

CHANGED CONDITIONS AHEAD

THE TRANSPORT REVOLUTION
AND WHAT IT MEANS
FOR AUSTRALIANS



MELBOURNE ROAD USAGE STUDY
REPORT OCTOBER 2016

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Congestion is the biggest thing we are facing in this city ... More cars per family, more families, our population is growing dramatically and the roads can't handle it. So people have to think about how they use the roads more carefully.

Frank, Dandenong North study participant



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FOREWORD



After seeing how participants behaved and listening to what they had to say, we believe that a usage-based road charging system could work in Australia.

Australia is facing the demands of a growing and increasingly urbanised population. At the same time, our major road-funding source, namely fuel excise, is diminishing as we move to more fuel-efficient and electric vehicles.

As technology changes transport, we must consider how we want the future to look and determine the services and systems that can best support us; and we must start by getting the foundations right.

If our cities are going to continue to be among the most liveable in the world, we need a road-funding system that will grow with demand and is built on the principle of those who benefit, pay. This will allow us to invest in and use our infrastructure more efficiently, while providing an equitable revenue stream that is aligned with actual road use.

In 2016, Transurban completed the first real-world test of user-pays road charging in Australia. Conducted over 17 months, 1,635 motorists drove 12 million kilometres under a range of charging options. The study tested user-pays as an alternative to the current funding model and also trialled two demand-management charging approaches.

After seeing how participants behaved and listening to what they had to say, we believe that a usage-based road-charging system could work in Australia.

The study showed that moving to a user-pays system would likely generate a sustainable funding source that could meet our future infrastructure needs. It also indicated that a user-pays model could help manage demand through the use of charging signals to vary driving behaviours in congested geographies and at peak travel times.

Through a series of attitudinal surveys conducted over the course of the study, we saw a significant swing in participants' preference from the current system, which they initially knew little about, to a user-pays model. This shows that, by

experiencing a different way of paying for their road use, participants could see the benefit of a direct and transparent user-pays model over the current system of opaque fees and charges.

For the purpose of this study, our road-usage charges were designed to reflect replacement of the current road-related expenditure. Lower or higher charges could be applied to amplify driving behaviours and therefore could help manage demand across road networks or address the needs of specific community groups.

In real-world implementation, the level of charges would depend on the objectives, which will be an important consideration for policymakers. A user-pays system offers that flexibility.

At Transurban, we constantly look for innovative transport solutions to improve the efficiency of our networks and ultimately the liveability of our cities.

Traffic congestion and the performance of the wider road network impact our ability to deliver on our value proposition for our customers, government partners, investors and the broader community.

We live and work in Australia's major cities and, like everyone else in the community, we want the best quality of life possible. Efficient transport networks are central to that proposition.

I would like to thank all of the participants in our study for giving up their valuable time and providing their insights. Most agreed to participate because they saw it as a way to contribute to finding better transport solutions for their communities.

They have given us what no amount of theory could – a genuine picture of Australians' views and behaviours when it comes to user-pays road charging. The insights they shared are detailed throughout this report.

We look forward to further discussion on how we can continue to make progress towards a fairer and more sustainable way to fund our roads.

Scott Charlton
CEO, Transurban

EXECUTIVE SUMMARY

Transurban's Melbourne Road Usage Study was the first real-world test of user-pays road charging in Australia.

The study captured the responses of 1,635 private light vehicle motorists from the Greater Melbourne region to five user-pays charging options. It was designed to meet three objectives:

- to gauge motorists' knowledge and understanding of our current road-funding system and assess their attitudes and preferences toward user-pays charging options.
- to understand motorists' behavioural responses to different charging and implementation options.
- to prove that technology is not a barrier to implementing a practical user-pays system.

Two road-charging models with distinct purposes were tested consecutively:

- **Usage-based model** – this model tested participant responses to a user-pays funding approach that is more transparent and sustainable as a funding source. Three usage-based charging options were tested: charge per kilometre; charge per trip; and flat rate (capped kilometres).
- **Congestion-based model** – this model tested how motorists responded to demand-management pricing signals to reduce road use in highly congested geographies or at peak travel times. Two congestion-based charging options were tested: cordon (area); and time of day.

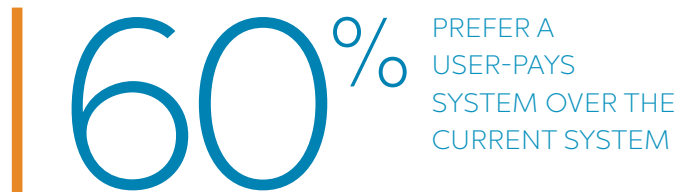
THE STUDY IN NUMBERS

1,635	Melbourne motorists*
5	Charging options
1B	Data points recorded
1.2M	Trips recorded
12M	Kilometres of travel recorded
5,000	Participant surveys completed
4,500	Participant statements issued

* Includes 70 pilot group participants and 300 control group participants

SUSTAINABLE FUNDING SOURCE

The study shows a user-pays road-funding model will work in Australia and can provide a sustainable, fair and flexible funding system that grows with demand.



It shows that participants were open to trying a more direct and transparent way of paying for their road use and that the different charging options tried by participants did not impede their usual driving behaviours.

The charging options used in the study broadly reflect current levels of national road-related expenditure, and do not represent specific policy recommendations. Through raising or lowering the charging levels, particular behaviours could be amplified or, similarly, the needs of specific community groups addressed.

Of the usage-based options, the charge per kilometre was the most popular, potentially due to its simple and easy-to-understand nature, with 59 per cent of participants preferring it over all the options tested, compared with 21 per cent for the charge per trip option and 20 per cent for the flat rate (Figure 1).

Highlighting the power of information sharing and practical experience in building awareness, a series of attitudinal surveys conducted at key points throughout the study shows a considerable shift in participant preference towards a user-pays model over the current system of opaque fees and charges. At the start of the study, 85 per cent of participants were comfortable with the current funding system. However after experiencing alternative ways of paying for their road use, 60 per cent said they preferred a user-pays system (Figure 2).

I hope what comes out of this study is that we see a change in road use patterns. I really do. It would be nice to give the people who have long commutes by car and don't have any other option a fair run at the road.

Rob | Hampton

FIGURE 1. PREFERENCES OF USAGE-BASED CHARGING OPTIONS (OF THOSE WHO PREFER USER PAYS)

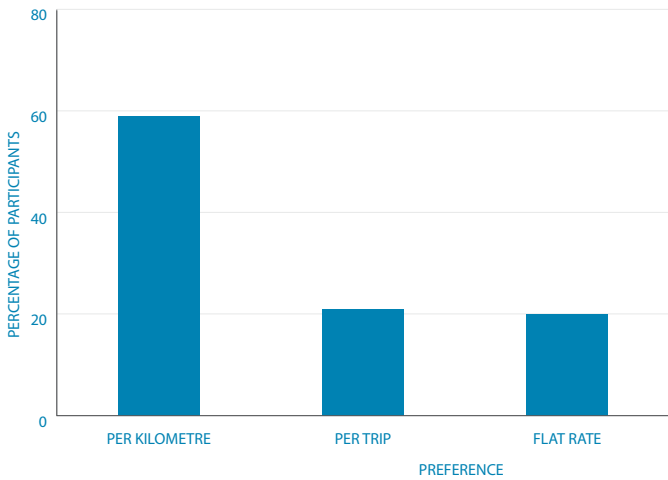
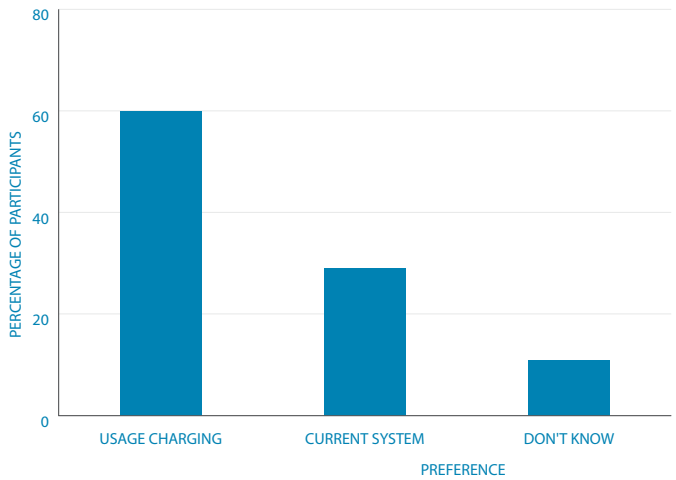


FIGURE 2. FUNDING SYSTEM PREFERENCES AFTER EXPERIENCING USER PAYS



MANAGING DEMAND

A user-pays funding system could also be adapted to assist with managing traffic across road networks through the use of pricing signals to modify behaviours in highly congested geographies or during peak travel times. This would add to the suite of tools available to policymakers to manage demand, including behavioural change initiatives, communication programs and the provision of alternative transport modes.

Only a small percentage shift in travel patterns is required to achieve peak spreading and make a considerable difference to the overall demand profile of the road network. Industry bodies have suggested that even a five per cent change in traffic levels during peak periods would increase traffic speeds by 50 per cent.¹ This variation is similar to the traffic flow changes commonly observed during school holiday periods.

CORDON CHARGING

The study showed that cordon charging could be effective in Australia as a congestion management tool, with a subset of participants reducing their road use within the central city during peak periods.

Of the 319 participants who completed trialling cordon charging, 51 per cent did not enter the cordon at peak times during the baseline period, with many not entering the area at all during the study. The group of participants who entered the cordon as part of their usual driving habits appeared to have reduced their weekly cordon travel by 10 to 15 per cent when driving under the cordon charging option.

Despite the observed downward trend for the participants who entered and travelled around the Melbourne CBD cordon, the road usage for the group in aggregate, including those who never entered the cordon, remained largely unchanged during the application of a cordon charge. This result supports the view that demand-management tools need to be specific and targeted to those who would respond to this charging signal.

While cordon charging was applied to the easily recognisable boundary of Melbourne's CBD (Figure 3) for the purpose of the study, cordon charging does not necessarily need to be limited to city centres. It also has application for other areas experiencing temporary or sustained congestion.

FIGURE 3. CORDON AREA



¹ Kelly, J and Donegan P, City Limits, Melbourne University Press, 2015, page 172

EXECUTIVE SUMMARY

TIME-OF-DAY CHARGING

In contrast, the time-of-day charging option applied one peak and one off-peak rate to all road usage regardless of location. The study's testing of behavioural responses to time-of-day charging showed no overall substantial change in participants' usual driving patterns when the option was applied. This does not necessarily mean that time-of-day charging would not have application in Australia, but rather, the charging signal needs to be clearer for users, and more specific in application before it can effectively address demand issues for targeted geographic zones or roads. Time-of-day charging has already been successfully implemented internationally.

OVERALL FINDINGS

Setting clear objectives for a user-pays system in Australia will underpin its effectiveness. The extent to which addressing congestion is prioritised alongside the restoration of a sustainable funding base for Australia's road networks will be an important consideration for policymakers.

The study demonstrates that a user-pays system could provide a sustainable funding source. It also demonstrates the flexibility a user-pays system could offer in enabling a wide range of price signal options to help manage demand. Furthermore, it shows that Australians are open to discussing user-pays as a viable alternative to the current system.

