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# Right time, right place, right price A practical plan for congestion charging in Sydney and Melbourne

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### **Overview**

Last week's Grattan report, *Why it's time for congestion charging*, showed that congestion charging is the most effective way to make Australia's capital cities work better. This new report lays out a detailed, feasible, and fair congestion-charging scheme for Australia's two biggest cities.

Within the next five years, the NSW and Victorian governments should introduce a cordon charge around the CBDs of Sydney and Melbourne. Drivers should be charged \$5 to enter the CBD during the weekday morning peak and another \$5 to exit in the afternoon peak.

The money raised should be spent on upgrading CBD streets to make them safer and less congested for pedestrians.

The \$5 charge should apply from 8am to 9.30am, and from 4pm to 6pm. A \$3 charge should apply in the half-hour either side of the morning peak, and in the hour before and the half-hour after the afternoon peak. Driving to and from the CBDs would remain free at all other times of the day, on weekends, and on public holidays.

The 'cordon' for the Sydney CBD should cover the area west of and including the Domain, north of Central Station, and east of Pyrmont.

The cordon for the Melbourne CBD should include the Hoddle Grid, the high-rise areas of Docklands and Southbank, and the wedge to the north of the city formed by Victoria, La Trobe, William, and Peel streets (encompassing the Queen Victoria Market).

Transport modelling by Veitch Lister Consulting for this report shows that in Sydney, average speeds on CBD roads would increase by 11 per cent in the morning peak – good news for tens of thousands of bus commuters. The cordon charge could improve traffic flow as far from the CBD as Frenchs Forest in the north, Brighton-Le-Sands in the south, Burwood in the inner west, and Macquarie Park in the north-west.

In Melbourne, average speeds in the Hoddle Grid would increase by about 16 per cent during the peaks. Traffic speeds could increase as far from the CBD as Niddrie in the north-west, Mulgrave in the south-east, Hampton in the south, and Altona North in the west.

Within five years of the CBD cordon charges being introduced, a per-kilometre charge should be imposed in peak periods on the most congested arterial roads and urban freeways in both cites. A 30-cents per kilometre charge could increase speeds on the charged roads by more than 10 per cent in the morning peak.

In Sydney, the 'corridor charge' could apply to sections of the A3 and the A6, Military and Spit roads, the Victoria Road - Western Distributor (A4) corridor, and the M5 East - M1 corridor past the airport.

In Melbourne, the corridor charge could apply on Hoddle Street - Punt Road, the Eastern Freeway - Alexandra Parade - Elliot Avenue corridor, the West Gate Freeway, and the Monash Freeway.

Eventually, drivers should be charged on a per-kilometre basis for driving across each city's entire road network at the busiest times – but only as part of a package of measures including abolishing fuel excise and creating a safety net to ensure people on low incomes and with impaired mobility are not disadvantaged.

Ambitious reforms are always challenging for governments. But Australian governments have the advantage that they can learn from cities around the world that have already successfully implemented congestion charging. It's time for Sydney and Melbourne to join these cities in the fast lane.

### **Recommendations**

### Recommendation 1: CBD cordon charges of \$5 (peak) and \$3 (shoulder) in Sydney and Melbourne within five years

Within the next five years the NSW and Victorian governments should introduce a cordon-style congestion charge in the CBDs of Sydney and Melbourne, that:

- charges drivers entering the cordon zone on weekday mornings between 8am and 9.30am at a rate of \$5, and \$3 in the half-hour on either side of this period;
- charges drivers leaving the cordon zone on weekday afternoons between 4pm and 6pm at a rate of \$5, and \$3 in the hour before and the half-hour after this period;
- does not impose charges at other times or on other days;
- is implemented using Automatic Number Plate Recognition technology;
- protects people's privacy by:
  - requiring that personal data be stored in a decentralised manner;
  - prohibiting law enforcement agencies from accessing personal information from congestion charging without a court warrant;
  - requiring that images and data collected for congestion charging be deleted after payment or, in specific circumstances, after 24 months from the date of the transaction;
  - establishing industry guidelines to cover how congestion charging entities use personal information; and

- tightening privacy law to limit the purposes for which personal information collected for congestion charging can be passed on to other entities;
- guarantees the net revenue will be used to improve pedestrian safety and amenity in the city;
- is accompanied by a waiving of vehicle registration fees for micro cars; and
- is accompanied by ongoing upgrades to public transport capacity, and mitigation of road bottlenecks, subject to all major investments having robust business cases.

## Recommendation 2: Corridor charges on key urban freeways and arterial roads in Sydney and Melbourne within 10 years

Having established a cordon charge in the most central part of Sydney and Melbourne, the NSW and Victorian governments should within the subsequent five years progressively introduce corridor charges on key arterial roads and urban freeways. The scheme should:

- apply on a per-kilometre basis on weekday mornings and afternoons in peak periods;
- apply only in the peak direction, where one exists;
- not apply at other times of the day or week;
- use the established Automatic Number Plate Recognition technology;
- include a fairness package to ensure vulnerable people are not disproportionately affected.

## Recommendation 3: Investigate the costs and benefits of network-wide distance-based charging

The NSW and Victorian governments should investigate the costs and benefits of network-wide distance-based charging, with a presumption to go ahead or show convincingly why not, and including:

- the feasibility, merits, and drawbacks of charging for the costs of road construction and maintenance in addition to congestion;
- whether urban centres other than the capital cities should be included;
- what existing road-related charges such as vehicle registration fees and fuel excise – should be replaced by the congestion charge;
- how to obtain location information and personal identity information, while preventing the recording or time-stamping of location information outside of the charged zone and time periods; and
- the costs and benefits of earmarking the revenues for road-related expenditure, and appropriate governance structures to do this.

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### 1 Phase 1: cordon schemes in the centre of Sydney and Melbourne

Sydney and Melbourne are ready for congestion charging. Congestion has become enough of a problem for enough of the population, and people can see that the same old remedies may help to a point, but don't actually solve excessive congestion. Our previous report, published last week, showed why now is the time.<sup>1</sup>

Even so, there is a degree of scepticism about congestion charging – whether it is actually feasible, how well it would work, and whether it would be unfair.

This report responds to those doubts with specifics for Sydney and Melbourne. These designs draw on the lessons from overseas, while also dealing with particular Australian challenges such as the characteristics of Sydney and Melbourne, the different levels of government in the federation, and the existing network of toll roads.

Our designs show that congestion charging is feasible, effective, and could be done fairly. Governments can use these designs as their starting point.

We recommend a three stage reform. The first phase is that the NSW and Victorian governments introduce cordon charges in the Sydney and Melbourne CBDs within the next five years. This chapter outlines where the cordon schemes should be, and the prices drivers should pay (Section 1.1). It explains why government should start here (Section 1.2), and how these schemes stack up as effective (Section 1.3), efficient (Section 1.4), and fair (Section 1.5). Section 1.6 explains why the revenue should be used for pedestrian safety and amenity improvements.

The second chapter of the report outlines how and why congestion charging should be extended in the subsequent five years to major freeways and arterial roads, to unclog these congestion hotspots. This is the second phase. The third chapter explores the further evolution of congestion charging – network-wide distance-based pricing – and the five conditions that must be satisfied before it would be feasible for governments to implement this third phase.

The fourth chapter explains the privacy concerns raised by each phase of congestion charging, and how governments can solve them.

There are six appendices that give more detail about the schemes we recommend and the evidence base we used, as well as outlining how governments might enforce the scheme and deal with existing toll road networks in each city.

## 1.1 Charge drivers \$5 to enter the CBD in the morning peak and \$5 to leave in the afternoon peak

We recommend a cordon-style congestion charge for the CBDs of Sydney and Melbourne, applying a peak charge of \$5 on drivers entering the cordoned area between 8am and 9.30am on weekdays, and a shoulder charge of \$3 during the 30 minutes on either side of that peak period.<sup>2</sup> A peak charge of \$5 should apply to drivers leaving the cordon between 4pm and 6pm on weekdays, and \$3 for the hour before and the 30 minutes after that peak period (see Table 1.1 on the following page). Higher charges should apply for trucks (see Section 1.2.2), because they cause more congestion.

<sup>1.</sup> Terrill et al (2019).

<sup>2.</sup> Excluding public holidays, on which there should be no charge.

Our recommended cordon for the Sydney CBD is shown in Figure 1.1 on the next page. It covers the area south of the harbour, west of and including the Domain, north of Central Station, and east of Pyrmont.<sup>3</sup>

Our recommended cordon for the Melbourne CBD is shown in Figure 1.2 on page 12. The cordon includes the Hoddle Grid, the high-rise areas of Docklands and Southbank, and the wedge to the north of the city formed by Victoria, La Trobe, William, and Peel streets (encompassing the Queen Victoria Market).

Appendix A.1 on page 52 contains specific details about which roads would be inside and outside the cordon for each city.

Governments should consider increasing on-street parking charges within 500 metres of the cordon.

Automatic Number Plate Recognition technology should be used to give effect to the scheme, backed up with additional legal safeguards to prohibit the use of personal information for non-charging purposes. In brief, personal data must be protected from hacking, from the possibility that it could be used for government surveillance, and from use for unwanted marketing.

Appendix A of our previous report provides the arguments in favour of Automatic Number Plate Recognition, while Chapter 4 of this report explains the need for additional privacy protection with this technology. Table 1.1: Congestion charges should apply only at busy times of day

Day	Time	Price, inbound	Price, outbound
Workdays	7.30am - 8.00am	\$3	No charge
	8.00am - 9.30am	\$5	No charge
	9.30am - 10.00am	\$3	No charge
	10.00am - 3.00pm	No charge	No charge
	3.00pm - 4.00pm	No charge	\$3
	4.00pm - 6.00pm	No charge	\$5
	6.00pm - 6.30pm	No charge	\$3
All other days	All other times	No charge	No charge

Note: 'Workdays' means weekdays excluding public holidays.

#### 1.2 Why start with CBD cordon charges of \$5 and \$3?

There are strong arguments that governments should start with a scheme focused on CBD congestion. The following sections explain why the CBD should be the initial focus and why it makes sense to start with a peak charge of \$5 and shoulder charge of \$3.

#### 1.2.1 Why it makes sense to start with the CBD

There is congestion right across the Sydney and Melbourne metropolitan areas during the morning and afternoon peaks. But developing charging schemes in the short term to properly tackle all of this congestion would be a major challenge. Among many other issues, it would require use of less-proven technologies, reforms to other charges paid by motorists, and would raise significant equity and privacy concerns. Such a scheme is only feasible in the longer term, when these challenges have been addressed.

Governments need not take this kind of 'big bang' approach to congestion charging as their first step. Instead, they should start where congestion is most evidently problematic: the CBD.

This closely follows the shape of the 'Sydney - Haymarket - The Rocks' Statistical Area 2, as defined by the Australian Bureau of Statistics. A 'Statistical Area 2' (SA2) is a geographic region representing 'a community that interacts together socially and economically': ABS (2016). In major cities, SA2s often represent single suburbs.

Figure 1.1: The Sydney cordon



Note: The northern boundary is the harbour. Source: Grattan analysis.

#### Figure 1.2: The Melbourne cordon



Source: Grattan analysis.

#### The CBD is each city's employment hub

Unsurprisingly, the CBD is the largest employment centre in both Sydney and Melbourne. About 320,000 people work in each city's CBD, constituting 15 per cent of each city's jobs.<sup>4</sup> This makes these CBDs five to six times larger than each city's next largest employment centre (Parramatta - Rosehill in Sydney, and Dandenong in Melbourne).

The CBDs are also the places where the largest number of people drive to work: almost 35,000 in Sydney and 61,000 in Melbourne. The next most common suburb for people driving to work is Macquarie Park - Marsfield in Sydney, with 28,000 drivers, and Dandenong in Melbourne, with 54,000.<sup>5</sup>

The CBDs are where the largest number of drivers converge on a relatively small space. The CBDs have the largest number of people driving to work there per square kilometre, at around 8,000 in both cities; this is much higher than the 2,600 per square kilometre in both Macquarie Park - Marsfield and Parramatta - Rosehill, and the 900 per square kilometre in Dandenong.<sup>6</sup>

People driving to the CBD for work come from all parts of the Sydney and Melbourne metropolitan areas. In Sydney, for example, there are almost 6,000 from the northern suburbs, more than 5,000 from the eastern suburbs, and more than 3,000 from each of the inner west and inner south-west.<sup>7</sup> In Melbourne, there are 12,000 from the west, more than 7,000 from each of the inner south and inner east, and more than

6. Grattan analysis of ABS (Census, ibid).

5,000 from each of the north-east and south-east.<sup>8</sup> This means that a CBD cordon would affect drivers from all over the city.

#### The CBD also attracts plenty of traffic unrelated to commuting

While many drivers to and from the CBD are commuters on their way to and from work, there are also many trips for other purposes.

Some trips are commercial, and include business meetings, deliveries, and tradespeople. Many trips are just passing through the city; in Melbourne, it is one third of traffic between 7.30am and 9.30am on weekdays, and nearly half of traffic between 4.30pm and 6.30pm.<sup>9</sup> Other trips are for socialising, recreation, and shopping.<sup>10</sup> Some of these business and personal trips are in hire cars, such as taxis and ride-sharing services.

#### The CBD is well served by public transport

Of all parts of the city, the CBD is the one that is best served by public transport. Direct travel to the CBDs of Sydney and Melbourne is possible via train, tram, ferry, or bus from almost all parts of these cities' metropolitan areas. A CBD cordon scheme is likely to increase reliance on public transport.

It is already true that more than three-quarters of workers in the Sydney CBD take public transport, and in the Melbourne CBD it is about twothirds. This means that the impacts of a cordon charge would be felt by only a small share of travellers in Sydney or Melbourne.

9. City of Melbourne (2019).

<sup>4.</sup> Terrill et al (2018, pp. 65–66). Sydney's CBD encompasses the 'Sydney - Haymarket - The Rocks' Statistical Area (SA2). Melbourne's CBD emcompasses the 'Melbourne', 'Docklands', and 'Southbank' SA2s.

<sup>5.</sup> ABS (Census, 2017).

Based on the following ABS-defined Statistical Areas (at the 'SA4' level): 'Sydney -North Sydney and Hornsby', 'Sydney - Eastern Suburbs', 'Sydney - Inner West', and 'Sydney - Inner South West'.

Based on the following ABS-defined Statistical Areas (at the 'SA4' level): 'Melbourne - West', 'Melbourne - Inner South', 'Melbourne - Inner East', 'Melbourne - North East', and 'Melbourne - South East'.

Across the Sydney metropolitan area, trips for socialising, recreation, and shopping make up 21 per cent of total trips in the morning peak; in Melbourne it's about 11 per cent: Grattan analysis of State of New South Wales (2019) and Victorian Department of Transport (2016).

It's not the case that everyone driving to the CBD is doing so only because they have no alternative. Most of these people have high incomes and are commuting from inner or middle-ring suburbs, which tend to be better served by public transport (see Figure 1.3). The fairness implications of congestion charging are discussed further in Section 1.5.

#### 1.2.2 Why it makes sense to start with charges of \$5 and \$3

We recommend a peak-period charge of \$5 to apply to traffic into the cordon zone between 8am and 9.30am on weekdays, and out of the cordon zone between 4pm and 6pm. We also recommend a shoulder charge of \$3 for the 30 minutes on either side of the morning inbound period, and for the hour before and the 30 minutes after the afternoon outbound period.

Higher charges should apply to trucks because they cause more congestion than cars. Following typical practice on Australian toll roads, it is reasonable to expect light commercial vehicles and heavy commercial vehicles to pay 1.5 and 3 times higher charges respectively.<sup>11</sup> This higher rate reflects the fact that commercial vehicles take up more space on the road, accelerate more slowly, and their bulk obstructs visibility for drivers behind and beside them.

The \$5 and \$3 charges are comparable to charges applying in overseas schemes, and public transport fares in Sydney and Melbourne.<sup>12</sup> They are sufficient to prompt a noticeable change in people's behaviour, with consequent improvements in traffic speed and reliability.<sup>13</sup>

While it is impossible to know in advance the perfect charge for a CBD cordon scheme, we do know that the current charge of zero is too low.

#### tend to live in the inner or middle suburbs Distribution of commute distances to the CBD within each personal weekly

Figure 1.3: Drivers to the CBD are overwhelmingly higher-income and

income bracket reported on the 2016 Census



Notes: Data is for full-time workers commuting by private vehicle. Line height is to scale – the highest income bracket is the most commonly reported income for those who commute to the CBD by private vehicle.

Source: Grattan analysis of ABS (2017).

<sup>11.</sup> Senate Economics References Committee (2017).

<sup>12.</sup> See Appendix A.2 for more detail.

<sup>13.</sup> This claim is based on modelling, explained in Section 1.3 on the next page.

We can also surmise that a charge that is many times higher than the relevant public transport fare would probably be too high, because it would deter too many drivers and leave roads under-utilised.<sup>14</sup>

The beauty of a congestion charge is that it changes the behaviour of the most flexible drivers. These are the people who have other options that are almost as good, such as travelling at a different time or by a different method.

Of course, it may also deter low-income drivers who don't have a suitable alternative, although this group would be very small. Ways to accommodate their needs are outlined in our previous report.<sup>15</sup>

The 'right' or 'optimal' level of charge will be the one that – having weighed all of the benefits and costs that it creates – maximises the estimated net benefit to society. This level of charge may change over time as people change where, why and how they travel.

State governments should be advised on the optimal level of charge by an independent body, such as NSW's Independent Pricing and Regulatory Tribunal, and Victoria's Essential Services Commission.<sup>16</sup> Over time, these bodies should also determine and advise government if, when and by how much the charge should be changed.

The independent body should use traffic statistics to indicate that the optimal level of charge has diverged from the level of charge in place. For example, the initial level of charge might correspond to 25,000 vehicles entering the cordon between 8am and 9:30am on average each day. This is a relatively easy traffic statistic to monitor. Other

easily-monitored statistics, such as average travel times on key arterials leading to the cordon, could also be used as indicators.

Every three months, these traffic statistics should be reviewed by the independent body. A sustained and material increase or decrease in these statistics should trigger a more detailed review of the level of the charge.<sup>17</sup>

There is merit in governments starting with a charge that they believe to be a little below rather than a little above the ideal. That is because a congestion charge would not be established on a blank slate, but in addition to various other measures.<sup>18</sup> In Sydney, these include a CBD parking levy, and public transport fares that vary depending on the time of day. In Melbourne, they include a CBD parking levy, along with a gradual reduction in on-street parking in the CBD.

It is prudent for governments to leave room to learn as they go, and to refine the scheme in light of the community's response.

## 1.3 CBD cordons would reduce cars on the road and increase traffic speeds

Cordon schemes work by deterring some traffic from entering the central city area at certain times. Instead of driving into the city, some people drive around it, while others stop short of it; some go earlier or later, some take another method of transport, and others do not take the trip at all.

This section highlights the likely impacts of a cordon scheme, based on modelling by Veitch Lister Consulting (VLC). Box 1 on the next page summarises the modelling used, and Appendix E provides more detail on the models and their assumptions.

<sup>14.</sup> For further discussion of this point, see Appendix A.2.4 on page 58.

<sup>15.</sup> Terrill et al (2019, p. 40).

<sup>16.</sup> In 2019, Infrastructure Victoria conducted a community panel to ask 'under what conditions, if any, [the community would] accept a change to the way they pay for roads and public transport'. A key condition was that the government establish an 'Independent Regulator for Pricing': IV (2019).

In Singapore, congestion charges are changed over time to ensure that average speeds on different roads remain within target ranges: Singapore Ministry of Transport (2019).

<sup>18.</sup> Nye (2008).

#### **Box 1: Veitch Lister Consulting modelling**

Veitch Lister Consulting (VLC) operates models of the Sydney and Melbourne transport networks as they existed in 2016. The models aim to simulate all travel by households, businesses, and visitors during an average weekday. Trips are simulated to occur during four distinct time periods: morning peak (7am to 9am); inter-peak (9am to 4pm); afternoon peak (4pm to 6pm); and off-peak (6pm to 7am).

By changing an aspect of the *modelled* transport network, the models can be used to predict the changes in travel patterns that will occur after a *real-world* change to a city's transport network – such as building a new road or introducing congestion charging.

The models can predict the mode and route switching that might occur if trips continue to be made to the same destinations as before the change to the network (a 'fixed departure time, fixed destination' simulation), as well as the mode, route, and destination switching that might occur if trip destinations are allowed to change (a 'fixed departure time, variable destination' simulation). The 'fixed departure time, fixed destination' simulation can be thought of as approximating short-term impacts, and the 'fixed departure time, variable destination' simulation as approximating longer-term impacts.

These models cannot predict how the timing of trips will change in response to a change in the network.

Unless specified otherwise, the modelling results quoted in this report are from fixed departure time, variable destination simulations. The modelled schemes are simplified versions of our proposed cordon schemes. VLC modelled a \$5 charge for inbound cordon crossings by all vehicles between 7am and 9am, a \$5 charge for outbound crossings by all vehicles between 4pm and 6pm, and no shoulder charges. In reality, peak and shoulder charges should apply at and around the specific periods of highest demand – see Appendix A.2.1 for more detail.

While VLC has another model for Melbourne with additional time periods, this model has not been used extensively, and so we rely on it only for an indication of the increase in revenue that shoulder charges might contribute (see Appendix A.5).

A further consideration is that cost inputs to the modelling are calibrated to 2011 dollars. In this report, we have inflated all costs, revenues and benefits to today's dollars. This means that – strictly speaking – the economic and financial outputs from the modelling presented in this report correspond to a charge of about \$5.70 in today's dollars. However, this does not change our recommendation that governments should consider a peak charge of \$5 for two reasons. First, even if economic and financial outputs are re-based to 2011 dollars to be perfectly consistent with the \$5 charge, their order of magnitude and sign are unchanged. Second, as we explain in Section 1.2.2, there is merit in governments erring on the side of a charge that is a little below the 'ideal'.

The impacts of a cordon would be most obvious in the central city itself. In both Sydney and Melbourne, modelling suggests that traffic heading into the cordoned area would drop by about 40 per cent in the morning peak. There would be a similar decrease in the amount of traffic driving out of the area in the afternoon peak.

Drivers could also expect a reduction in traffic across the city as a whole. While it would not be a major reduction, a key benefit of congestion charging is that deterring one driver does not create an equivalent level of demand for a new driver to emerge to take their place. Modelling suggests that a cordon would not just lead to some changes in people's method of travel, but would also reduce the total number of car trips taken in both Sydney and Melbourne.

And while a cordon works by deterring some drivers, the great majority of Sydneysiders and Melburnians would not be affected (see Figure 1.4).

The following two sections provide more detail on the improvements to traffic that could be expected in Sydney and Melbourne.

#### 1.3.1 How Sydney drivers would benefit from a CBD cordon

A Sydney CBD cordon would mean at least 3,000 fewer cars on the road during the morning and afternoon peaks, with some people switching to public transport at those times. Although there would be some additional crowding on public transport in the absence of additional services, these impacts would be modest and well below the significant benefits that a cordon scheme offers. Section 1.4 on page 21 details these costs and benefits.

