WORKING PAPER

The Congestion Question

Could road pricing improve Auckland's traffic?

Workstream 4

Complementary policy measures

February 2019

Working draft vB

Auckland Council · NZ Transport Agency · Ministry of Transport · The Treasury · State Services Commission · New Zealand Government

Table of contents

1 Purpose

This paper investigates policy based complementary measures that could be designed to support the success of a congestion charging scheme and form part of a wider demand management toolkit.

They may or may not include a pricing mechanism. They are in the nature of 'push' and 'pull' factors or incentives and disincentives to encourage a reduction in single occupancy vehicle/private vehicle travel that contribute to traffic congestion.

2 Executive summary

2.1 Scope

This paper explores four options identified for further investigation as complementary measures to a congestion pricing scheme. The four options were identified as having some potential for consideration in conjunction with a congestion pricing scheme following a multi-criteria analysis (MCA) of the longlist of 26 (direct and indirect) congestion pricing options in February 2018. They are described in Table 1 below along with further commentary from the evaluation on each individual option.

Table 1: Four complementary measures being considered

Option	Evaluation commentary
Option 21: Parking Policy	Depending on the type of parking scheme there may be potential for unintended consequences and significant implementation issues.
Option 22: Car Sharing	Already in practice and should continue to be promoted noting that it is unlikely to make a significant impact on network performance.
Option 24: Reverse Tolling	On-going funding would present long-term challenges for sustainability, and raises significant equity issues.
Option 26: Free Public Transport	Significant capacity constraints and on-going funding would present long-term challenges for sustainability. Reducing fares (higher subsidy levels) may be more effective.

The MCA found that none of these options represented an effective stand-alone intervention capable of improving network performance in a meaningful way, but could be explored further as part of a wider demand management toolkit that could support or complement a congestion charging scheme.

Public transport (PT) or active mode offerings are the most obvious complementary measure to support a congestion pricing scheme. In cities around the world where congestion pricing has been introduced, there are often extensive PT networks in existence. This means there are reliable and efficient alternative travel modes on offer to members of the public who choose not to pay the congestion charge (eg London, Stockholm). As part of Auckland Regional Land Transport Plan (RLTP), extensive improvements to both the road network and the PT system will be delivered. It is important to note that, while not discussed in this paper, public transport coverage (including the provision of Park and Ride facilities) and frequency of service will be considered alongside further investigation and refinement of a congestion pricing scheme.

It is worth noting that both parking policies and car sharing are existing mechanisms/initiatives that are already utilised in the transport environment. In the context of congestion pricing it would be prudent to review their application and use to understand if they could be modified or enhanced to further support the outcomes sought by the introduction of a congestion pricing scheme.

2.2 Summary

2.2.1 Parking policies

Three parking policies in particular (parking pricing, parking taxes/levies and reducing the supply of parking) have the greatest potential for supporting travel demand management and more efficient land use.[1] Parking policies tend not to have any impact on through traffic – instead they target journeys which terminate in an urban centre.

Parking pricing - the pricing of publically owned carpark spaces can be varied by factors such as the time of day, day of the week or length of stay, to achieve particular objectives. In some cities, demand-responsive pricing has been implemented to target a particular occupancy rate. This generally reduces parking congestion, but does not necessarily contribute to reducing vehicle congestion. Additionally, parking restrictions can be applied to public car parking spaces – eg to allow only commercial vehicles to park, with escalating fees to encourage short-stay and high turnover (New York does this).

In 2014, Auckland Transport (AT) only controlled 16% of the central city parking supply. This will limit the ability of a parking pricing strategy implemented by AT to significantly support a congestion charging scheme.

Parking taxes – a tax applied to commercial parking, usually in major urban centres where parking is priced, but not usually in suburban areas where parking is free or cheaper. While commercial parking taxes are relatively easy to implement, the cost burden tends to be concentrated in a few areas (eg city centres, campuses and hospitals), and there is no evidence that they represent an effective mechanism to improve network performance. Limitations to introducing parking taxes are the legislative changes that would be required to make this an implementable option.

Parking space levy – parking space levies (PSLs) are a tax on all private non-residential premises with parking facilities. It is similar to a property tax but applies specifically to parking spaces. PSLs are challenging to implement, controversial and much depends on the extent to which employers absorb costs rather than pass them onto consumers.[2] They may encourage property owners to reduce parking supply and manage their parking more efficiently and as a result, PSLs can support compact urban form, increased access and multi-modal land use patterns. In order to be effective, consumers need to pay the costs directly, however there is limited evidence that they are an effective mechanism to support improved network performance as they may just shift parking to other un-taxed areas.

Reducing parking supply – initiatives to directly reduce the supply of parking are generally implemented through planning or regulatory instruments. Accordingly, they can take time to have an impact. Auckland supports initiatives to reduce parking supply in specified zones through the imposition of parking maximums and removal of parking minimums. The provisions are set out in section E27 of the Auckland

[1] Parking Solutions: A comprehensive menu of solutions to parking problems. TDM Encyclopedia, Victoria Transport Policy Institute. Updated 17 April 2017.

[2] Parking measures and policies research review', Palmer, D., Ferris, C., Department for Transport, Transport Research Laboratory (2010), p. 65; 'Parking Taxes',

Unitary Plan. The parking provisions support growth and intensification, reduce development costs, improve housing affordability, support more efficient and attractive land use and support the use of public transport.[3]

2.2.2 Car and ride sharing (shared mobility)

Shared mobility schemes have the ability to support congestion charging by reducing single occupancy vehicle trips and making better use of vehicle capacity. These schemes can operate anywhere but are likely to be most effective in serving relatively dispersed suburban locations that are not well served by public transport. Shared mobility schemes are likely to be popular for sites that attract many people, eg large employers or campuses. Substantial adoption of shared mobility services would need to be in place before significant improvements to network performance are observed.

Carsharing is a sub-category of shared mobility whereby vehicle rental services offer a substitute for private vehicle ownership. Carsharing schemes such as Cityhop are well established in Auckland.

Ridesharing is a sub-category of shared mobility whereby a vehicle carries additional passengers when making a trip, with minimal additional travel required. AT is preparing to implement *AT Metro Local*, a rideshare service for Devonport which will operate within 3km of the ferry terminal and will be supported by a smartphone app. Another rideshare initiative supported by AT is the *Smart Travel* application and online travel tool that supports carpooling.

Note that ride-hailing services such as Uber and Lyft are not considered part of shared mobility as these are essentially taxi or chauffeur services that can increase the number of vehicles on the road and move people from PT or active modes into making more vehicle trips.

Significant publicity and organisation is required to increase the frequency of use of shared mobility initiatives and generate tangible network benefits alongside congestion charging. Care is required to ensure initiatives complement rather than undermine or substitute for PT ridership and active modes.

2.2.3 Free public transport

The concept of free public transport means there is no direct user payment, ie it is fare-free. The service is funded by a central body and fare-free services may be limited, for example, to certain periods of time, by user type (eg students or seniors) or by geographical area.

As a congestion reduction tool the fare-free public transport (FFPT) concept does not appear sensible. In particular:

- There have been few universal FFPT schemes, and most pilot schemes apply to towns or cities of a modest scale.

[3] Auckland Unitary Plan, E27 Transport, http://unitaryplan.aucklandcouncil.govt.nz/Images/Auckland%20Unitary%20Plan%20Operative/Chapter%20E%20Auckland-wide/4.%20Infrastructure/E27%20Transport.pdf

- Research into price responses indicates that people are more sensitive to other direct pricing mechanisms (such as parking pricing, congestion pricing and fuel taxes) and PT service improvements, than decreasing PT fares.
- While FFPT may increase PT ridership, studies show that a significant proportion of new PT riders are not a direct transfer from people using a car, rather they are the result of an unintended shift from walking or cycling, or they are completely new trips.
- Short term increases in ridership are generally not sustained for the longer term.
- Where a scheme results in significant increased demand, this can require a costly response in terms of increasing services and/or capacity.
- Paying for the schemes can be costly, with the scale and durability of benefits uncertain.
- Those who benefit most tend to be students or pensioners and those on lower incomes – mobility increases for these groups.

By contrast, variable PT pricing for the peak and off-peak, and potentially more finely-tuned and differential peak pricing is supported by the literature because it would help spread demand across the peak and interpeak, which is useful if there are capacity issues during peak travel periods.