SYSTEM DESIGN

Study participants provided insights into several elements that need to be considered in the design and implementation of any new system, including:

- transparency and awareness
- choice
- fairness
- technology
- privacy and information security.

TRANSPARENCY AND AWARENESS

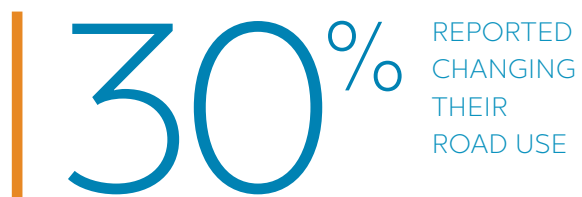
By trialling a direct and transparent way of paying for their road use, study participants became more aware of their driving behaviours. In line with results from national market research, participants had a low awareness of their road use with only 20 per cent accurately stating how many kilometres they drove or trips they made each week, month or year. By experiencing a user-pays system over the duration of the study, participants became more aware of their road use, with one in two reporting their awareness had increased (47 per cent).

Participants were three times more likely to look at the travel statements they received in the mail rather than visit the website to monitor their road use (94 per cent versus 31 per cent) and gained more information from that direct and proactive communication channel.

Through exposure to information, participants' understanding of the current road-funding system also increased by 23 per cent.

With this understanding came greater appreciation of today's challenges. Thirty-five per cent of participants who were uncomfortable with the current system said so because they believed the system should be user-pays. This contrasts with only 11 per cent for those who had not experienced a charging option.

While achieving an understanding of the current road-funding system was important for participants to recognise the need for reform, ultimately their awareness of their own road use only increased after they had experienced a more transparent system.



CHOICE

Thirty per cent of participants said they changed their road use during the study. Participants who trialled the usage and congestion-based options reported greater use of alternative transport modes. Of those who provided details, 30 per cent said they had used more public transport; 23 per cent said they walked more; and five per cent said they cycled more.

Practical access to alternative transport modes emerged as a key factor in determining participants' ability and willingness to change their road use. Wider societal factors, such as flexibility in work hours, also played a role. Ensuring Australians can make genuine choices about how and when they use the roads will be critical in meeting the demand-management objectives of any new system.

FAIRNESS

Participants expected any new system would be fair for all users, including regional drivers, and would provide adequate protections for the vulnerable. They also expected that with the introduction of any new system, existing road-related charges would be eliminated and funding raised would be hypothecated into transport networks.

TECHNOLOGY

Participants showed openness to trialling new technologies, including in-vehicle GPS technology. Eighty-four per cent of participants were comfortable with the GPS devices used in the study and 82 per cent felt that the devices accurately measured their road usage.



These devices transmitted 16 locational and operational data-points every 60 seconds, amounting to one billion data points over the course of the study. More than 99 per cent of the confirmed travel data was considered valid.

Practical implementation measures, such as an agreed approach for telematics, software configuration, vehicle compatibility and device installation among many others, would need to be considered in the design and selection of technologies to achieve the scale required for a broad-based user-pays system.

PRIVACY AND INFORMATION SECURITY

While participants were generally comfortable with the technology system used in the study, they reinforced the importance of personal information security and protection in any system design. Sixty-three per cent of participants said they would be comfortable having the GPS device in their car indefinitely, while 13 per cent mentioned privacy and data security concerns. This highlights the need for further work towards solutions that are acceptable to the community as a whole.

The Melbourne Road Usage Study provides encouraging signs that Australians are ready to start talking about road-funding reform and willing to try a user-pays system. This openness is essential to moving Australia to a system that delivers:

- a sustainable funding base that provides fairness to all users
- flexibility to manage demand and traffic congestion.

It is clear that the path to reform needs to begin with building a common understanding of how motorists currently use and pay for roads, and we hope this study provides the first practical step in this process. The path ahead will be challenging, but we believe Australia has a unique opportunity to take advantage of the imminent arrival of new transport technologies as a catalyst for rethinking the transport system as a whole and creating a sustainable, fair and flexible funding future.

NATIONAL MARKET RESEARCH – KEY FINDINGS

To accompany the Melbourne Road Usage Study, Transurban commissioned national market research involving more than 2,200 Australians to form a national perspective on road funding and user-pays charging. Key findings of this research include:

- 88 per cent of respondents had little or no knowledge about our primary road-related funding sources, such as fuel excise and vehicle registration fees.
- 52 per cent thought that, in principle, paying for actual road use was a better way than the current system.
- 67 per cent would like to see governments take action on the issue of transport and funding reform. Many respondents indicated that they were keen to see road-funding issues start to be addressed now through trials or further research. They also wanted assurance that any proposed solution would be thoroughly researched and trialled successfully.
- The charge per kilometre was the preferred user-pays option, with respondents saying they thought this was a fair option as it was most directly associated with actual road use.
- 45 per cent were positive about cordon charging and 42 per cent were positive about time-of-day charging.
- With the introduction of any new system, respondents expected to see more public transport, hypothecation of funding into transport, protections for vulnerable groups and fairness for all road users.



THE TRANSPORT REVOLUTION

The invention of mass-produced automobiles was a defining feature of the 20th century. Cars drove social changes by reshaping our cities with road networks and increasing access to mobility, enabling considerable personal and commercial outcomes. For most of the last century, fuel excise was a suitable funding regime, providing a steady income stream based on motorists' fuel usage.

A century on, new technologies are triggering the largest revolution of the transport sector since cars replaced horses. The impact of this revolution will be far reaching.

INTRODUCTION

Electric, connected and autonomous vehicles and ride sharing are among the many transport innovations poised to enter the mainstream in the coming decade, and will fundamentally change the way Australians travel.

This new wave of transport technology promises opportunities for more efficient and safer mobility, significant reductions in greenhouse gas emissions, large-scale transport service integration and improved mobility options for the disadvantaged. Significantly, it also provides a tipping point for changing how we fund transport.

Our growing population and progressive urbanisation are challenging our transport system. Simultaneously, our ageing population is placing increasing demands on health, aged-care and other services, further stretching government budgets across a broad range of service provisions including infrastructure.

Vehicle manufacturers have continued to make progress towards a more sustainable future by improving the fuel efficiency of motor vehicles and, in more recent times, introducing hybrid and electric models. This important and commendable forward thinking will help protect the future of the environment, but, at the same time, highlights the imminent expiry of Australia's current fuel-sale-based funding stream.

How we fund road infrastructure must be central to discussions about Australia's transport future as this underpins many of the technology-based services to come.

\$25 BILLION
TOTAL ROAD
EXPENDITURE
(2013-2014)

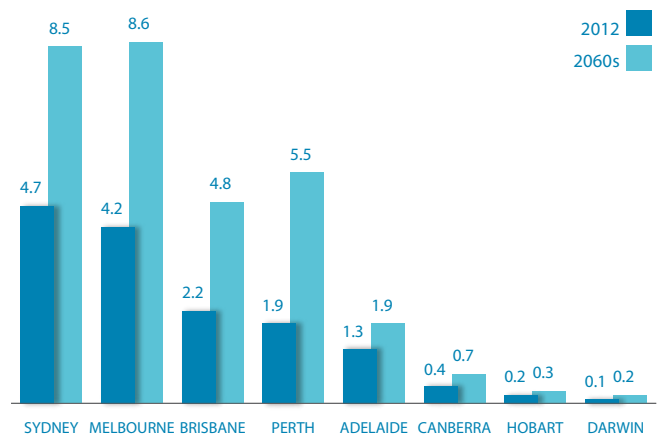
Source: BITRE Infrastructure Statistics Yearbook 2015

A proactive and holistic approach that systematically addresses future opportunities and challenges is crucial to finding effective and sustainable solutions for supporting Australia's growth and liveability.

AUSTRALIA'S CHANGING POPULATION

Australia's current population of 24 million is expected to grow to 30 million by 2030 and 40 million² by 2060. At the same time, our population is ageing. At current rates, the proportion of our population aged 65 years and over is expected to increase from 14 per cent today to 20 per cent by 2030 and almost a quarter of our population by 2060.³

FIGURE 4. AUSTRALIAN CAPITAL CITY POPULATION PROJECTIONS (MILLIONS)



Source: Australian Bureau of Statistics Population Projections, Australia, 2012 (base) to 2101, November 2013

Australia, like much of the rest of the world, is also becoming highly urbanised. With 80 per cent of employment based in cities, people are seeking homes closer to where the jobs are.⁴ The proportion of our population living in capital cities is expected to grow from 66 per cent of the national population in 2011 to 73 per cent in 2061.⁵

In preparation, governments are continuing to invest in enhancing and expanding transport services as well as looking at creating regional hubs or multiple city centres to help ease pressures of population concentration. While these measures are expected to address some of the strains, transport demand will likely continue to grow, creating new challenges for our networks.



I think that it's not more roads, but more effective use of the roads we have.

David Burnley



² Australian Bureau of Statistics, Population Projections Australia: 2012 (base) to 2101, November 2013

³ Ibid

⁴ Grattan Institute, Mapping Australia's Economy: cities as engines of prosperity, July 2014, page eight

⁵ Infrastructure Australia, Population Estimates and Projections, Australian Infrastructure Audit Background Paper, April 2015

INTRODUCTION

DECLINING FUNDING SOURCE

Fuel excise currently contributes 57 per cent of Australia's total road-related revenue (Figure 5). However, this revenue source has been decreasing steadily for years.⁶ Despite growth in vehicle-kilometres-travelled, revenue raised from fuel excise in 2015 was less than that in 2001, in real terms.⁷ The decline is largely driven by the introduction of newer and more fuel-efficient vehicles into the fleet. The expected growth in uptake of electric vehicles will likely further reduce fuel excise revenue. Recent CSIRO modelling highlighted the adoption of fuel-efficient and electric vehicles as key factors in reducing fuel excise revenue⁸ (Figure 6).

The ongoing decline of fuel excise will present further challenges to government budgets. Australia's backlog of infrastructure projects has been estimated at up to \$800 billion,⁹ increasing the urgency of creating a more sustainable funding approach.

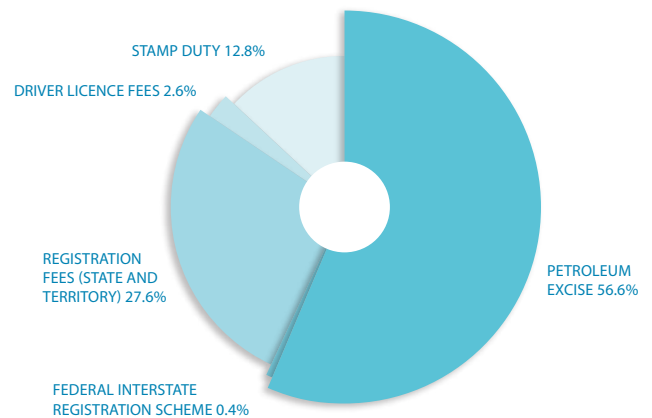
TOWARDS A FAIRER FUNDING SYSTEM

Fuel excise is sometimes described as a 'blunt' charging system. While there are exemptions in place for certain vehicle types and conditions (such as fuel for off-road driving), applying a standard rate per litre of fuel consumed means that vehicles taking the same road journey are charged differently, depending on their fuel efficiency. Motorists with less fuel-efficient and typically older-model vehicles are effectively being charged at a higher rate than those with more fuel-efficient and typically newer vehicles for equivalent usage of the road networks (Figure 7), raising equity concerns for the community as a whole.