Fewer cars on the road would of course mean better traffic flow. Across the Sydney metropolitan area, the effect would be small – an increase in speed of up to 1 per cent in the peaks. But this is not unexpected given the targeted nature of the cordon. It would be substantially

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**Figure 1.4: Some CBD drivers will pay the charge, others will find another way, but most people will remain unaffected by a cordon charge** Trips, by car or otherwise, made in the AM peak in Melbourne



Notes: Data for a modelled weekday morning (7am to 9am) in Melbourne is shown – Sydney presents a similar story. Bar heights are to scale, but flow widths are illustrative and assume about 10 per cent of drivers to the CBD in the post-charge scenario did not previously do so – longitudinal modelling data is not available. Source: Grattan analysis of modelling by Veitch Lister Consulting.



### Figure 1.5: A Sydney cordon would increase traffic speeds well beyond the cordon area

AM peak, model with fixed departure time and variable destination choice

Notes: Colour blind-friendly maps are available on our website. Roads with a change in speed less than 2 per cent are uncoloured. Source: Grattan analysis of modelling by Veitch Lister Consulting.

greater than the speed improvements of 0.3 per cent across the day from the first stage of the F6 Extension, which will cost \$2.6 billion.<sup>19</sup> And a cordon scheme is just the first phase of a broader reform program aimed at better addressing congestion through charging.

In particular parts of the city, by contrast, traffic speeds would increase much more (see Figure 1.5 on the previous page). The average speed on roads in the CBD would increase by 11 per cent in the morning peak,<sup>20</sup> and much of the benefit of this speed improvement would be felt by motorists who actually pay the charge.

Less traffic in the CBD would also be good news for tens of thousands of bus commuters, many of whom find just getting through the CBD the most delayed and frustrating part of their commute.

Benefits would extend beyond the CBD too. The cordon would materially speed up a number of routes toward the city from the eastern suburbs, the airport, the inner west, and the north shore. And although the effects further out may be minor, the cordon has the potential to improve traffic flow as far from the city as Frenchs Forest in the north, Brighton-Le-Sands in the south, Burwood in the inner west, and Macquarie Park in the north-west.

As Figure 1.5 shows, some roads would slow down as traffic patterns changed in response to the cordon. These roads are typically around the edge of the cordon, or ones that could be used to bypass the cordon. These side-effects are undesirable, but are no reason to defer. Overall, the average speed on Sydney's roads would increase as a result of the cordon, and the benefits of the cordon to the community would outweigh the costs, as explained in Section 1.4.

Policy makers might also mitigate some of these side effects through traffic management or slight changes to the cordon design.

#### 1.3.2 How Melbourne drivers would benefit from a CBD cordon

The improvements to traffic in Melbourne would be similar to those in Sydney.

A cordon could be expected to take about 5,000 cars off Melbourne's roads in the morning and afternoon peaks. The increase in average speed network-wide would be about 1 per cent, but the increase in average speed in the Hoddle Grid would be about 16 per cent.<sup>21</sup>

Material improvements in speed would spread to the inner suburbs (see Figure 1.6 on the following page), with arterial roads to the city from all points of the compass flowing better. Major north-south tram corridors, such as Sydney Road and Brunswick Street, would also become less congested. Small increases in speed would be seen on roads as far from the city as Niddrie in the north-west, Mulgrave in the south-east, Hampton in the south, and Altona North in the west.

As with Sydney, there would be some localised speed reductions. But again, the costs of these side effects would be outweighed by the benefits.

Some of these localised speed reductions might be directly mitigated by modifying the cordon design. For example, it would be worth weighing up the costs and benefits of making City Road the cordon's southern, uncharged boundary, to prevent increased congestion on some smaller roads around Southbank;<sup>22</sup> similarly, carving out Wurundjeri Way from the cordon as a north-south bypass could

<sup>19.</sup> Grattan analysis of RMS (2018, Chapter 8, pp. 86-89) and INSW (2018a).

These speed improvements relate to average speeds, and arise from a combination of slightly faster driving speeds and less stationary time waiting at intersections.

<sup>21.</sup> These speed improvements relate to average speeds, and arise from a combination of slightly faster driving speeds and less stationary time waiting at intersections.

<sup>22.</sup> The reasons for the current boundary design are discussed in Appendix A.1.



Figure 1.6: A Melbourne cordon would increase traffic speeds well beyond the cordon area AM peak, model with fixed departure time and variable destination choice

Notes: Colour blind-friendly maps are available on our website. Roads with a change in speed less than 2 per cent are uncoloured. Source: Grattan analysis of modelling by Veitch Lister Consulting.

dampen some of the increased north-south traffic on the southern section of CityLink.

#### 1.4 Clear net benefits at minimum cost and hassle

The point of CBD cordon schemes for Sydney and Melbourne is to reduce congestion in such a way that people can get around in a timely and predictable way – while also keeping the cost and inconvenience as low as possible for everyone.<sup>23</sup>

There are clear net benefits to the community from the CBD cordons in Sydney and Melbourne, as specified in Section 1.3. The benefits they would bring in improved travel times and more reliable trips are larger than the costs of running the scheme and the inconvenience and other detriments they would cause to some travellers or would-be travellers.

A Sydney CBD cordon would yield a net benefit of \$13 million per year in value to the community (see Table 1.2). Much of the value would not be monetary, but in time. The time savings to people travelling for private purposes would be by far the largest benefit, and expressed in financial terms would be worth \$41 million per year. There would also be valuable time savings to commercial operators – about \$6 million per year. Improved reliability would be a substantial benefit to both private and commercial travellers.<sup>24</sup>

The costs of a Sydney cordon would primarily be the set-up and running costs, including the costs of compliance.<sup>25</sup>

Table 1.2: High-level cost-benefit analysis for the Sydney cordonNominal annual benefit or cost, \$ million, by model type

	Fixed departure, fixed destination	Fixed departure, variable destination
Value of net travel time savings, private vehicles	53	41
Value of net travel time savings, commercial vehicles	12	6
Value of improved travel time reliability	9	7
Lower vehicle operating costs	6	2
Lower environmental costs	2	<1
Disbenefit of deterred vehicle trips to cordon	-7	-9
Increased crowding on public transport	-6	-3
Compliance costs	-4	-4
Amortised set-up cost	-10	-10
Annual operating cost, low	-10	-9
Annual operating cost, medium	-19	-18
Annual operating cost, high	-27	-25
Net result, low operating cost	45	21
Net result, medium operating cost	36	13
Net result, high operating cost	28	5

Notes: The 'fixed departure time, fixed destination' simulation can be thought of as approximating short-term impacts, and the 'fixed departure time, variable destination' as approximating longer-term impacts.

Sources: Grattan analysis, including of modelling by Veitch Lister Consulting.

<sup>23.</sup> More formally, the objective is to come as close as possible to an economically efficient outcome, meaning that no other option to reduce congestion can provide a higher net benefit.

<sup>24.</sup> Reliability means that drivers don't have to allow as much of a time buffer on each trip.

<sup>25.</sup> Because operating costs are a substantial proportion of total costs, and due to uncertainty about those costs, the table provides three estimates. We report the medium cost estimate. Details of the method for costing the set-up and operating costs are in Appendix A.3.

There would also be costs to individuals, particularly to people who would have driven into the cordon zone without the charge but now change their plans and either use a different mode of travel or a different destination. These costs can be expressed in financial terms as worth \$9 million per year.

Public transport users would suffer some increase in crowding, which can be expressed in financial terms as worth \$3 million per year.

Further detail on the underlying assumptions is in Appendix A.4.

A Melbourne CBD cordon would yield a net benefit of \$38 million per year in value to the community (see Table 1.3 on the following page). As with Sydney, by far the largest benefits come in the form of time savings. These can be translated into financial terms as worth \$75 million per year to private travellers. Improved reliability would also be a substantial benefit, worth \$11 million per year. These benefit estimates are substantially higher than the equivalents in Sydney – we discuss this further in Box 2. Commercial operators would benefit modestly, to the value of \$3 million.

The cost to people who switch their travel mode or destination would be \$15 million per year. The cost of increased crowding on public transport would be \$2 million per year.

This high-level assessment of costs and benefits shows that cordon schemes in Sydney and Melbourne are well worth pursuing. But the net benefits could be higher still, because our estimate is conservative. We did not, for instance, have the data to quantify the likely reduction in traffic accidents as a result of cordon charging. Nor have we considered the reduced road up-keep costs, or the benefit of being able to delay other infrastructure investments.

And within the cost-benefit analysis, our estimates also tend to be conservative. Vehicle operating cost savings have been determined from the reduction in vehicle kilometres travelled, but drivers travelling

#### Box 2: Potential improvements to the Sydney cordon

The estimated net benefit of the Sydney cordon is much lower than that of the Melbourne cordon. It is also much lower than the net benefit when estimated using results from the fixed destination model. The main reason is that the modelled scheme allows people to change destination and to travel through the Sydney cordon without paying the charge using the Western Distributor, Cross City Tunnel, or Cahill Expressway. It might also reflect that fewer people drive to work in the Sydney CBD than the Melbourne CBD.

Allowing uncharged bypasses of the cordon means less traffic is captured by the scheme, and this is consistent with introducing congestion charging by starting 'small'. But capturing less traffic also means that fewer car trips are deterred, and there are smaller savings to society in travel times and vehicle operating costs.

There are two main changes to the design of the Sydney cordon that we would encourage the NSW Government to explore.

The first is to expand the cordon to include some of the suburbs bordering the CBD, such as Pyrmont, Ultimo, Chippendale, and Surry Hills. These are busy, inner-city areas that attract a relatively high number of people driving to work per square kilometre.

The second is to eliminate uncharged bypasses of the cordon. This would mean any entry to or exit from the cordon on any road would incur the relevant charge. on less congested roads will also use less fuel, and impose less wear-and-tear on their vehicles. The transport network model did not allow people the option of forgoing a trip entirely – this means slightly more cars on the roads in the model than we would expect in reality, leading to underestimated travel time savings. The value of time of those drivers who actually pay the cordon charge is likely to be higher than of those who stop driving to the CBD, so the average value of time for drivers in a world with congestion charging would be higher than the current guidelines suggest<sup>26</sup> – but we have not made any adjustment to reflect this.

Also, the model is based on the 2016 road network; the benefits of reducing congestion could be much higher in years to come, particularly because the costs imposed on society are projected to grow over the next decade.<sup>27</sup>

Of course, there is much more work to be done, and governments have the resources to do further analysis, modelling, and costing. But given the promising net benefits for Sydney and Melbourne, governments should not be asking *whether* to implement cordon congestion charging in the CBD, but refining the details on *how* to do so.

Not only do cordon charging schemes provide net benefits to the community, but they do so very efficiently. It would be difficult to find a better method of reducing congestion while still giving people in Sydney and Melbourne as much as possible of what they value and at as little cost and inconvenience as possible. It is also remarkable that traffic speed improvements of the order outlined in Section 1.3 above can be accompanied not by a multi-billion-dollar price tag, but by a net contribution to government coffers – net revenue each year could be up to \$84 million in Sydney and \$124 million in Melbourne.<sup>28</sup>

Table 1.3: High-level cost-benefit analysis for the Melbourne cordonNominal annual benefit or cost, \$ million, by model type

	Fixed departure, fixed destination	Fixed departure, variable destination
Value of net travel time savings, private vehicles	66	75
Value of net travel time savings, commercial vehicles	8	3
Value of improved travel time reliability	10	11
Lower vehicle operating costs	13	6
Lower environmental costs	3	2
Disbenefit of deterred vehicle trips to cordon	-12	-15
Increased crowding on public transport	-4	-2
Compliance costs	-4	-4
Amortised set-up cost	-10	-10
Annual operating cost, low	-15	-15
Annual operating cost, medium	-30	-28
Annual operating cost, high	-43	-40
Net result, low operating cost	55	52
Net result, medium operating cost	41	38
Net result, high operating cost	27	26

Notes: The 'fixed departure time, fixed destination' simulation can be thought of as approximating short-term impacts, and the 'fixed departure time, variable destination' as approximating longer-term impacts.

Sources: Grattan analysis, including of modelling by Veitch Lister Consulting.

<sup>26.</sup> Raux et al (2012).

<sup>27.</sup> BITRE (2015, p. 25).

<sup>28.</sup> We explain how we estimated revenue in Appendix A.5 on page 69.

## Box 3: A better flowing road network wouldn't just mean quicker trips – it would mean new business opportunities

Jane runs a bakery and her partner delivers their products to cafes across Melbourne's west. They currently do not have time to make deliveries to the CBD in the morning – congestion on the roads means that delivering to one CBD cafe would have to come at the expense of delivering to several locations elsewhere in the city. A cordon charge would reduce the time and unpredictability of trips into the CBD, opening up a new market for Jane and her partner.

### 1.5 A congestion charge would be paid predominantly by higher-income drivers

A cordon around the CBD causes far fewer fairness concerns than other congestion charging models and other methods of reducing congestion, as outlined in detail in our previous report.<sup>29</sup> Drivers to the CBD tend to be a much more advantaged group than other workers. Jobs in the CBD pay more, and people who choose to drive are either willing to pay substantial fees for parking or receive a parking space from their employer.<sup>30</sup>

While it's reasonable to worry about outer-suburban commuters who have few alternative transport options, the reality is that a CBD cordon charge would mostly be paid by people from inner and middle suburbs (see Figure 1.7 on the following page).

These suburbs tend to be relatively more advantaged. Figure 1.8 and Figure 1.9 on page 27 show that the neighbourhoods with the highest proportions of residents commuting to the CBD by private vehicle also tend to have the highest incomes.

From an equity perspective, these residents tend to be doing just fine. People who commute to the CBD by private vehicle are much more likely to command higher incomes than their neighbours (see Figure 1.10 and Figure 1.11 on page 28). They typically earn more than people who take public transport to the CBD – 19 per cent more in Melbourne, and 32 per cent more in Sydney – and significantly more

<sup>29.</sup> Terrill et al (2019, Chapter 4).

<sup>30.</sup> And some employers pay the cost of commercial parking; this occurs for about a quarter of those car trips to the City of Melbourne that involve a parking fee. Another 10 per cent are paid through a salary arrangement. For work-related trips, a third of parking fees are paid by employers: Grattan analysis of Victorian Department of Transport (2016).



**Figure 1.7: The closer to the CBD a person lives, the more likely they would be to pay the congestion charge** Proportion of residents of each SA3 who would pay an AM peak cordon charge

Notes: Only residents aged 15 years or older on the 2016 Census are included. The map is divided into Statistical Areas (at the 'SA3' level) as defined by the ABS. The total number of charged trips is based on modelled trips originating in the SA3 except for light and heavy commercial vehicles. This introduces some uncertainty, because not every trip from an SA3 is necessarily taken (and paid for) by a resident of that SA3. For example, many trips that originate in the SA3 containing the airport are likely to be taken by non-residents. Sources: Grattan analysis of ABS (2017) and Veitch Lister Consulting modelling.

than the median worker in their city.<sup>31</sup> In Sydney, more than a third of these workers are in the highest income bracket reported in the Census (more than \$3,000 per week); for Melbourne, it's almost a quarter.

For the very small group of drivers who are both low-income and have virtually no alternative to driving, there should be safeguards in place (see Chapter 4 of our previous report).<sup>32</sup> This is discussed further in Section 1.6.2. Appendix C outlines how congestion charging can be enforced to avoid excessive penalties for people who cannot pay.

#### 1.6 The purpose of congestion charging is not to raise revenue, but we should be smart about how we spend the money that is raised

The aim of congestion charging is to encourage efficient use of the road network, not to raise revenue. But provided the operating costs are reasonable, the government stands to collect a substantial amount of money each year: up to \$84 million from the Sydney cordon and up to \$124 million from the Melbourne cordon (see Appendix A.5).

There are many options for spending this money – some better than others.

The first option is to just add the revenue to the state's coffers. This gives the government maximum flexibility; it can spend the money on whatever is most needed at the time, or use it to balance the budget. But this would be a missed opportunity.

Promising the money for something in particular – known as 'hypothecation' – is a useful way to win public support for congestion charging.<sup>33</sup>

In this section, we outline some smart ways to use the revenue. We also consider often-cited alternatives that we do not recommend.

#### 1.6.1 Smart ways to spend the revenue

Our preferred option is to guarantee the money for upgrading streets in the CBD, making them safer and less congested for pedestrians. Alternatively, governments could spend the money on delivering more effective bus services, fixing bottlenecks in the road network, or eliminating registration fees for the smallest, least-congesting vehicles.

#### Guarantee the revenue for improving inner-city streets for pedestrians

The revenue should be spent on improving the city streets for pedestrians. Congestion is a real issue on CBD footpaths, as well as roads. And where crowds spill onto the road, there are serious safety risks for pedestrians and the vehicles using the roads. The City of Melbourne reportedly has Victoria's highest rate of pedestrian road trauma.<sup>34</sup>

Drivers to the CBD would also benefit. Virtually all drivers who park in the CBD become pedestrians for at least some of the day. Within Sydney's CBD, more than a million trips are made each day and 92 per cent of these are on foot.<sup>35</sup> By upgrading the streets and improving the CBD's amenity, many people who have paid the cordon charge will benefit from the revenue, in addition to their time savings.

35. Transport for NSW (2013, p. 10).

<sup>31.</sup> These values include part-time workers, and are therefore slightly different to the values published in Terrill et al (2019, pp. 34–35), which relate to full-time workers only.

<sup>32.</sup> Terrill et al (2019, pp. 33-40).

D'Artagnan Consulting (2018, p. 131). Useful, but possibly not essential – Börjesson et al (2012) found in Stockholm hypothecation had much less impact than expected on public acceptance of congestion charging.

<sup>34.</sup> City of Melbourne (2019, p. 6).

Figure 1.8: Higher-income areas tend to have a larger share of people who drive to the CBD for work

Median total personal weekly income, by NSW state electorate



Notes: Only state electorates with at least 0.25% of their adult residents (i.e. people aged 15 years or older on the 2016 Census) commuting to the CBD by private vehicle are shown, for clarity. Median income is calculated across all employed people, excluding those who reported being away from work on the 2016 Census. Incomes are as stated in 2016 (i.e. not inflation-adjusted).

Source: Grattan analysis of ABS (Census, 2017).

Figure 1.9: As in NSW, Victoria's higher-income areas have a larger share of people who drive to the CBD for work Median total personal weekly income, by Victorian state electorate



### Figure 1.10: In every electorate, the typical driver to the CBD earns more than most of their neighbours

NSW state electorates, ordered by proportion of adult residents who drive to the CBD



Notes: Only electorates with at least 0.25% of the adult population commuting to the CBD by private vehicle are shown. Median income cannot be estimated for groups where more than half of the people are in the highest income bracket (more than \$3,000 per week).

Source: Grattan analysis of ABS (2017).

### Figure 1.11: As in NSW, the typical Victorian driver to the CBD earns more than most of their neighbours

Victorian state electorates, ordered by proportion of adult residents who drive to the CBD

![](_page_27_Figure_8.jpeg)

Notes: See Figure 1.10. Only electorates with at least 1% of the adult population commuting to the CBD by private vehicle are shown. Source: See Figure 1.10. Improvements could include reallocating road space to widen footpaths, giving signal priority to pedestrians to reduce dwell times at intersections, and creating safety barriers such as bollards to separate pedestrians from other modes of traffic.<sup>36</sup>

#### Spend the revenue on targeted transport investments

Dedicating the revenue to transport is an attractive alternative.<sup>37</sup> Drivers as a group would benefit from congestion charging through travel-time savings, and would receive further benefits if the government invested the revenue in roads. Those drivers who switched to public transport during peak times could benefit from investment in upgraded infrastructure and services.

Investment in transport infrastructure is popular with voters. A new motorway or train line provides concentrated benefits to certain voters, while the costs are dispersed over the entire tax base.<sup>38</sup> Even residents who don't plan on using the new infrastructure themselves hope it will lure other drivers off the routes they use.

International jurisdictions have hypothecated congestion charging revenue for transport infrastructure. In Sweden, the funds were initially promised to public transport, but later spent on a new motorway.<sup>39</sup> And in New York, lawmakers are discussing how to introduce congestion charging specifically to fund renovation of the ageing subway.<sup>40</sup>

- 37. Santos and Rojey (2004) find that public acceptance of congestion charging tends to rise if the revenue is spent within the transport sector.
- 38. Terrill (2018).
- 39. Börjesson et al (2012).
- 40. New York State, Governor's Press Office (2019).

For Sydney and Melbourne, the revenue from a CBD cordon is not likely to be large, certainly well short of the billions of dollars required for city-shaping mega-projects. But while modest, any amount of revenue spent on transport should be used efficiently to ensure net benefits for citizens. Fortunately, both the NSW and Victorian governments have independent infrastructure bodies that can advise them on worthwhile investments.<sup>41</sup>

Priorities could include:

- Expanding bus routes in under-serviced outer suburbs, with a focus on linking residents to the existing train network.<sup>42</sup>
- Reviewing and re-tendering bus routes to increase patronage.<sup>43</sup>
- Giving buses and trams signal priority at key junctions.
- Tackling road network bottlenecks, building on the NSW Pinch Point Programs and the Victorian Level Crossing Removal Project.

Motoring advocates may argue that the revenue should be spent on roads, since it is road users who pay the charge. But public transport investments have a stronger claim, where they involve improvements in under-serviced parts of the city. Improving public transport access for lower-income people would reduce their financial burden, if it offered a feasible alternative to owning and operating a car.<sup>44</sup>

#### A third option is to abolish vehicle registration fees for micro cars

When Australians buy new cars, they like them big. As consumers have become more affluent, they have chosen bigger, heavier, more powerful cars.

<sup>36.</sup> The City of Sydney submitted a proposal to do this to Infrastructure Australia in February 2016: Infrastructure Australia (2019, p. 79). The City of Melbourne has endorsed a transport strategy to improve pedestrian amenity, amongst other goals: City of Melbourne (2019).

<sup>41.</sup> See, for example, INSW (2018b) and IV (2016).

<sup>42.</sup> IA (2018a, p. 7).

<sup>43.</sup> IV (2018, p. 6).

<sup>44.</sup> In financial terms; see, for example, Davies (2011).

In 2001, passenger cars made up 72 per cent of new car sales. But by 2013, this had fallen to 52 per cent. Passenger cars were supplanted by sports utility vehicles (SUVs), which grew from 15 per cent to 29 per cent of new car sales, and light commercial vehicles, which grew from 13 per cent to 19 per cent.<sup>45</sup>

Smaller cars cause less congestion, both in traffic and when parked, but are not very popular. The smallest cars, classified as 'micro' cars, with a footprint of less than 6.3 metres squared, accounted for less than 1 per cent of new car sales in 2018. The next size up, 'light' cars, with a footprint of 6.3 to 7.5 metres squared, were just 7 per cent of new car sales.<sup>46</sup> This is well down from a decade ago, when the two categories combined accounted for 13 per cent of new car sales.<sup>47</sup>

If the vehicle fleet was made up of smaller vehicles, there would be many opportunities to get more use out of urban road space and parking space than at present. Our previous report outlined some of these opportunities.<sup>48</sup>

To encourage people to consider micro cars, governments could waive registration fees for them. At present, with so few people choosing micro cars, the cost would be modest.