While it may 'feel' right to support congestion pricing with significant PT capacity increases and/or significant reductions in PT fares, in practice, that may not realise all the benefits anticipated. Much will depend on the nature of any particular pricing scheme and the PT mode share for the areas most impacted.

2.2.4 Reverse tolling

Reverse tolling incentivises people to change the time or way in which they travel by rewarding them for changing their behaviour (eg with points, cash, credits etc). Internationally, no reverse tolling schemes have been deployed at scale. A small-scale trial in the Netherlands has shown that reverse tolling led to a decrease in rush hour trips, reduced stress and provided more free time to those who avoided travelling during peak times. The concept of reverse tolling is attractive but it suffers from a number of potential shortcomings:

- Observed price responses do not lend support to a concept of paying people for a behaviour change that would be more cost-effective to achieve from pricing.
- While capital costs may be low, operating and reward costs are potentially very high and may become unsustainable over the longer term.
- The scheme potentially excludes other travel modes and may therefore undermine the broader use of alternatives such as PT, walking and cycling.
- It may generate trips and perverse travel patterns.
- There are fairness issues; because higher income travellers with flexible schedules are more able to take advantage than those on fixed incomes and inflexible schedules.
- The scheme would appear to be vulnerable to abuse, and would therefore require significant enforcement and administration costs.

2.2.5 Conclusions

Initiatives that will complement a congestion pricing scheme will have greater demand reduction impacts when implemented alongside network and PT improvements. Effects of these initiatives on their own, are likely to be negligible. A coherent and sequenced package of policies to incentivise modal shift at peak from private vehicle use to PT, active and/or shared modes is more likely to have a noticeable effect on network performance improvements. These policies could be introduced in a staged approach to complement a congestion pricing scheme.

3 Option 21: Parking policy

3.1 Scope

This discussion explores a sub-set of parking policies that could support congestion charging. These are policies to reduce demand and that can form part of a broader travel demand management approach supporting behaviour change alongside congestion charging. The discussion is not a comprehensive review of parking policies and it does not focus on solutions to parking problems.

In a review of parking management policies, three parking policies have the greatest potential for supporting travel demand management and more efficient land use.[4] They are:

- **Parking pricing** (of public parking)
- **Parking taxes** (of commercial and/or private parking)
- **Reducing parking supply**

Another parking intervention that can help increase PT ridership (and therefore act as a demand management tool) are Park and Ride facilities. These facilities form an important part of the PT network. AT has policies relating to Park and Rides and further provision would be considered as part of the PT network development that would accompany any preferred congestion pricing option(s).

3.2 Pricing public parking[5]

Public parking refers to the parking provided by local government, including on-street parking, off-street parking at public facilities (eg offices, schools, parks) and municipal parking facilities. It does not refer to commercial parking facilities offered to the public. Table 2 provides a brief summary of pricing public parking.

[4] Parking Solutions: A comprehensive menu of solutions to parking problems. TDM Encyclopaedia, Victoria Transport Policy Institute. Updated 17 April 2017.

[5] Parking Management: Strategies, Evaluation and Planning. (12 September 2016). Victoria Transport Policy Institute. Litman, T.; Parking Taxes: Evaluating Options and Impacts. (29 August 2013). Victoria Transport Policy Institute. Litman, T.; Understanding Transport Demand and Elasticities. (27 February 2017). Victoria Transport Policy Institute. Litman, T.

Table 2: Public parking pricing summary

Public parking	
Operation Parking pricing can be structured to achieve particular objectives, eg convenient parking for customers/clients can be supported by hourly rates, with first hour free discounts and time maximums (eg 2 hours). Other pricing can favour long-term parkers like commuters and residents (eg discounted monthly rates). Pricing strategies that may support reduced travel demand include: • **Priced parking**: Varying rates apply, sometimes alongside a time restriction. Most jurisdictions deploying variable pricing also impose time restrictions or escalating fees to discourage long-stay parkers from monopolising convenient spaces. They are typically used in busy centres. • **Demand responsive priced parking**: Prices charged for on-street parking are adjusted based on parking demand, with an escalating scale based on time and not usually with a time restriction. Price rates are adjusted up or down with a goal (generally) of maintaining an average 85% occupancy at peak times (sometimes also called 'performance parking pricing'). Demand responsive priced parking is *not adjusted in real-time*, but parking availability is (usually enabled by an app). Pricing is adjusted following surveys that may be conducted monthly, quarterly or at some other time interval; and consumers are advised in advance of new pricing schedules. • **Parking restrictions** eg restricting on-street parking to commercial vehicles and applying pricing, with an escalating fee to encourage short stays, high turnover and fast delivery. New York applies these types of parking restrictions. • **Free or discounted parking for registered rideshare or car share vehicles** The *Auckland Transport Parking Strategy* supports all of these mechanisms, including demand responsive priced parking.[6]	
Impacts	
Network	Only a limited number of studies have attempted to quantify the effect of parking charges on PT travel demand. Results vary and are not necessarily transferable. In terms of impacts of large scale pricing policies on car travel demand, short-run elasticities[7] of between -0.1 to -0.6 were observed across six studies, with an average of -0.3.[8] This means that a 10% increase in parking price may yield a 1-6% reduction in parking demand. **Parking pricing structure matters** • Price elasticities are greater for long stay users than for short stay users

[6] Auckland Transport Parking Strategy (2015), https://at.govt.nz/media/1119147/Auckland-Transport-Parking-Strategy-May-2015.pdf

[7] Refer Appendix A for explanation of elasticities

[8] Exploring travel and parking impacts of the Melbourne CBD parking levy, Hamer, P; Currie, G; Young, W., pp. 2-3

Public parking	
	• Large discounts for long stay parkers (commuters) tend to encourage car commuting. • Pricing that discounts short stay use (eg first hour free), support shoppers and shorter business trips.
Where most effective	• Parking pricing is most effective when the person parking pays the fee directly. • Impacts are higher where there are other viable alternatives, suggesting that parking pricing is best included as part of wider package of travel demand management (TDM) initiatives, including increased provision of PT and rideshare options.
Limitations or unintended consequences	• Parking pricing may not address through-traffic congestion • Reductions in parking demand do not automatically translate into reduced travel demand and/or modal shift (eg people may park elsewhere). • Increases in parking pricing may: o Reduce use of parking facilities, potentially leading to over-supply and sunk investment unless an alternative productive use of the space can be found o Shift vehicle travel to other locations, resulting in **spillover** parking problems as people find nearby places to park instead.[9] • **Demand responsive priced parking** is generally designed to reduce *parking congestion* (ie circling for a car park), rather than broader network congestion.
Barriers to implementation	Pricing of areas that previously provided free-parking (eg on-street) can be unpopular with local businesses. Some jurisdictions address this by returning revenue to improvements in local amenity (lighting, street furniture, cleaning, etc). Research generally shows that pricing parking does not adversely affect visitor demand or use, rather turnover increases and revenue is generated.

3.2.1 International examples

Parking pricing is not new and most cities around the world deploy some kind of parking pricing. Most of it however is designed to address parking congestion, rather than broader network congestion and travel demand.

Many European cities[10] are deploying a range of innovative parking policies that seek to improve amenity values, through a reduction in car use, improvement in air pollution and better quality of urban life.

- **Paris**: Reduced on-street parking supply by 9% and the remaining stock is 95% paid parking. Along with other improvements, this has led to a 13% decrease in driving.

[9] Parking Management: Strategies, Evaluation and Planning. (12 September 2016). Victoria Transport Policy Institute. Litman, T. pp. 21-22.

[10] Parking Taxes: Evaluating Options and Impacts. (29 August 2013). Victoria Transport Policy Institute. Litman, T. p. 13.

- **Zurich** has invested significantly in new tram and bus-lines, while making parking more expensive and less convenient. Between 2000 and 2005 the mode share of PT went up 7% and the mode share of cars declined 6%.

In San Francisco, **SF*park*** is a large application of **demand responsive pricing**.[11] Trialled in 2011, fully adopted and expanded in 2017, the programme now captures 28,000 on-street parking meters and all relevant metered surface parking lots in San Francisco. The programme sees hourly meter prices go up or down. The rate adjustments are based on demand, and occur every three months. Changes are communicated in advance. The scheme is supported by an app that helps drivers find parking spaces in real-time, and also supports easy payment.