To compensate for reductions in funding from fuel excise, state governments have progressively increased vehicle registration and licence fees.¹⁰ With charges generally set at fixed rates, existing registration and licence fees also present equity challenges, with infrequent and low-demand motorists subsidising frequent, high-demand motorists.

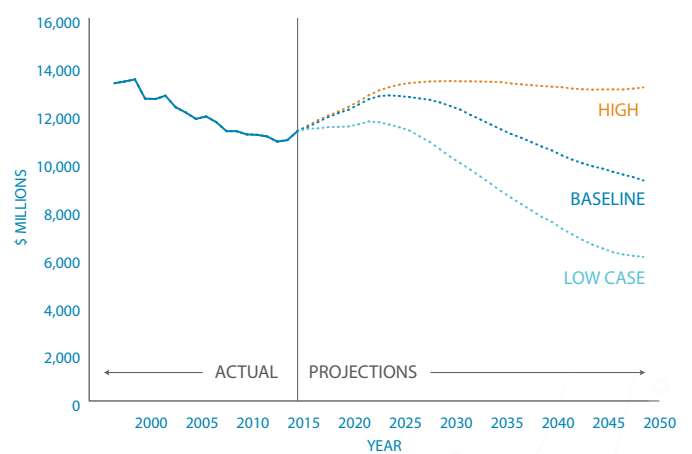
In the design of a sustainable and equitable funding system, a broad range of considerations will need to be taken into account. In the area of equity, the system needs safeguards and measures in place to protect vulnerable groups. A transparent system, based on the principle of those who benefit, pay, is a fairer way to fund road infrastructure.

FIGURE 5. 2013–2014 ROAD-RELATED REVENUES*



Source: Bureau of Infrastructure, Transport and Regional Economics, Australia Infrastructure Yearbook 2015

FIGURE 6. AUSTRALIA'S DECLINING FUEL EXCISE REVENUE



Source: Transurban analysis; Bureau of Infrastructure, Transport and Regional Economics, Australia Infrastructure Yearbook 2015; CSIRO (report for the NTC), Projecting future road transport revenues 2015–2050, May 2015

6 Bureau of Infrastructure, Transport and Regional Economics, Australia Infrastructure Yearbook 2015

7 Ibid

8 CSIRO (report for the NTC), Projecting future transport revenues 2015 – 2050, May 2015

9 Infrastructure Partnerships Australia, Submission to Australia's Future Tax System Review Panel, October 2008

10 Bureau of Infrastructure, Transport and Regional Economics, Australia Infrastructure Yearbook 2015

* Taxes and duties for specific purposes such as GST, fringe benefit tax, tolling revenue, luxury car tax or passenger vehicle customs duty and local government revenues from their own sources are not included.

GETTING THE MOST OUT OF EXISTING INFRASTRUCTURE

While introducing a sustainable funding source to meet our infrastructure needs is critical, we must also look for opportunities to use our existing transport infrastructure more efficiently.

Increasing congestion is impacting parts of Australia's urban road networks, with workday morning and afternoon peaks extending travel time, reducing journey time predictability and impacting productivity and the experience of road users.

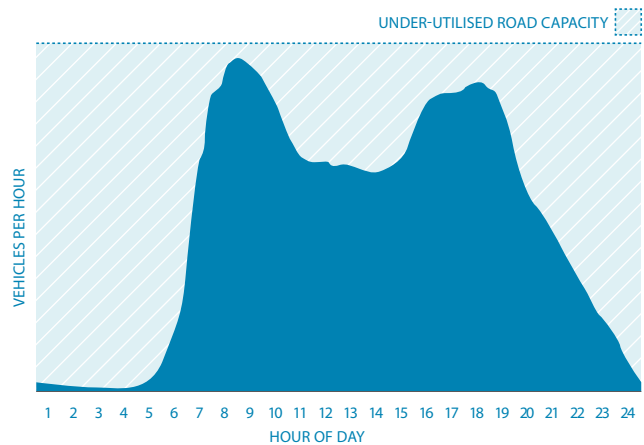
The economic cost of road congestion has been estimated at \$13.7 billion in 2011 and is expected to grow to \$53 billion by the 2030s.¹¹

Congestion is not limited to road networks. Public transport systems also experience significant variations in passenger numbers during peak and off-peak periods.

Outside of peak periods, road networks are under-utilised (Figure 8). These inefficiencies present opportunities for easing congestion. A vast range of approaches to peak spreading, including price signalling, has been tried around the globe and implemented in some places.

Technology application and demand management represent an opportunity to improve traffic flow without necessarily building more physical roads or adding new lanes.

FIGURE 8. AUSTRALIAN CITY TRAFFIC PROFILE ON AN AVERAGE WORKDAY



Source: Transurban (2016) for illustrative purposes only



Something probably needs to be done, doesn't it, with the way the roads are, and with the way traffic is escalating all the time.

Lenore | Bentleigh



FIGURE 7: ROAD REVENUE CONTRIBUTIONS

Measure: 12,540km; Fuel excise: \$0.396/L	2006 Holden Commodore*	2015 Toyota Corolla**	2016 BMW i3 (electric vehicle)
Fuel economy (L/100km)	10.9L	6.1L	0L
Litres of fuel used	1,367L	765L	0L
Annual fuel tax revenue contributions	\$541	\$303	\$0
Annual vehicle registration fee***	\$387	\$297	\$260
Total contribution to Australian road revenue	\$928	\$600	\$260

Total annual travel of 12,540 kilometres is based on the average annual kilometres travelled by Melbourne Road Usage Study participants.

* 2006 Holden VE Commodore Omega 4-Speed Auto (Commodore was 2006 top-selling passenger vehicle in Australia).

** 2015 Toyota Corolla Ascent Hatch 7-Speed CVT (Corolla was 2015 top-selling passenger vehicle in Australia).

*** Vehicle registration fees vary between states and territories. Some states and territories also offer discounts for fuel-efficient vehicles and vary fee prices according to the vehicle weight.

Fees used here are based on the national average for each vehicle shown.

¹¹ Infrastructure Australia, Australian Infrastructure Audit, 2015, page 32

INTERNATIONAL RESPONSES TO A CHALLENGING ISSUE

Declining revenue from fuel excise is not an issue specific to Australia. Across the world, cities, states and countries that rely on fuel taxes to fund roads and other transport infrastructure are now looking for alternative sources of revenue.

In addition, user-pays charging is also becoming an increasingly prevalent demand-management tool as governments and transport agencies look for ways to shift traffic out of excessively congested areas. Some governments, such as in London, use revenue raised from usage charges to fund new public transport projects, creating more alternative transport options for their communities.

Various countries, states and cities have already introduced, or are trialling, user-pays charging, using mass, distance, location and/or time dimensions to address specific issues such as:

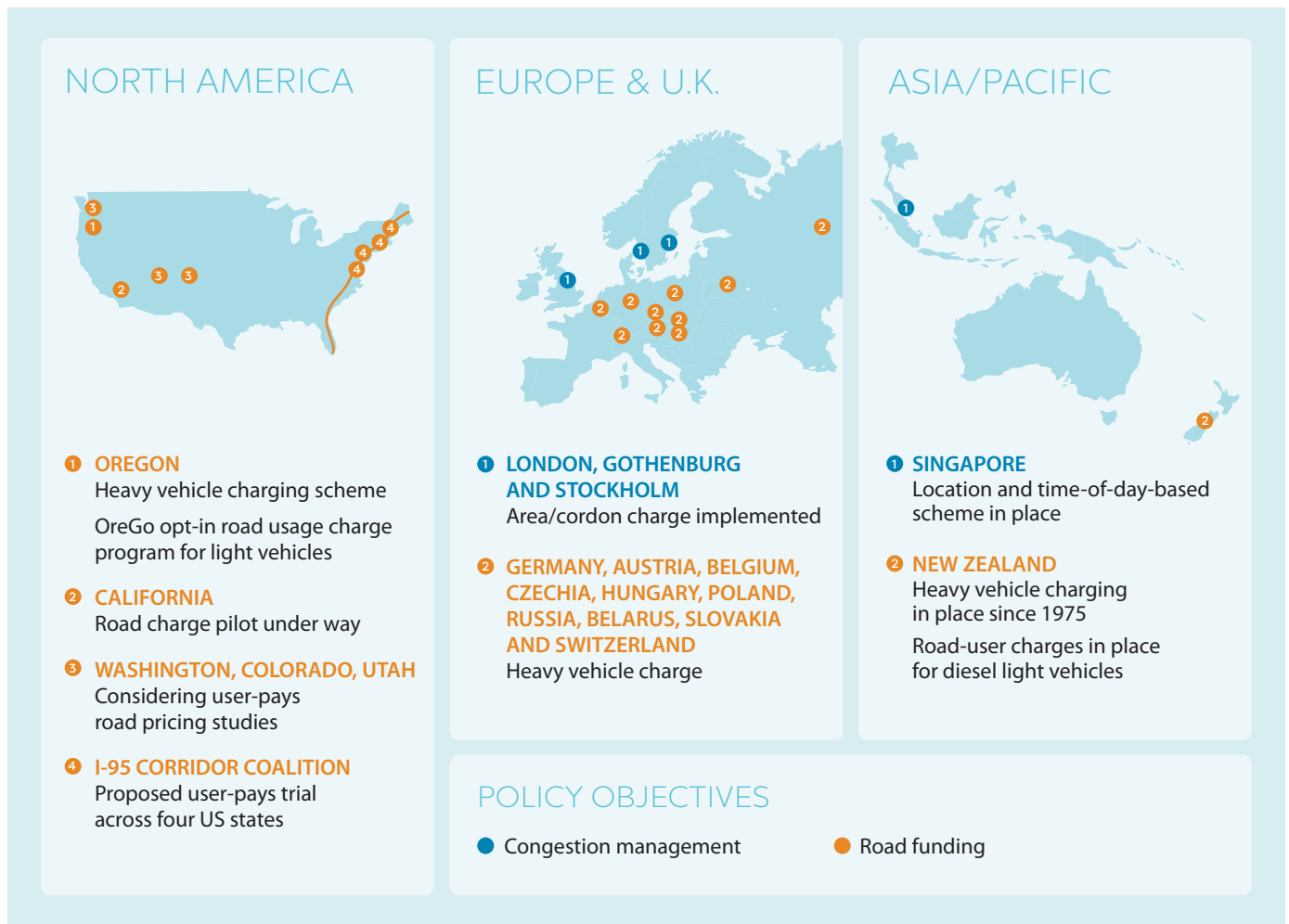
- compensating for the additional road wear-and-tear caused by heavy vehicles and use of the road by transiting foreign heavy vehicles
- addressing funding shortfalls for transport infrastructure
- managing congestion in high-demand areas.

Figure 9 shows examples of how the international community is using user-pays charging models to solve specific issues.

Transurban is not alone in calling for change in the way Australian roads are funded. Independent government advisors, industry representatives, city strategy groups and motoring clubs have presented valuable perspectives on this important topic.