#### 1.6.2 Ineffective ways to spend the revenue

Governments should not squander the revenue by offering wideranging exemptions or discounts, nor should they spread the revenue

- 47. National Transport Commission (2009, p. 43).
- 48. Terrill et al (2019, pp. 22–24).

too thinly, such as by offering all drivers a meagre reduction in vehicle registration. The revenue is likely to be too small to spend on major infrastructure projects – such projects would require additional state funding, as well as solid business cases.

#### Exemptions, discounts, rebates, and caps are mostly unnecessary

Reducing certain drivers' liability to congestion charges can be viewed as a use of revenue because it means forgoing some of the money that would have been collected in the absence of discounts.

There are four main classes of subsidy that could be used:

- an exemption from paying the congestion charge;
- a discounted rate (e.g. half-price cordon crossings);
- a rebate (e.g. refunding the first \$20 of congestion charges each month);
- a cap (e.g. a maximum charge of \$40 per week).

Each option undermines the effectiveness of the congestion charge. An exemption completely removes the price signal, and should be considered only for public transport and emergency vehicles. Residents inside the cordon, in particular, do not warrant an exemption – the cordon charge needs to be paid only inbound in the morning and outbound in the afternoon, so they will benefit from the better traffic flows even if they sometimes need to travel in the peak direction and thus pay the charge.

A discounted rate dilutes the price signal. And providing a discount actually encourages drivers to cross the cordon – because drivers gain no benefit from a discount unless they exercise it.<sup>49</sup> We therefore recommend a discount apply only to those drivers on low incomes

<sup>45.</sup> BITRE (2014).

<sup>46.</sup> National Transport Commission (2019a, pp. 8, 30). Examples of micro cars are the Kia Ja Picanto, Mitsubishi Mirage, Holden Spark, Fiat 500, Fiat Abarth, Suzuki Celerio, and Fiat Panda. Examples of light cars are the Hyundai Accent, Mazda 200, Toyota Yaris, Suzuki Swift, Honda Jazz, Kia YB Rio, Volkswagen Polo, Holden Barina, Mini Cooper, and Suzuki Baleno.

<sup>49.</sup> Stiglitz and Rosengard (2015, pp. 277–281).

whose mobility is impaired so that public transport is not feasible, but who must drive regularly to the CBD in peak periods.

A fixed rebate means that drivers face no price signal at all the first few times they drive in peak hour. For casual visitors to the CBD, the congestion charge may not deter any of their trips. And other drivers may feel the need to 'use up' their monthly allowance and make extra trips to the CBD when they wouldn't otherwise.

A cap on charges only insulates people who can afford to pay up to the cap limit. And once a driver has reached the cap, they face no price signal at all – this is particularly relevant for motorists who may cross the cordon several times in a peak period, such as taxis, ride-sharing vehicles, and delivery vehicles.

Given that drivers to the CBD tend to be much more highly advantaged than the general population, these subsidies would be a poor way to use the scheme's revenue. But the state governments may wish to consider subsidising the cost for the most disadvantaged travellers – those on low-incomes whose mobility is also constrained.<sup>50</sup>

#### Public transport fares should not be further subsidised

The revenue raised through congestion charging should not be used to reduce the price of public transport, though this is often touted as an option.<sup>51</sup> The basis for this idea is that public transport users tend to be less advantaged than drivers, so a public transport subsidy helps to redistribute wealth while compensating the drivers who are tolled off the road and onto the train or bus.

But Australian cities are very car dependent.<sup>52</sup> Even among the poorest fifth of households, car ownership is common.<sup>53</sup> And public transport accessibility is worse in outer areas, which tend to have lower-income households.<sup>54</sup> A public transport subsidy would fail to help many lower-income drivers, while providing a benefit to some already-advantaged commuters.

Public transport is already heavily subsidised. Fare revenue accounts for only 30 per cent of service costs in metropolitan Melbourne; across NSW, it's about 22 per cent.<sup>55</sup> These cost-recovery rates are very low by international standards.<sup>56</sup>

And there's a case to actually reduce subsidies if congestion charging is implemented. The NSW Government has decided to subsidise about three quarters of the cost of public transport, on the advice of the Independent Pricing and Regulatory Tribunal (IPART). This figure reflects the benefits that public transport patronage confers on society above what the user receives.<sup>57</sup>

For example, a commuter who takes the train reduces congestion on the roads, resulting in faster travel for other drivers, fewer emissions, and a lower risk of accidents. The commuter doesn't gain these benefits directly, so the government pays for them in the form of a fare subsidy.

With congestion charging, there would be slightly fewer drivers and the road network would operate more efficiently; removing an additional driver would therefore confer fewer benefits on the rest of society than

55. Public Transport Victoria (2018a, p. 13); and Audit Office of NSW (2018, p. 1).

57. IPART (2014a, p. 1).

<sup>50.</sup> This group could be identified through possession of both a disability parking permit and a Commonwealth-issued Health Care Card, or a Pensioner Concession Card for a disability support pensioner, for example.

<sup>51.</sup> See, for example, Manville and Goldman (2018) and International Transport Forum (2018, pp. 23–25).

<sup>52.</sup> Terrill et al (2018, p. 31).

<sup>53.</sup> Terrill et al (2019, Chapter 4).

<sup>54.</sup> IA (2018a).

<sup>56.</sup> IA (2018a, p. 14).

in the absence of congestion charging.<sup>58</sup> The logic of public transport subsidies suggests that this would warrant a lower fare subsidy.<sup>59</sup>

## There are too many vehicle owners for state transport taxes to be reduced very much

At the state level, there are two main vehicle-related taxes that can be reduced: registration fees, and motor vehicle duty. The revenue collected from congestion charging could in theory be returned to drivers through either or both of these taxes.

But a CBD cordon charge would not raise enough revenue to replace or even substantially reduce these charges. Due to the large number of vehicle-owners across Victoria and NSW, the pool of revenue would be spread very thinly. A registration discount of, say, \$20 may not be enough to gain many motorists' support.<sup>60</sup>

## **1.6.3** Governments have the scope to be creative with how they spend the revenue

While the revenue should be spent in a fair and efficient way, it's possible that other claimants could better capture people's imaginations. If political will is the major barrier to congestion charging, finding a political solution will be necessary, even if it's not quite as fair or efficient as other options. For example, arguably the most disadvantaged group in Australian society at the moment is the homeless population. The revenue from congestion charging could be dedicated to social housing and other crisis services that help the most vulnerable members of society.

This option unashamedly gives priority to welfare gains for the most disadvantaged.<sup>61</sup> Drivers may accept this rationale, particularly if they feel troubled seeing homeless people around their city.

Similarly, governments could appeal to drivers' sympathy by spending the revenue on a new facility at the Sydney Children's Hospital, or an upgrade to the trauma centre at Royal Melbourne Hospital. Signs could be installed at every entry point to the cordon reminding drivers of where their money is going. Such an investment might help in 'selling' congestion charging as a positive contribution to society rather than just a personal cost.

These options are unconventional ways of hypothecating congestion charging revenue. But they serve to remind governments that they can market congestion charging creatively if they wish, particularly if voter opposition is the major barrier to implementation.

<sup>58.</sup> For a discussion of this non-linearity, see Hubbard (2009).

<sup>59.</sup> IPART (2014b, p. 6) notes that subsidising public transport is a second-best alternative to socially-optimal road pricing.

<sup>60.</sup> A second issue is that concession card holders may already receive discounted vehicle registration, in which case their remaining liability may be smaller than the discount funded by the congestion charge. In that case, more advantaged drivers would be able to claim the entire discount while concession holders would be able to claim only their remaining liability, reducing their registration fees to zero. Taking congestion charging in isolation, this would mean a larger subsidy for richer drivers than for poor.

<sup>61.</sup> This might be described as the Rawlsian approach: Rawls (1971).

### 2 Phase 2: start charging on key arterial roads and urban freeways

Bedding down a cordon charge will take time. If overseas experience is any guide, state governments can reasonably expect that support for a well-designed CBD cordon charge will grow over time.<sup>62</sup>

While CBD cordons in Sydney and Melbourne would have the greatest impact in the inner parts of the cities, there is a limit to what impact it could have across the city as a whole. Accordingly, the next priority is to establish congestion charging on key arterial roads and urban freeways, within five to ten years. That is where much of the worst congestion is today (see Figure 2.1 on the next page and Figure 2.2 on page 35), and where it will continue to varying degrees once cordon charging has been established around the CBDs of Sydney and Melbourne – unless further action is taken.

## 2.1 A per-kilometre charge on the most congested arterial roads in peak periods

Governments should introduce per-kilometre 'corridor' charges on the most congested arterials and urban freeways in the morning and afternoon peaks. The charge should apply only in the peak direction where there is a clear peak direction (e.g. city-bound in the morning peak), and in both directions on some corridors.

While the optimal charge depends on traffic patterns in the future, modelling of corridor charges applied to the road network as it was in 2016 suggests that 30 cents per kilometre could improve speeds on most parts of these charged roads by more than 10 per cent in the morning peak. As with cordon schemes, governments should also introduce a lower shoulder charge in the hour or half-hour either side of the peaks. In Sydney, the corridors to be charged first could include sections of the A3 and the A6, Military and Spit roads, the Victoria Road - Western Distributor (A4) corridor, and the M5 East - M1 corridor past the airport.

In Melbourne, charged corridors could include Hoddle Street - Punt Road, the Eastern Freeway - Alexandra Parade - Elliot Avenue corridor, the West Gate Freeway, and the Monash Freeway.

Existing and planned toll roads are a complication. Sydney has nine toll roads (and one tolled ramp; see Figure B.1 on page 72 for more details), and tolls are planned for the remainder of the WestConnex project, NorthConnex, the F6 Extension, Western Harbour Tunnel, and Beaches Link.<sup>63</sup> Melbourne has two toll roads, with the North East Link and West Gate Tunnel to be added.<sup>64</sup> We do not recommend that governments impose corridor charges on roads that are already tolled. Appendix B explains the implications of carving out toll roads from a corridor charging scheme.

As for cordon charges, governments should be advised on the level of corridor charges by an independent body (see Section 1.2.2).

#### 2.2 Why corridor charging should be the next step

Corridor schemes work by charging traffic travelling in a high-demand direction on arterial roads and urban freeways. These roads are designed to carry higher volumes of traffic, and they are at their most effective when as many people as possible can rely on using them to get to their destination in a timely and predictable way.

<sup>63.</sup> Portfolio Committee No. 2 - Health and Community Services (2017, pp. 12-15).

<sup>64.</sup> See North East Link Authority (2018, Chapter 9, p. 2), and West Gate Tunnel (Truck Bans and Traffic Management) Act 2019.

<sup>62.</sup> Terrill et al (2019, pp. 13–14).

![](_page_33_Figure_1.jpeg)

#### **Figure 2.1: Much of the worst congestion in Sydney is on key arterial roads and urban freeways** Volume-to-capacity ratios in the morning peak (7am-9am), 2016

Notes: Line width is scaled to the traffic volume of the road. In the left figure, only roads with volumes of at least 1,000 vehicles are shown. Sources: Grattan analysis of IA (2019a) and IA (2019b).

![](_page_34_Figure_1.jpeg)

**Figure 2.2: Much of the worst congestion in Melbourne is on key arterial roads and urban freeways** Volume-to-capacity ratios in the morning peak (7am-9am), 2016

Notes: Line width is scaled to the traffic volume of the road. In the left figure, only roads with volumes of at least 1,000 vehicles per hour are shown. Sources: Grattan analysis of IA (2019a) and IA (2019b). When traffic on an arterial road or urban freeway slows to a crawl, it's clear that the road is reaching its physical capacity; in engineering terms, its volume-to-capacity ratio approaches one. Figure 2.1 and Figure 2.2 show that, in 2016, many of Sydney and Melbourne's largest freeways and most important arterial roads were operating at capacity in the morning peak – and still more people wanted to use those roads than could fit.<sup>65</sup>

When roads become too crowded, just a few more cars can halt the flow altogether, while taking a modest number of vehicles off the road can improve traffic speeds dramatically.<sup>66</sup>

Chapter 1 showed that CBD cordon schemes would improve congestion on some freeways and arterial roads beyond the CBD. But severe congestion is likely to remain on many corridors, particularly those not connected to the CBD. Corridor charging is a way to directly address these sources of congestion, thus complementing a cordon scheme and moving toward network-wide distance-based congestion charging.

Corridor charging can be implemented using Automatic Number Plate Recognition and can therefore use the technology platform and back office infrastructure that would already be in place for cordon schemes.

Corridor charging could be combined with a reduction or abolition of state government charges for driving. For instance, the ACT Government is considering replacing vehicle registration fees with a charge that varies according to the level of road use.<sup>67</sup>

## 2.3 Corridor charging should improve speeds on major arterial roads

Corridor charging schemes are effective at reducing congestion, much as prices are generally used to allocate goods and services that are in demand.

Exactly how effective is difficult to quantify, because corridor charging schemes should be introduced after CBD cordons are well-established. This means that the transport network into which corridor charging would be introduced would differ substantially from the network of today.

Nevertheless, we have indicative results. Veitch Lister Consulting modelled a broad network of corridor charges in Sydney and Melbourne, consisting of about 200 kilometres of the highest-volume and most congested arterial roads and freeways, for 2016.<sup>68</sup> The charge modelled was 30 cents per kilometre in the peak direction (or both directions, as appropriate), in both the morning and afternoon peaks.

The modelling showed an increase in travel speeds of about 2 per cent across Sydney and Melbourne's metropolitan areas in the peaks. On the charged corridors themselves, speeds generally improved by at least 10 per cent in the morning peak.

While some drivers may take small roads and side streets to avoid corridor charges – known as 'rat-running' – the modelling suggested this would be limited and localised. This is perhaps not surprising considering alternative routes to freeways and arterials often involve roads with lower speed limits and more intersections. It would appear that the time cost of taking alternative routes might deter many drivers.

<sup>65.</sup> This is evident on roads where the modelled volume-to-capacity ratio was greater than one.

<sup>66.</sup> Orosz et al (2009).

<sup>67.</sup> ACT Government (2019, p. 56).

<sup>68.</sup> This network of corridor charges was modelled without a cordon scheme in place. The results can be interpreted as showing the effectiveness of a broad network of corridor charges as a standalone scheme.
#### 2.4 Corridor charging should deliver a net economic benefit

Corridor charging is an efficient way to tilt the balance of which trips are taken in peak periods. But quantifying the net benefits to the community is difficult, for three main reasons.

First, determining which roads would be charged and the level of charge depends on the shape of the road network and travel patterns in the future, after the introduction of cordon schemes. Because we recommend a cordon first, we cannot be too prescriptive yet in our recommendations about corridor charging (though some options were canvassed in Section 2.1). While roads in the CBD will always be in-demand, congestion on individual roads across each city may look different in five years from what we see today.

Second, the nature of our modelling means we cannot reliably estimate the 'disbenefit' to drivers who are priced off charged corridors, beyond those who are assumed to switch to public transport. One reason is that it's difficult to separate the drivers who, facing a congestion charge, chose a less-preferable destination from the drivers who actually started driving somewhere more favourable as a result of the better-flowing road network.

Third, both examples of and proposals for the kind of corridor charging scheme we envisage are rare. This means there is little publicly available information with which to estimate likely set-up and operating costs.

Despite being unable to present the full economic case here, we remain confident that corridor charging would deliver a net benefit, again for three main reasons. First, we know that charging the use of roads directly will reduce congestion on them, and therefore yield travel time savings. This accords with both commonsense and the modelling that we have had undertaken. Second, the modelling shows that any shifting of congestion to other roads would be limited. This accords with common sense. Third, we are optimistic about cost effectiveness because the systems and infrastructure required to implement corridor charging might at least partly leverage those that will be already in place for cordon schemes.

## Box 4: Charging corridors means benefits for travellers as well as costs – and these benefits can be substantial

Jack is a landscaper who travels all over Sydney's north shore for work. He pays tolls on many trips, but still endures a lot of traffic.

Congestion charging on Military and Spit roads would mean paying an extra couple of dollars to get to or from jobs during peak times, but also saving a few minutes on each journey. Every so often, that extra time would be the difference between fitting in another job or going home early. Like all the other tradespeople operating in the area, Jack could pass on to his customers the full costs of a congestion charge. He would have the option of passing on some of the benefits, too.

### 2.5 Corridor charges would be substantially paid by better-off drivers

Corridor charging in the peak would mainly affect commercial traffic, such as freight, and commuters. Commercial and commuting trips are often very constrained as to when and where they occur, and they constitute a large proportion of trips during peak times (see Figure 2.3 and Figure 2.4 on the following page). Other drivers tend to travel shorter distances, may face the charge only occasionally, or may have greater flexibility to change the time at which they travel. This is especially true for people going shopping or socialising.

for driving, but there are many other reasons too



Figure 2.3: In Sydney's morning peak, work is the most common reason

Notes: Data includes only drivers who depart between 7am and 9am on weekdays. There are classification differences between the Sydney and Melbourne surveys. While trips in Melbourne are described according to their main purpose, a Sydney trip to work that includes stopping to buy something could count as two trips (one work-related, one shopping). In Sydney, the 'Other' category includes trips to change mode of travel (such as driving to the station); in Melbourne, this would probably be coded according to the main purpose, so all park-and-ride trips would be allocated as 'Work-related' rather than 'Other'.

Source: Grattan analysis of State of New South Wales (2019).

Figure 2.4: In Melbourne's morning peak, most drivers are commuting or travelling for work

Percentage of driving on weekday mornings



Notes: Data includes only drivers who depart between 7am and 9am on weekdays. Original survey contains 9,674 morning-peak driver observations, sampled between 2012 and 2016. Each observation is weighted to reflect the population at the SA3 level. Here, SA3s have been aggregated to the Melbourne Greater Capital City Statistical Area.

Source: Grattan analysis of Victorian Department of Transport (2016).

And while parents with young children have fairly strict drop-off times, school is typically closer to home than work. Dropping off or picking up someone in the morning peak accounts for 32 per cent of trips in Melbourne and Sydney, but no more than 17 per cent of kilometres on the road (see Figure 2.3 and Figure 2.4). And for parents driving to primary school, most journeys are less than 3km.<sup>69</sup>

Corridor charging would affect some low-income drivers who have to travel to particular places in peak periods. These trips may be work-related or personal. A corridor charging scheme should include a safety net for low-income drivers who have long distances to travel, need to do so by car, and lack flexibility to travel at another time or to a different destination.<sup>70</sup>

There are unlikely to be a large number of such drivers. Those who drive further to get to work tend to earn more, as explained in our previous report.<sup>71</sup> And perhaps surprisingly, lower-income people typically don't have to drive further than people with higher incomes, especially in the morning peak (see Figure 2.5). About 30 per cent of people work in the same suburb as they live, or the next one.<sup>72</sup>

Many low-income drivers today avoid incurring tolls, and many would also avoid corridor charges.<sup>73</sup> They may change when they travel, where to, by what method, by what route, or they may not take the trip at all. In the longer term, they may move closer to work or take a job closer to home.

- 70. See, for example, Terrill et al (2019, p. 40). Different types of travel subsidy were discussed in Section 1.6.2.
- 71. Ibid (Chapter 4).
- 72. Terrill et al (2018).
- 73. Terrill et al (2019, pp. 37–39). And it's not just low-income drivers a congestion charge provides a financial incentive for *all* drivers to avoid the busiest roads at the busiest times.

### Figure 2.5: Lower-income drivers don't actually travel further than higher-income drivers

Distribution of commute distances within each personal weekly income bracket reported on the 2016 Census



Notes: Data is for full-time workers who reside in the greater capital city statistical area and commute by private vehicle. Line height is to scale – the \$1,000-\$1,249 income bracket is the most commonly reported income for people who commute by private vehicle. A similar chart showing the median distance driven to work for both full-time and part-time workers is in our previous report: Terrill et al (2019, p. 36). Source: Grattan analysis of ABS (2017).

<sup>69.</sup> Grattan analysis of Victorian Department of Transport (2016). Data for Sydney was not available.

### **3** Phase 3: network-wide distance-based charging

Network-wide distance-based congestion charging is much more comprehensive than cordon or corridor charging. It encompasses not just congested places and times, but potentially all parts of the road network, and finer differentiation of large vehicles from small ones.

Network-wide congestion charging has many supporters, some of whom are attracted by the higher revenue, which they want to see earmarked for road construction and maintenance.<sup>74</sup> Other supporters see network-wide charging as a way to manage all aspects of road costs and use, including but not limited to congestion.<sup>75</sup>

There is no consensus on even the broad outline of a model: whether there would be a charge in off-peak as well as peak periods, whether different zones of the city would have different levels of charge, and whether charges should be higher in the direction that most traffic is travelling in peak periods.

Comprehensive road-user charging is only an option for the longer term. With so many sceptics and opponents, proving the value of congestion charging through a more modest scheme is the first step. Even corridor charges are best implemented in stages, for reasons covered in Chapter 2. And even if governments wanted to proceed more quickly, there are significant areas of work required before network-wide distance-based congestion charging would be feasible. First, the technology would need to mature. Second, stronger legal protections of privacy would have to be in place. Third, state governments would have to decide how to integrate network-wide charges with existing and future toll roads, Fourth, governments would need to show how such schemes could operate fairly. And fifth, as part of any 'fairness package', the states would have to gain Commonwealth agreement to abolish fuel excise. The following five sections explain these conditions.

#### 3.1 The technology would need to mature

Automatic Number Plate Recognition technology is well suited to cordon and corridor charging (as explained in our previous report).<sup>76</sup> For either scheme, the number of stationary data collection points would not be huge, and the technology itself has become more accurate over time.

But network-wide distance-based congestion charges need much more frequent data collection, both on entry and exit to the charged area and also throughout the zone. Automatic Number Plate Recognition would be too expensive as the primary technology.

A Global Positioning System (GPS) approach is a better option, with Automatic Number Plate Recognition used solely for enforcement and thus requiring fewer stationary data collection points. For a GPS system, each car would need an on-board unit capable of receiving signals from the GPS.<sup>77</sup>

<sup>74.</sup> For instance, the Productivity Commission recommends road user charging, with the revenue hypothecated to bodies known as Road Funds that would make investment decisions in consultation with road users: PC (2017a) and PC (2017b, pp. 18–19). IA (2016a, pp. 8–9) has argued that road pricing is needed 'to allow charging to be linked to funding and supply to demand', as has Infrastructure Partnerships Australia (2014, p. 8), the AAA (2016), the RACV (2016), and the National Roads and Motorists' Association: Siorokos (2014).

<sup>75.</sup> For instance, Hensher (2018) sees it as the form of congestion charging with the greatest scope for achieving public acceptance.