3.2.2 Auckland

The *Auckland Transport Parking Strategy* (2015) is a comprehensive strategy covering on-street parking across Auckland, AT-controlled off-street surface car parks, including Park and Ride facilities and AT controlled car park buildings. Wider parking policy and regulations for new developments are covered under the *Auckland Plan*, the *Unitary Plan* and related district plans (discussed under the section 'Reducing Parking Supply'). The strategy does not apply to private parking (residential or employer provided), or commercial parking.

In terms of the city centre, the total number of AT-controlled parking facilities is a minority of what is available. In 2014, there were 51,800 parking spaces in the city centre, including off-street/multi-story parking facilities, commercial parking associated with businesses, private residential parking and on-street parking. AT controls only 8,400 or 16% of the total, 3,500 of which are on-street and mostly short-stay, and 4,900 are in parking buildings, 73% of which are long stay.[12]

The limited coverage of the strategy vis-a-vis total parking supply in the city centre, may limit its ability to significantly support a congestion charging scheme. However, its objectives are complementary to congestion charging objectives and include:

- Prioritising the safe and efficient movement of people, services and goods on the road network
- Facilitating a transformational shift to public transport
- Supporting the economic development of the Auckland city centre, metropolitan and town centres
- Supporting place-making, amenity and good urban design outcomes[13]

[11] https://www.sfmta.com/getting-around/drive-park/demand-responsive-pricing/learn-more-about-demand-responsive-parking

[12] Auckland Transport Draft Parking Discussion Document (2014), p10 https://at.govt.nz/media/503106/ATParkingDiscussion.pdf, p. 15

[13] Auckland Transport Parking Strategy, pp.4-5.

3.2.3 Conclusions for Auckland

All of the pricing mechanisms discussed above appear to be available and pricing for reduced vehicle use/increased PT ridership is consistent with current objectives. The limitations relate to limited coverage as AT controls a minority of parking spaces available. In relation to congestion charging, parking pricing in busy centres is likely to be most effective for cordon rather than corridor schemes, and where there are good alternatives available to the parking 'destination'.

A limitation of such schemes as noted earlier is that they are usually designed to reduce parking congestion, rather than network congestion. They may perversely incentivise more travel to congested centres if finding a park becomes easier (albeit more expensive). These types of schemes would need to have pricing that deters peak travel if they are to have an appreciable impact on broader network congestion.

3.3 Parking taxes

Parking taxes can typically be applied in two ways:

- On a commercial parking space transactional basis - discussed below as commercial parking tax.
- On a per space basis (regardless of usage) – discussed below as a parking space levy.

3.3.1 Commercial parking tax[14]

Table 3 provides a brief summary of commercial parking taxes.

Table 3: Commercial parking tax summary

Commercial parking tax	
Operation This instrument is based on a tax on commercial parking transactions.	
	Impacts
Network	• Tends to reduce commercial parking and encourage free parking. • May reduce total supply where a significant proportion is provided by commercial operators. • Many commercial operators pass on a portion but not the total tax to users, undermining the full potential of network impacts. • Tends to reduce some vehicle trips (but may also shift travel from urban to suburban locations), increase free parking and increase vehicle use.
Where most effective	Generally not supported due to limitations and unintended consequences (see below).
Limitations or unintended consequences	**Competitive disadvantage**: Commercial parking taxes usually apply to downtowns and major urban centres where parking is priced, and is not usually applied in suburbs where parking is free or cheaper. Because of this, urban centres may become less

[14] Parking taxes as a second best congestion pricing mechanism. pp. 1-21.

	competitive relative to suburban locations. This can in turn encourage sprawl, contrary to other planning objectives. Commercial parking taxes can perversely increase the supply of parking and the value of 'free' or 'bundled' parking for developers, building owners and employers. For example: • A commercial parking tax increases the value of free parking spaces. Employers may capitalise on this by providing more unpriced parking that they can bundle into attractive employee packages with minimal cost involved if they already own the space. • A commercial parking tax increases the value of building space with parking included rather than rented separately. Developers are therefore likely to increase the amount of parking bundled in building rents.
Barriers to implementation	Implementation requires commercial parking operators to maintain reliable records of revenues and transactions. There are risks of under-reporting. Revenue control systems can address this, but they increase up-front costs.

3.3.1.1 International examples[15]

There is limited discussion of commercial taxes, and even less discussion of their impacts.

- **San Francisco** imposes 25% tax on all commercial off-street and non-residential parking transactions. Revenues are divided between the city's general fund, PT and senior citizens.
- **Pittsburgh** imposes a 40% tax on parking throughout the city, most of which is passed on to users.
- **Miami** imposes a 20% tax on all commercial, non-residential, off-street parking. While commercial parking operators indicated it had a negative impact on their operating incomes, no decline in business activity was found.
- **Los Angeles** imposes a 10.6% tax on fee-based parking, excluding on-street and residential parking. The tax is fully passed on to users. It had negligible impact on driving behaviour.

3.3.1.2 A natural experiment in Chicago[16]

While theoretical models suggest that parking taxes or fees may provide a second-best pricing mechanism, there is little empirical evidence to support this, and the models used have limitations. A 2015 paper evaluates the ability of parking taxes to reduce congestion and induce commuters to switch modes. The analysis is based on a 'natural experiment' in Chicago where, in 2012, existing parking taxes[17] were increased using a progressive schedule targeting the top-tier rates for daily, weekly and monthly

[15] 'Parking Taxes: Evaluation Options and Impacts', (29 August 2013), Litman, T., Victoria Transport Policy Institute

[16] Parking taxes as a second best congestion pricing mechanism. Inter-American Development Bank Working Paper Series No IDB-WP-614. Miller, S., Wilson, R.

[17] Note: *The parking taxes appear to apply to commercial parking that was already subject to a parking tax.*

parking. Only the most expensive parking was liable to the tax, and overall the increased tax amounted to an additional $2 per day per space.

The study found that a moderately large and progressive increase in tax can reduce vehicle trips in high income areas by 4-6%, with the most significant response seen on roads more heavily used by commuters. It also found a corresponding increase in the use of PT, a 3.1% reduction in vehicle trips and some evidence of increased car-pooling behaviour. It concludes that parking taxes can help to reduce congestion, but they are no more than half as effective as a more efficient congestion charge; moreover, they cannot say whether parking taxes are a long-run solution to congestion.[18]

3.3.1.3 Conclusions for Auckland

While commercial parking taxes are relatively easy to implement, the cost burden tends to be concentrated in a few areas (eg city centres, campuses and hospitals), and there is no evidence that they represent an effective mechanism to improve network performance. Limitations to introducing parking taxes are the legislative changes that would be required to make this an implementable option.

3.3.2 Parking Space Levy[19]

Table 4 provides a brief summary of parking space levies, which are applied on a per space basis regardless of usage.

Table 4: Parking space levy summary

Parking Space Levy (PSL)	
Operation PSLs are a tax on all private non-residential premises with parking facilities. It is similar to a property tax but applying specifically to parking spaces. It captures office building and retail store parking facilities. The levy can be a flat fee for each parking space or calculated according to the land area dedicated to parking. The levy may vary by location and may be paid by the owner or passed onto the user. PSLs require a parking space inventory, and residential parking spaces are usually exempt.[20]	
Impacts	
Network	Creating or increasing the annual cost of each parking space in busy locations, can help reduce parking demand, reduce vehicle use and reduce total parking supply, particularly if implemented with improvements to other travel modes. Parking supply reductions primarily affect infrequently used spaces, particularly if property operators are encouraged to reduce parking supply. Taxes that apply broadly to all spaces encourage reduced parking supply and more compact development.

[18] Parking taxes as a second best congestion pricing mechanism. pp. 23-24.

[19] Most material sourced from 'Parking Taxes: Evaluation Options and Impacts', pp.5-9; and 'Parking Management', p. 21

[20] It's Time: Phase 1 Project Update Full Report', Mobility Pricing Independent Commission (January 2018), Appendix C: Coarse-level evaluation: Mobility pricing policy instruments for motor vehicles, p.112.