Effective progress is dependent upon the Australian community understanding the funding and congestion challenges we face and the need for reform. Doing so as a community will enable us to identify suitable and sustainable options that secure the prosperity and liveability of our country.

FIGURE 9. SUCCESSES IN OTHER JURISDICTIONS – A CLEAR FOCUS ON OBJECTIVES IS CRITICAL





INTRODUCING THE MELBOURNE ROAD USAGE STUDY

Transurban's Melbourne Road Usage Study was designed to capture field-tested information to equip policymakers with insights into how Australian motorists responded to user-pays road-charging options.

The study involved 1,635 private light vehicle motorists from Melbourne testing five user-pays charging options. It was designed to meet three objectives:

- to gauge motorists' knowledge and understanding of our current road-funding system and assess their attitudes and preferences toward user-pays charging options.
- to understand motorists' behavioural responses to different charging and implementation options.
- to prove that technology is not a barrier to implementing a practical user-pays system.

Conducted over 17 months, the study was undertaken in stages commencing with a detailed design stage. This incorporated a condensed pilot study with 70 participants testing the proposed methodology and technology. Findings from the pilot informed the design of the main study. Conducted over 12 months, the main study tested two road-charging models with distinct purposes:

- **Usage-based model** – this stage tested participant responses to a user-pays funding model that is more transparent and sustainable as a funding source.
Three usage-based charging options were tested: charge per kilometre; charge per trip; and flat rate (capped kilometres).
- **Congestion-based model** – this stage tested how motorists responded to demand-management road charging that used pricing signals in highly congested geographies or at peak travel times to manage road use.
Two congestion-based charging options were tested: cordon (area); and time of day.

For practical reasons, a rolling approach to the recruitment of participants and testing of the charging options was adopted.

Participants were recruited from three geographical zones within the Greater Melbourne region, which were reflective of the public transport options available at different locations.

Upon recruitment, in-vehicle GPS devices were installed in participants' cars and their usual (baseline) driving data was collected for a minimum of 35 days (not including the end-of-year holiday period). Following this, participants drove under one of the usage-based charging options. For the final stage, a group of participants was transitioned onto the congestion-based charging options.

A control group of approximately 300 participants did not experience any of the charging options and continued driving as usual throughout the study period. This group was used to adjust observed behavioural changes for seasonal and external factors that would have been experienced by all participants.

Quantitative data was collected via the GPS devices and analysed to understand potential behavioural changes as a result of the charging options. Additionally, qualitative feedback was captured through a series of surveys completed by participants at key points throughout the study.

In line with common market research practices, participants were provided a \$100 gift card on joining the study. To simulate the financial impact of a real-world charging system as much as possible, virtual 'travel accounts' were created for each participant. By changing their road use, participants could be credited a maximum of \$80 per month, which was accumulated and paid out at the end of the study.

Specialised technology was assembled to create an end-to-end system for the field-testing of road charging. This included integrating various components such as in-vehicle GPS devices, a billing system (based on the five charging options), payment processing, exception-handling, and customer management.

FIGURE 10. FIGURES USED IN THE STUDY'S CHARGING OPTION CALCULATIONS

\$24B*

The total government road-related expenditure for 2012-13

240B*

The total kilometres travelled on all Australian roads in 2012-13

65M^

The estimated total number of trips taken on Australian roads each day

* Bureau of Infrastructure, Transport and Regional Economics, Australia Infrastructure Yearbook 2014.

^ Transurban estimate, based on Road Usage Study pilot.

MEASURING BEHAVIOUR UNDER A USER-PAYS SYSTEM

GPS devices were installed in the newest vehicle of each participant's household. These devices collected information such as the number of trips made; the start time and duration of each trip; and distance travelled and location covered.

In the first phase of the study, participants drove under normal conditions, to establish their baseline road usage. In order to obtain usual driving patterns to form the baseline, participants were not provided with any information about potential charging alternates upfront.

Once the baseline was established, participants were then asked to choose or were allocated a usage-based charging option and observations were made on how their behaviours changed, if at all. On completing this phase, a group of 675 participants was randomly allocated one of two congestion-based charging options and their travel data was compared against their baseline data to determine if any behavioural changes had occurred.

MEASURING ATTITUDES AND PREFERENCES TOWARDS A USER-PAYS CHARGING SYSTEM

Participants were surveyed at key points throughout the study to find out how their attitudes changed as they experienced road charging first-hand. Participants were surveyed on their:

- awareness of and attitudes towards road funding in Australia
- attitudes towards different user-pays charging options trialled in the study
- shifts in awareness and attitudes after experiencing user-pays, particularly in relation to perceived behavioural changes, knowledge levels, technology use and communication channels.

On completion of the study, participants were asked to complete a final survey by phone, with additional questions relating to the use of the GPS devices in their vehicles and their own assessment of any awareness and attitude shifts after experiencing road charging. More in-depth feedback on the study experience was also collected through selected participant focus groups and video diaries.

SETTING ROAD CHARGES

The charging levels set for the study were not intended to advocate for specific future road-charging levels or to indicate any form of policy recommendation. For the purpose of this study, the (then) current total government road infrastructure expenditure and national road usage estimates were used as the basis for charging calculations (Figure 10).

Simple, rounded charges were used for ease of explanation and participant understanding.

USAGE-BASED CHARGING OPTIONS

The usage-based charging options used units of measurement – trips and kilometres – to charge for road usage. Three usage-based charging options were available (Figure 11).

Participants were invited to choose their preferred charging option, and, where possible, this choice was accommodated. However, to ensure adequate sample sizes across all three charging options, some participants were allocated an alternate when their preferred option was fully subscribed.

FIGURE 11. USAGE-BASED CHARGING OPTIONS

Option	Charge
Charge per trip	\$1 per trip. Vehicle movement is defined as a trip if the vehicle travels more than 100 metres after being stopped for at least five minutes
Charge per km	10c per kilometre
Flat rate	10c per kilometre for a capped number of kilometres, and 20c per kilometre for all excess kilometres



Working in health care, I understand that research is a very important part of learning and discovery, so I felt being a part of road usage research might actually help long-term planning for Melbourne's roads.

Linda | Carrum Downs



INTRODUCING THE MELBOURNE ROAD USAGE STUDY

CONGESTION-BASED CHARGING OPTIONS

Congestion-based charging options were based on the concept of using pricing signals to influence behaviour in high-use geographies or at peak travel times (Figure 12).

The charging levels for these options were based on distance travelled (kilometres) – the same as the charge per kilometre usage-based option – with adjustments to test specific pricing signals. For example, for the time-of-day charging option, the charge per kilometre was set at eight cents in off-peak times, half of the peak charge of 15 cents, to measure any propensity to change driving behaviour in the peak period.

Similarly, for the cordon-charge option, the charge was set at eight cents per kilometre any time plus a cordon area access charge of \$8. This amount was chosen because it was comparable with similar charges internationally and was also benchmarked against other regular transport costs in Melbourne, such as public transport fares and parking fees.

The cordon area bordered the inner-city (Figure 13) as most Melbourne drivers are aware of the high-demand area in the CBD during peak periods. However, it could have been applied to any area that experiences congestion either on a sustained basis or temporarily at certain times of day.

Participants were randomly and evenly allocated to the cordon and time-of-day groups regardless of their driving activity in the baseline period. The control group was unchanged throughout the entire course of the study.

FIGURE 12. CONGESTION-BASED CHARGING OPTIONS

Option	Charge
Cordon (area)	8c per kilometre anytime plus \$8 access charge per day to enter or move within a defined zone in inner-city Melbourne between 7am and 6pm, Monday to Friday
Time of day	15c per kilometre during peak hours (Monday to Friday, 7am–9am and 3pm–6pm); 8c per kilometre at all other times, with charges applicable in all areas

FIGURE 13. CORDON AREA



TRAVEL ACCOUNTS AND PIGGYBANKS

Participants were not required to contribute their own money to experience the road-charging options. To simulate the financial impact of a real-world charging system as much as possible, virtual 'travel accounts' were created for each participant. These accounts were used to simulate the experience of being charged for road use.

Travel account opening balances were calculated based on each participant's usual (baseline) road usage and the parameters of their specific charging option. As a participant used the roads, their road charges (calculated either by trip or kilometre and with/without a cordon charge applied) were deducted from their travel account.

At the end of each monthly billing period, if the participant did not change their road usage in line with the charging option being trialled, the account balance would be \$0. At the start of each new billing period, the travel account was reset to the original opening balance. If the participant had reduced their road usage during the course of the billing period, the account balance would be in credit. Road usage exceeding the baseline amount would simply result in a \$0 balance.

At the end of each month, any credit remaining in a participant's travel account was deposited into the participant's 'piggybank' (capped at \$80 per month). Piggybank balances accrued and the totals were paid out to participants at the conclusion of the study.

Participants could keep track of their road usage via monthly travel statements (Figure 15) – similar to household account statements for gas, water or mobile phone services. An online portal was also available for participants to check their daily usage and access additional information (Figure 16).

FIGURE 15. TRAVEL STATEMENTS WERE DESIGNED TO LOOK LIKE OTHER UTILITY STATEMENTS



FIGURE 14. PARTICIPANT SURVEYS WERE COMPLETED AT KEY POINTS THROUGHOUT THE STUDY



FIGURE 16. AN ONLINE PORTAL, UPDATED DAILY, PROVIDED DETAILED INFORMATION ON PARTICIPANTS' ROAD USE



INTRODUCING THE MELBOURNE ROAD USAGE STUDY

TECHNOLOGY

Creating a practical technology suite to support the field-testing of road-charging options involved assembling several technology components into an end-to-end system, which included:

- in-vehicle GPS devices
- a billing system (based on the five charging options), including a road-charging algorithm and simulated account balance
- payment processing
- exception handling
- customer management.

In-vehicle GPS devices are already in use in Australia and internationally. Public and private transport operators, emergency services, freight companies, fleet managers and insurance companies regularly use these devices to identify, locate and manage vehicle assets and driver performance. Private vehicle owners also use similar devices to monitor vehicle performance.

Two types of in-vehicle GPS devices (Figures 17 and 18) were used in the study to accommodate the wide range of models in Australia's existing vehicle fleet. These included:

- **OBD-II GPS device**

The OBD-II (On-Board Diagnostics – Second Generation) GPS device was compatible with the majority of passenger vehicles in Australia (Figure 19). All vehicles sold in Australia since 2006 have an OBD port, usually located under the dashboard, and this is where the OBD-II device was installed. The OBD port is used by mechanics to run diagnostic and performance tests on vehicles during servicing. Once installed, the device is not generally visible to the driver. If a participant's vehicle required servicing during the study period, the device was simply removed and then reinstalled.

- **Plug-in GPS device**

For vehicles without an OBD port, generally those manufactured prior to 2006, a plug-in GPS device was used. The plug-in device included a power cable, installed via the vehicle's dashboard accessories port and a GPS antenna, placed on the dashboard for best reception. The plug-in device had an aesthetic disadvantage as its installation involved a visible cable.

The OBD-II GPS device was used in the majority of vehicles in the study (Figure 20).