<sup>76.</sup> Terrill et al (2019, Appendix A).

<sup>77.</sup> The GPS is the US government's set of satellites in the Global Navigational Satellite System. Each satellite transmits information at regular intervals about

GPS systems have several advantages for congestion charging. They are very accurate,<sup>78</sup> they are flexible enough that they could be programmed for extra functions such as navigation, and they could be updated relatively easily with changes in the geographic zone, the price, or the charged time periods.

Even so, GPS systems have their drawbacks. The built-up central parts of Melbourne and Sydney could create a canyon effect, causing temporary loss of signal.<sup>79</sup> There is a one-off logistical challenge in getting cars fitted with on-board units. And there is the ongoing challenge in ensuring that on-board units operate as intended, without fault or tampering.

Most importantly, despite some progress, GPS has not yet been proven in a comparable context overseas.

To date, GPS has worked as one technology option alongside others in several places. Oregon's OReGO program gives drivers the option of GPS and non-GPS on-board units for its distance-based road user charge.<sup>80</sup> The German Toll Collect system primarily uses GPS-enabled on-board units, and also uses Automatic Number Plate Recognition and Dedicated Short Range Communication technologies for verification on its national motorway network.<sup>81</sup> Switzerland's heavy vehicle charging system uses a GPS-enabled on-board unit as its primary technology, backed up by Dedicated Short Range Communication, covering all Swiss roads. Heavy vehicles without an on-board unit must comply with a manual system. To update its

- 78. Modern GPS on-board units can be accurate to within a few metres: NOAA (2019).
- 79. Palma and Lindsay (2011, pp. 1, 387).
- 80. Oregon Department of Transportation (2017).
- 81. Palma and Lindsay (2011).

existing congestion charging scheme, Singapore plans to introduce GPS-enabled on-board units in cars.<sup>82</sup>

GPS is very promising as a technology for network-wide distancebased congestion charging, but there are advantages to letting another jurisdiction prove it first.

#### 3.2 Privacy protections would have to be tightened

Several privacy protections should accompany a cordon or corridor scheme implemented using Automatic Number Plate Recognition. But a network-wide scheme that uses GPS raises an additional privacy concern – that people might be tracked. This could happen because a GPS on-board unit records periodic clusters of information, each of which consists of the time, location, and identity of the vehicle.

There are solutions, and these are explained in further detail in Chapter 4.

## 3.3 What happens with existing toll roads would have to be resolved

Sydney and Melbourne already have toll roads, and more planned, as outlined in Section 2.1 on page 33. The arrangements are written into contracts that extend, in some cases, for the next 40 years and beyond.

Just as governments would need to address the interaction of corridor charges with existing toll roads, so too would they need to do so for network-wide distance-based congestion charging.

In fact, the tension is substantially more acute for network-wide charging, for two reasons. First, it's less straightforward to excise existing toll roads from a network-wide congestion charge. It may be difficult to determine when a driver is on a toll road versus a non-toll

the current time and its position; these signals would be intercepted by the car's on-board unit, which would use this information to pinpoint the car's location and determine whether it was in the charging zone.

<sup>82.</sup> D'Artagnan Consulting (2018, p. 11).

road if the two overlap, as they could in the Lane Cove Tunnel and on Epping Road in Sydney, or on Grant Street and in the CityLink tunnels in Melbourne.

And second, network-wide distance-based congestion charging could also encourage many more people to use non-car forms of transport than either cordon charging or corridor charging. This shift could cause a noticeable reduction in demand for toll roads, for which the operators might seek compensation. Governments need to decide how to resolve this 'patronage risk'. One option would be for governments to renegotiate toll road contracts to take back the patronage risk from the private sector. Other options are presented in Appendix B.

#### 3.4 There would have to be a fairness package

Network-wide distance-based congestion charges are likely to have a greater impact on higher-income drivers, but it cannot be ignored that they will also substantially affect lower-income drivers. This is a key point of difference between CBD cordon schemes and other forms of congestion charging.

Governments have many options to ensure fairness. They could use the funds to:

- Provide a travel allowance for low-income drivers, to use for their road user charges or, if they make other adaptations, to use on whatever they prefer.
- Provide a travel allowance for all low-income people, to use for road user charges or whatever else they like.
- Cut inefficient taxes, such as stamp duty on conveyancing, or payroll tax.
- Cut other road-related charges, such as vehicle registration.

- Return the money as a Decongestion Dividend to every person or every household in Sydney and Melbourne.
- Dedicate the funds to public transport improvements.
- Dedicate the funds to road improvements.
- Spend the money on the most vulnerable in the community in Sydney and Melbourne.

The revenue should be used to improve fairness in the eyes of the community, without undermining the core objective of the scheme – to reduce congestion.

#### 3.5 Fuel excise would have to be abolished

Fuel excise significantly increases the running cost of most cars. It is a Commonwealth tax, levied on petrol and diesel at a rate of 41.8 cents per litre.<sup>83</sup>

While fuel excise taxes driving, it is a very blunt instrument when it comes to congestion. It may be that people who drive the most in peak conditions in busy parts of the city pay a high share of fuel excise, but so do people in regional areas who cover longer distances in uncongested conditions.

Rather than levy both fuel excise and congestion charges on drivers for the same trip, any comprehensive network-wide distance-based congestion charging scheme should replace fuel excise.

Ultimately the Commonwealth Government will need to move away from fuel excise. It is gradually declining as a proportion of

ATO (2019). Other fuels are taxed at different rates. Fuel excise raised about \$13 billion in 2018-19, constituting less than 5 per cent of Commonwealth tax receipts: Treasury (2019).

GDP, as vehicles become more fuel-efficient.<sup>84</sup> And over time fuel excise is likely to decline further – though very slowly – as the fleet shifts towards electric vehicles.<sup>85</sup> Once electric vehicles start to become widespread, it will become more apparent that there is no corresponding road-related tax or charge on people who drive electric vehicles, which are typically more expensive than petrol cars or diesel cars, and that this is unfair.

Network-wide distance-based congestion charging remains within the realm of state governments, unless the Commonwealth were to introduce a road user charge or tax that applied across the whole country.<sup>86</sup> For as long as it is up to individual state governments to introduce network-wide distance-based charges, it is difficult to see the Commonwealth agreeing to a nation-wide reduction or abolition of fuel excise. Such a negotiation could occupy the Council of Australian Governments (COAG) for quite some time.

- Only 0.2 per cent of the current vehicle fleet is electric today. This figure is projected to reach 4 per cent – or 20-to-25 per cent of sales – by 2030: IA (2019c, p. 284) and Energeia (2018, p. 7).
- 86. s. 51(ii) of *The Constitution* prohibits the Commonwealth from discriminating between states or parts of states when it levies tax.

<sup>84.</sup> PBO (2018, p. 9). It declined markedly between 2001 and 2014, because it was not indexed during that period.

### 4 How to address privacy concerns with congestion charging

To implement a congestion charge, the authorities need to know who to bill for being in a relevant location at a relevant time. This means the authorities need to collect data about vehicles: where they were, at what time, and who is liable for paying the bill. Current law is not well equipped to deal with the privacy concerns this could cause.

This chapter is primarily about the privacy implications of Automatic Number Plate Recognition (ANPR), which we recommend as the most viable option for cordon and corridor charging. It is also relevant to GPS, which is likely to be the most viable technology for a whole-of-network congestion charging scheme in the longer term. Figure 4.1 illustrates how ANPR and GPS work.

The next section outlines why privacy should be taken seriously in the establishment of a congestion charging scheme. The following three sections identify solutions to the three main concerns about congestion charging from a privacy perspective: how to protect personal data from hacking; how to ensure it could not be used for surveillance; and how to ensure it is not used for unwanted marketing. The final section identifies ways to protect individuals from being tracked – a concern specific to GPS.

# 4.1 Why privacy should be taken seriously in congestion charging

Congestion charging relies on authorities collecting large numbers of images of vehicles' number plates, at particular times and places, and a way of linking this information to individual bill payers.<sup>87</sup>

Figure 4.1: How Automatic Number Plate Recognition (ANPR) and GPS work





Source: Graphics obtained from flaticon.com.

<sup>87.</sup> Even if another technology, such as GPS, were used as the primary technology, it is very likely that it would be backed up by ANPR.

This is not the same as people simply being observed going about their business. When we enter a public place, such as a road or a park, we make our presence known to all who see us. But we do not give permission to be photographed. Nor do we allow someone to log our name and geographical coordinates. If we do give permission to be photographed or have our location recorded, we expect that this information will be properly safeguarded.

The fact that many people don't want others having access to such information about them should in no way suggest they have nefarious intent. The very large number of observations that would be collected, along with their link to a specified individual vehicle owner at a time and place, are key differences between casual observation and infringement of privacy.

#### 4.2 How to protect personal data from hacking

When people worry about unauthorised access to personal data, the typical concern is that a database could be hacked, and their information could be viewed, modified, or removed. This concern is intensified in the case of sensitive information, if, for example, the ANPR images captured information about the racial or ethnic origin of a driver. Appendix D.3.2 on page 88 explains the difference between personal and sensitive information in more detail.

Privacy laws do not require an individual's consent to collect personal information, but they do for sensitive information. Consent must be informed, voluntary, current, and specific, and individuals must have the capacity to understand what they are consenting to.<sup>88</sup> The congestion charging legislation would need to address directly the classification of the information collected and its relationship to the relevant privacy laws.

While privacy laws do not require an individual's consent for collecting personal information, they do require that entities take reasonable steps to ensure that personal information is protected from misuse, interference, loss, unauthorised access, modification, and disclosure.<sup>89</sup>

#### 4.2.1 Store personal data in a decentralised system

While traditional data storage relies on a centralised database, it has become common to rely instead on a distributed database system (as depicted in Figure 4.2 on the following page).

In a centralised database system, all data are stored in the same physical location. This central location is the main computer, called a 'server'. Other computers, or nodes, are connected to and can provide data inputs to the central server. This type of system is used in traditional data storage.

The disadvantage of such a system is that it can act as a honeypot: the pay-off for a successful hack is greater than if the information was more dispersed. A hacker who gains access to a central server can read, modify, or remove all data, not just parts.<sup>90</sup>

By contrast, in a distributed system, there are no servers or dedicated physical data storage facilities. Information is encrypted and contained in the computers or nodes, which can be geographically separate. Encryption prevents one node from gaining access to data from another node. If one node is hacked, less information is at risk than with a centralised database.

A further protection, known as 'sharding', is to break files into pieces such that no single participating node can access the entire content.

<sup>88.</sup> Office of the Australian Information Commissioner (2019, Chapter B).

<sup>89.</sup> Australian Privacy Principle 11 of the *Privacy Act 1988* (Cth); s. 12 of the *Privacy and Personal Information Protection Act 1988* (NSW); Information Privacy Principle 4 of the *Privacy and Data Protection Act 2014* (Vic).

<sup>90.</sup> Katalyse.io (2018).

The entire content can only be accessed by an external application which has the unique key.  $^{\rm 91}$ 

The entity holding the data needs also to provide staff training, adequate resources, and a management focus on safeguarding information. This should be done in accordance with the Office of the Australian Information Commissioner's guidance on the security of personal information.<sup>92</sup>

While no system is perfect, a distributed system offers a better way for authorities to protect personal information from misuse, interference, loss, unauthorised access, modification, or disclosure.

We therefore recommend that state governments require personal information collected for congestion charging be stored in a decentralised database system.

#### 4.3 How to protect against government surveillance

Some people may worry that data from ANPR cameras could be used by authorities as part of mass surveillance. This 'Big Brother' concern was cited as a common source of data privacy uncertainty in the Productivity Commission's *Data Availability and Use* report.<sup>93</sup>

Currently, Australian privacy legislation does not adequately protect against individual or mass surveillance by law enforcement agencies. In fact, conducting surveillance is one of the law enforcement activities expressly permitted in Commonwealth and Victorian legislation.

Australian privacy legislation currently allows entities to disclose personal information to law enforcement agencies if the entity reasonably believes disclosure is necessary for law enforcement

92. The guidance is provided to flesh out Privacy Principle 11 in the *Privacy Act 1988* (Cth): Office of the Australian Information Commissioner (2018).



Figure 4.2: Centralised and decentralised databases

Source: Graphics obtained from flaticon.com.

<sup>91.</sup> Bains (2018).

<sup>93.</sup> PC (2017c, Chapter 3).

activities.<sup>94</sup> In addition, Victorian legislation facilitates information sharing between roads corporations and law enforcement.<sup>95</sup>

The concern about surveillance is all the more intense because of the length of time that personal and locational information may be retained by the congestion charging authority. Commonwealth law states that entities must take reasonable steps to destroy or de-identify personal information after it is no longer required for use or disclosure purposes.<sup>96</sup> Victorian legislation requires that information must be permanently destroyed if it is no longer required for *any* purpose.<sup>97</sup> NSW legislation states that the personal information must not be retained for longer than is required, though it does not specify the de-identification or destruction requirement.<sup>98</sup>

These legal provisions, when applied to multiple images from ANPR, do not guard against the possibility that de-identified data could be re-identified, especially where entities have access to other datasets for cross-referencing.<sup>99</sup> Entities have plenty of leeway where they are not required to de-identify or destroy information and may instead continue to use it.

Two changes to privacy law are needed to protect individuals against the risk that their personal information is used for surveillance: court warrants to access personal information, and stricter controls on how long entities can retain personal information.

- 95. s. 90K of the *Road Safety Act 1986* (Vic). Potentially also relevant are the Commonwealth's *Surveillance Devices Act 2004*, which authorises use of surveillance devices to protect the public from a terrorist act or similar, and the NSW *Workplace Surveillance Act 2005*, which applies to employees who could be tracked on the job while in their employer's vehicle – particularly since employee records are exempt under s. 7B(3) of the *Privacy Act 1988* (Cth).
- 96. Australian Privacy Principle 11, Privacy Act 1988 (Cth).
- 97. Information Privacy Principle 4 (2), Privacy and Data Protection Act 2014 (Vic).
- 98. s. 12, Privacy and Personal Information Protection Act 1988 (NSW).
- 99. National Transport Commission (2019b, p. 15).

## 4.3.1 Prohibit use of personal information for law enforcement without a court warrant

Court warrants would provide an effective protection against use of personal information, such as ANPR images, for surveillance. Personal information from congestion charging is arguably a special case, because the volumes of information are potentially very high. Therefore the requirement to obtain a court warrant need only apply to congestion charging information, not all personal information.

While this requirement could slow down law enforcement agencies' investigative processes, it would not completely restrict them. If courts decide that having access to this location information is required to perform the relevant law enforcement activity, they will authorise disclosure. This strikes a reasonable balance between law enforcement and assurance that individuals' personal information is not accessed without adequate reason.

This requirement would constitute a change from current arrangements, where entities – such as a congestion charging entity – are the ones to decide when disclosure of information to law enforcement is reasonably necessary. It would shift decision-making to the courts, which have a long history of delineating what is reasonable and unreasonable, necessary and unnecessary.

We therefore recommend that the *Privacy Act 1988 (Cth)* and relevant state privacy law be changed to require a court warrant for law enforcement agencies to access personal information collected as part of a congestion charging scheme.

# 4.3.2 Establish stricter controls on the length of time personal information can be retained

The second safeguard is stricter controls on how long entities retain personal information. ANPR images and data should be deleted after

<sup>94.</sup> Australian Privacy Principle 6, Privacy Act 1988 (Cth).

payment of the charge has been received or, if the vehicle is subject to a discount or exemption, after 24 months from the date of the transaction. These time periods allow for correspondence, concerns, and complaints, and are equivalent to those in place for the London congestion charging scheme.<sup>100</sup>

We therefore recommend that privacy law be updated to specify that images and data collected as part of a congestion charging scheme should be deleted after payment of the charge has been received or, if the vehicle is subject to a discount or exemption, after 24 months from the date of the transaction.

#### 4.4 How to protect against unwanted marketing

Concern about use of personal information for unwanted marketing could arise if several companies were vying for customers and one was able to make use of location information from congestion charging to gain an advantage in a different part of its business. Alternatively, an operator could disclose or sell personal information to third parties.

Such concerns are valid. Existing legislation does not completely rule out disclosure without consent, and at the least give rise to some uncertainty for drivers.

Australian privacy legislation states that if personal information has been collected for a particular purpose, the entity cannot use it for a secondary purpose unless the affected individual has consented, or would reasonably expect use for this secondary purpose.<sup>101</sup> It also states that this information cannot be used for direct marketing purposes unless the affected individual would reasonably expect information to be used for marketing and can unsubscribe from direct marketing.<sup>102</sup>

- 101. Australian Privacy Principle 6, Privacy Act 1988 (Cth).
- 102. Australian Privacy Principle 7, Privacy Act 1988 (Cth).

Two changes to privacy law are needed to address concerns about use of data for marketing: clearer industry guidelines for use of data by the entity that collected it; and stronger law covering the circumstances in which data can be sold or given to another entity.

### 4.4.1 Clearer industry guidelines for entities to use personal information they have collected

If governments contract out the operation of a congestion charging scheme, clearer industry guidelines will be needed to cover the use within a company or group of companies of personal information collected for the primary purpose of congestion charging. These guidelines should be publicly accessible and reflect community expectations about how such information is used.

We therefore recommend that state governments establish as part of a congestion scheme the industry guidelines to cover the use of personal information.

### 4.4.2 Regulate the purposes for which personal information from congestion charging can be used

Stronger law is needed to regulate the purposes for which personal information collected for congestion charging is provided to a separate entity. In particular, the law should recognise the possibility that de-identified personal information can be re-identified, if the party to which it is disclosed has access to relevant information for cross-referencing.<sup>103</sup>

We therefore recommend that Commonwealth and state law should be tightened to limit and regulate the purpose to which personal information collected as part of congestion charging can be put.

<sup>100.</sup> Transport for London (2019a).

<sup>103.</sup> This point has been made in the context of a recent data breach of Victorian public transport cards, known as Myki cards: see Baird (2019), for example.

#### 4.5 How to protect against location tracking

Drivers might be uneasy with the idea that the personal information collected about them could allow location tracking. This concern mainly arises with GPS on-board units because of the high volume of location information collected.<sup>104</sup>

The kind of tracking that gives rise to this concern is not so much anonymous monitoring of cars, as might occur if an air traffic control helicopter were to monitor the movement of vehicles on a road. It is rather the situation where the driver's identity can be linked to that tracking that gives rise to the concern.

Some people may be concerned about tracking within a congestion zone (in the case of a cordon charging scheme). But an additional concern is the potential for location tracking anywhere, even beyond the congestion zone.

#### 4.5.1 Structural separation of the congestion charging authority

The system should be designed to ensure that the organisation processing the data does not have sufficient information at any time to link a driver's identity to their location information.<sup>105</sup>

The technology permits such a design. A GPS on-board unit records periodic clusters of information. Each cluster consists of the time, location, and identity of the vehicle. Over a period of time, as the car moved through the congestion zone, it would generate and store many of these clusters of information. The solution to the concern about tracking location is to separate the time and location information from the identity information (see Figure 4.3).



Source: Graphics obtained from flaticon.com.

On-board

Figure 4.3: An encryption solution

<sup>104.</sup> This concern would also apply to Dedicated Short Range Communication, because it also relies on an on-board unit.

<sup>105.</sup> Privacy by design is a requirement of Australian Privacy Principle 1, and is explained in Office of the Australian Information Commissioner (2014).

This could be done by separating the congestion charging operator into two entities, which would not share information. The on-board unit would compute time, location, and identity information, and encrypt the identity information. It would also attach to the time and location information a unique code, or nickname, for the vehicle's identity on that particular trip.

The on-board unit would send the encrypted identity information and the time, location, and nickname to the first division of the congestion charging authority. This first division would aggregate all the time and location information for a particular nickname, to compute distance information. It would place this into a cost function to determine how much the driver should be billed. It would send the still-encrypted identity information along with the billing information to the second division of the congestion charging authority.

This second division would have the key required to decrypt the identity information. Because these two divisions would not share information, the second division would not receive the time and location information associated with that identity – only the billing information. It could then use the billing and identity information to bill the right driver.

The strength of this system is the separation of identity from time and location information, including over time; with the nickname generated for each separate trip, the first division would not be able to establish a longitudinal dataset for a given driver.

An alternative option is to design the on-board unit to process the time and location information itself. It would then send the pre-processed billing information and identity information to the congestion charging authority, ensuring that location data never leaves the on-board unit.

## 4.5.2 Prohibit any recording of location information for vehicles outside the charging zone

A GPS-enabled on-board unit may be able to identify where a vehicle is at all times, but it does not need to record and time-stamp this information, and should not.

A model for ensuring that an on-board unit does not record data outside the relevant area is the German heavy vehicle tolling system. This system, which uses GPS technology, is set up so that the on-board unit automatically identifies when a heavy vehicle has entered a tolled road.<sup>106</sup>

This is preferable to a system that requires a driver action, such as the Swiss heavy vehicle scheme. In this scheme, drivers of heavy vehicles are expected to press a button upon entering the zone, to begin charging.<sup>107</sup> Implementation of this scheme would require adequate signage to remind drivers, and adequate back-up in the form of ANPR cameras at entries to the zone – which could be very costly in a whole-of-network charging scheme.

We therefore recommend that state governments prohibit their charging authority from recording or time-stamping location data outside the charged zone, or at times of the day and week that are not charged.

106. Bereni (2012, p. 31). 107. Ibid (pp. 46, 52).

#### Guide to the appendices

There are many barriers, real and perceived, to congestion charging. Governments need to determine a price that encourages efficient use of the roads, but does not deter too many drivers. The costs of setting up and running a scheme are not trivial, and are difficult to estimate without going to tender. State governments lack control over the entire road network, due to their contracts with private toll road operators. And while congestion charging needs to be enforced, criminal penalties would be a step too far.

The appendices to this report address these issues.

Appendix A outlines further details of the congestion charging schemes that we recommend, as well as discussing how we determined the prices, costs, net benefits, and revenue figures quoted in earlier chapters.

Appendix B discusses what governments can do to manage the way that congestion charging will interact with existing toll roads.

Appendix C suggests a fair method for enforcing congestion charging.

Appendix D explains the privacy laws that may be relevant to congestion charging.

Appendix E explains the transport network modelling that was done for this report.

And Appendix F outlines other congestion charging schemes that were considered and their modelled effects.

### Appendix A: Scheme details and justifications

- A.1 Location details for the cordon schemes
- A.1.1 Sydney

Our recommended cordon for the Sydney CBD is shown in Figure A.1 on the next page. It closely follows the shape of the Sydney - Haymar-ket - The Rocks SA2.

The following boundary roads would be deemed outside the cordon:

- Sir John Young Crescent (until Hospital Road, approaching the city).
- Yurong Parkway.
- Wentworth Avenue.
- Elizabeth Street (south of Campbell Street).
- Pyrmont Street.

The following boundary roads would be deemed inside the cordon:

- College Street.
- Murray Street (which provides access to a number of large hotels on Darling Harbour, as well as a large carpark near the convention centre).