Parking Space Levy (PSL)	
Where most effective	PSLs are most effective where they are: • Structured so that users pay them directly – because people are more responsive to costs they pay personally and directly • Applied as broadly as possible – by area and by type, across motorists and property owners • Part of a wider programme to encourage efficient use of parking, allow supply to be reduced and anticipate spillover issues • Part of wider TDM and smart growth initiatives that offer viable alternatives • Implemented in cooperation with property tax assessment agencies and the business community (to reduce implementation costs) • Used to fund local improvements • Parity between public parking pricing and parking taxes.
Limitations or unintended consequences	PSLs may discourage some driving, but not necessarily discourage driving that causes congestion (ie peak travel). A tax or fee applying to a relatively small geographic area may shift some parking facilities and activities to lower-taxed areas. The Canadian 'It's Time' project evaluated PSLs as having a low potential for managing congestion in the short term because: • PSLs do not address through-traffic • They do not differentiate by time (ie peak vs off-peak), and so cannot be targeted directly at congestion • The competitive advantage of providing free parking may incentivise owners to absorb rather than pass on the cost of the levy to users, reducing the impact on overall travel demand. The evaluation noted that PSLs may have more influence over time, reducing supply as owners are incentivised to reduce parking spaces (or repurpose them) in order to save costs. It notes that a region-wide PSL could exert a considerable influence over time, depending on the scale of the charge and supporting planning controls.[21]
Barriers to implementation	PSLs are controversial and unlikely to be implemented without challenge.

3.3.2.1 International Examples - PSLs

Nottingham: Introduced in 2012[22]

In 2012, Nottingham imposed a tax on employers providing 11 or more parking places. It was the UK's first PSL, and took 12 years to implement, but it is considered that new schemes could be introduced within three years. The levy was £379 per parking space per year. Some exemptions applied. Employers

[21] 'It's Time', p.112

[22] 'Workplace Parking Levy, Nottingham, UK', *International Case Studies for Scotland's Climate Plan*, https://www.wwf.org.uk/sites/default/files/2016-12/nottingham%20case%20study%20-%20Workplace%20parking%20levy.pdf

were able to decide for themselves whether to pass the charge onto employees in part or in full. 42% of the city's workplace parking was liable for the levy. All revenue was invested in improving PT. It was implemented as an alternative to a road user charge and was projected to reduce congestion.[23]

2016 research into the impacts of the PSL found:

- 33% reduction in carbon emissions, 13% of which was estimated to be as a result of modal shift to PT and active modes.
- £25M raised for PT in the first three years, supporting investment in 45 new electric buses, and a range of other public transport improvements. Improved PT in turn is understood to be a major factor in attracting inward investment and employment to the city.
- The scheme generates around £9M pa and costs 5% of the revenue amount, to run.
- Research showed the levy significantly contributed to a 33% fall in car emissions and a modal shift to PT, with a 40% increase in ridership.

Melbourne: Introduced 2006[24]

In 2006, the Victorian Government introduced a levy on public and private parking spaces within the Melbourne CBD and adjacent inner city areas. It was introduced to:

- Reduce traffic congestion by encouraging commuters to move to PT for travel to the city
- Create more parking options for shoppers and visitors.

It generates about $40M pa, some of which is returned to transport improvements.

Overall the scheme had relatively small impacts. This is thought to be because of the limited number of drivers required to pay the levy personally – 78% of trips terminate in a parking space that is not directly paid for by the driver or passengers. Other studies showed more modest impacts, but factors other than the levy are likely to have reduced vehicle usage.

Perth: Introduced in 1999[25]

In Perth, parking suppliers within the CBD and surrounding area must pay a Parking Licence Fee which applies different rates for short-stay and long-stay spaces. Providers only pay for the parking that is actually used, and have the flexibility to shift a space from 'in use' to 'out of use'. Businesses with five parking spaces or fewer, are exempt.

[23] 'Parking Taxes', p. 9

[24] 'Exploring travel and parking impacts of the Melbourne CBD Parking Levy', Paul Hamer, Graham Currie, William Yound, pp. 1-13

[25] 'Parking Taxes', pp. 5-6.

The fee reduced some downtown parking supply, much of which was near the edge of the levy area and not in areas of high parking demand. Some businesses de-commissioned spaces to meet the five spaces exemption, and some long-stay parking was converted to short-stay, increasing availability and turnover.

Importantly the Parking Licence Fee was introduced as part of a wider Perth Parking Policy that included:

- Parking maximums for new non-residential development in the city
- Establishment of three types of parking zone to control public parking: pedestrian priority zone (no parking permitted); a short stay zone (long stay parking not permitted); and a general parking zone, on the perimeter of the city.

By 2010, there had been a 10% reduction of parking within the city; mode share of journey to work in central Perth shifted from car (down 17%), to PT (up 27%); car travel on city streets and roads approaching the city decreased; and these positive outcomes did not come at the expense of economic activity or vitality.[26]

3.3.2.2 Auckland - PSLs

Auckland currently does not impose parking space levies on private, commercial or other priced or unpriced parking. The Auckland Road Pricing Evaluation Study (ARPES) in 2006, considered a PSL as a stand-alone congestion reduction scheme. The scheme would charge for parking on public and private property (eg parking buildings or businesses) within the central Auckland, Newmarket, Manukau, Henderson and Takapuna centres. It concluded that relative to other schemes, much higher prices would be necessary to generate meaningful congestion impacts; and that it would be necessary to apply the levy to private parking, public parking and all street parking. ARPES concluded that the levy would be less successful at reducing congestion than other road pricing schemes because parking charges would not capture through traffic, and the parking zones themselves were small. [27] PSLs were not evaluated as a complementary initiative at the time.

3.3.2.3 Conclusions - PSLs

PSLs are challenging to implement, controversial and much depends on the extent to which employers absorb costs rather than pass them on to consumers.[28] They may encourage property owners to reduce parking supply and manage their parking more efficiently, and as a result, PSLs can support compact urban form, increased access, multi-modal land use patterns and they can reduce sprawl. In order to be effective, consumers need to pay the costs directly, however there is limited evidence that they are an effective mechanism to support improved network performance.

---

[26] 'Extracting maximum benefit from parking policy – 10 years experience in Perth, Australia', Emmerson Richardson, Sinclair Knight Merz, *Association for European Transport and contributors* (2010), pp. 1-17.

[27] 'Tackling Congestion in Auckland', Auckland Road Pricing Evaluation Study, March 2006, Summary Document, pp. 5-7. https://www.transport.govt.nz/assets/Import/Documents/arpes-summary-document.pdf

[28] Parking measures and policies research review', Palmer, D., Ferris, C., Department for Transport, Transport Research Laboratory (2010), p. 65; 'Parking Taxes',

3.4 Reduce parking supply[29]

Many of the initiatives discussed above may reduce parking supply indirectly. Other initiatives can reduce parking supply directly as summarised in Table 5.

Table 5: Reducing parking supply summary

Reduce parking supply	
Operation Initiatives to reduce parking supply are generally planning or regulatory instruments. Accordingly, they can take time to have an impact. Initiatives to reduce parking supply include: • Reduce minimum parking requirements for planning and development policies, particularly for locations with good transport access and choices • Use in-lieu fees to fund shared parking instead of each building having its own off-street parking • Limit the maximum amount of parking that can be built – by individual area, or by a cap on total parking in an area • Restrict certain types of parking facilities, such as temporary parking lots	
Impacts	
Network	Reducing parking supply tends to increase parking prices and support strategic transport and land use objectives, particularly if implemented as part of a comprehensive TDM and smart growth program: • Smart growth – compact, multi-modal development can potentially reduce parking demand by 10-30%; and can reduce traffic • Increased provision for walking and cycling can reduce parking demand by 5-15%; and can reduce traffic • Mobility management/TDM in the context of the above can support modal shift, change travel times and reduce parking demand by 10-30%; and can reduce traffic.[30]
Where most effective	Most effective when implemented as part of a wider programme of accessibility improvements, behaviour change and TDM.
Limitations or unintended consequences	May increase parking congestion and spillover and lead to competitive disadvantage issues where applied unevenly.
Barriers to implementation	May require new planning, financing and admin systems. Consumer/residential parking entitlement mind-set for new developments may need to change.

[29] Material sourced from 'Parking Solutions', p. 18

[30] 'Parking Management', p. 23

3.4.1 International examples: Reducing parking supply

Many jurisdictions are actively reducing parking supply:[31]

- In Amsterdam, Paris, Zurich and Strasbourg parking supply is connected to PT availability. Limits are imposed on how much parking is allowed in new developments based on how far it is to walk to a PT stop.
- Parking reform is more popular than congestion charging: Parking caps apply in Zurich and Hamburg's business districts to freeze supply where access by PT is easiest.