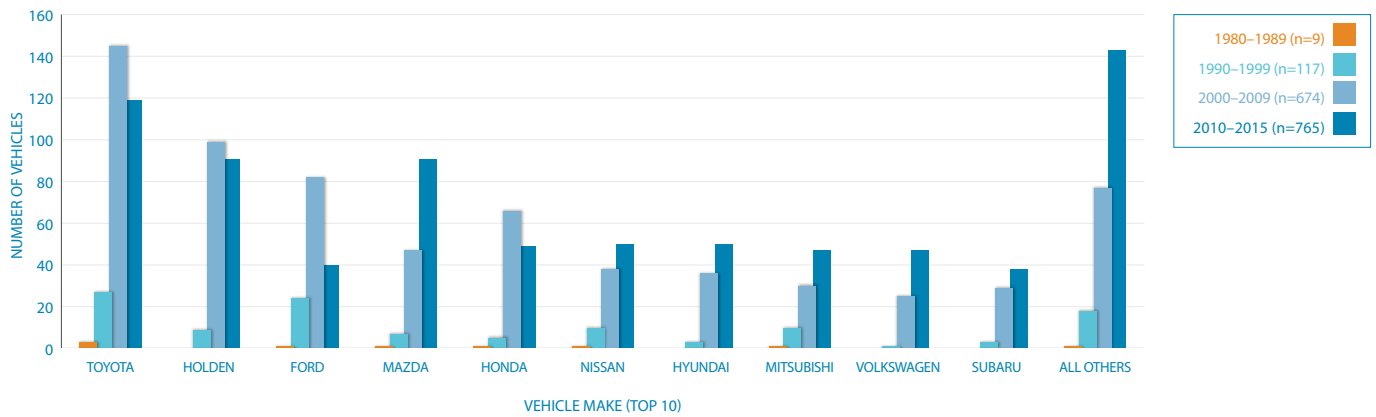
FIGURE 17. OBD-II GPS DEVICES WERE INSTALLED IN POST-2006 VEHICLE MODELS



FIGURE 18. PLUG-IN GPS DEVICES WERE INSTALLED IN PRE-2006 VEHICLE MODELS



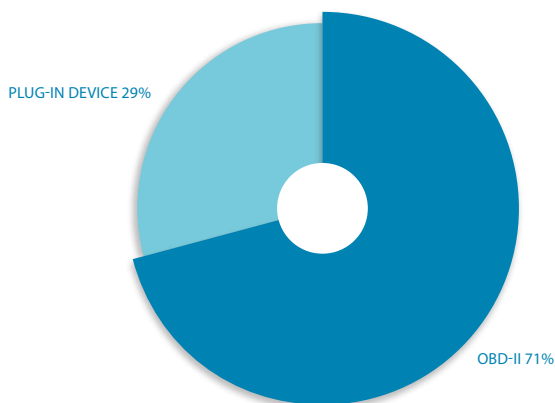
FIGURE 19. VEHICLES IN THE MELBOURNE ROAD USAGE STUDY



Devices were monitored to ensure they were properly installed and operational. If a device appeared to have been removed or had stopped transmitting trip data, follow-up processes were undertaken to make contact with the participant and look into the potential causes. Such occasions were limited and example causes included when the device was removed during servicing, and not reinstalled afterwards; when the vehicle had not been driven for an extended period; and, in rare cases, when the device was malfunctioning and required replacement.

In cases where the device was confirmed as not having been installed or working correctly for a known period during the study, appropriate exclusions were made according to agreed and consistently applied business rules. This ensured the analysis incorporated only valid travel data and time periods.

FIGURE 20. PROPORTION OF PARTICIPANTS USING EACH TYPE OF DEVICE IN THE STUDY



TYPE OF DATA COLLECTED

Both the OBD-II and plug-in devices were configured to capture only data specific to the study. Data collected was for two broad purposes, namely, to assess behavioural change and evaluate the performance of the GPS device (Figure 21). Sixteen data points were collected for every transmission from the GPS devices, which occurred approximately every 60 seconds.

Aggregating the raw locational data provided an accurate picture of how participants used the road networks. Figures 22, 23 and 24 on page 20, map the data points recorded for a select period during the study at a metropolitan, regional and state level.

FIGURE 21. TYPES OF DATA TRANSMITTED

Participant travel data	Device performance data
<ul style="list-style-type: none"> time of day at the start and end of each journey 	<ul style="list-style-type: none"> battery status and GPS connectivity
<ul style="list-style-type: none"> distance travelled per journey and the duration of each journey 	<ul style="list-style-type: none"> if the device was attached, detached or moved to a different vehicle
<ul style="list-style-type: none"> location (except in an area near the participants' home, which was masked for privacy reasons) 	<ul style="list-style-type: none"> if the ignition was on or off and if the vehicle was in motion or idling

DATA TRANSMISSIONS

FIGURE 22. MELBOURNE METRO LEVEL



FIGURE 23. VICTORIAN REGIONAL LEVEL



FIGURE 24. VICTORIAN STATE LEVEL



PRIVACY AND DATA SECURITY

Participants' privacy was of paramount importance. A range of security measures were put in place throughout the study to protect participant privacy.

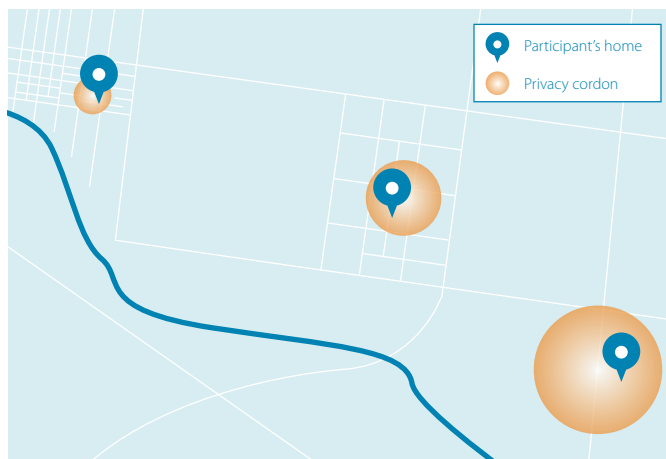
A privacy cordon was applied to an area around participants' homes; concealing the GPS coordinates when the participant's device entered the cordon, until the participant exited the privacy cordon again. Each privacy cordon radius varied based on the population density of the area with the participant's home not necessarily in the centre of the masked area, as illustrated by the circle (Figure 25).

To ensure the separation of participants' personal information from vehicle trip information, information access and identity controls were put in place for the study team.

Data security protections were also established to safeguard information collected during and subsequent to the study.

This study complied with the Australian Government's Privacy Act (1988) and the Association of Market and Social Research Organisations' Privacy (Market and Social Research) Code (2014).

FIGURE 25. ILLUSTRATION OF PRIVACY CORDON APPLIED TO MASK PARTICIPANTS' HOME ADDRESSES





NATIONAL MARKET RESEARCH

AUSTRALIA SAYS ...

Before road-funding reform can be progressed in Australia, the community needs to be brought into the discussion.

To help identify where this discussion should start, Transurban engaged independent market researchers to conduct both qualitative and quantitative research, including focus groups, online discussion groups and an online survey of more than 2,200 Australians. Respondents were representatively sourced from all Australian states and territories, covering both urban and regional areas. The research was conducted in accordance with the international quality standard for market and social research (ISO 20252).

Focus groups were designed to ensure diverse representation, and moderated by market research professionals in line with standard market research practice.

The online survey was conducted with respondents from across Australia, drawn from a professional market and social research panel.

The total sample size of 2,224 results in a maximum margin of error of +/-2.1 per cent at the 95 per cent confidence level.

The data set was weighted using population data from the Australian Bureau of Statistics' Census 2011 to ensure the findings accurately reflected the views of the Australian population.

Transurban's national market research reveals how the broader Australian community responded to the idea of road-charging reform in Australia. Some of these insights are included in the findings section of this report.

A STAGE-BY-STAGE GUIDE TO THE MELBOURNE ROAD USAGE STUDY

2015												
MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	
PLANNING AND DEVELOPMENT												
Exploratory research, study design and pilot testing ¹												
					PARTICIPANT RECRUITMENT							
					Introductory letter sent; First survey conducted; GPS devices installed ²							
					BASELINE DATA COLLECTION							
					Participants drove under 'usual' conditions ³							
					CONTROL GROUP DATA COLLECTION							
					Control group drove under 'usual' conditions for the study's duration ⁴							
										USAGE-BASED CHARGING OPTION		
										Three charging options introduced; Second survey conducted ⁵		

PLANNING AND DEVELOPMENT

- 1 Transurban designed and developed the Melbourne Road Usage Study in consultation with technical specialists. Exploratory research, focus groups, representative sampling design, technology development and pilot testing were conducted prior to the launch of the main study.

PARTICIPANT RECRUITMENT

- 2 An introductory letter was posted to target households, explaining that interviewers would be visiting households to invite residents to join the study.
Interviewers visited the targeted households to recruit participants. When a participant consented to join, interviewers recorded their vehicle information and household demographics, conducted a survey and installed a GPS device in his/her vehicle. A \$100 gift card was provided to each participant as an incentive for joining. The control group was recruited at the same time.

BASELINE DATA COLLECTION

- 3 Each participant's usual (baseline) driving data collection commenced following the successful installation of a GPS device. A minimum 35 days of usual road usage data (with no charging options applied) was collected (not including the end-of-year holiday period).

CONTROL GROUP DATA COLLECTION

- 4 A control group of approximately 300 participants continued driving under usual (baseline) conditions for the duration of the study.

USAGE-BASED CHARGING OPTION DATA COLLECTION

- 5 Study participants were transitioned, via face-to-face interviews, onto a usage-based charging option. Three options were tested:
 - **Charge per trip** – \$1 per trip
 - **Charge per kilometre** – 10c per kilometre
 - **Flat rate** – 10c per kilometre for a capped number of kilometres and 20c per kilometre for all excess kilometres.

Study participants drove under one of these charging options for three months. Their road usage data was collected throughout this period. Participants also received monthly travel statements detailing their road usage and associated charges. Participants accrued piggybank credits when they reduced their travel. A second survey was also conducted.

CONGESTION-BASED CHARGING OPTION DATA COLLECTION

- 6 675 study participants were transitioned, via face-to-face interviews, onto congestion-based charging options. Participants were assigned one of two options:

2016				
MAY	JUN	JUL	AUG	SEP
DATA COLLECTION				
CONGESTION-BASED CHARGING OPTION DATA COLLECTION				
Two demand-management charging options introduced; Third survey conducted ⁶				
		PARTICIPANT CLOSE OUT		
		Final survey conducted; Piggybank payments made ⁷		

- **Cordon (area)** – 8c per kilometre plus a daily \$8 cordon area access charge to enter or move within a defined zone in inner-city Melbourne from Monday to Friday, 7am to 6pm
- **Time of day** – 15c per kilometre during peak hours (Monday to Friday, 7am–9am and 3pm–6pm); 8c per kilometre at all other times, with prices applicable in all areas.

From this point, participants’ road usage was charged according to their new charging option. A third survey was also conducted. Participants drove under their new option for two months, and their road-usage data was collected throughout this period. Participants continued to receive monthly travel statements, this time detailing their road usage and associated congestion-based charges.