There are arguments for including job-dense suburbs that neighbour the CBD, such as Pyrmont, Ultimo, and Surry Hills. But some parts of these suburbs are more residential in nature or less accessible by train than the CBD. For these reasons, and to maintain the principle of a smaller and more targeted approach to introducing congestion charging, we do not recommend they be included in the cordon. Also in line with this principle, we recommend that motorways that pass through the cordon should be left uncharged. These motorways include the Western Distributor, Cross City Tunnel, and Cahill Expressway. Only exits from or entries to these motorways from within the cordon would incur the appropriate inbound or outbound charge.

Our desktop assessment suggests that this cordon would require about 42 detection points (see Figure A.1). The precise number would depend on how access to certain carparks can be controlled (e.g. the Domain carpark) and whether traffic restrictions could supplant detection points at certain places (e.g. Lyons Lane and Commonwealth Street, off Wentworth Avenue). Government roads departments are best placed to resolve these finer details.

It's important that the cordon includes any carparks around the edge of the boundary that drivers to the CBD are likely to use. Leaving these carparks outside the cordon could encourage congestion around the edge of the cordon.

#### A.1.2 Melbourne

Our recommended cordon for the Melbourne CBD is shown in Figure A.2 on page 54. The cordon includes the Hoddle Grid, the high-rise areas of Docklands and Southbank, and the wedge to the north of the city formed by Victoria, La Trobe, William, and Peel streets (encompassing the Queen Victoria Market).

The following boundary roads would be deemed outside the cordon:

- Victoria Street.
- St Kilda Road.
- West Gate Freeway.

Figure A.1: The Sydney cordon with detection points



Source: Grattan analysis.

Figure A.2: The Melbourne cordon with detection points



Source: Grattan analysis.

• Peel Street.

The following boundary roads would be deemed inside the cordon:

- Spring Street.
- Flinders Street.
- Sturt Street, north of Kavanagh Street (which provides access to the Arts Centre carpark).
- Kavanagh Street.
- La Trobe Street.
- William Street.

The cordon boundary through the eastern part of Southbank aims to capture the high-rise area of Southbank while excluding the lower-rise areas (see Figure A.3).

This section of the cordon boundary follows a complex path but we consider it the most effective option. A potentially more salient boundary along City Road would not capture the high rises on the southern side of City Road. A potentially more salient boundary further south, say along Grant Street, would divide a lower-rise area of largely uniform character. For example, a boundary along Grant Street would split the arts precinct, leaving the Malthouse Theatre and Australian Centre for Contemporary Art outside the cordon but the Southbank Theatre and Victorian College of the Arts inside the cordon.<sup>108</sup>

Our desktop assessment suggests that this cordon would require about 45 detection points (see Figure A.2). As for Sydney, the precise number in Melbourne would depend in part on how access to certain Figure A.3: Cordon boundary through Southbank



Sources: Grattan analysis; Nearmap; Google Earth.

<sup>108.</sup> Although the cordon already splits the precinct to some extent by including the Arts Centre and State Theatre, this is necessary if we are to capture major carparks in the area.

carparks can be controlled. In particular, there are major carparks just outside the cordon's nominal southern boundary – the West Gate Freeway – through the western part of Southbank and South Wharf. We have proposed detection points on Meaden Street (36), Normanby Road (35), and Munro Street (34) to control access to these carparks. Alternative arrangements could be made with the carpark operators that would retain the effectiveness of the cordon while minimising infrastructure needs and any undue effects on nearby businesses. Again, local and state governments are best placed to resolve these issues.

As discussed in Section 1.3.2, it is open to the NSW and Victorian governments to consider the benefits and costs of different boundaries for the Sydney and Melbourne CBD cordons. Our focus when designing each boundary was to encompass all of, and no more than, the high-rise, predominantly commercial areas of each CBD, as well as any carparks that serve those areas.

But slightly narrower or broader cordons might be optimal if, for example, they allow more salient boundaries (e.g. major roads) or raise fewer traffic management issues. It was beyond our resources to find such 'optimal' designs by modelling multiple variations of our designs or by engaging traffic engineering experts. Rather, our main goal in this work has been to demonstrate the effectiveness of CBD cordons in concept, not in all specifics.

### A.2 How we chose the the recommended times and levels of charges

In Section 1.2.2 we discussed when congestion charges should apply, and the levels of charges. In this section, we explain how we came to the times and level of charges that we would recommend in the first instance.

### A.2.1 We used daily traffic patterns to determine the times that charges should apply

A 'peak' charge should apply during the periods in the morning and afternoon when demand for travelling to and away from the cordon is highest. A slightly lower 'shoulder' charge should also apply in the periods around the peak charge periods. Applying a shoulder charge reflects that demand is still quite high at these times, provides motorists with more time-price options with which to adapt their behaviour, and can help reduce 'bunching' of traffic – where congestion arises from vehicles avoiding the charge by crossing the cordon either just before the charging period begins or just after it ends.

We used typical travel time data from Google Maps to identify when roads in and leading to the CBD are currently busiest. For each of Sydney and Melbourne, we looked at trips between the GPO and a selection of inner-to-middle suburbs in the north, south, east, and west.

For Sydney, we considered trips to and from Chatswood, Mascot, Bondi Beach, and Ashfield. For Melbourne, we considered trips to and from Coburg, Elwood, Camberwell, and West Footscray.

We looked at Google Maps' predicted travel time for each of these trips for every 15 minutes on a Wednesday morning and afternoon. While the results differ by route and by city, the broad pattern suggests that:

• In the morning, the most delayed trips arrive in the CBD between 7.45am and 9.30am.

- There's much less delay on trips arriving before 7.30am.
- Delay tends to fall after 10am.
- In the afternoon, the most delayed trips depart the CBD between 4pm and 6pm.
- There's material delay on trips departing the CBD as early as 2.45pm.
- Delay tends to fall after 6.30pm.

If we round times to the nearest half-hour for simplicity, then the results above suggest:

- AM shoulder charge: 7.30am to 8am.
- AM peak charge: 8am to 9.30am.
- AM shoulder charge: 9.30am to 10am.
- PM shoulder charge: 3pm to 4pm.
- PM peak charge: 4pm to 6pm.
- PM shoulder charge: 6pm to 6.30pm.

## A.2.2 Charges overseas and previous Australian research informed our choice

Charges currently applying in schemes overseas include an £11.50 (\$21) daily charge in London, a  $\in$ 5 (\$8) daily charge in Milan, and a peak charge of SEK35 (\$5.30) per crossing in Stockholm.

Previous research has modelled or considered different levels of charge that might apply in cordon schemes in Australia. A 2011 proposal for a Brisbane CBD cordon modelled charges of \$3, \$4, and \$5 for private

vehicles.<sup>109</sup> A previous proposal for a Sydney CBD cordon suggested a daily charge of \$10 to \$15.<sup>110</sup> Modelling for Infrastructure Victoria in 2016 considered a \$3 charge to cross a 'CBD' cordon, combined with a \$2 charge to cross a broader, inner-suburban cordon.<sup>111</sup> The Melbourne Road Usage Study conducted by Transurban in 2015 and 2016 involved an \$8 daily charge to enter or drive within a cordon essentially the same as the 'CBD' cordon modelled for Infrastructure Victoria.<sup>112</sup>

Across the charges set out above, the implied range for charges to cross a cordon at peak times is about \$3 to \$10. In choosing a charge of \$5, we leaned toward to the lower half of this range, while also allowing scope for a level of shoulder charge (\$3) that would be both materially lower than the peak charge yet still at a level that we suspect would create behavioural change.<sup>113</sup>

### A.2.3 Our suggested peak charge seems reasonable when compared to public transport fares

We also considered how our suggested charge compared to typical public transport fares in Sydney and Melbourne. Ignoring all other costs, we might consider a cordon charge too low to create behavioural change were it lower than the alternative cost of getting public transport to the CBD.

A charge of \$5 mostly satisfies this criterion. In Melbourne, a two-hour Zone 1 and 2 full fare is \$4.40.<sup>114</sup> Sydney's train and bus fares are more

- 110. Veysey et al (2016).
- 111. Under this scheme, a trip to the CBD from outside the inner-suburban cordon would cost \$5: KPMG et al (2016, p. 45).
- 112. Transurban (2016, p. 16).
- 113. We suspect that a charge of \$1 or \$2 might not be high enough.
- 114. Public Transport Victoria (2018b).

<sup>109.</sup> Whitehead et al (2011). Higher charges for commercial vehicles were also modelled in some scenarios.

varied, but Opal card fares for trips up to 35 kilometres on trains and buses range from 2.24 to 5.15.<sup>115</sup>

### A.2.4 Why governments need not worry about estimating the perfect price from the start

The levels of charge that we recommend are necessarily an estimate of the levels that would encourage people to take account of their own contribution to congestion, but no more. These levels cannot be known in advance.

But it is not critical to get the levels exactly right. Charges that are close to an ideal level are better than zero, as at present, and they are also better than a very high charge, which would deter too many drivers. As Figure A.4 shows, the greatest gains (the steepest part of the curve) lie with deterring the most flexible drivers.

We recognise that reducing traffic might reduce not only the downside of crowding, but potentially some of the upside in the form of fruitful non-market interactions.<sup>116</sup> But what is more important than seeking to predict the price exactly is to set a price that is both above zero and likely to induce those drivers with reasonable alternatives to take other times, routes, or methods of travel. Social gain or loss from congestion charging

levels of gain or loss to the community



Figure A.4: Different levels of a congestion charge would offer different

Note: This stylised diagram does not consider the economic costs of setting up and operating a congestion charging scheme, which would outweigh the benefit of an extremely low charge. *P*<sub>rec</sub> is the level of congestion charge recommended in this report, which we believe may be a little below the optimal level, *P*<sub>opt</sub>. *P*<sub>upper</sub> is the highest level of charge that would deliver the same level of benefit as our recommended charge. It's impossible to know the optimal level of charge in advance, but slightly under- or over-shooting the optimal level would still deliver overall benefits to society. However, overshooting badly could make things worse, not better.

<sup>115.</sup> Transport for NSW (2019).116. Arnott (2007).

#### A.3 The evidence we used to estimate scheme costs

#### A.3.1 Set-up costs

We estimated the likely set-up costs of each cordon scheme at about \$100 million.

The most recently implemented cordon scheme, the Gothenburg congestion tax, cost €76 million to set up in 2013 (\$115 million in today's dollars), €35 million (\$53 million) of which was for a new central system for both the Stockholm and Gothenburg schemes.<sup>117</sup> This scheme initially involved 36 detection points, a broadly similar number to our recommended schemes.

The 2020 New York State Budget included US\$100 million (\$142 million) to 'plan, design, procure and install the new tolling technology and infrastructure' for New York City's forthcoming scheme.<sup>118</sup>

We also conducted a rough, bottom-up costing of our schemes based on a wide range of publicly available information. This produced an estimate of about \$110 million.

But as well as this evidence that suggests a cost a little higher than \$100 million, there is also recent evidence which suggests a cost less than \$100 million.

A proposal for a cordon in Los Angeles prepared by the Southern California Association of Governments in March this year estimates a set-up cost of just US\$14.7 million (\$21 million) for a scheme involving 47 detection points.<sup>119</sup> It seems this low estimate is because the scheme would use an existing central system for processing transactions. But even if the assumed cost of a new central system A report last year by KPMG for the Queensland Department of Transport and Main Roads estimates that roadside infrastructure to implement a cordon scheme in the Brisbane CBD could be installed at a cost of \$100,000 per detection point.<sup>120</sup> This suggests that the detection points in our schemes could be installed for about \$4.5 million in each of Sydney and Melbourne. If this cost is added to the assumed cost of a central system (\$53 million), as well as a 50 per cent buffer for any additional design and engineering costs, the implied total cost would be around \$86 million.

# The set-up costs of the London and Stockholm schemes were much higher, but probably less relevant

The London congestion scheme cost about £80.8 million to set up (\$294 million in today's dollars).<sup>121</sup> This estimate excludes the cost of 'road traffic measures associated with the scheme', which appear to have included 'projects for cyclists and pedestrians, bus priority, signal re-timing and road improvements'.<sup>122</sup> The scheme initially involved 250 camera (detection) sites.<sup>123</sup>

The Stockholm congestion scheme cost SEK1,050 million to set up, and initially involved 18 detection gantries.<sup>124</sup> But about SEK150 million of this was spent on Dedicated Short Range Communications infrastructure that did not end up being used, so the set-up cost might have been as low as SEK900 million (\$215 million in today's dollars).<sup>125</sup>

<sup>117.</sup> West and Börjesson (2018).

<sup>118.</sup> Slevin and Matthiessen (2019).

<sup>119.</sup> Southern California Association of Governments (2019).

<sup>120.</sup> KPMG (2018).

<sup>121.</sup> Mayor of London (2006).

<sup>122.</sup> Lehe (2019).

<sup>123.</sup> Transport for London (2003).

<sup>124.</sup> Eliasson (2009).

<sup>125.</sup> Hamilton (2011).

These set-up costs are not very useful for estimating the set-up costs of our recommended schemes for Sydney and Melbourne.<sup>126</sup> The London scheme is about 16 years old and the Stockholm scheme is about 13 years old. We would expect the real cost of the relevant systems and technology to have fallen. The ability to learn from these and other schemes probably also allows policy makers today to be much more efficient in setting up any new scheme. And finally, in London's case, the scheme involved about six times as many detection sites as our recommended cordons for Sydney and Melbourne.

#### Sydney and Melbourne could save costs by working together

As Stockholm and Gothenburg have demonstrated, a single central system can be used to operate cordon schemes in different cities. If Sydney and Melbourne followed a similar approach, each city could halve the set-up costs of a central system – a saving for each city of about \$25 million.

#### A.3.2 Operating costs

We have estimated that annual operating costs would be between 13 per cent and 36 per cent of annual revenue. This is based on:

- In 2017, the operating cost of the Milan scheme was €3.9 million, or 13 per cent of revenue.<sup>127</sup>
- In 2013, the operating cost of the Stockholm and Gothenburg schemes was €24 million, or 16 per cent of revenue.<sup>128</sup>

- 127. Zavatta (2018).
- 128. West and Börjesson (2018).

- The Southern California Association of Governments plan for Los Angeles estimates costs of US\$27 million in the scheme's first year of operation, or 32 per cent of revenue.<sup>129</sup> This percentage is projected to fall to 15 per cent by the 15th year of operation.
- In 2018-19, the operating cost of the London scheme was £83.2 million, or 36 per cent of revenue.<sup>130</sup>

Our mid-range estimate is the approximate mid point, at 25 per cent.

<sup>126.</sup> Note that we have also not relied on the set-up costs of the Milan scheme. Reported set-up costs for this scheme are very low, largely because it made use of existing infrastructure.

<sup>129.</sup> Southern California Association of Governments (2019).

<sup>130.</sup> Transport for London (2019b).

#### A.4 Cost-benefit analysis details

The main benefits to society in a given year of implementing a congestion charging scheme are:

- net travel time savings for cars;
- travel time savings for commercial vehicles;
- more reliable travel times;
- lower vehicle operating costs; and
- lower environmental costs.

The main costs to society are:

- the disbenefit to people who change mode and/or destination in response to the charge;
- increased crowding on public transport;
- time spent complying with the scheme;
- the amortised set-up cost of the scheme; and
- the operating cost of the scheme.

#### A.4.1 Net travel time savings for cars

After a congestion charging scheme is introduced, the total reduction in time spent travelling by car reflects:

- the time spent on trips previously made by car that are now made by another mode;
- an increase in speeds due to less traffic; and
- changes in time spent travelling associated with car trips that have changed destination and/or route.

We subtract the increase in time spent travelling by other modes from the decrease in time spent travelling by car to estimate the net travel time savings to cars (see Table A.1).

Table A.1: Decrease in travel timeHours per day, by model type

	Sydney		Melbourne	
	Fixed	Variable	Fixed	Variable
	destination	destination	destination	destination
Car	14,700	9,300	24,400	19,200
Public transport	- 3,200	- 100	- 9,300	- 2,300
Active transport	- 300	- 500	- 900	- 900
Net change	11,200	8,800	14,100	16,000

Note: Hours rounded to the nearest 100.

The Australian Transport Assessment and Planning Guidelines specify values of time for different types of car travel that are proportional to full-time average weekly earnings, assuming a 38-hour week.<sup>131</sup> Private (i.e. non-business) car travel time is valued at 40 per cent of average weekly earnings – \$16.90 per hour based on average weekly earnings in November 2018. Private car travel includes commuting to work. For business car travel, the value of travel time is valued at 129.8 per cent of average weekly earnings – \$54.84 per hour based on average weekly earnings in November 2018.

Veitch Lister Consulting (VLC) has advised that, based on proportions in its 'base case' Sydney model, 5 per cent of car travel is business and 95 per cent is non-business. Using these proportions, we can estimate a weighted-average value of time for cars of \$18.80 per hour.

Combining this value of time with net travel time savings for cars, and annualising using a factor of 250, yields the benefits in Table A.2.

<sup>131.</sup> Transport and Infrastructure Council (2016, Parameter Values).

 Table A.2: Value of net travel time savings to cars

 \$ million per year

Syc	dney	Melb	ourne
Fixed destination	Variable destination	Fixed destination	Variable destination
53	41	66	75

#### A.4.2 Travel time savings for commercial vehicles

All travel time savings for commercial vehicles are 'net' travel time savings because trips made by commercial vehicle cannot switch to another mode.

VLC models trips by two types of commercial vehicle: light commercial vehicles (LCVs) and heavy commercial vehicles (HCVs). The estimated value of time per vehicle-hour for light commercial vehicles is \$38.23, and for heavy commercial vehicles it is \$71.36, as of December 2017.<sup>132</sup> These values take into account the value of time for the occupants of the vehicles and the value of time for the freight being transported. Average weekly earnings rose 2.3 per cent between November 2017 and November 2018,<sup>133</sup> so we inflate these values to \$39.11 and \$73.00.

Applying these values to the reduction in commercial vehicle travel times yields the benefits shown in Table A.3.

#### A.4.3 More reliable travel times

The Australian Transport Assessment and Planning Guidelines note that the 'standard' approach to estimating the benefit of improved travel time reliability involves valuing the estimated reduction in the Table A.3: Value of travel time savings to commercial vehicles

	Sydney		Melbourne	
	Fixed dest.	Variable dest.	Fixed dest.	Variable dest.
Decrease in travel time, LCVs (hours per day)	400	200	300	100
Decrease in travel time, HCVs (hours per day)	400	200	300	100
Value of travel time savings (\$m per year)	12	6	8	3

Note: Hours rounded to the nearest 100.

standard deviation of travel time.<sup>134</sup> We do not have the data to apply this approach. Instead, we estimate the benefit of improved reliability as a share of the value of travel time savings, with the share we use based on observations from other road projects.

Reliability benefits have been estimated at about 14 per cent of the value of travel time savings in both the London and Stockholm congestion charging schemes.<sup>135</sup> This share sits within the range of shares implied by figures reported in recent Infrastructure Australia evaluations of major road projects in Sydney and Melbourne (see Table A.4).

<sup>132.</sup> Veitch Lister Consulting (2019a, p. 106). 133. ABS (2019a, Table 2).

<sup>134.</sup> Transport and Infrastructure Council (2016, Parameter Values); and NZ Transport Agency (2016).

<sup>135.</sup> Raux et al (2012, Table 1).

Project	Year	Reliability benefits as a share of travel time savings
North East Link, Melbourne	2018	16%
Monash Freeway Upgrade	2018	18%
Stage 2, Melbourne		
Northern Road Upgrade, Sydney	2017	12%
WestConnex, Sydney	2016	12%
M4 Motorway Upgrade, Sydney	2016	33%

Sources: Grattan analysis of IA (2018b, North East Link), IA (2018c, Monash Freeway Upgrade Stage 2), IA (2017, Northern Road Upgrade), IA (2016b, WestConnex) and IA (2016c, M4 Motorway Upgrade).

Applying a share of 14 per cent to the total values of travel time savings yields the values of more reliable travel times shown in Table A.5.

Table A.5: Value of more reliable travel times\$ million per year

Syc	dney	Melb	ourne
Fixed	Variable	Fixed	Variable
destination	destination	destination	destination
9	7	10	11

#### A.4.4 Lower vehicle operating costs

We assume vehicle operating costs consist of fuel costs, and repairs and maintenance costs.

The Australian Transport Assessment and Planning Guidelines specify average 'resource costs' of petrol of 96.5 cents per litre and 94.5 cents

per litre (\$2013) for Sydney and Melbourne, respectively.<sup>136</sup> We take the midpoint of the Sydney and Melbourne petrol costs as our estimate of fuel costs (95.5 cents per litre).<sup>137</sup>

To convert to a cost per kilometre, we use the Bureau of Infrastructure, Transport and Regional Economics estimate of the average rate of petrol consumption for passenger vehicles (0.1061 litres per kilometre).<sup>138</sup> This equates to a fuel cost per kilometre of 10.1 cents per kilometre in \$2013, or 11.2 cents per kilometre in \$2019.

The Australian Transport Assessment and Planning Guidelines specify average repairs and maintenance costs for cars of 6.3 cents per kilometre (7.0 cents per kilometre in \$2019).<sup>139</sup>

Combining fuel and repairs and maintenance costs yields a total vehicle operating cost of 18.2 cents per kilometre. Table A.6 applies this rate to the reduction in car kilometres travelled.

 Table A.6: Decrease in vehicle operating costs

 \$ million per year

Syd	dney	Melb	ourne
Fixed destination	Variable destination	Fixed destination	Variable destination
6	2	13	6

136. 'Resource costs' differ from the pump price because they exclude fuel excise and GST: Transport and Infrastructure Council (2016, Parameter Values).

<sup>137.</sup> Diesel costs are very similar to petrol costs: Transport and Infrastructure Council (ibid, Parameter Values). Vehicles using fuels other than petrol and diesel account for only 3 per cent of total kilometres driven in capital cities, and so their fuel costs are ignored for simplicity: ABS (2019b).

<sup>138.</sup> BITRE (2017).

<sup>139.</sup> Transport and Infrastructure Council (2016, Parameter Values).

#### A.4.5 Lower environmental costs

The Australian Transport Assessment and Planning Guidelines recommend the use of the following environmental costs (\$2005):<sup>140</sup>

- Air pollution: 2.45 cents per kilometre.
- Greenhouse gases: 0.30 cents per kilometre.
- Noise: 0.78 cents per kilometre.

These equate to total environmental costs of 3.5 cents per kilometre (or 4.9 cents per kilometre in \$2019). Table A.7 applies this rate to the reduction in car kilometres travelled.

### Table A.7: Decrease in environmental costs\$ million per year

Syc	lney	Melb	ourne
Fixed destination	Variable destination	Fixed destination	Variable destination
2	<1	3	2

#### A.4.6 Disbenefit to people who change mode or destination

The introduction of a congestion charge creates a disbenefit for people who, in response to the charge, change to a less preferred mode or destination.