3.4.2 Auckland

Auckland supports Initiatives to reduce parking supply in specified zones through the imposition of parking maximums and removal of parking minimums. The provisions are set out in section E27 of the Auckland Unitary Plan. The parking provisions support growth and intensification, reduce development costs, improve housing affordability, support more efficient and attractive land use and support the use of public transport.[32]

3.5 Conclusions: Parking policy

Parking policies are likely to discourage some trips, but not necessarily those that contribute the most to congestion. In particular, parking policies do not address through-traffic and they struggle to differentiate by time (ie peak vs off-peak), and so cannot directly target congestion.

Nevertheless they may represent a complementary measure to support a congestion pricing scheme.

The impact of parking policies depends on a wide range of factors including geography, availability of alternatives and pricing structure. In general, the following apply:[33]

- Parking policies will have greater demand reduction impacts if implemented alongside improvements in rideshare and PT services and other TDM approaches.
- Some strategies are complementary eg shared parking becomes more effective if implemented with suitable regulations, pricing and walkability improvements.
- Price elasticities tend to be greater for long-stay users such as commuters than for short stay users such as shoppers.
- Impacts generally increase over time as programs mature and are most effective when the costs are borne by end consumer (ie the users of the parking spaces).

[31] 'Parking Taxes', p. 12

[32] Auckland Unitary Plan, E27 Transport, http://unitaryplan.aucklandcouncil.govt.nz/Images/Auckland%20Unitary%20Plan%20Operative/Chapter%20E%20Auckland-wide/4.%20Infrastructure/E27%20Transport.pdf

[33] 'Parking Management', p. 24

4 Option 22: Car or ridesharing

4.1 Definitions and scope

4.1.1 Definitions

Car and ridesharing are sub-categories of 'shared mobility'. They encourage shared mobility on an 'opt-in' basis, and have the potential to reduce single occupancy vehicle trips and make better use of vehicle capacity. Generally accepted definitions are set out in Table 6 below, with each discussed in more detail in this section.

Table 6: Shared mobility

Term	Definition[34]
Ridesharing	Initiatives in which a vehicle carries additional passengers when making a trip, with minimal additional travel required. They can be informal and local or they can be more organised, supported by ride-matching services or encouraged and incentivised by workplaces. Ridesharing includes carpooling and vanpooling: • **Carpooling** generally involves the use of participants' own vehicles • **Vanpooling** often uses rented vans (often supplied by employers, non-profits or government agencies). Ridesharing does not include trips where a driver makes a special trip to carry a passenger (eg taxi or chauffeur), or commercial ride-hailing services such as Uber and Lyft.
Car sharing	Automobile rental services that substitute for private vehicle ownership.
Mobility as a service (MaaS)	Technology enabled mobility – shared or otherwise. Using smartphone apps, it enables people to search, book and pay for a range of different journey options to suit their needs.

[34] Definitions from Victoria Policy Institute Travel Demand Management Encyclopedia: http://www.vtpi.org/tdm/index.php

4.2 Ridesharing[35]

Table 7 presents a summary of ridesharing as a means of shared mobility.

Table 7: Ridesharing summary

Ridesharing	
Operation • Ridesharing is one of the most common and cost-effective alternative travel options, particularly in areas not well served by public transport. Many commuters rideshare part of the time. • Ridesharing operates in a number of ways. At the informal end of the spectrum, casual carpooling may be supported by known pick up stops. At the organised end of the spectrum, motorists and passengers may be pre-registered to increase security, and standard cost-sharing or reimbursement rates may be established. More organised rideshare programmes can be implemented by employers, transport entities or education entities as part of commuter trip management approaches. • Ridesharing can include regularly scheduled trips, or, when enabled by a ride-matching service, can include matching drivers and passengers for individual trips. • Vanpooling may require more organisational structure to address vehicle ownership, cost recovery and liabilities.	
Impacts	
Network	• Can reduce peak-period travel trips and increase commuter choices, reduce congestion, reduce parking costs, improve safety and emissions. Can improve travel-time savings, particularly if (High Occupancy Vehicle) HOV lanes can be used. • Vanpooling can be resource efficient and a cost effective motorised mode. Vanpooling tends to be most common for longer commutes.
Where most effective	Rideshare schemes can operate anywhere but may be particularly effective in serving relatively dispersed suburban locations that are not well served by public transport. Rideshare schemes may also be useful for sites that attract many people, eg larger employers and universities/campuses. Rideshare schemes will tend to be more effective when forming part of a wider set of travel demand initiatives.
Limitations or unintended consequences	• While financial costs may be comparatively low, participants may face additional travel time costs (to pick up passengers), schedule constraints to match available commute times, loss of privacy and reduced flexibility, eg to combine commuter trips with other errands such as shopping. • Widespread use of ridesharing may encourage urban sprawl by making longer distance commutes more affordable.

[35] Much of this material is sourced from Ridesharing: Carpooling and vanpooling, TDM Encyclopedia, Victoria Transport Policy Institute, Updated 23 April 2016: http://www.vtpi.org/tdm/tdm34.htm

Ridesharing	
	• Ridesharing schemes may also divert people from choosing other travel alternatives such as public transport, walking or cycling. • Rideshare programs generally do not shift peak travel to off-peak, or reduce the need to travel.
Barriers to implementation	Ridesharing tends to require economies of scale and coverage in order to realise network and other benefits. While costs are generally low, funding may be required to support either ride-matching services, information and marketing, or a range of supporting measures forming part of a wider travel demand management approach.

4.2.1 International examples

The VTPI TDM Encyclopedia section on ridesharing contains many, mostly North American, examples. Below is one particularly useful example showing a range of offerings enabled by a transport agency in Seattle.

Seattle King County Metro Transit Rideshare Options[36]

Seattle's King County Transport Department provides a range of rideshare options and ride-matching services, including:

- **Vanpool:** Utilising branded vans and registered users paying monthly.
- **Vanshare**: First and last 'mile' connections to transit or place of education/employment/home.
- **TripPool** (Pilot): Drivers use branded vans to connect commuters with park and ride facilities – supported by a ride-matching app.
- **SchoolPool**: A program for parents and schools to coordinate ridesharing and active modes.
- **CarPool Rideshare**: Supported by a rideshare app.
- **Community Van** (Pilot): Providing services to residents not well served by bus or other transit options.

4.2.2 Auckland

Auckland Transport has trialled and is preparing to implement *AT Metro Local* – a rideshare service for Devonport. A smartphone app enables an on-demand rideshare service to pick people up and drop them off at the Devonport Ferry Terminal. The scheme supports three branded electric cars and three electric vans, one of which is wheelchair-accessible. It will operates within three km of the ferry terminal and mainly during the morning and afternoon peak.[37]

[36] https://kingcounty.gov/depts/transportation/metro/travel-options/rideshare.aspx

[37] https://at.govt.nz/about-us/news-events/new-electric-rideshare-service-coming-to-devonport/ ; https://www.nzherald.co.nz/index.cfm?objectid=12128770&ref=twitter

Auckland Transport[38] also hosts the NZ-wide **Smart Travel** application and an online Smart Travel tool that aims to support carpooling. It helps to connect drivers and passengers with similar routes and schedules. It notes that carpooling enables access to the HOV lanes (T2/T3 lanes). It also supports connections for shared walking and cycling. Carpooling is further supported by the availability of priority parking until 9 am at a number of AT-owned parking facilities at or near transit stations, and there is a discount on car park lease options at Downtown and Victoria Park parking facilities.

4.3 Car sharing[39]

Table 8 presents a summary of car sharing as a means of shared mobility.

Table 8: Car sharing summary

Car Sharing	
Operation Refers to automobile rental services that substitute for private vehicle ownership. Vehicles are generally located in residential areas, priced by the hour and have convenient pick-up and drop-off procedures. There are three types of car sharing: • For profit, often, but not exclusively, oriented to local residential use • Not for profit cooperatives that rent vehicles to members • Peer to peer schemes where owners list their vehicles for rent for short periods of time, usually enabled by the internet or mobile applications. Car sharing is expanding in the US and is becoming a lot more common in places like Germany and Great Britain. Car sharing offers medium convenience (compared to high for private vehicle ownership), low fixed costs (high for private vehicles) and high variable costs (low for private vehicles).	
Impacts	
Network	• Those who would otherwise own a private vehicle tend to reduce their travel between 40-80% • Those who would otherwise not own a private vehicle tend to increase their vehicle use.
Where most effective	Carsharing services are usually located in urban areas. They are most effective in higher density, lower and middle-income residential areas where there are good alternatives to driving. They may be particularly appropriate for 'location efficient development' and where residences have limited or no provision for car parking.
Limitations or unintended consequences	• Is not necessarily responsive to peak travel times if needing to travel at that time • Does not necessarily include ridesharing

[38] Auckland Transport Parking Strategy (2015); https://at.govt.nz/driving-parking/ways-to-get-around-auckland/carpooling/

[39] Much of this material is taken from 'Carsharing: Vehicle rental services that substitute for private vehicle ownership', TDM Encyclopedia. Victoria Transport Policy Institute, Updated 23 April 2018: http://www.vtpi.org/tdm/tdm7.htm

Car Sharing	
	• Is unlikely to be of use to those who regularly commute to and from work unless a scheme captures both origins and destinations.
Barriers to implementation	The most significant barrier to implementation is the need to establish and maintain a critical mass of users. Most schemes require supporting mechanisms (eg education, marketing and possibly seed funding), at least to get going and build membership.