PARTICIPANT CLOSE OUT

⁷ On completion of the charging option phase, a final survey was conducted by phone. GPS devices were returned and total piggybank balances were paid to participants.

ANALYSIS AND REPORTING

Each participant’s baseline data was compared with their usage and congestion data to identify road-usage behaviour changes. Survey responses were also compared to identify shifts in understanding and attitudes to road funding over time.

PARTNER ACKNOWLEDGEMENT

A multi-disciplinary team led by Transurban delivered the Melbourne Road Usage Study. This included social research and behavioural change professionals, technology and traffic modelling specialists, data technicians and statisticians.

This team included:

- **Concepts of Change**, behaviour-change and survey design consultants
- **Ctrack**, vehicle tracking systems supplier
- **Ipsos**, market and social research specialists
- **Optus**, telecommunications supplier
- **Symbolix**, analysis and statistical consultants
- **Newgate Communications**, communication consultants
- **Newgate Research**, market and social research specialists

In addition, a study reference group was established comprising federal and state government departments, industry bodies and motoring associations. Through regular engagement with the study team, the reference group provided valuable guidance that helped shape the study design and implementation.

Transurban thanks the 1,635 study participants for taking part in this landmark study and providing their perspectives on road funding, usage and charging.

STUDY DESIGN IN DETAIL

The study was designed with a staggered Before-After, Control-Impact structure to show differences in daily travel between participants driving under the charging options and a control group of approximately 300 participants. The control group's driving patterns were applied to the data collected from participants driving under the charging options, the "treatment groups", to enable necessary adjustments to account for variations in road use caused by seasonal impacts and other external factors.

The usage and congestion charging options were applied to the treatment groups consecutively to allow for assessment of both sets of data independently and to ensure the manageability of communications. In addition, the size of each treatment group was balanced to ensure adequate sample sizes across all charging options. Participant opt-out rates were monitored throughout the study to ensure minimum group sizes were maintained.

Detailed analysis and statistical modelling techniques were developed by Transurban's internal data specialists in accordance with guidelines from independent professionals.

As part of the participant sampling approach, a sample weighting matrix was developed to map participant responses against a response expected of the broader Melbourne population. Three dimensions were selected for weighting matrix alignment: number of household occupants, dwelling type and home ownership.

REPRESENTATIVE SAMPLING

The study sample was determined using stratification and a household cluster design using the Australian Statistical Geographic Standard (ASGS) to ensure that (as far as possible) every dwelling in Greater Melbourne had equal probability of selection.

Households were sampled from all listed private residences in Greater Melbourne; household selection was restricted to Statistical Area 1s (SA1s) with greater than 120 dwellings. SA1 is the second smallest grouping of households under the ASGS and typically ranges from 100 to 300 dwellings (or between 200 and 800 people).

Ninety SA1s were targeted for recruitment with a further 30 identified and held as reserves in case of non-response. This is known as household clustering, which involves choosing groups of households in the same neighborhood. Clustering offers efficiency in the field as field workers can approach multiple households for recruitment in a short period of time. However, it can come at a small statistical cost as households within a certain area may have similar behaviours. This potential effect was tested and accounted for using standard statistical techniques during the analysis phase.

The sample was segmented into three geographical zones to ensure adequate coverage and representation. The zones were defined at a Statistical Area 3 (SA3) level. The zones reflected distinct regions in Greater Melbourne related to the different access to public transport options experienced by Melburnians (Figure 26).

PILOT STUDY

The study design, sampling approach and targeted communication methods were tested and refined through a 70-participant pilot conducted prior to the full-scale study.

Field testing the methodology – from recruitment through to data collection and its findings – provided valuable insights that informed the design and operation of the study.

Data collected during the pilot study was excluded from the main study's data and analysis.

Within each target household, the most modern vehicle was chosen for the study participant. In a small number of cases (79) where the most recent vehicle was not available, the next newest vehicle was chosen.

The participant was the main driver of the targeted vehicle. Where households indicated during recruitment that there were joint main drivers, one was selected.

The configuration of the final treatment group was informed by a statistical power analysis suggesting a sample size of 300 in each treatment group would be required to optimise opportunity to detect a material change in behaviour that could be attributed to the charging option trialled, as well as a control group of 300 participants.

WEIGHTING AND CORRECTIONS

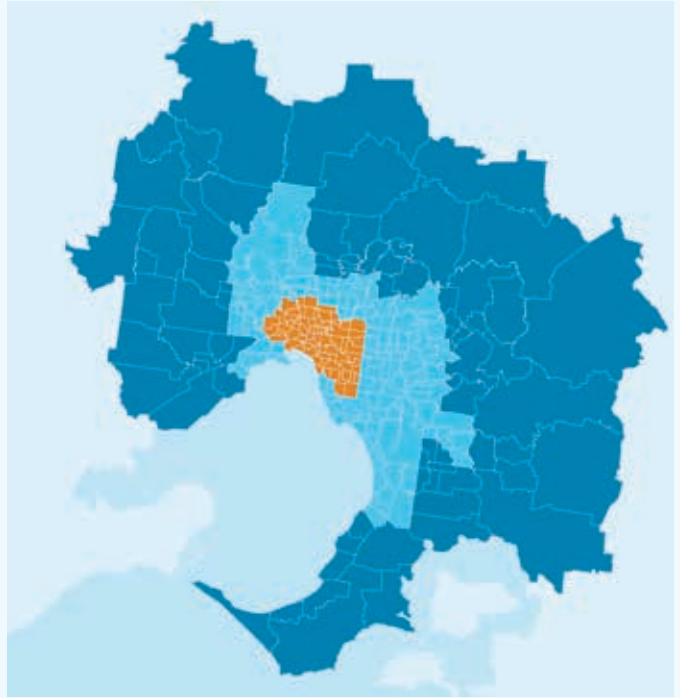
The demographic data gathered in the recruitment phase demonstrated that households in the study were broadly representative of the households of the Greater Melbourne region. Differences in demographics were addressed through weighting and post-stratification correction (using Australian Bureau of Statistics' Census 2011 as target values for home ownership, dwelling type and number of occupants).

Some slight differences in the participant demographics remained as an outcome of choosing the newest vehicle in each household rather than a random participant within a household. For example, the under-30 age class was under-represented, while full-time workers were slightly over-represented. There was also a minor over-representation of higher incomes and under-representation of lower incomes. The nature and small magnitude of these differences did not affect the strength of the statistical analyses.

FIGURE 26. PARTICIPANT ZONE BOUNDARIES

MELBOURNE ROAD USAGE STUDY
GEOGRAPHIC ZONE DEFINITIONS

- **Zone One:** inner-city suburbs with access to all modes of public transport, includes Balwyn 10 kilometres east of the CBD, Caulfield 12 kilometres south-east and Footscray 6 kilometres west of the city centre.
- **Zone Two:** middle and outer suburbs with access to some modes of public transport, includes Frankston 40 kilometres south of the CBD, Dandenong 30 kilometres south-east of the city centre and Tullamarine 20 kilometres north.
- **Zone Three:** outer regions with partial access to some modes of public transport, includes Mornington Peninsula approximately 80 kilometres south of the CBD, Bacchus Marsh 65 kilometres west, and Yarra Ranges approximately 60 kilometres east of the city centre.



BASELINE DATA COLLECTION

During the baseline period of the main study, participants drove with the GPS devices installed, but with no usage or congestion charges applied to their road usage. This baseline data was crucial to the study as it provided a means of comparing road usage behaviour under normal conditions and under the different charging options. A minimum of five weeks of baseline data was collected for each participant.

Figures 27 and 28 show the baseline data collected by trip and by average trip length for all participants. This data was compared against the estimated trips in the Victorian Integrated Survey of Travel and Activities 2012/13 (VISTA 2012/13) and found to be in reasonable alignment, with average daily trips of participants in the study just slightly lower than the 3.7 car driver trips per day for people in the Melbourne and Geelong regions.

FIGURE 27. PARTICIPANTS' AVERAGE NUMBER OF TRIPS PER DAY DURING THE BASELINE PERIOD

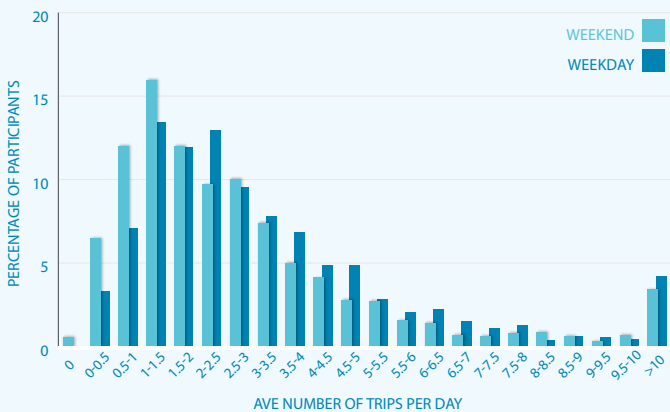
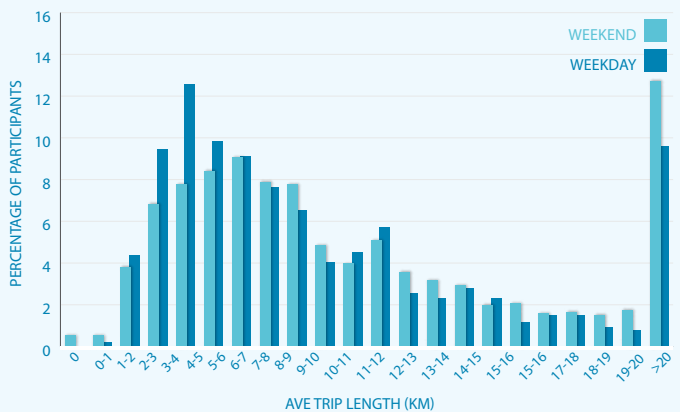


FIGURE 28. PARTICIPANTS' AVERAGE TRIP LENGTHS DURING THE BASELINE PERIOD



STUDY DESIGN IN DETAIL

USAGE AND CONGESTION CHARGE DATA COLLECTION

Once a participant's baseline data was established, they were progressed into the charging-options stages. Data was collected to identify whether, and how, participants changed their road-usage behaviour under different charging options.

Three months of individual participant data was collected during testing of the usage-based charging options, and two months of individual participant data was collected during testing of the congestion-based charging options. Participants moved from one stage to the next on a rolling schedule. To complete testing within the study timeframes, recruitment for the congestion-based charging stage was concluded once the quota of approximately 300 participants for each charging option was reached.

ANALYSIS APPROACH

The main objective of the study was to characterise the behaviours, attitudes, understanding and preferences of Melbourne motorists towards different road-charging options.

Behaviour (travel patterns) and stated attitudes were compared across groups and before-after treatment using a mixed, general linear modelling approach. Analysis was undertaken by response variable (number of trips per day, average distance per trip or distance per valid travel day) and the individual factors potentially influencing the mean (such as treatment group, strata, and so on).

Weighted regression models were applied to the data in order to discount any impacts of a cluster effect due to the sampling approach used. That is, where households within a certain area may have more similar patterns than households of the broader region.

As is expected in non-compulsory research, not all participants completed final surveys within the study timeframes, and the number of participants included in the attitudinal results varies accordingly.