People who value driving across the cordon at or more than \$5 will continue to drive across the cordon. People who do not value driving across the cordon will not cross it, either before or after the introduction of the charge.

This leaves people who value driving across the cordon somewhere between zero and \$5. These people will no longer drive across the cordon, will lose the value of driving across the cordon, and will not pay the charge. The standard approach to quantifying the disbenefit to these people is to apply the 'rule of half', whereby the average value lost is assumed to be halfway between the range of potential losses.<sup>141</sup>

To calculate the disbenefit, therefore, we multiply:

- the change in the number of car trips originating outside the cordon with destinations inside the cordon in the morning peak; and
- the change in the number of car trips originating inside the cordon with destinations outside the cordon in the afternoon peak; by
- half the value of the charge.

The results are shown in Table A.8.

 Table A.8: Disbenefit to people who change mode or destination

 \$ million per year

Syc	Iney	Melbo	ourne
Fixed	Variable	Fixed	Variable
destination	destination	destination	destination
- 7	- 9	- 12	- 15

#### A.4.7 Increased crowding on public transport

We do not include the costs of additional public transport services or capacity in the cost-benefit analysis, because no such improvements were modelled. But the increase in public transport patronage resulting from the cordon scheme could lead to a material increase in the cost

<sup>140.</sup> Australian Transport Council (2006, p. 101), as recommended in Transport and Infrastructure Council (2016).

<sup>141.</sup> VTPI (2015, Chapter 7, p. 3).

of crowding. We estimate this increase by extrapolating VLC's existing estimates of the cost of crowding in Sydney and Melbourne.

In work for Infrastructure Australia's 2019 Infrastructure Audit, VLC lists the sections of the Sydney and Melbourne public transport networks that are the most crowded on average in the morning and afternoon peaks. VLC reports two measures of crowding: the volume-to-seated capacity (V-SC) ratio and the volume-to-crush capacity (V-CC) ratio.

Table A.9 and Table A.10 show the highest V-SC ratio and V-CC ratio observed in either peak on any individual section of each public transport mode's network (i.e. the train network, the bus route network, etc.) in Sydney and Melbourne. Note that ratios for light rail and ferry in Sydney were not provided in VLC's work, so they are not shown. The tables also present the weighted-average ratios based on shares of boardings reported in VLC's work.

VLC's base model for Sydney estimates that there are 809,000 public transport trips in the peaks each weekday. Using the weighted-average ratio in Table A.9, this suggests that seated capacity would be reached at 809,000 / 1.17 = 692,000 trips, and crush capacity reached at 809,000 / 0.73 = 1,107,000 trips.<sup>142</sup>

Note that after the introduction of the cordon the number of public transport trips in the peaks increases to 820,000 in the fixed destination model, thus much lower than crush capacity. The increase in the number of public transport trips in the variable destination model is even lower.

Note also that our estimated seated and crush capacities are conservatively low because weighted-average ratios have been calculated using the *highest* ratio observed on any individual section of each mode's network – that is, we have essentially assumed that all

#### Table A.9: Public transport crowding in Sydney

	Mode share of total	Max V-SC ratio	Max V-CC ratio
Rail and metro	69%	1.2	0.7
Bus	31%	1.1	0.8
Weighted average		1.17	0.73

Notes: 'V-SC' is the volume-to-seated capacity ratio and 'V-CC' is the volume-to-crush capacity ratio.

Source: Grattan analysis of Veitch Lister Consulting (2019a, pp. 26, 67-68).

#### Table A.10: Public transport crowding in Melbourne

	Mode share of total	Max V-SC ratio	Max V-CC ratio
Suburban rail	52%	1.6	0.7
Tram	25%	2.9	0.7
Bus	20%	0.9	0.6
Regional rail	3%	1.1	0.7
Weighted average		1.78	0.68

Notes: 'Bus' excludes SkyBus. 'V-SC' is the volume-to-seated capacity ratio and 'V-CC' is the volume-to-crush capacity ratio.

Source: Grattan analysis of Veitch Lister Consulting (2019b, pp. 26, 88-91).

<sup>142.</sup> We have performed our calculations using non-rounded figures, which explains any minor discrepancies in this section.

sections of each mode's network are as crowded as the most crowded section.

VLC's base model for Melbourne estimates that there are 678,000 public transport trips in the peaks each weekday. Using the weighted average ratio in Table A.10, this suggests that seated capacity would be reached at 678,000 / 1.78 = 382,000 trips, and crush capacity reached at 678,000 / 0.68 = 997,000 trips.

Note that after the introduction of the cordon the number of public transport trips increases to 697,000 in the fixed destination model, thus much lower than crush capacity. Again, as for Sydney, the increase in the number of public transport trips in the variable destination model is even lower.

The crowding cost function indicates that crowding costs increase linearly between all seats being taken and crush capacity (see Figure A.5).

VLC estimates that the current cost of crowding in the peaks in Sydney is \$236,000 per day (in \$2016).<sup>143</sup> If we assume that the cost of crowding begins to accrue from seated capacity onwards, then this suggests that the cost of crowding increases by \$236,000 / (809,000 - 692,000) = \$2.02 per additional public transport trip in Sydney (\$2.11 in \$2019).

For Melbourne, VLC estimates that the current cost of crowding in the peaks is \$261,800 per day (in \$2016).<sup>144</sup> Assuming again that the cost of crowding begins to accrue from seated capacity

### Figure A.5: Crowding on public transport is felt most acutely by the people without a seat

Crowding penalty (minutes of penalty per minute of travel time) 1.6



Notes: A crowding penalty reflects people's discomfort when a public transport service is too crowded. For example, a penalty of one minute per minute of travel time means that a person finds travel twice as costly as uncongested conditions. Source: Adapted from Veitch Lister Consulting (2019a, p. 108).

<sup>143.</sup> Veitch Lister Consulting (2019a, Table 7-11). Note that VLC's model of 'Sydney', used for both this report and for the Australian Infrastructure Audit, actually includes Greater Sydney, the Hunter and the Illawarra.

<sup>144.</sup> Veitch Lister Consulting (2019b, Table 7-15). Note that VLC's model of 'Melbourne', used for both this report and for the Australian Infrastructure Audit, actually includes Greater Melbourne and Geelong.

onwards, this suggests that the cost of crowding increases by 261,800 / (678,000 - 382,000) = 0.88 per additional public transport trip in Melbourne (0.93 in 2019).

Table A.11 applies these incremental crowding costs to increases in public transport patronage in each city.

Table A.11: Increased	crowding or	n public transport
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	Sydney		Melbo	ourne
	Fixed dest.	Variable dest.	Fixed dest.	Variable dest.
Change in PT trips in AM peak per day	5,500	3,200	9,500	5,100
Change in PT trips in PM peak per day	5,300	3,100	8,800	5,000
Cost of increased crowding (\$m per year)	- 6	- 3	- 4	- 2

Note: Trips rounded to the nearest 100.

#### A.4.8 Time spent complying with the scheme

Regular payers of the cordon charge are likely to set up an account with direct debit or auto top-up arrangements. This means they are likely to face a one-off time cost when setting up their account, but potentially very few if any costs after that.

Irregular payers of the charge might not set up an account, and simply pay their charge when they are invoiced in the mail. Payment would most likely be made by BPAY, but potentially also via Post Billpay.

In either case – setting up an account or paying a single charge – we do not expect that the time spent would be in excess of 30 minutes. Accordingly, we assume that over the initial 10-year time horizon of the charge, 30 minutes is spent complying with the scheme for every

vehicle in the metropolitan area. Of course, some people might spend more than 30 minutes complying with the scheme over a 10-year period, but our approach implicitly assumes that this is countervailed by the number of people who spend no time complying with the scheme.

There are 5.7 million vehicles registered in NSW, and 5 million in Victoria. As of the 2016 Census, almost two-thirds of the population of NSW lived in Greater Sydney, and about three-quarters of the population of Victoria lived in Greater Melbourne. We therefore estimate that there are around 3.7 million registered vehicles in Sydney and 3.8 million in Melbourne. We assume that 30 minutes of time is spent complying with the scheme for each vehicle. Applying a weighted-average value of time for all road-users based on shares of registered vehicle type in NSW (see Table A.12 on the next page) of \$20.6 per hour yields a total compliance cost over 10 years of \$38 million in Sydney and \$39 million in Melbourne, and an average annual compliance cost of about \$4 million in each city. Table A.12: Value of time by vehicle type, NSW

	Share of regis- trations in NSW	Value of time (ATAP Guidelines)
Passenger vehicles	75.6%	\$ 18.8
Camper vans	0.3%	\$ 16.9
Light commercial	16.1%	\$ 28.2
Light rigid trucks	1.0%	\$ 28.2
Heavy rigid trucks	1.8%	\$ 29.0
Articulated trucks	0.4%	\$ 29.7
Non-freight trucks	0.1%	\$ 29.7
Buses	0.5%	\$ 28.5
Motorcycles	4.4%	\$ 16.9
		\$ 20.6

Note: The share of registrations in Victoria is very similar to NSW, giving a similar but slightly lower average value of time. For simplicity and conservatism, we use the NSW value in our analysis of compliance costs. ATAP Guidelines are the Australian Transport Assessment and Planning Guidelines.

Sources: Grattan analysis of ABS (2019c) and Transport and Infrastructure Council (2016).

#### A.4.9 Amortised set-up cost of the scheme

Appendix A.3.1 explains how we estimated the \$100 million set-up cost of a cordon scheme. We assume that this set-up cost is amortised over a period of 10 years, meaning the annual amortised set-up cost is \$10 million for each cordon.<sup>145</sup> Given the low level of interest rates, financing costs are ignored because they would be small relative to the other costs and benefits being estimated in this analysis.

#### A.4.10 Operating cost of the scheme

Appendix A.3.2 explains why we estimate operating costs to be between 13 per cent and 36 per cent of revenue. We also report a 'medium' operating cost of 25 per cent (approximately the mid-range estimate). Table A.13 shows what this equates to for each city.

Table A.13: Revenue and operating cost\$ million per year

	Sydney		Melbourne	
	Fixed dest.	Variable dest.	Fixed dest.	Variable dest.
Revenue	74	71	119	112
Low operating cost (13% of revenue)	- 10	- 9	- 15	- 15
Medium operating cost (25% of revenue)	- 19	- 18	- 30	- 28
High operating cost (36% of revenue)	- 27	- 25	- 43	- 40

<sup>145.</sup> As discussed in Appendix A.3.1, this set-up cost would be lower if Sydney and Melbourne shared a single, central system.

#### A.5 Revenue estimates

#### A.5.1 Gross revenue from the Sydney cordon

As explained in Section 1.3, Veitch Lister Consulting modelled simplified versions of our proposed cordon schemes. Veitch Lister Consulting's main models for Sydney and Melbourne involve just four time periods: 7am-9am; 9am-4pm; 4pm-6pm; and 6pm-7am. Therefore, the precise charging periods we are recommending were not modelled, nor were shoulder charges. Instead, a \$5 charge for entering the cordon between 7am and 9am, and a \$5 charge for leaving the cordon between 4pm and 6pm, was modelled. And for simplicity, a \$5 charge was applied to all vehicles, whereas we recommend that a higher charge apply to larger vehicles.

Under these specifications, Veitch Lister Consulting's modelling indicated that the Sydney cordon would raise about \$74 million per year under a fixed departure time, fixed destination simulation, and about \$71 million per year under a fixed departure time, variable destination simulation.<sup>146</sup>

If the higher charges we recommend for commercial vehicles applied, revenue could be as high as \$94 million if the higher charges are simply applied to the modelled number of cordon crossings by commercial vehicles. But this estimate is too high if a higher charge on commercial vehicles deters some of them from crossing the cordon. Therefore, a more conservative estimate of the revenue taking into account the higher charge for commercial vehicles might be \$82 million, which is the midpoint of the upper bound estimate (\$94 million) and the estimate that assumes commercial vehicles are charged the same as cars (\$71 million). We can also extrapolate our revenue estimate for the potential effect of shoulder charges. Modelling for Melbourne, which is discussed in the next section, suggests that revenue might be about 30 per cent higher (\$109 million) if a \$3 shoulder charge applied in the hour before and after each peak charging period, and people changed when and where they travelled in response to the cordon.

#### A.5.2 Gross revenue from the Melbourne cordon

In addition to its four time period models, Veitch Lister Consulting has an eight time period, variable departure time model for Melbourne. The additional four time periods are one-hour periods on either side of the two-hour morning and afternoon peak periods. This more complex model allowed modelling of a specification closer to what we are recommending (i.e. with shoulder charges), and of an important behavioural response to the cordon that we would expect to see – the re-timing of trips.

Using the four time period model, Veitch Lister Consulting's modelling indicated that the Melbourne cordon would raise \$119 million per year under a fixed departure time, fixed destination simulation, and \$112 million per year under a fixed departure time, variable destination simulation.

Using the eight time period, variable departure and destination model, Veitch Lister Consulting's modelling indicates that the Melbourne cordon would raise \$148 million per year. This is about 30 per cent higher than the revenue estimate from the fixed departure time, variable destination model.

Applying the same approach as for Sydney, we estimate that revenue for Melbourne might increase to \$154 million if the higher charges we recommend for commercial vehicles are applied.

<sup>146.</sup> We propose that the cordon would operate on all non-public-holiday weekdays (about 250 days per year).

#### A.5.3 Net revenues in Sydney and Melbourne

As explained in Appendix A.3 and Appendix A.4, we have estimated the annual amortised set-up cost of each cordon to be about \$10 million, and the annual operating costs to be between 13 per cent and 36 per cent of revenue.

Taking these cost estimates with the gross revenue estimates above suggests annual net revenue of between \$59 million and \$84 million for the Sydney cordon and between \$88 million and \$124 million for the Melbourne cordon.

### Appendix B: How congestion charging will affect existing toll roads

Australian cities do not have roads in isolation – they have road *networks*.<sup>147</sup> Changes in one part of the network can influence traffic many kilometres away. That means there will inevitably be an interaction between congestion charging and toll roads. This Appendix looks at the possible impacts on private toll road operators and implications for governments.

Section 2.1 noted that the large number of toll roads in Sydney and to a lesser extent Melbourne poses complications for congestion charging (see Figure B.1). Where congestion charging reduces the number of drivers on private toll roads, the government may be liable to compensate the operators.<sup>148</sup>

But the objective of congestion charging set out in this report – to achieve the most efficient use of the existing road network – means seeking to reduce traffic volumes on certain roads at certain times of the day. Reducing toll road volumes does not align with that objective if a toll road is flowing well in the morning and afternoon peaks.

And even if a toll road is highly congested in the peak, it is preferable to smooth the demand across the day rather than simply dissuade drivers from travelling. Toll roads are typically large, valuable pieces of infrastructure; spreading demand allows them to be worked more efficiently throughout the day, not just at peak periods.

The effect of congestion charging on toll road operators would be minimal if any reduction in trips during the peak was fully or substantially offset by trips rescheduled to off-peak times. But it is not clear that this will be the case. Governments need to be prepared in case of claims for compensation. The next section explains the most likely impact of congestion charging on toll road revenues.

### B.1 There may be an impact on toll roads operators' balance sheets, but it would be small

Different congestion charging schemes will interact with toll roads differently. For example, under a corridor congestion charging scheme, many of the alternatives to taking a toll road will no longer be 'free', so the congestion charge will reduce the *relative* cost to use the toll road for some journeys.

A CBD cordon, on the other hand, will cause some motorists to switch mode, travel elsewhere, or stay home – and these adaptations could reduce demand for toll roads near the CBD (see Figure B.1). But some trips that previously crossed the CBD may re-route onto nearby toll roads, given that they would become comparably priced.

Modelling suggests that the impacts will vary by city and scheme. The modelled scenarios used in this report are based on the 2016 road network in Sydney and Melbourne. As a consequence, some recently completed toll roads were not present in the model. For Sydney, this includes the widened M4 and the New M4 tunnel (Stage 1 of WestConnex), which are both now open.<sup>149</sup> Future toll roads were also not modelled. In Sydney, this includes the remainder of the WestConnex project (the New M5 and the M4-M5 Link), NorthConnex, the F6, the Western Harbour Tunnel, and Beaches Link.<sup>150</sup> In Melbourne, this includes the West Gate Tunnel and the

<sup>147.</sup> Hensher (2017).

<sup>148.</sup> A federal parliamentary inquiry noted that the 'most egregious constraint [of toll roads] on other policy areas is through the inclusion of "non-compete" clauses and undertakings to compensate for loss of traffic through government actions': Senate Economics References Committee (2017, p. 41).

<sup>149.</sup> WestConnex (2019).

<sup>150.</sup> Portfolio Committee No. 2 - Health and Community Services (2017, pp. 12-15).



Figure B.1: Existing and future toll roads in Sydney and Melbourne (2019), and potential cordon charging areas

Notes: Scale is 1:250,000. The Sydney Harbour Bridge has been omitted because the NSW Government keeps the toll revenue. Dotted lines on the North East Link indicate that the Victorian Government is intending to keep the toll revenue – at least initially – through an availability PPP (see Appendix B.4). WestConnex Stage 1 (the new M4 East) opened in July 2019. Source: Grattan analysis.
North East Link, though the state government will retain North East Link revenues initially.<sup>151</sup>

In Sydney, the CBD cordon is likely to actually increase workday toll road revenue across the city, but by less than 1 per cent.<sup>152</sup> This is likely because driving through the CBD would become costly and therefore less attractive compared to using nearby toll roads. This may shift substantial traffic to those toll roads, offsetting impacts elsewhere on the network.<sup>153</sup>

Melbourne's CBD cordon is estimated to reduce toll road revenue on workdays by less than 1 per cent.<sup>154</sup>

#### B.1.1 Expected balance sheet impacts

Table B.1 on the next page lists privately-owned toll roads currently in operation. As outlined above, it seems reasonable to think that the effect of a CBD cordon in Sydney and Melbourne would change city-wide toll revenues each workday by no more than 1 per cent – in either direction.

A 1 per cent change in revenue on workdays is likely to result in a lessthan-1 per cent change in toll road operator revenue. This is because no congestion charge would apply on weekends or public holidays, so volumes on those days are unlikely to be affected. Analysis of NSW toll road data suggests that non-workdays accounted for between 25 per cent and 29 per cent of all car traffic on toll roads in 2018, and between 9 per cent and 14 per cent of heavy vehicle traffic.<sup>155</sup>

Given this, a 1 per cent change in total revenue is a fairly conservative upper-bound on the possible impacts of a CBD congestion charge. If implemented tomorrow, toll road operators should gain or lose no more than \$10 million over the subsequent 12 months (see Table B.1 on the following page).

Because of the longevity of toll road contracts, these effects could add up substantially over time. Table B.1 also includes the impact of a hypothetical scenario where toll road revenues are projected to grow at 2 per cent each year, but 1 per cent of each year's revenue is gained or lost for the remainder of the concession period.<sup>156</sup> This is by no means a prediction of what will actually occur – it simply makes the point that long contracts are more sensitive to revenue changes.

# B.2 It is unclear under what circumstances toll road operators can claim compensation

Toll road operators may be entitled to compensation if governments introduce congestion charging schemes that reduce toll road traffic volumes. The circumstances under which compensation is owed differ by contract, so governments will need to do their due diligence and find workable solutions in cases where they are liable.

But the barriers to claiming compensation for network changes appear to be high. The last well-documented claim was made in 2001 by Transurban for the impact on traffic volumes of the newly constructed

<sup>151.</sup> See West Gate Tunnel (Truck Bans and Traffic Management) Act 2019, and North East Link Authority (2018, Chapter 9, p. 2).

<sup>152.</sup> This result is determined from the model as described in Section 1.3 on page 15. Including shoulder charges could amplify the increase.

<sup>153.</sup> In this case, the windfall gain to toll road operators may need to be partially shared with the state; see, for example, RTA (2008, pp. 31–32).

<sup>154.</sup> City-wide results may mask variability of the impacts on individual toll roads. This problem is particularly acute in Sydney, where there are many more existing toll roads than in Melbourne.

<sup>155.</sup> Grattan analysis of Transurban (2019a).

<sup>156. 2</sup> per cent annual growth is about the rate of population growth in each capital. It should be noted that real toll road revenue growth has typically been between 3 per cent and 9 per cent since 2011, but this could also be driven by network improvements over that time: Grattan analysis of Transurban (2019b).

Table B.1: Toll road operators' revenue may change by up to 1 per cent with a CBD cordon - which is currently less than \$10 million a year

City	Private toll roads operating in FY2019	Concession expiry	Transurban ownership	Transurban toll revenue (FY2019, \$m)	Total toll revenue (FY2019, \$m)	Upper-bound estimate of a 1% change in revenue (FY2019, \$m)	Hypothetical impact of a 1% change in revenue over life of contract (\$m)
Melbourne	CityLink	2045	100.0%	813	813	8.1	279.2
	EastLink	2043	0.0%	-	-	-	-
Sydney	Hills M2	2048	100.0%	312	312	3.1	123.5
	Lane Cove Tunnel	2048	100.0%	102	102	1.0	40.4
	Cross City Tunnel	2035	100.0%	69	69	0.7	13.1
	M1 Eastern Distributor	2048	75.1%	114	152	1.5	60.1
	M5 (South West)	2026	65.4%	183	280	2.8	21.2
	Westlink M7	2048	50.0%	218	436	4.4	172.5
	Widened M4	2060	25.5%	40	157	1.6	100.2
	Sydney Harbour Tunnel	2023	0.0%	-	-	-	-

Notes: 'Total toll revenue' has been estimated by dividing Transurban's toll revenue from the asset by its percentage ownership. 'Hypothetical impact until expiry' is discussed in Appendix B.1.1. Recent financial results for EastLink and the Sydney Harbour Tunnel could not be found. Sydney's new M4 East tunnels were not open during the 2018-19 financial year.

Sources: Grattan analysis of Transurban (2019c); Portfolio Committee No. 2 – Health and Community Services (2017, p. 15); and State of Victoria and ConnectEast Nominee Company Pty Ltd (2018, Schedule 1).

Wurundjeri Way. The claim was not successful.<sup>157</sup> It may be difficult for toll road operators to demonstrate that a network change has had a material impact on their asset, particularly if the effects are small and masked by otherwise-rapid growth in patronage.

Governments may face similar difficulties claiming their share of excess revenue if a toll road experiences much higher patronage than expected. On 2 January 2014, the Victorian Government lodged a compensation claim for the excess growth on EastLink as a result of opening Peninsula Link. The claim remains outstanding.<sup>158</sup>

# B.2.1 NSW toll road contracts are often confidential and rarely mention congestion charging

Many NSW toll road contracts are not published online.<sup>159</sup> Summaries of these contracts often state that the project contracts and associated documents are 'subject to confidentiality restrictions'.<sup>160</sup> The summaries themselves suggest that compensation may be required if the state makes certain network changes.<sup>161</sup> Compensation involves the state and company renegotiating the contract in a way that redresses financial damage to the company (see Figure B.2).