4.3.1 International examples

- For profit private vehicles rentals: Zipcar and Car2Go
- Not for profit cooperatives: Modo and City Car Share
- Peer-to-peer services: Relay Rides and WhipCar

4.3.2 Auckland

There are a small number of car share providers that offer services in Auckland (for example Cityhop (a commercial car share operation) and Yourdrive (a peer-to-peer car share service)). The car share market, facilitated by technology, is expected to steadily increase but it is not expected to have measurable impact on forecast traffic volumes.

As noted by the Ministry of Transport, vehicle-sharing alone would be unlikely to reduce the level of traffic, since the vehicle kilometres travelled would tend to shift from private vehicles to vehicle-share vehicles and vehicle-sharing with self-driving vehicles may actually increase traffic, since there will be additional empty vehicle trips to pick up passengers as well as additional trips by people who currently do not drive'.[40]

4.4 Mobility as a Service (MaaS)

MaaS describes a shift away from personally-owned modes of transportation towards mobility solutions that are consumed as a service. It has the potential to make accessing any kind of transport choice, shared or otherwise, easier. As with shared mobility, its network impacts are variable depending on what choices people make. It has the potential to both increase and decrease motor vehicle travel. If MaaS is to support congestion reduction, then incentives built into a wider travel demand management approach would need to be reflected in supporting MaaS applications. MaaS on its own is not a congestion-reduction tool.

[40] Transport Outlook: Future State, Ministry of Transport (November 2017), p.24. https://www.transport.govt.nz/assets/Uploads/Research/Documents/GOTO-Future-State-A4.pdf

In Auckland**, Ridemate** is a MaaS app designed to help people get to and from the airport across a range of modes, although it can be used more widely to get around the city; and there are a range of parking apps to help people find, book and pay for parking more easily.

4.5 Conclusions: Car or ridesharing

Ridesharing is likely to have some potential for supporting congestion pricing since it has the effect of increasing vehicle occupancy for some peak period trips. This may form a useful complementary measure alongside parking policies and other travel demand mechanisms that incentivise a shift from single occupancy vehicle use. It is likely that further organised support (eg marketing, administration, etc) would be required to attract the relatively large numbers of people required for ridesharing to have significant network performance impacts.

Car sharing may become a more viable and widespread option when land use supports higher density urban areas and new developments are planned to reduce reliance on private vehicles.

Care is required to ensure initiatives complement rather than undermine or substitute for PT ridership and active modes.

5 Option 26: Free public transport

5.1 Definitions and scope

5.1.1 Definitions

The concept of 'free public transport' is a misnomer, as obviously the provision of PT infrastructure and services requires considerable and on-going expenditure. When proponents discuss 'free public transport' they actually means 'fare-free PT'. To aid the discussion the key terms are defined as follows:

- **Fare-Free Public Transport** (FFPT) means no direct user payment or 'fare-free' travel on PT, ie fully subsidised. FFPT includes free PT for limited periods of time (eg introductory services to build ridership), limited users (eg students, elderly) and/or of a limited geographical scale (eg feeder services).
- **Variable PT pricing** means fares that vary by time (eg peak vs off-peak), by user (eg children, students), or by mode (bus vs train fares).
- **PT Farebox** refers to the fares from ticket sales and passes.
- **Farebox recovery** is a measure of cost recovery. It refers to how much of the cost of providing public transport services is recovered from public transport customers through the fares charged.
- **Farebox recovery rate or ratio** refers to the actual cost of public transport services and the contribution to these costs from fare revenue. It is typically expressed as a percentage.

5.1.2 Scope

This section focuses primarily on fare-free PT schemes and their potential impacts on ridership, and in relation to a congestion pricing scheme.

5.2 Public transport subsidies

The provision of PT is often viewed as a public good (like libraries and schools) that should be free, because it supports universal access, participation and social inclusion, helps address congestion, supports reducing environmental impacts, and assists in removing barriers to access education and employment. This view also tends to underpin a policy belief that in order for road pricing to be successful and acceptable, more and better public transport should be available to serve as a viable alternative; ***and*** PT fares should be low or even free as a further incentive to encourage modal shift from cars to public transport.[41]

Internationally most provision of public transport is subsidised in some form – there are few fully commercial public transport systems. A recent review of European PT subsidies found that virtually all

[41] 'Reforming private and public transport pricing', (Proost, S) International Transport Forum Discussion Paper No. 2017-XX, (Prepared for the ITF Roundtable on Social Impacts of Time and Space-based Road Pricing), p.7.

urban public transport systems are subsidised and subsidies vary from 15% (Hanover) to over 60% (Den Haag).[42]

Farebox policies apportion the costs of providing PT between providers and users. Farebox recovery rates vary in their calculation, what level they are set at and what objectives they serve. The level of farebox recovery has implications for the level of subsidy required and how funding is split between PT users (as fares), and the subsidy. In New Zealand the cost of the subsidy is shared between local government (through regional rates) and the NZ Transport Agency (through the National Land Transport Fund).

The NZ Transport Agency has a national farebox recovery policy with the objective to 'provide an equitable sharing of costs' between public transport customers and funding from local government (via rates) and the National Land Transport Fund. The policy set a target national farebox recovery ratio of at least 50%, to be achieved by the end of the 2015-18 National Land Transport Programme. Local government and the NZ Transport Agency share the remaining 50% subsidy more or less equally. Regional Councils set their own farebox recovery targets within Regional Public Transport Plans, to achieve the national target, while also considering regional concerns such as equitable sharing of costs and benefits and value for money.

5.3 PT price responses

5.3.1 PT pricing elasticities[43]

- Fare increases and reductions do not have equal impacts: fare increases tend to cause a greater reduction in ridership than the same size fair reduction will increase ridership. Demand is therefore slightly more sensitive to rising than to falling fares.
- PT service improvements (speed, coverage, frequency, comfort) have a greater impact on demand/ridership than fare reductions.
- Elasticities are higher for higher fares.
- Elasticities are higher for those on higher incomes and lower for those on lower incomes or who are PT dependent (eg the disabled, the young and the old).
- Elasticities are higher for off-peak, discretionary and/or non-commuting trips; and elasticities are lower for high value, non-discretionary trips (most often in the peak periods).
- Elasticities decline as people get older.
- Rail and bus elasticities may differ. In many major cities, rail transit fare elasticities tend to be relatively low due to users' relatively high incomes. Fare elasticities tend to be lower on routes that serve more people who are transit dependent and higher on routes where travellers have viable alternatives such as suburban rail systems.

[42] 'The prospects of fare-free public transport: evidence from Tallinn', Cats, Susilo and Reimal, *Transportation* (2017) 44, p.1084.

[43] Sourced from: 'Understanding Transport Demands and Elasticities', Litman, T, Victoria Transport Policy Institute (27 February 2017), pp. 51-54; 'Reforming private and public transport pricing', 'The prospects of fare-free public transport: evidence from Tallinn', pp. 1085-1086

5.3.2 Cross-elasticities[44]

Overall, studies show that modal shift from private vehicles to public transport is enabled more by increasing the costs of using a vehicle (eg through a congestion charge or parking pricing) rather than reducing PT fares.

- The diversion co-efficient of those shifting from car to PT is generally low – 0.15-0.35. That is, for every 100 new PT passengers, only 15-35 are former car users.
- Several studies indicate that parking pricing (and probably tolls) tend to have a greater impact on PT ridership than other vehicle costs such as fuel costs, typically by a factor of 1.5 to 2 because they are paid directly in a per-trip basis.
- In a survey of willingness to shift to PT, motorists were more sensitive to parking fees, travel time and crowding – indicating that transit service improvements can increase discretionary ridership.

