allow for trips to be changed – only the mode, route and time of travel – so it is best placed to demonstrate short run impacts. This means that there are also equity impacts that are not captured, such as new journeys that are conducted as a result of cheaper fares (or alternatively, journeys that no longer exist due to more expensive fares).

- The focus of the report has been on regions of metropolitan Melbourne due to the limited geographic coverage of the MABM.

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About us

Infrastructure Victoria is an independent advisory body, which began operating on 1 October 2015 under the *Infrastructure Victoria Act 2015*.

Infrastructure Victoria has three main functions:

- preparing a 30-year infrastructure strategy for Victoria, which is refreshed every three to five years
- providing written advice to government on specific infrastructure matters
- publishing original research on infrastructure-related issues.

Infrastructure Victoria also supports the development of sectoral infrastructure plans by government departments and agencies.

The aim of Infrastructure Victoria is to take a long-term, evidence-based view of infrastructure planning and raise the level of community debate about infrastructure provision.

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Printed by Infrastructure Victoria

September 2020

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