The study's analytical approach was designed in conjunction with independent specialists in statistics, market research and behavioural change. Aggregate-level analyses across sampling, weighting, and attitudinal and behavioural change were performed by these specialists to ensure the accuracy of the findings.

Beyond analyses undertaken at the aggregate level, more detailed examinations were undertaken to explore particular areas of interest. One example is the extended analysis undertaken to explore the behavioural differences (if any) across and within the different charging options. Notes have been included where analysis of behavioural and attitudinal results differed from the approach outlined in this section.¹²

PARTICIPANT ENGAGEMENT

An engagement approach was specifically designed for Melbourne Road Usage Study participants, to offer support and access to information through a range of channels.

The communications program was aligned to two broad objectives, namely, to ensure effective-yet-unbiased participant communication and to provide ongoing support for participants. The strategies used to achieve these objectives are outlined in Figure 29.

FIGURE 29. COMMUNICATION STRATEGIES

Effective, yet unbiased, communications	Support for participants
<ul style="list-style-type: none">to ensure baseline road usage data was not influenced by participant expectations or interpretations, initial communications made no mention of user-pays or other charging terminology	<ul style="list-style-type: none">to ensure participants could contact the project team quickly, reducing potential impacts on the data collection process, a staffed 1800 enquiries number, open from 8am to 8pm, seven days a week and an email address were established
<ul style="list-style-type: none">simple visual concepts such as easily recognisable icons and travel statements that are visually similar to other common household account statements were created	<ul style="list-style-type: none">an online portal where participants could find frequently asked questions and access more detailed information was also available with content updated daily

¹² For example, refer to the direct and descriptive analysis for high change group on page 32 of this report.

The study used a two-way engagement approach to recruit and survey participants, to give participants opportunities to ask questions and provide direct feedback.

A comprehensive communications program was implemented throughout the study. Figure 30 broadly outlines the techniques used to engage with participants.

By the end of the study, participants had made 4,000 unique visits to the online portal, approximately 230 email enquiries to the study's participant-dedicated email address and 500 phone enquiries via the 1800 number. The most common contact types involved:

- providing information about their GPS device when requested
- asking for information about their role in the study – what was expected of them and what they could expect in the future
- providing updated personal details
- providing feedback on their study experiences.

FIGURE 30. COMMUNICATIONS PROGRAM

	Initial letter announcing program
	Three face-to-face surveys (at recruitment and the commencement of each charging option phase)
	Monthly travel statements, sent by post and email
	1800 enquiries line for participants to ask questions and for researchers to contact participants to investigate and resolve observed data and/or technology queries during the study
	Six focus groups held during the main study to gain insights into the success and impact of the communications and to recruit participants for video interviews
	Website content updated daily on participants' portals
	Final telephone survey





STUDY FINDINGS

Findings from the Melbourne Road Usage Study provide valuable insights into what motorists think about Australia's current road-funding system and reveal how motorists respond when roads are charged transparently and according to use under a range of charging options.

The findings suggest that a user-pays road-charging system could work in Australia and could provide a sustainable, fair and flexible system that grows with demand.

SUSTAINABLE FUNDING SOURCE – USAGE-BASED CHARGING OPTIONS FINDINGS

The first stage of the study tested three usage-based charging options, including a charge per kilometre, charge per trip and a flat rate, to determine whether a user-pays road-charging system could work in Australia by providing sufficient funding to meet our infrastructure needs.

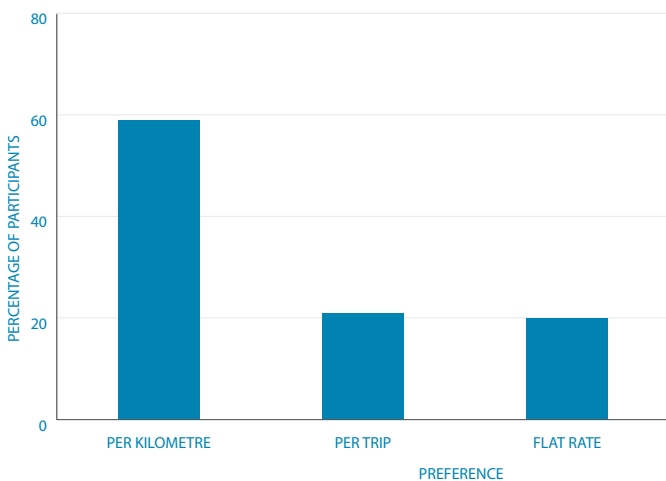
Participants indicated their charging options preference through a series of attitudinal surveys. The surveys showed the charge per kilometre was the most popular and memorable option, and potentially, the easiest to understand.

Of the participants who preferred a usage-based system over the current system, 59 per cent preferred the charge per kilometre option compared with 21 per cent for the charge per trip and 20 per cent for the flat-rate option (Figure 31).

Seventy-two per cent of participants driving under the charge per kilometre option could recall that this was the regime they were driving under. Comparatively, only 64 per cent of participants driving under the charge per trip and 37 per cent of flat-rate participants could recall their particular option (Figure 32).

The number and nature of charging options to be made available would need to reflect not only the priority policy objectives but also practicalities of broad-based roll-out. Among the three example usage-based charging options used in the study, the charge per kilometre and charge per trip options are arguably more direct in nature than the flat-rate option which sets fixed usage amounts per billing period.

FIGURE 31. PREFERENCES OF USAGE-BASED CHARGING OPTIONS (OF THOSE WHO PREFER USER PAYS)



On the other hand, the flat-rate option could more easily cater for vehicles not equipped for GPS device installation by relying on periodic odometer readings, thus providing more practical choices across the diverse range of models in Australia's existing vehicle fleet. For the Melbourne Road Usage Study, all participants' vehicles did have GPS devices installed.



I was on a pricing plan based on kilometres which actually provided me with probably a better insight into my driving habits than I'd ever had before.

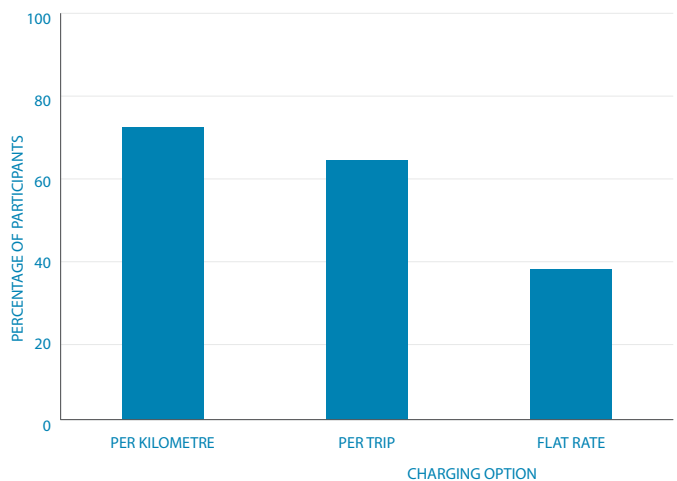
Rob | Hampton

For me, I would probably prefer the charge per trip option because I do a lot of kilometres, but I'm not stopping and starting a lot. Whereas someone who's doing a few kilometres but lots of trips would find the charge per kilometre option better. So I don't think there's a one-size- that- fits-all charging plan, unfortunately.

Linda | Carrum Downs



FIGURE 32. PARTICIPANTS' RECALL OF THEIR CHARGING OPTION



STUDY FINDINGS

TESTING THE SUSTAINABILITY OF USER PAYS AS A FUNDING OPTION

The study showed that participants were open to trying more direct and transparent ways of paying for their road use and, after doing so, preferred a user-pays model over the current road-funding system.

At an aggregate level, participants who trialed the usage-based charging options maintained largely consistent travel activities.* This suggests the charging options did not impede their usual driving behaviours.

“ *I haven't been completely religious and regimented on vehicle usage. I have been conscious of it, but if I can avoid using the car I will.*

Cam | Whittlesea



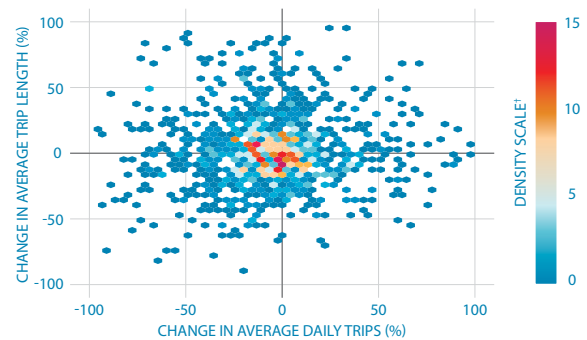
* Other than variations adjusted for factors not related to charging such as seasonality, in line with observation of control group behaviours.

† Density represents the number of participants who demonstrated similar behavioural changes

Figure 33 plots the degree of travel behaviour change exhibited by participants at an aggregate level. Changes are also analysed by control and the three charging options (Figures 34 - 37).

Travel behavioural change is shown as a percentage change in the average number of daily trips (horizontal axis) and the average trip length (vertical axis) made by participants, with the centre of the chart representing those who did not exhibit any change. The similarity in plot distribution across all groups of participants, control and charging options, suggests that the charging options did not substantially impede participants' usual driving behaviours.

FIGURE 33. CHANGE IN DAILY TRAVEL – ALL PARTICIPANTS



MEET BOB FROM ESSENDON – CHARGE PER KILOMETRE

Bob is a keen footy fan and a dedicated Essendon supporter. Bob mainly uses his car to make short trips across Melbourne, often to visit friends and family and to play golf. However, when he's travelling to the city, he takes public transport. Bob explains, "It's pretty hard to take a car into the city now. You don't really want to. I certainly don't. I either go by tram from the end of the street, or I drive the car down to the train station."

While driving under the charge per kilometre option and despite making "a conscious decision not to vary his driving at all", Bob reduced his overall driving and his overall trips. "When I saw my results, I thought, gee whiz, I've travelled less than what I estimated. It surprised me as I haven't altered what would be my normal type of driving habits."

"Price per kilometre seems the most logical way. You think about what you do and you can certainly change your pattern of what you do, or how you do it. Maybe you'll do three things in one trip rather than do three separate trips."