Combining strategies (eg reducing PT fares and raising parking pricing) may have a multiplier rather than an additive effect. A stated preference survey for commutes to the University of Laval, Quebec, found that reducing PT fares to zero and increasing parking costs by 60% would lead to a 42% reduction in car trips, which is more than the sum of the effects of each measure taken separately (respectively 18% and 10% reduction in car trips).[45]

5.4 International review [46]

There are only a few FFPT schemes in operation. Most schemes have been limited in terms of time, users or scale (services and/or locations). With one exception, universal FFPT has only been tried in small cities (up to 100,000 population), generally with high PT subsidy and low PT mode share. The exception is the city of Tallin in Estonia with a population >430,000. The universal schemes can show good short-term results, but on closer inspection, the modal shift is often modest, particularly over the longer term. More interestingly, increases in FFPT uptake have generally not come predominantly from those substituting PT for car use, but have come from those substituting PT for walking or cycling, or completely new trips.[47]

The following tables provide a summary of international examples and impacts of limited and universal FFPT schemes, noting that not all the impacts have been measured with consistency across jurisdictions.

[44] Ibid

[45] 'Understanding Transport Demands and Elasticities', pp.56-57.

[46] This discussion is sourced from two documents: 'The prospects of fare-free public transport: evidence from Tallinn', pp 1083-1104; and *Implementation and Outcomes of Fare-Free Transit Systems*, Volinksi, J (National Academies Press), Summary, Literature Review and Conclusions.

[47] 'The prospects of fare-free public transport: evidence from Tallinn', p.1091

Table 9: Limited period FFPT schemes

Location	Impacts
Stavanger, Norway (2011): Limited services + limited period	No evidence of reduced car usage Induced demand caused by modal shift from walking and new 'fun riders'
Gottenburg, Sweden (2008 and 2013)	25% short term success rate, but the long term impact was not measured (ie duration of modal shift beyond the limited period)
Copenhagen, Denmark (2009): Free month travel card	PT commuters increase from 5-10%, but six months later this had reduced to 7%.
Asheville, North Carolina (2006): Three month trial	Ridership increased 59% during implementation, with capacity a major problem. An increase in ridership of 9% was retained after the trial ended.

Table 10: Limited scale FFPT schemes

Location	Impacts
US: Review of 39 agencies – all deploying small fleets (< 100), in university, resort or rural communities. Largest population with free PT is 175,000	Agencies reported increases in ridership of 20-60%, generally from a low base. Only 5-30% of increased ridership were from people substituting PT for car travel. Most new trips were made by people who would have otherwise walked or cycled. A disproportionate amount of new trips were made by existing riders, as well as students and seniors who are more sensitive to price. Reports suggest that choice riders are more likely to use the service.
Den Haag, Netherlands (2006): Two existing bus lines and one new route were made free for everyone on workdays for 1 year. The objective was to reduce congestion on a parallel freeway.	Ridership tripled with 16% new trips. A large share of substitution came from cars (45%) and PT alternatives (30%) due to the relatively long distances involved. The pilot was not big enough to meet its congestion reduction objective, but it led to better utilisation of service capacity.
Chengdu, China (2007): FFPT for seniors (70+) when transferring within 2 hours in the early morning (5-7am) and for trips shorter than 1km. Supported by increased PT service frequency.	PT mode share increased by 1.87%

Table 11: Limited user FFPT schemes

Location	Impacts
Netherlands: Higher education students travel for free across the country and can choose a weekday or weekend pass.	PT share increased from 11-21% of students' trips. Most users change from cycling (52%), followed by former car users (34%). Average trip length increased by 15%. It led to increased crowding, especially on weekends and the national railway carrier increased service frequency. The Netherlands threatened to scrap the scheme due to increased costs and congestion, but has recently approved its continuation.
Brussels: For students enrolled in Flemish universities.	26% of new PT trips generated, with 60% coming from car users and 15% from other PT alternatives, 19% from walking and 5% from cycling. The average reduction in car vkt per student per week was 82km. The scheme has been abolished, but a discounted fee is offered.
England: A third of all bus trips in England are free due to concessions and 80% are age-based.	PT usage for over 60s rose from 30% to 40% and the proportion of over 60s that never travelled by bus fell from 46% to 32%. It is estimated that approximately 20% of the increase has come from those substituting bus for car usage. Bus companies are compensated for lost revenue and the scheme costs 1 billion pounds per annum, covered by the taxpayer.
France: Many cities enjoy free PT zones.	Have been largely successful in boosting ridership without bankrupting the system – but most places that have attempted this have been relatively small (the largest being the city of Niort, pop 120,000).

Table 12: Universal FFPT schemes

Location	Impacts
Hasselt, Belgium: Introduced in 1996, alongside substantial additions to the relatively small network supply.	Ridership increased tenfold and 37% of new trips were attributed to new users, and more than half of these substituted PT for walking or cycling. Many existing users simply travelled more. After 15 years however, the bus mode share was only 5%. Due to rapid increases in operational costs, the scheme became unviable and was withdrawn. Fees were re-introduced in January 2014, with exemptions for special user groups.
Templin, Germany: Introduced in 1997.	Ridership increased 1200% within three years, but from a very low base. The vast majority of users were children and youth, and the majority of substitution effects were due to a shift from 'soft modes': 30-40% from cycling, 35-50% from walking; only 10-20% was from substitution of car trips. The scheme also led to increasing problems with vandalism.
Aubagne, France: Free for all users since 2009 (100,000 population), and with very low fare revenue (9%).	Ridership doubled and more resources were allocated to increase capacity.

Location	Impacts
Kiruna, Avesta and Kristinehamm (small towns of about 20,000 in **Sweden**); and **Orebro** (population approx. 100,000).	Abolished in Kristinehamm and Orebro after finding that ridership increases were not sustained. Interviews in Avesta indicate that 80% of increased ridership was attributed to existing PT users making more trips.
Paris is launching research into a plan to make the city's PT entirely free. Research due to be completed by the end of 2018.	Potential cost of $6B euros, but benefits include cleaner air, reduced healthcare costs, reduced emissions, improved liveability (attracting inward investment). There is a possibility that congestion fees would help to raise the funds needed to support the scheme.[48]
Tallinn, Estonia[49] (2013): Population approx. 430,000. The scheme had several objectives, including mode shift from car to PT, improving mobility for the unemployed and low income residents and stimulating residents to register as inhabitants to increase the municipal income tax. Farebox losses were covered by this increased tax.	**Context** • In 2012, PT modeshare for all trips was about 40%; pedestrian mode share was 30%. • Farebox recovery rate was low, at about 33% • Smart card users with a 40% discount, and concessionary fares captured a large proportion of users FFPT can therefore be seen as the final stage in making PT in Tallinn more attractive and accessible. **Immediate effects**: • Increased passenger demand within 3 months, with 1.2% attributed to FFPT. • Average passenger trip length decreased by 10%, suggesting that FFPT led to modal shift where PT substitutes for walking or cycling. Individual behaviour change unknown. • Overall 14% increase in PT trips one year on: 10% of this derived from decreased car trips and 40% decrease in walking trips. • The effects are not universal across demographic variables. PT share increased dramatically among age groups 15-19 and 60-74, very low income earners and people out of education or employment. These groups are likely to be the most sensitive to price and it appears that in terms of equity, their mobility was increased. Conversely, share of PT trips by very high income earners decreased substantially, possibly due to image and crowding issues. **Conclusions**: While the modal shift objective was achieved (car user mode share dropped by 5%, PT mode share increased by 14% one year on), this modal shift was accompanied by an undesired shift from walking to PT. In

[48] 'Paris gets serious about free transit', Feargus O'Sullivan, May 16, 2018, Citylab.

[49] 'The prospects of fare-free public transport: evidence from Tallinn', Cat, O., Susilo, Y.O., Reimal T., (April 2016), *Transportation* (2017) 44:1083-1104.