Only one contract summary expressly mentions congestion charging: the Cross City Tunnel contract envisioned that a Minister may in future wish to impose a 'congestion toll' on certain CBD traffic if the tunnel itself caused 'significant infiltration of traffic from the western portal Figure B.2: The compensation process generally follows this structure

Changes in state law, the application of state law, or new laws (possibly to introduce congestion charging) may constitute a ... 'Key Risk Event', which is an event that the parties to the contract have agreed would have a negative financial impact on the operator. If this impact is large enough, it is a ... 'Relevant Effect' or 'Material Adverse Effect'. When the parties agree that this has happened, they must negotiate a way to ... Allow the company to repay its debt and achieve the same returns/cashflow as before the event (or the base case returns/cashflow). This can be achieved by... Extending the concession; varying the tolls; changing the risk allocation between the parties; making payments from the state to the company; or making other contract amendments.

Notes: Illustrative only. Governments will need to seek their own legal advice for each toll road contract.

Source: Grattan analysis of NSW and Victorian toll road contracts, where available.

<sup>157.</sup> Senate Economics References Committee (2017, p. 18).

<sup>158.</sup> Victorian DTF (2019, p. 191).

<sup>159.</sup> Portfolio Committee No. 2 - Health and Community Services (2017, pp. 14-30).

<sup>160.</sup> See, for example, RTA (2003, p. 36), RTA (2008, p. 37), RTA (2010, p. 51), RMS (2012, p. 56) and RMS (2013, p. 82).

See, for example, RTA (1998, pp. 26–27), RTA (2003, pp. 38–39), RTA (2008, pp. 38–41), RTA (2010, p. 53), RMS (2012, pp. 63–66) and RMS (2013, pp. 87–93).

of the westbound tunnel'.<sup>162</sup> If such a toll has a 'material adverse effect' (see Figure B.2) on the company's returns, the contract would need to be renegotiated to compensate the company.<sup>163</sup> But this 'congestion toll' is not equivalent to the CBD cordon proposed in this report; as such it is unclear whether a cordon would similarly trigger renegotiation.

In most contracts, it is agreed that a 'flexible approach' would be taken in any compensation negotiations.<sup>164</sup> Options include:

- changes to the project's concession term (extending the contract);
- adjustments to the project's tolls;
- changes to the risk allocation between the state and the company;
- financial contributions from the state; or
- other amendments to the contracts.

In recent contracts, financial payments from the state to the toll road operator are typically the 'last resort'.<sup>165</sup>

For each toll road contract, the NSW Government will need to seek its own legal advice to determine whether compensation is required, and what appropriate redress entails. It seems likely that reductions in traffic in the Sydney Harbour Tunnel will require state compensation – at least until the asset ownership passes to the government in 2023. This is because the government already compensates the private owners for shortfalls in revenue via the 'Ensured Revenue Stream Agreement'.<sup>166</sup> This Ensured Revenue Stream means that the government is likely to make payments to the operator each year until the concession expires anyway.<sup>167</sup> Any further dampening of demand caused by congestion charging would clearly need to be compensated.

The Sydney Harbour Bridge, which is owned by the state government, may see lower volumes due to congestion charging. Since the government collects the tolls, there may be an impact on the government's balance sheet. But there is no private operator that can claim compensation in this case.<sup>168</sup>

### B.2.2 Victorian toll road contracts are ambiguous, even where congestion charging is mentioned

The main toll road of interest in Victoria is CityLink, and by extension the future West Gate Tunnel. This is because the two projects are bound together; they will connect, they will have the same operator (Transurban), and their contracts interact.

- 166. Schedule 5 of Sydney Harbour Tunnel (Private Joint Venture) Act 1987.
- 167. NSW Auditor-General (2008, pp. 75-76).
- 168. Unless the state government bundles the right to collect and retain Sydney Harbour Bridge tolls in a concession for another project, such as the Western Harbour Tunnel.

<sup>162.</sup> RTA (2008, pp. 28, 41). There is also a provision in the case that a toll is imposed on the southbound ramp from the Cross City Tunnel to the Eastern Distributor, or on the southbound Eastern Distributor south of this connection.

<sup>163.</sup> The renegotiation should enable to the company to 'repay their debt financiers in accordance with the project's debt financing arrangements', and give the project's equity investors the lower of: 'the after-tax equity return they would have received had the event or circumstance not occurred, and the after-tax equity return they were originally predicted to receive, in the private sector participants' 'base case financial model': RTA (ibid, p. 42).

<sup>164.</sup> RTA (1998, p. 28); RTA (2003, p. 39); RTA (2008, p. 42); RTA (2010, pp. 53–54); RMS (2012, p. 64); RMS (2013, p. 90); and RMS et al (2018, Clause 23A.6(b), pp. 214-215).

<sup>165.</sup> Direct payments are 'considered as a measure of last resort and will, unless RMS requires otherwise, only apply to the extent that the other methods of redress cannot reasonably be used so as to achieve' the objective of compensating the company: RMS and NorthConnex Company Pty Ltd (2015, Clause 21.7,

p. 172), RMS et al (2015, Clause 23A.7, p. 204), RMS et al (2018, Clause 23A.7, p. 215), RMS and WCX M4 Pty Ltd (2015, Clause 23A.7, p. 165) and RMS and WCX M4 Pty Ltd (2014, Clause 23A.7, p. 133).

Victorian toll road agreements – and their amendments – are tabled in parliament.<sup>169</sup> But it is still unclear whether certain forms of congestion charging could require the state to compensate private operators.

The CityLink contract generally allows the state to manage the road network – apart from CityLink itself – as it sees fit.<sup>170</sup> However, one clause aims to deter the state government from introducing tolls on a section of the West Gate Freeway.<sup>171</sup> But a CBD cordon as outlined in Chapter 1 would not impose any charge on the West Gate Freeway. As such, the cordon design recommended in this report may not constitute a breach of contract.

However, changes to state law or state policy – including 'road taxes, transport taxes, carbon taxes, fuel taxes, environmental taxes or new taxes which directly affect the Project' – could have a 'Material Adverse Effect'.<sup>172</sup> This could require the state to compensate the operator<sup>173</sup> by:

- amending the toll calculation schedule (which caps the tolls that the Company can charge);
- varying the Concession Period and the terms of the Leases;
- 169. Section 15(2) of *Melbourne City Link Act 1995*; Section 12 of *West Gate Tunnel* (*Truck Bans and Traffic Management*) *Act 2019*; and Section 21 of *EastLink Project Act 2004*.
- 170. State of Victoria et al (2019, Clause 2.4(b)).
- 171. Clause 2.4(h) reads: 'It is agreed that the State will not impose or allow to be imposed any toll or levy for the use of (or for the grant of, or agreement to grant, a right or authority to use) the Westgate freeway link between Sturt Street and Graham Street for the passage of vehicles.'
- 172. State of Victoria et al (2019, Appendix, Clause 2.9(4)). A 'Material Adverse Effect' includes negative impacts on 'the level of timing of revenues... or of outgoings incurred or paid in respect of the Project': State of Victoria et al (ibid, Clause 1).
- 173. To 'restore the ability of the... Equity Investors to achieve the... Equity Return which would have applied but for the relevant event': State of Victoria et al (ibid, Appendix, Clause 2.9(4)).

- altering the allocation of risk between the parties;
- financial contributions from the state;<sup>174</sup> or
- other amendments to the contracts.<sup>175</sup>

The West Gate Tunnel agreement demonstrates that the state and toll road operator are conscious that congestion charging could be introduced in the near future. There is an explicit acknowledgement that the state may 'implement a Relevant Price or Restriction' on the road network.<sup>176</sup> But it is also a Key Risk Event if the state implements a 'Road Network Price or Restriction'.<sup>177</sup> This is important because, just as in the EastLink contract, Key Risk Events can allow the operator to claim compensation from the state, provided that a 'Relevant Effect' can be demonstrated.<sup>178</sup> This may be difficult for the operator to establish: small changes in road volumes resulting from government policies may be difficult to distinguish from other factors, especially in a fast-growing city such as Melbourne.

There is further ambiguity on whether a cordon is excluded from the definition of a Road Network Price or Restriction. The definition of a Road Network Price or Restriction reads:

Road Network Price or Restriction means a Relevant Price or Restriction that:

(a) other than in the case of a Cordon Price or Restriction or Principal Road Interface Price or Restriction, applies on a network wide

174. A 'measure of last resort': State of Victoria et al (ibid, Appendix, Clause 2.9(4)).

- 176. State of Victoria and Transurban WGT Co Pty Ltd (2019, Clause 26.3).
- 177. Ibid (Clause 1).
- 178. State of Victoria and Transurban WGT Co Pty Ltd (ibid, Clause 27.2, 27.3). In relation to a Road Network Price or Restriction, a Relevant Effect is 'an adverse effect on the projected net operating cashflows in connection with the West Gate Tunnel from the date of the occurrence of the Key Risk Event until the Final Expiry Date, the net present value of which exceeds... \$20 million (Indexed)': State of Victoria and Transurban WGT Co Pty Ltd (ibid, Clause 1).

<sup>175.</sup> Ibid (Clause 2.10(c)).

basis, or substantially on a network wide basis, within the Greater Melbourne  $\ensuremath{\mathsf{Area}}\xspace$  and

(b) has a purpose of changing road network travel volumes (for example, by effecting modal shift).  $^{179}\,$ 

It is ambiguous whether a Cordon Price is excluded from the definition of a Road Network Price,<sup>180</sup> or whether it is excluded from the requirement to apply on a network-wide basis but indeed remains a Road Network Price.

The EastLink contract contains similar clauses to the West Gate Tunnel agreement, but with no mention of road pricing. A 'Change in Law'<sup>181</sup> is a 'Key Risk Event'<sup>182</sup> that, if resulting in a 'Relevant Effect',<sup>183</sup> could require redress from the state using the methods listed above<sup>184</sup> *except* for a financial contribution from the state.<sup>185</sup>

#### B.3 What governments can do now

#### B.3.1 Minimise risk of compensation in the first instance

The existence of private toll roads is not an insurmountable barrier to congestion charging, for two reasons. Firstly, governments can and should take the steps outlined below to reduce their liability. Secondly, compensation payments do not, in fact, affect the merit of congestion charging in a cost-benefit analysis. This is because compensation

But there are transaction costs to compensating toll road operators – each party must pay its lawyers to spend time renegotiating the contracts for an uncertain outcome. As such governments should minimise any potential compensation liability.

The two main options are: to avoid adding congestion charging onto toll roads; and to allow tolls to count towards a congestion charge (creating a combined toll and congestion charge cap).

Where possible, governments should not levy a congestion charge on top of existing toll roads. This is particularly the case for corridor charges. Directly increasing the cost of using a toll road will almost certainly reduce demand for the road. While the government is likely to collect more than enough money from the corridor to compensate the toll road operator, there will be transaction costs in renegotiating the contracts, and the public will doubtless object to paying 'twice' for using the one road.<sup>187</sup>

The second option – a combined cap on tolls and congestion charges – requires more careful consideration. The extreme version of this strategy would be to allow motorists to fully count their tolls towards a congestion charge each trip. A motorist who pays more than \$5, say,

<sup>179.</sup> Ibid (Clause 1).

<sup>180.</sup> See, for example, Jacks (2019).

State of Victoria and ConnectEast Nominee Company Pty Ltd (2018, Schedule 1).

<sup>182.</sup> Ibid (Clause 45.1).

<sup>183.</sup> Ibid (Schedule 1).

<sup>184.</sup> Ibid (Clause 45.4(d)).

<sup>185.</sup> Ibid (Clause 45.4(e)).

<sup>186.</sup> Transport and Infrastructure Council (T2 Cost Benefit Analysis, 2016, p. 14) and DFA (2006, p. 27). One way to think about this seemingly arcane point is to consider the impact of congestion charges on fuel excise: while governments may collect less fuel excise when congestion charges are introduced, their loss would be offset by the gain to motorists who paid less fuel excise. Because the funds would still be able to be spent by somebody, they would be considered transfers rather than costs, for the purposes of an economic cost-benefit analysis.

<sup>187.</sup> The government is likely to collect more money than the toll road operator will lose because the current toll road prices are 'well-below the profit-maximising tolls': ACCC (2018a, p. 18). This means that the extra revenue collected from a higher toll will offset the reduction in revenue from fewer motorists using the road.

of tolls would face no congestion charge for entering the CBD during the morning peak. But this would completely remove the congestion price signal for many drivers, undermining the effectiveness of the charge. It is also a very generous concession for toll road operators that have motorways leading to the CBD – provided their road is faster than untolled routes, it makes their road the obvious choice.

A more moderate strategy would be a discount above a threshold, such that a motorist who has already spent \$10, say, would face only a half-price congestion charge. Given that drivers to the CBD are typically high-income earners (see Section 1.5), this strategy may not be warranted. But it could be useful for building public acceptance of an expanded congestion charging scheme.

# B.3.2 If compensation is owed, governments should amend the contract in a mutually-beneficial way

In the event that an operator can demonstrate a 'material adverse effect' and compensation is required, state governments should negotiate a deal that provides redress to toll road operators while further managing congestion. One such option would be to amend the tolls that operators can levy.

Toll road operators are restricted in the prices that they can charge for access to the road.<sup>188</sup> These caps – and how they change over time – are generally specified in detail in the contracts.<sup>189</sup> A particularly efficient way to allow operators to recover revenue would be to lift the cap on toll prices that they can charge – but only during peak times. This approach would, in effect, both compensate toll road operators for the effects of congestion charging, and introduce a form of time-of-day tolling on their roads.

Toll road operators are likely to be willing to raise the prices on their roads. In 2018, the Australian Competition and Consumer Commission (ACCC) concluded that current toll caps are well below the 'profit maximising' tolls that would be applied if there were no caps in place.<sup>190</sup> As such, increasing the toll may not have a major impact on the volume of traffic travelling on toll roads, boosting overall revenue and effectively redressing the operators.

# B.3.3 Direct payments are politically-tricky and often a 'last resort' – but they're more transparent than contract extensions

Appendix B.2 noted that financial transfers from the state to the toll road operator are often a last resort. State governments may have wanted such a condition because of the political risk of paying compensation. This political risk was particularly on display in the aftermath of the Victorian Government cancelling the East West Link project in 2015.<sup>191</sup>

But compared to extending concession deeds, a direct payment to the toll road operator is a better outcome for Australians. Firstly, the value of a direct payment is more transparent than a contract extension. And secondly, contract extensions constrain future governments' abilities to manage the road network.

#### B.3.4 Buying out the contract is not an easy option

It is very difficult to know precisely how congestion charges will affect traffic volumes. Accordingly, governments might need to make several small changes to road pricing arrangements over a number of years to establish a congestion charging scheme that addresses any unintended consequences that arise. Governments may also need to

<sup>188.</sup> The maximum price that can be charged for access is capped, and operators generally charge at the maximum: ACCC (2018a, pp. 17–18).

<sup>189.</sup> Senate Economics References Committee (2017, pp. 16-17).

<sup>190.</sup> ACCC (2018a, p. 18).

<sup>191.</sup> ABC News (2015a); Savage (2015); ABC News (2015b); and Edwards (2015).

compensate toll road operators multiple times. And given that there will be a transaction cost each time, governments might instead want to simply buy out toll road contracts once-and-for-all.

Proposals for renationalisation or forced divestiture of various industries have received much attention in recent years, both in Australia and abroad.<sup>192</sup> Re-acquiring all the privately-owned toll roads would preserve the greatest flexibility for the state to manage traffic on the network without requiring it to pause to negotiate over the costs of contract variations each and every time a congestion charging price is amended, or a scheme's geographic coverage is revised, or the types of vehicles it charges are changed.

However, such a sweeping move would be costly; either for the budget, the state's reputation, or both. Buying out a toll road contract could require offering a substantial market-value price to the operator, or else terminating the contract – which may involve providing compensation to the operator.<sup>193</sup> And nationalisation can carry the danger of discouraging business investment in the state.<sup>194</sup>

These are large risks for governments to take on, given that toll road operators may not be successful in any claims for compensation resulting from congestion charging, and even if successful the amounts may be small.

### B.4 Governments can take steps to regain policy flexibility on roads

Australian toll roads have generally been delivered through public-private partnerships (PPPs).<sup>195</sup> A PPP is a contract that bundles investment and service provision of infrastructure – such as roads, railways, or prisons – into a single long-term contract. The bundling of construction and operation creates efficiencies because it 'forces investors to internalise operation and maintenance costs, and generates incentives to design a project so that it minimises life-cycle costs'.<sup>196</sup> Additionally, builders have an incentive to consider quality carefully in the design phase when they are responsible for meeting enforceable service standards.

There are several models of PPP, each of which involves allocating different types of risk between the state and the private company. In many cases, the private company assumes the risk of building and operating the asset and collects tolls as part of its payment.<sup>197</sup> This means that the company is exposed to the 'patronage risk' – the possibility of fewer drivers using the road than anticipated.

This approach – known as an 'economic PPP' – has shielded governments' balance sheets from the impacts of disastrously optimistic patronage forecasts, which plagued Sydney's Cross City Tunnel and Lane Cove Tunnel, Melbourne's EastLink, and Brisbane's Clem7 and Airport Motorway.<sup>198</sup> But it also leads to restrictive clauses being added to contracts, requiring government compensation

197. The remainder of the payment is typically a direct financial contribution from the government, using tax revenue: Terrill (2017) and Senate Economics References Committee (2017, p. 16).

<sup>192.</sup> See, for example, Scott (2019), McIlroy (2018), The Economist (2017a) and The Economist (2017b).

<sup>193.</sup> For example, there is an early termination clause of the WestConnex M5 project that applies if a court ruling renders the operators unable to carry out the project, through no fault of their own: RMS et al (2015, Clause 1, 31.7, 31.11). In this case, the state must pay an 'Early Termination Amount' that includes a sum that gives 'the Equity Investors the Projected Equity Return on the Equity Contributions to the date of termination'. Some toll road contracts may also allow governments to terminate the contract 'for convenience', subject to payment of compensation: McNair (2017, pp. 385–386).

<sup>194.</sup> Di Lieto (2017). The ACCC has noted that 'divestiture of privately owned assets is an extreme measure to take in any market': ACCC (2018b, p. 89).

<sup>195.</sup> PwC (2015, p. 30).

<sup>196.</sup> Engel et al (2014, p. 195). PPPs also encourage greater project discipline and may allow infrastructure to be funded without government debt, though the higher costs of private finance may erode these benefits: PwC (2017).

<sup>198.</sup> Senate Economics References Committee (2017, p. 16).

for network changes that might reduce toll road volumes (see Appendix B.2).<sup>199</sup>

In a Senate inquiry submission, Professor David Hensher noted that:

Only the state thinks 'network'. This is a key issue. The state gives away pricing controls and then finds it difficult to optimise the network when it only has control over this important lever for part of the network. This is of little concern when there are small, isolated sections of privately-operated toll roads. It suddenly becomes a massive concern when these privately-operated toll roads 'become' the network!<sup>200</sup>

There is an alternative: the 'availability payment public-private partnership' (availability PPP) model. In such a model, the government retains the patronage risk (i.e. keeps the toll revenue), while still paying a private operator to build, operate, and maintain the asset.<sup>201</sup> This model has been used on the Toowoomba Second Range Crossing in Queensland, the Peninsula Link in Victoria, and is the current approach for the North East Link in Melbourne.<sup>202</sup> The benefit, as explicitly noted in the North East Link business case, is that governments retain policy flexibility, allowing them to more easily make network changes such as pricing reform.

There are two drawbacks for governments. By taking on the patronage risk, the availability PPP results in less budget certainty. And because the state has a financial obligation to make service payments, a

'liability' is recorded on the state's balance sheet.<sup>203</sup> This could affect the state's credit rating.<sup>204</sup>

In contrast, no asset or liability was recorded on the state's balance sheet for economic PPPs prior to 2019.<sup>205</sup> This may have been convenient for budget-conscious governments, allowing new roads to be built at 'zero cost to the state in theory, from a cash perspective'.<sup>206</sup> A 2019 change in accounting standards now requires governments to recognise foregone tolls as a liability,<sup>207</sup> though this may not affect the state's credit rating.<sup>208</sup>

There is also a strong argument that risk should sit with the party best equipped to manage it.<sup>209</sup> In the case of toll road patronage, governments have the policy levers at their disposal: they can change or upgrade the road network, vary motorist charges (such as registration), improve public transport, introduce reforms to promote economic growth, and impose land-use policies. Beyond ensuring the asset is well-maintained, toll road operators have relatively little influence on demand for their road. This forces them to foresee government actions that might slow their revenue streams, and write compensation clauses into the contracts to mitigate these risks.

Governments have two main options if they want to maintain policy flexibility but continue delivering toll roads through PPPs. They can adopt the availability PPP model and retain the tolls themselves, accepting any budget impacts this may have. Or they can negotiate

<sup>199.</sup> This issue was noted even as early as 1995 by the NSW Auditor-General: 'private ownership of tollways imposes important constraints on the exercise of Government powers... the Government as owner of these motorways is in a better position than the private sector to harness the external benefits and to mitigate the external costs imposed by these motorways/distributors': Harris (1995, pp. 20–21).

<sup>200.</sup> Hensher (2017).

<sup>201.</sup> PwC (2015, p. 17).

<sup>202.</sup> PwC (2015, p. 30) and North East Link Authority (2018, Chapter 10, pp. 25-26). In the case of the Peninsula Link, there are no tolls.

<sup>203.</sup> PwC (2017, pp. 9, 17).

<sup>204.</sup> PwC (2015, p. 37).

<sup>205.</sup> PwC (2017). See AASB (2019) for the 2019 change in accounting standards.

<sup>206.</sup> North East Link Authority (2018, Appendix S, p. 71).

<sup>207.</sup> AASB (2019); and Victorian DTF (2019, pp. 47-53).

<sup>208.</sup> This is because the liability is recognised as a 'deferred revenue liability', which is a non-financial liability, and therefore does not contribute to net debt; see, for example, Victorian DTF (2019, p. 51).

<sup>209.</sup> Department of Finance (2019, p. 19); and Engel et al (2014, p. 213).

the contract of an economic PPP such that the imposition or change of future congestion charges (or road user charges more generally) would not constitute a key risk event, and therefore any impacts on operators resulting from such charges would not be compensable.

The second option requires the private company to price in the risk of such policy changes upfront. Given the difficulty of quantifying this risk, the company may demand other substantial concessions, such as higher tolls, a longer concession period, or additional government contributions to the project. This approach may or may not represent good value for money for the Australian taxpayer. Governments will need to consider the merits of each approach, and whether the costs are outweighed by the benefit of policy flexibility, given the possibility and quantum of compensation that may be otherwise owed.

As for existing toll roads, if the introduction of congestion charging were to result in compensation being owed, and if toll caps cannot be easily lifted, or if any subsequent tweaks to the congestion charge could trigger further renegotiation, governments should consider the merits of renegotiating the contracts to take control of the patronage risk, and determine whether this option represents good value for money for taxpayers.