Location	Impacts
	addition, while car mode share declined, average distances travelled by car increased, resulting in a 31% increase in total car vkt (p. 1101). A CityLab article notes that 'it's working' and has high levels of public support, but It relies on a local funding quirk to reimburse for lost revenue (national income tax transfer to the municipality when people register).[50]

5.5 Reduced PT fares

A policy of lowering PT fares is sometimes discussed alongside FFPT schemes. In this sense low PT pricing is considered by some an example of 'second best pricing', because when car usage is priced low, it might make sense to lower the price of a significant substitute (PT). However, in the context of thinking about congestion pricing, the need for low PT pricing may be substantially reduced because road pricing 'corrects' the price of car usage, and so it may no longer make sense to set PT prices at well below the marginal cost.

This position is put forward by Proost (2017)[51] who undertakes a theoretical examination of optimal PT pricing both with and without road pricing. Using two theoretical scenarios (a congested corridor in Stockholm; and a whole-of-Paris scheme), the modelling demonstrates:

- In the absence of road pricing, pricing PT below its marginal cost is a sensible second-best strategy. But when road pricing is introduced, it is optimal to also charge the full marginal social cost of PT.
- While PT pricing reform on its own does not reduce the need for a subsidy, it generates a clear welfare gain by reducing peak ridership that does not cover its social costs and by encouraging off-peak ridership that is almost costless from a societal perspective.
- While the best performing scheme is fully optimised tolls, the partial optimisation of PT pricing or frequency in the presence of road tolls has welfare benefits over and above the reference scenario.

It is important to caveat Proost's findings:

- He is using theoretical economic models – in practice significant price rises would likely face significant public and political opposition and would need to be carefully tested and communicated.
- The PT mode share assumption is very high at 80%, so may not be transferable to lower PT share scenarios, such as is the case in Auckland.

[50] 'Paris gets serious about free transit'

[51] 'Reforming private and public urban transport', p.7

5.6 Conclusions: Free PT

As a congestion reduction tool the fare-free PT concept does not appear sensible. In particular:

- There have been few universal FFPT schemes, and most pilot schemes apply to towns or cities of a modest scale.
- Research into price responses indicates that people are more sensitive to other direct pricing mechanisms and PT service improvements than decreasing PT fares.
- While FFPT may increase PT ridership, studies show that a significant proportion of new PT riders are not a direct transfer from people using a car, rather they are the result of an unintended shift from walking or cycling, or they are completely new trips.
- Short term increases in ridership are generally not sustained for the longer term.
- Where a scheme results in significant increased demand, this can require a costly response in terms of increasing services and/or capacity.
- Paying for the schemes can be costly, with the scale and durability of benefits uncertain.
- Those who benefit most tend to be students or pensioners and those on lower incomes – mobility increases for these groups.

By contrast, variable PT pricing for the peak and off-peak, and potentially more finely-tuned and differential peak pricing is supported by the literature because it would help spread demand across the peak and inter-peak, which is useful if there are capacity issues at peak.

Overall the work supports the need to carefully interrogate assertions or beliefs around the need to support congestion pricing with significant PT capacity increases and/or significant reductions in PT fares, as was evidenced in Stockholm when congestion charging was introduced. While they may 'feel' right, in practice they may not realise all the benefits anticipated. Much will depend on the nature of any particular pricing scheme and the PT mode share for the areas most impacted.

6 Option 24: Reverse tolling

Reverse tolling incentivises people to change the time or way in which they travel by rewarding them for changing their behaviour.

Internationally, no reverse tolling schemes have been deployed at scale, but a limited scheme was introduced in the **Netherlands** in 2013-2014.[52] The *SLIM uit de spits* project was aimed at reducing traffic in the Arnhem urban area during their rush hour. For the duration of the project, 20,000 commuters were challenged to avoid driving their car during peak hours. For each rush hour avoided, participants were rewarded points, which served as currency in an online shop that offered a wide variety of products. Drivers were found to have avoided rush hour by driving at different times, taking a bicycle or making use of public transport.

When combined with a variety of supply and ITS measures such as extra travel information, the scheme led to a weekly decrease of 35,000 rush hour trips. Research also showed that participants not only appreciated the reward system; avoiding rush hour also reduced their stress and provided them with more free time.

The scheme was found to support rather than undermine alternative modes, however the main constraint relates to the source and costs of rewards on an on-going basis. There are likely to be high costs associated with the reward scheme, as well as potentially more investment needed in public transport capacity and infrastructure. There are also high risks around enforcement and the potential for people to 'game' or abuse the system.

Another variation on the theme of reverse tolling is **credit based congestion pricing**.

Credit-based congestion pricing (CBCP) was considered in **Austin, Texas**, in 2005.[53] In the scheme, drivers would receive a monthly allowance of monetary travel credits to travel where the use of the roads would be priced by time, location, etc. Drivers do not pay any actual money for using roads unless they have exceeded their allowance or credit balance. Drivers spending less than their limit can use the credits later or exchange them for cash. Drivers who exceed their limit through frequent long-distance and peak-period travel effectively pay for the system. Additional credit can be loaded for socially desirable welfare travel (eg welfare to work; low income users etc). The scheme is considered revenue neutral as any actual monthly revenues are returned as the next month's credit allowance.

In principle, the idea of providing people with credits that they can 'lose' draws on the heuristics of endowment and loss-aversion whereby people feel an overt attachment to their 'property' and a strong aversion to losing it. The focus on road (presumably car-based) travel excludes whole segments of network users from the scheme, suggesting fairness issues. This could be addressed by extending the scheme to all forms of travel (like the Netherlands). The difficulty then will be determining what is

[52] https://www.ars-traffic.com/en/reverse-tolling

[53] 'Credit-based congestion pricing: A policy proposal and the public's response', Kockelman, K., Luce,C.B., Kalmanje, S., Transport Research 39A:671-690 (2005).

reasonable and desirable use (over and above which journeys will be charged), how are transport services (that need real money) paid for in such an approach, and will the revenue generated by the scheme be enough to 'pay out' those who don't use their credits and choose to cash them in? The scheme as proposed is also vulnerable to abuse and enforcement would be required.

6.1 Auckland reverse tolling proposal

The Ridesharing Institute has proposed a reverse tolling scheme for Auckland[54] whereby people are paid to travel as passengers in carpools when they would otherwise drive. It would utilise an app which tracked commuters' starting location and destination, the time of day, number of people riding with them, and the total distance travelled. The scheme could also enable payment of differing rates for different times and congestion levels.

The proposal claims that no capital costs are anticipated as the app would be supplied by a third party. The reward costs are significant, calculated at $100 million per annum for Auckland, based on a $5 per day payment to 100,000 passengers for 200 days of the year. The scheme essentially incentivises rideshare and is envisaged as an alternative to congestion charging rather than a complementary measure.

6.2 Conclusions: Reverse tolling

The concept of reverse tolling is attractive but it suffers from a number of potential shortcomings:

- Observed price responses do not lend support to a concept of paying people for a behaviour change that would be more cost-effective to achieve from pricing.
- While capital costs may be low, operating and/or reward costs are potentially very high and may become unsustainable over the longer term.
- The scheme potentially excludes other travel modes and may therefore undermine the broader use of alternatives such as PT, walking and cycling.
- It may generate trips and perverse travel patterns.
- There are fairness issues; because higher income travellers with flexible schedules are more able to take advantage than those on fixed incomes and inflexible schedules.
- The scheme would appear to be vulnerable to abuse, and would therefore require significant enforcement and administration costs.

[54] Letter from Paul Minett, CEO Trip Divergence to the Project Director, Auckland Smarter Transport Pricing Project (2 October 2017)

Appendix A – Measurement of price responses

The impacts of pricing are commonly measured using **elasticities**, which refers to the percentage change in consumption of a good (eg travel activity) that results from a percentage change in price. For example, PT demand reduces as fare prices rise. **Cross-elasticities** refer to the changes in demand for a good that result from a change in the price of a substitute good. For example, changes in PT demand due to increased vehicle costs (such as a congestion charge), or vice versa.

General observations on elasticities relating to vehicle journeys include[55]:

- Commercial/business travel tends to be less elastic/price sensitive than personal travel
- Commuter trips tend to be less elastic than shopping or recreational trips
- Higher income travellers tend to be less price sensitive than lower income travellers
- Weekday trips may have very different elasticities from weekend trips
- Urban peak-period trips tend to be price inelastic because congestion discourages lower value trips, leaving only higher value vehicle trips.

Introduction of a congestion pricing scheme (and potential complementary measures) will result in different outcomes, driven by price elasticities.

[55] Understanding Transport Demands and Elasticities: How Prices and Other Factors Affect Travel Behaviour. (27 February 2017). Victoria Transport Policy Institute. Litman, T. pp. 17.