### Appendix C: How to fairly enforce congestion charging

Congestion charges need to be enforced. The scheme would be undermined if drivers could flagrantly disregard their obligation to pay for using scarce road space. But penalties for non-compliance should be proportionate, transparent, and efficient. Excessively harsh treatment is costly for taxpayers, unfair on vulnerable drivers, and unlikely to build community support for congestion charging.

The way toll road debt is enforced provides many lessons for congestion charging.

## C.1 State governments should learn from the handling of toll road debt

Drivers need to comply with strict rules to use a toll road. Breaking these rules can have serious consequences: warnings, fines, restrictions on driving, and even criminal convictions, in some cases. These penalties are designed to promote safe behaviour on the road.

Toll road debts are treated unusually. Even though this debt is owed to private companies and has no safety implications, state governments treat unpaid tolls as an infringement – which means they can issue fines. At least in Victoria, debtors who repeatedly fail to pay infringement fines can face imprisonment.<sup>210</sup>

NSW has a less draconian system. Toll road operators can recover unpaid debt through debt collectors who have a Code of Practice.<sup>211</sup> Any extra administrative fees must be reasonable. Infringement notices can be issued at the toll road operator's request, but the government limits the number of requests to 300 per month per road asset.<sup>212</sup> This ensures a more nuanced approach – toll road operators have to decide which drivers are worth pursuing in this manner, such as repeat offenders.

Victoria has been slower to address the risk of snowballing costs. Before 2019, a driver could be issued a fine for every day of travel if they continued using a toll road without paying.<sup>213</sup> Even now, each infringement incurs a penalty of at least \$155, so drivers who attract multiple fines can see their penalty rapidly inflate far in excess of the original toll debt. The costs can become unmanageable, especially for low-income drivers, and in extreme circumstances the debt has been paid by prison time.<sup>214</sup>

Recent legislative changes now mean that:

- only one infringement notice can be issued in any seven-day period, regardless of how many offences occur in that period;
- toll road operators must have a hardship policy, and cannot refer a toll offence for enforcement if the person has a hardship application pending;
- where a person commits toll offences on the same day on multiple Victorian toll roads operated by the same operator, only one offence can be referred for enforcement; and
- the toll road operator must attempt to contact an offender twice by telephone, SMS, email, or electronic message if they still haven't

<sup>210.</sup> WEstjustice (2017, pp. 2-3).

<sup>211.</sup> Senate Economics References Committee (2017, p. 25). 212. Ibid (p. 25).

<sup>213.</sup> Linkt (2019, accessed 9 April 2019, but subsequently modified).

<sup>214.</sup> See WEstjustice et al (2018) for an explanation of the pathways that can lead a driver from a toll infringement to a prison sentence.

paid the bill by the due date set out in the second request for payment.  $^{\rm 215}$ 

Governments can learn from these changes, as outlined in the next section.

#### C.2 A fairer enforcement process

Congestion charging allows drivers access to an in-demand community asset. Failing to pay for such a service is not a safety risk to others, but it is anti-social behaviour. Penalties for such action should be productive, not punitive – they should encourage drivers to comply with the scheme, not burden them with unreasonable debt.

Building on the NSW approach to toll road debt, we propose the following system for congestion charging enforcement:

- The owner of the registered vehicle should be sent a bill either monthly or quarterly, similar to utilities bills. This bill would be due within 30 days, but recipients could apply for a hardship program to seek an extension or pay by instalment. The bill should be sent via mail, email, and text message, with these details collected when a driver registers their vehicle.<sup>216</sup>
- If the bill remained unpaid by the due date and no extension or payment plan had been arranged, a late notice would be sent to the vehicle owner. This would incur a modest administration

fee.<sup>217</sup> The notice would remind the driver about the hardship program, and include a warning that failure to pay within 14 days would result in a further administration fee and possible civil debt recovery action.

• At the end of these 14 days, a final notice would be sent to the owner. This would detail their full debt (the original charges, plus the two late fees) and inform the driver that the state will begin the civil debt recovery process.

This system would mean the driver's final debt would be only slightly larger than if they had paid on time. Drivers would not be punished for every single unpaid use of a road involved in the congestion charging scheme. And even if they failed to pay, no restrictions would be placed on their driving, nor would the matter be pursued in criminal proceedings.

Issues might arise where drivers other than the registered owner used a vehicle and incurred congestion charges. The registered owner should be able to transfer any portion of their congestion charging debt to the primary driver, subject to submitting a statutory declaration signed by both parties. In situations of family violence, victims can apply to have fines withdrawn in Victoria through the Family Violence Scheme; such a process should also be in place for congestion charges.

Transparency is crucial to help drivers stay on top of their debts. They should be able to view and pay their debt online at any time. There should be adequate signage to warn drivers when congestion charging applies. And drivers should be sent bills and reminders via as many channels as possible, unless they opt out of certain forms of communication.

<sup>215.</sup> See Sections 31, 32, 96, 97, 119, and 120 of *West Gate Tunnel (Truck Bans and Traffic Management) Act 2019.* For the hardship policy requirements, see Exhibit YY to the *CityLink Concession Deed* and Schedule 35 of the *West Gate Tunnel Project Agreement.* 

<sup>216.</sup> Aggregating payments over a month or quarter means fewer financial transactions for both driver and the state, saving on transaction costs: Eliasson (2010, p. 8).

<sup>217.</sup> This approach means one fee per month or quarter per vehicle. The modest administration fee should reflect the costs of issuing the notice and collecting the debt.

### Appendix D: Australian privacy law

This appendix explains the privacy laws that may be relevant to congestion charging in Sydney and Melbourne. The first section explains that there are both Commonwealth and state laws that could govern a congestion charging scheme. The next section explains the different types of entities, whether government agencies or private firms, and how this determines what jurisdiction's privacy laws will apply. The final section explains the different kinds of data, and how privacy law treats them.

#### D.1 There are Commonwealth and state laws

Commonwealth and state privacy laws cover similar subject matter. The Commonwealth privacy laws are captured in the *Privacy Act 1988* (Cth); New South Wales has the *Privacy and Personal Information Protection Act 1988* (NSW); and Victoria has the *Privacy and Data Protection Act 2014* (Vic). Similar laws operate in Queensland, Tasmania, the Northern Territory, and the ACT.

The Commonwealth and state laws are intended to operate consistently. That is to say, the Commonwealth laws are not intended to override state legislation, but to operate in line with it.

The key determinant of which level of government's laws will apply to a congestion charging scheme is what kind of entity is operating the scheme. The following section explains this.

#### D.2 Which laws apply depends on the type of entity involved

A government wanting to implement a congestion charging scheme has a range of choices as to whether to operate the scheme entirely within the public sector, whether through a department of state or a separate agency, or to involve private firms in some aspects of the operation. These public sector agencies, government departments, and private firms are what we mean by the term 'entity' in this section.

# D.2.1 Commonwealth laws apply to private organisations and Commonwealth agencies

The Commonwealth's *Privacy Act 1988* applies to organisations with an annual turnover of more than \$3 million. An organisation is an individual, body corporate, partnership, any other unincorporated association or a trust that is not a registered political party or a government agency. The *Privacy Act 1988* (Cth) also applies to 'agencies'; an agency is a Commonwealth Minister, Commonwealth Department, or a body (whether incorporated or not) established for a public purpose under a Commonwealth law. Figure D.1 on the next page depicts this coverage.

In the case of a congestion charge, the Commonwealth law would apply if a private company was collecting vehicle data (assuming the company had an annual turnover of more than \$3 million). The relevant state government department, to which data could be disclosed for regulatory purposes, would probably not be subject to Commonwealth privacy law, but state law, as explained below.

#### D.2.2 NSW laws apply to public sector agencies only

The privacy laws in the NSW *Privacy and Personal Information Protection Act 1988* (NSW) apply to NSW 'public sector agencies' (Figure D.2 on page 87). Public sector agencies include government departments, statutory bodies representing the Crown, the NSW Police Force, and local government authorities. They do not include state-owned corporations. It is therefore possible that a private firm operating a congestion pricing scheme in Sydney may not be subject to NSW privacy laws, but it would be subject in that case to Commonwealth laws.

### D.2.3 Victorian laws apply to government bodies and bodies granted public functions

The Victorian *Privacy and Data Protection Act 2014* (Vic) applies to Victorian Government officials, government agencies, councils, bodies granted public functions under a state law, bodies granted public functions by a Minister, and individuals holding a position under a state law or through granting of power by a Minister or the Governor in Council.

If a private company were to operate a congestion charging scheme in Melbourne, it would be covered by Victorian law through being granted public functions under a state law. This is not dissimilar to the *Melbourne CityLink Act 1995* (Vic) which grants CityLink Melbourne Limited, a company owned by Transurban, the right to operate the CityLink toll road. Thus a private operator would be subject to state privacy law, as well as Commonwealth law, as established above.

The government department with regulatory oversight of a scheme would be a 'government agency' as described in the Act, and therefore subject to Victorian privacy laws.

#### D.3 Which laws apply depends on the type of data

Privacy laws cover information that is classed as 'personal information'. If an entity is dealing with personal information, it must comply with the relevant privacy laws. But privacy laws do not apply to information that is not classed as personal information.

#### Figure D.1: Commonwealth laws and different entities



Notes: Organisations include individuals, body corporates, partnerships, and unincorporated associations. Agencies include the Commonwealth minister, department, and bodies established by Commonwealth law. Source: Privacy Act 1988 (Cth). This section explains what personal information is, and the additional restrictions applying to the subset of personal information known as 'sensitive information'.

#### D.3.1 What is personal information is not always black and white

Commonwealth law defines personal information as 'information or an opinion about an identified individual, or an individual who is reasonably identifiable', regardless of whether the information is true or whether the information or opinion is recorded in material form or not.<sup>218</sup> While there are subtle differences in the wording between the relevant Commonwealth, NSW, and Victorian legislation, these differences are unlikely to be significant in practice.<sup>219</sup>

Nevertheless, what is classified as personal information can be a fluid concept. To be considered personal information, data must meet both of the following requirements:

- The information must be 'about' an individual; and
- The identity of the individual must be reasonably ascertainable from the information.

Information collected as part of running a congestion charging scheme will most likely be about an individual, since it will relate to each driver's use of the congestion zone.

Determining whether a person's identity is reasonably ascertainable is not solely an intrinsic feature of the information, but also a feature of the context and the legal and practical resources available to those who seek to identify someone. It is likely that number plate information is personal information in the hands of a roads or transport agency with access to other data allowing them to link number plates to an

<sup>219.</sup> Vaile et al (2018, pp. 12–14).



Figure D.2: NSW laws and different entities



Source: Privacy and Personal Information Protection Act 1988 (NSW).

<sup>218.</sup> s. 6, Privacy Act 1988 (Cth).

individual driver. But it might not be personal information for other organisations without access to such data.

It is advisable for organisations and agencies handling such information to be cautious as to the possibility that such information is personal information and therefore subject to privacy law. They can also take steps as explained in Section 4.5.1 to separate identity information from information about the times a vehicle was in particular locations. By definition, de-identifying the information means that it is no longer personal information.

But agencies should also recognise that de-identification is not necessarily permanent. It can still be personal information if the same nickname or pseudonym is consistently used for a particular individual. A single trip, viewed in isolation, might not reveal much, but a pattern can reveal an individual's work and home address, and habits of travel, and thus reveal the identity of the individual. It can also be personal information if the de-identified data is successfully linked to other data that does show an individual's identity.<sup>220</sup>

#### D.3.2 Sensitive information is governed by stricter laws

In the Commonwealth and Victoria, there is a subset of personal information known as 'sensitive information'. More stringent laws apply to sensitive information. NSW laws do not provide for sensitive information.

Sensitive information is defined as information or an opinion about an individual's racial or ethnic origin, political opinions or party membership, religious beliefs or affiliations, philosophical beliefs, membership of a professional or trade organisation, membership of a trade union, sexual preference or practices, or criminal information.



Figure D.3: Victorian laws and different entities

Source: Privacy and Data Protection Act 2014 (Vic).

<sup>220.</sup> If the charging authority used an existing pseudonym, such as a tax file number, higher protections would apply to the individual: s. 17-18, *Privacy Act 1988* (Cth).

To be classed as sensitive information, the information must also be personal information; that is, the identity of the individual to whom the information relates is reasonably ascertainable. Commonwealth laws also include health, genetic, and biometric information as sensitive information.

It appears unlikely that this kind of information could be extracted from time and location information used for congestion charging. But there are some possibilities; for example, if GPS data was anonymised using a consistent nickname or pseudonym, an individual attending a specialist medical centre could be unintentionally identified, and this information could be classified as sensitive information. Similarly, as mentioned in Section 4.2, an Automatic Number Plate Recognition camera could, in capturing an image of an individual's face, make it possible to identify their racial or ethnic origin.

#### D.3.3 Notifiable Data Breaches

In February 2018, the Notifiable Data Breach provision in the Commonwealth Act came into force. All agencies and organisations which are subject to the *Privacy Act 1988* must notify the Office of the Australian Information Commissioner and affected individuals in the case of an Eligible Data Breach.

This occurs if there is an unauthorised access to, unauthorised disclosure of, or loss of personal information that the entity holds, *and* that such access, disclosure, or loss is likely to result in serious harm to any individuals to whom the information relates.

The factors determining whether serious harm is likely include the kind of information, sensitivity of the information, the kinds of people who have obtained the information, and the likelihood that these people have an intention to cause harm. These provisions could be relevant for a congestion charging scheme if operated by a private company.

### Appendix E: Veitch Lister Consulting's Zenith model

#### E.1 What is the Zenith family of transport models?

Veitch Lister Consulting (VLC) operates transport models for a number of cities and regions in Australia. It has provided modelling for a number of major projects, including the M1 Pacific Motorway Upgrade, North East Link and Sydney Metro. Most recently, VLC was engaged by Infrastructure Australia to provide modelling for the Australian Infrastructure Audit 2019.

VLC's 'Zenith' family of transport models shares a common architecture.<sup>221</sup> Each modelled region is divided into thousands of travel zones. Trips in the model take place between these zones. The zones are connected via links that represent the existing transport network of roads, train and tram lines, and bus and ferry routes.

The links that make up the modelled road network possess attributes that allow the simulation of traffic behaviour. These attributes include the:

- length of the link;
- types of transport mode that are permitted to use the link;
- relationship between demand and speed that is assumed to exist on the link (i.e. the speed-flow curve);
- free-flow speed of the link; and
- hourly capacity of the link.

The models simulate all travel by households, firms, and visitors to the region during an average weekday. Travel is simulated in four time

periods: morning peak, inter-peak, afternoon peak, and off-peak. The demand for travel to different zones is based on demand for participation in 'activities' – these are explained in Appendix E.2.

The model produces outputs for each time period, and these include:

- traffic volumes on each road link, by type of vehicle;
- passenger loads on each public transport route and stop;
- number of trips between origin and destination pairs, by mode; and
- costs of travel (e.g. public transport fares paid, vehicle operating costs incurred, etc.), by mode.

#### E.2 What are the inputs to the models?

The four main types of input to the models are:

- information about the existing transport network, discussed in the previous section;
- data on the households and 'activities' that exist in each travel zone;
- costs of travel; and
- data from household travel surveys.

VLC has used a wide range of data to identify the types of households and 'activities' in each travel zone in the model. 'Activities' are the reasons people might travel to that zone, and include work, education, shopping, personal business, recreation, social, and 'other' journey purposes. The data used by VLC includes population and demographic data on workforce participation, age profiles, and car ownership

Technical detail in this appendix comes from Veitch Lister Consulting (2014), IA (2019d) and Veitch Lister Consulting (2019a).

levels. It also includes land-use data on the presence of office blocks, factories, shops, schools, hospitals, and airports.

Inputs relating to the costs of travel include public transport fares, road tolls, parking costs, fuel prices, and other vehicle operating costs. These factor in to the out-of-pocket cost of travel choices.

Data from household travel surveys – such as the Sydney Household Travel Survey and the Victorian Integrated Survey of Travel and Activity – are used to statistically estimate a large number of behavioural parameters. In turn, these parameters are used to predict how different types of people travelling for different types of purpose make their travel decisions.

#### E.3 How do the models simulate travel behaviour?

Conceptually, the models express travel decisions as a series of choices. If framed as personal choices, these are:

- How many trips for each activity (e.g. work, shopping, or education) will I make today?
- To where will I make each trip?
- By what mode will I make each trip (e.g. car, public transport, or walk)?
- What route will I take for each trip?

Choices about destination, mode, and route are driven mainly by the behavioural parameters mentioned and the 'expected' costs of those choices. Once all choices have been made, the 'actual' costs are fed back into the model and choices about destination, mode, and route are made again. The reason for this iterative process is that the 'expected' cost of an individual travel choice can differ from the 'actual' cost depending on the travel choices of others – for example, because

of traffic congestion. This iterative process continues until a satisfactory level of convergence is reached – that is, any further changes in travel choices or cost are sufficiently small.

### Appendix F: Other schemes that were considered

In addition to the CBD cordons discussed in Chapter 1, we asked Veitch Lister Consulting to model a number of other types of congestion charging scheme in both Sydney and Melbourne:

- A 'broad' cordon charge.
- A network of corridor charges.
- A network-wide, distance-based charge.

This appendix describes what was modelled, sets out some high-level results, and briefly discusses why we did not recommend that governments implement these schemes in the short term.

#### F.1 Broad cordon

As an alternative to a CBD cordon, we also considered broader cordons that encompassed a selection of inner suburbs surrounding the CBD. These inner-city areas can be heavily congested at peak times, attract high numbers of drivers per square kilometre, yet are still relatively accessible by public transport.

For Sydney, our broad cordon closely followed the boundary of the City of Sydney Local Government Area (see Figure F.1).

For Melbourne, we chose a cordon roughly bounded by Moonee Ponds Creek, the Elliot Avenue - Alexandra Parade corridor, the Yarra River, and Albert Park (see Figure F.2 on the next page). This cordon captures at least partially the 15 suburbs in Melbourne with the highest share of commuters travelling by public transport.

We modelled a charge of \$3 to enter the cordon in the morning peak, and a further \$3 to exit in the afternoon peak.



Figure F.1: Sydney broad cordon

Source: Grattan analysis.

#### Effects of a broad cordon on traffic

The modelling suggested that the charge would reduce the number of vehicles entering the cordon in the morning peak by 16 per cent in Sydney and by 19 per cent in Melbourne. The charge also improved average speeds in the peaks by between 1 and 2 per cent across each city's whole road network.

#### Why we are not recommending broad cordons in the short term

A government trying to design a broad cordon is likely to run into a number of arguments about where to draw the boundary. This is much less of an issue if the cordon is drawn around an area widely agreed to be the 'CBD'.

Given that the boundary for a broad cordon is likely to run through areas that are more residential in nature, a number of households could suffer a very direct, adverse effect (or perceive that they will be adversely affected). An example is parents who face the cordon charge to drop their children off at school, even when this is only a short trip within their suburb or to the neighbouring one.

While the broader benefits of the cordon could outweigh these and other negatives, the publicity around such stark examples of adverse effect could derail the scheme.

#### **Corridor charges F.2**

We considered per-kilometre charges applied to a large network of the highest volume and most congested roads.

The corridor charging network for Sydney is shown in Figure F.3 on the following page and for Melbourne in Figure F.4 on page 95. Both networks are about 200 kilometres long.



Figure F.2: Melbourne broad cordon

Source: Grattan analysis.

Figure F.3: Sydney corridor charging network



Source: Grattan analysis.

Figure F.4: Melbourne corridor charging network



Source: Grattan analysis.

We did not follow any strict criteria when choosing the corridors to be charged, but rather applied our judgement with regard to:

- traffic volume data from VicRoads and Roads and Maritime Services;
- Google Maps typical traffic data;
- the 'M' and 'A' route network in NSW, and freeways and highways in the 'Declared Roads' network in Victoria;
- modelled volume-to-capacity ratios (see Figure 2.1 on page 34 and Figure 2.2 on page 35); and
- the geographic spread of the network.

We modelled a charge of 30 cents per kilometre for travel in the peak direction in both the morning and afternoon peaks. For some roads it was appropriate to charge for travel in both directions – this was determined with regard to the sources of information on traffic and congestion listed above.

#### Effects of corridor charges on traffic

The modelling suggested that speeds on most sections of each city's charged corridor network would increase by at least 10 per cent in the morning peak. Average network-wide speeds in the peaks increased by about 2 per cent in both cities. Importantly, this network-wide speed improvement suggests that corridor charges would not just shift congestion to uncharged roads.

#### Why we are not recommending corridor charges in the short term

As for a broad cordon, a government seeking to design a large network of corridor charges from scratch is likely to run into arguments about what to include. As noted above, we applied our judgement with regard to a wide range of evidence to come up with the network we modelled. But in reality, the roads to be included and how far out from the city charges should apply could all be debated. Again, these debates could derail implementation of the scheme.

Many of these debates will essentially go to the question of who will and won't be affected by the charge. Any large network of corridor charges could, by definition, affect a material share of the city's population. This means a larger number of people who need to be convinced to support the scheme from the outset. By contrast, a CBD cordon begins where congestion is most evident but directly affects only a small share of a city's population. The prospects for introducing corridor charges on a selection of the busiest roads in each city are much better once people have seen the concept of paying for the most in-demand roads at the most in-demand times in operation via the cordon.

#### F.3 Network-wide, distance-based charge

The final scheme we modelled involved charging for every kilometre driven in each city's metropolitan area ('network wide').

For Sydney, we defined the metropolitan area to be the ABS Significant Urban Area (see Figure F.5 on the following page). We considered that the obvious alternate definition, the Greater Capital City Statistical Area, was too broad in that it captured the Central Coast and large areas of national park to the south-west, west, and north-west.

For Melbourne, we took the opposite approach, defining the metropolitan area as the Greater Capital City Statistical Area (see Figure F.6). We considered the boundary of the Significant Urban Area unnecessarily complex and therefore less feasible.

We modelled a charge of 10 cents per kilometre during the morning and afternoon peaks, and 5 cents per kilometre at all other times. For Figure F.5: Sydney distance-based charging area



Source: Grattan analysis.

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Figure F.6: Melbourne distance-based charging area



Source: Grattan analysis.

simplicity, the charge was modelled on top of all existing taxes and charges for road use. As we discuss in Chapter 3, in reality any move to distance-based charging should be accompanied with reform to other taxes and charges, for both fairness and efficiency reasons.

#### Effects of network-wide, distance-based charges on traffic

The modelling suggested that the charge would increase average speeds in the peaks by about 6 per cent in Sydney and by about 4 per cent in Melbourne. Over the entire day, the number of kilometres that people travelled by car would fall by 8 per cent in Sydney and 9 per cent in Melbourne.

## Why we are not recommending network-wide, distance-based charges in the short term

We discuss in Chapter 3 the significant work that would need to be done before network-wide, distance-based charging is feasible. The technology solution would need to be mature and enforceable. Stronger legal protections for people's privacy would need to be in place. And governments would need to decide how to integrate these new charges with existing charges, taxes, and tolls.

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