FIGURE 34. CHANGE IN DAILY TRAVEL – CONTROL GROUP

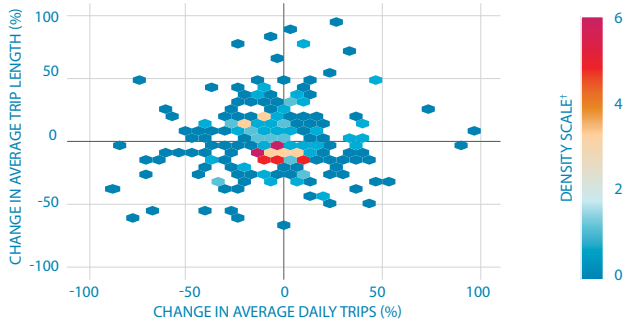


FIGURE 35. CHANGE IN DAILY TRAVEL – CHARGE PER KILOMETRE OPTION

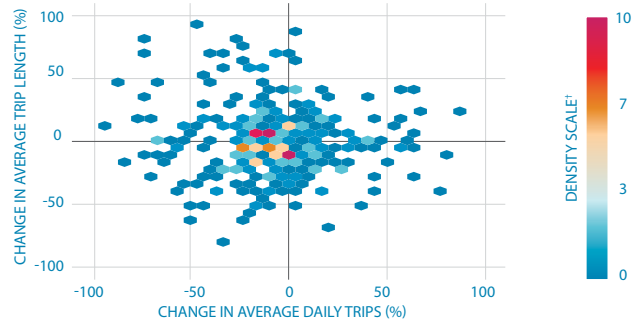


FIGURE 36. CHANGE IN DAILY TRAVEL – CHARGE PER TRIP OPTION

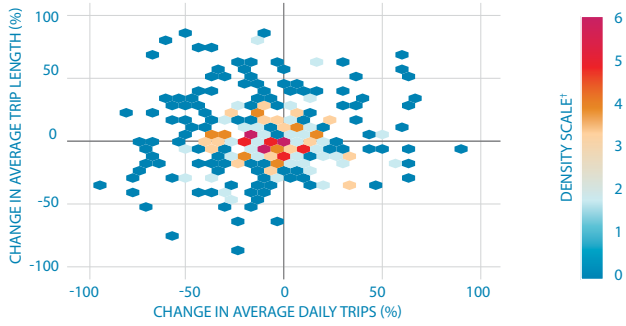
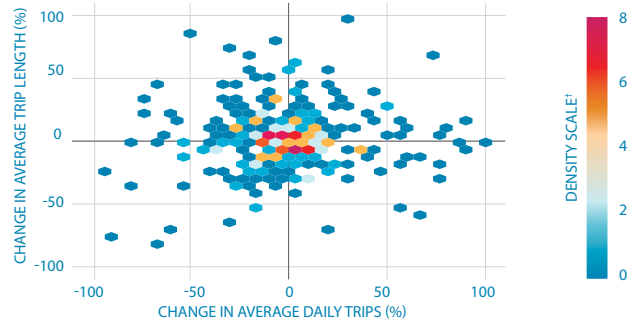


FIGURE 37. CHANGE IN DAILY TRAVEL – FLAT-RATE OPTION



STUDY FINDINGS

ANALYSIS OF THE HIGH-CHANGE GROUP

Looking beyond the collective observations, descriptive analyses were undertaken to compare participants who exhibited high levels of change (either increased or reduced travel) with those who exhibited low levels of change (Figure 38), in order to identify any demographic distinctions across the two groups. Outliers – participants with the highest levels of change – were excluded from this process.

The analyses compared the high-change and low-change groups across common demographic factors such as age, income and household type. No substantial differences were found between the two behavioural groups (Figures 39, 40 and 41).

While no significant behavioural change was noted at an aggregate level, some differences were observed between the options trialled. While the road use of participants trialling the direct usage options – charge per kilometre and charge per trip – remained relatively aligned with seasonal traffic levels, participants on the flat-rate option have shown a tendency to increase the average number of trips taken per day.¹³

Further testing is required to confirm the trend and ascertain the particular factors causing these differences. Notably, only 37 per cent of those on the flat-rate option could correctly recall this as the option they were driving under. Potentially, participants who trialled the flat rate, which is a similar concept to a capped plan for a mobile phone, may have interpreted the charging option as unlimited travel.



I'm a little bit vague about how it transpired. But what's happened is I've been allocated so many kilometres per month. That's the baseline. Some months I go over it and some months I go under it.

David | Forest Hill



FIGURE 38. RANKING OF PARTICIPANTS' CHANGE IN TRAVEL

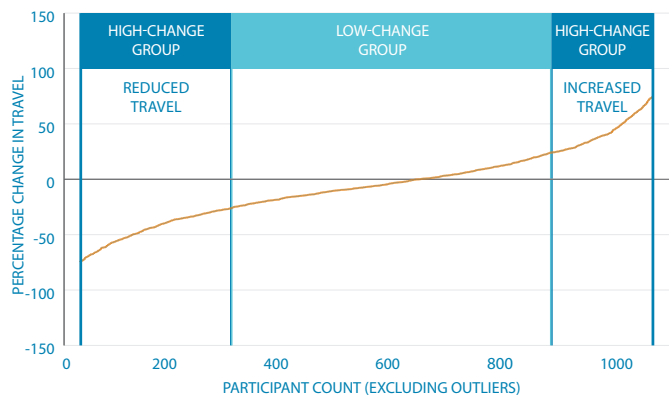


FIGURE 39. HIGH-CHANGE GROUP VS LOW-CHANGE GROUP – BY HOUSEHOLD TYPE

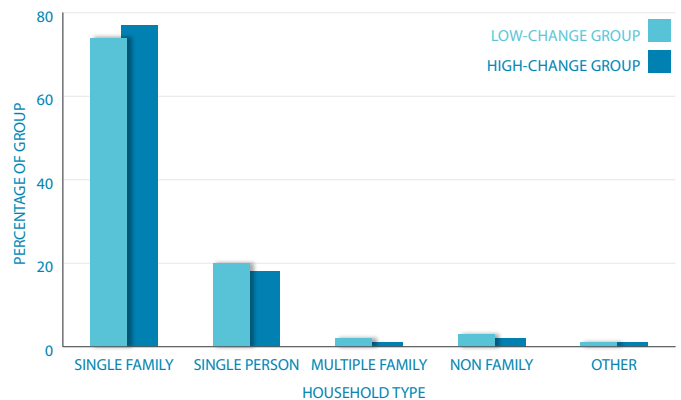


FIGURE 40. HIGH-CHANGE GROUP VS LOW-CHANGE GROUP – BY INCOME BRACKET

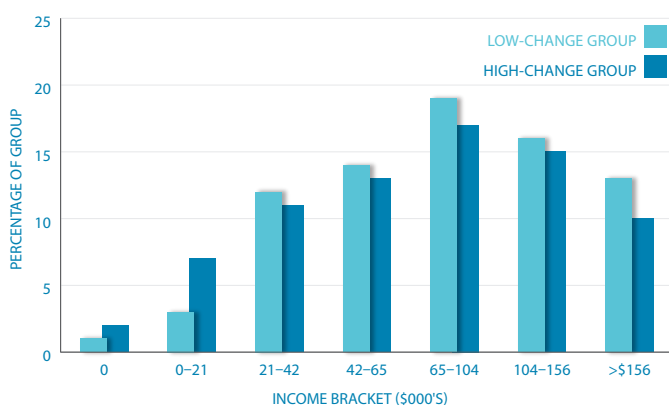
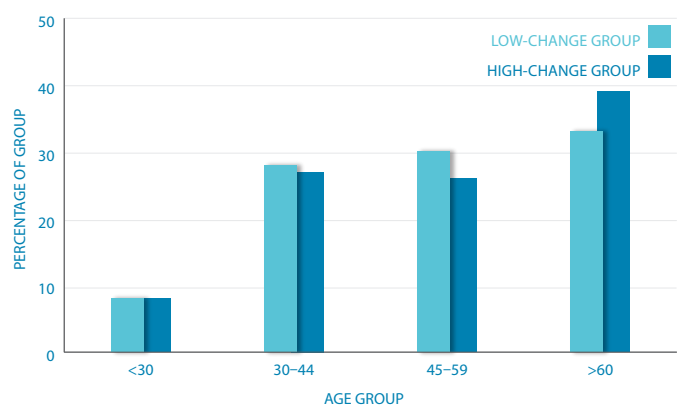


FIGURE 41. HIGH-CHANGE GROUP VS LOW-CHANGE GROUP – BY AGE GROUP



¹³ Relative to the control group and the flat-rate group's behaviour during the baseline period

MANAGING DEMAND: CONGESTION-BASED CHARGING OPTIONS FINDINGS

In addition to providing a sustainable funding base that grows with demand, a user-pays system offers the flexibility Australia needs to help manage traffic congestion through the use of price signals to modify behaviours in highly congested geographies or at peak travel times.

This would add an effective tool to the suite available to policymakers to manage demand, including behavioural change initiatives and communication programs, and the provision of alternative transport modes.

Only a small percentage shift in travel patterns is required to achieve peak spreading and make a considerable difference to the overall demand profile of the road network. Industry bodies have suggested that even a five per cent change in traffic levels during peak periods would increase traffic speeds by 50 per cent¹⁴, similar to the traffic flow changes commonly observed during school holiday periods.

Building on the usage-based charging options, two congestion charging options – an area-based option (cordon charge) and a time-based option (time-of-day charge) – were tested.

CORDON CHARGING

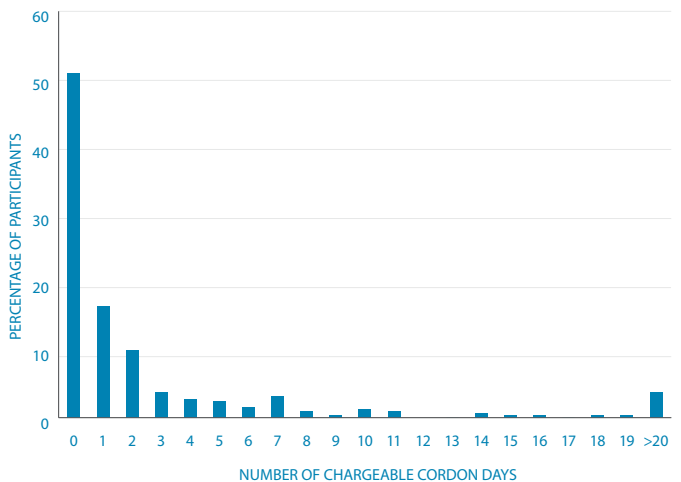
The study showed that cordon-charging could be effective in Australia as a congestion management tool, with a subset of participants reducing their road use within the CBD during peak periods.

Of the 319 participants who completed trialling cordon charging, 51 per cent did not enter the cordon in peak times during the baseline period (Figure 42), with many not entering the area at all during the study. The group of participants who entered the cordon as part of their usual driving habits appeared to have reduced their weekly cordon travel by 10 to 15 per cent.

Despite the observed downward trend for the participants who entered and travelled around the Melbourne CBD cordon, the road usage for the group at aggregate, including those who never entered the cordon, remained largely unchanged during the application of a cordon charge. This result supports the view that demand-management tools need to be targeted to deliver desired outcomes.

¹⁴ Kelly, J and Donegan P, City Limits, Melbourne University Press, 2015, page 172

FIGURE 42: PERCENTAGE OF PARTICIPANTS WHO ENTERED THE CORDON AREA DURING THE BASELINE PERIOD



While cordon charging was applied to the easily recognisable boundary of Melbourne's CBD for the purpose of the study (Figure 43 on page 34), it does not necessarily need to be limited to city centres. It also has application for other areas experiencing temporary or sustained congestion.



Look, I think (congestion charging) is sort of fair, especially if it has an impact where it's reducing a lot of congestion ... I think it's going to be, to some degree, maybe even inevitable in Melbourne ... that's a bit of a gut feeling.

Trish | Burnley

(With the GPS devices) you have the capability of geo-fencing the whole, if you like, metropolitan area. So you can define what you call the Greater Melbourne area and say charges apply within these hours in this area. And outside, they don't apply. That would be a fairer way of doing it.

Rob | Hampton



FIGURE 43. CORDON AREA TRAVEL DURING A DEFINED TIME PERIOD

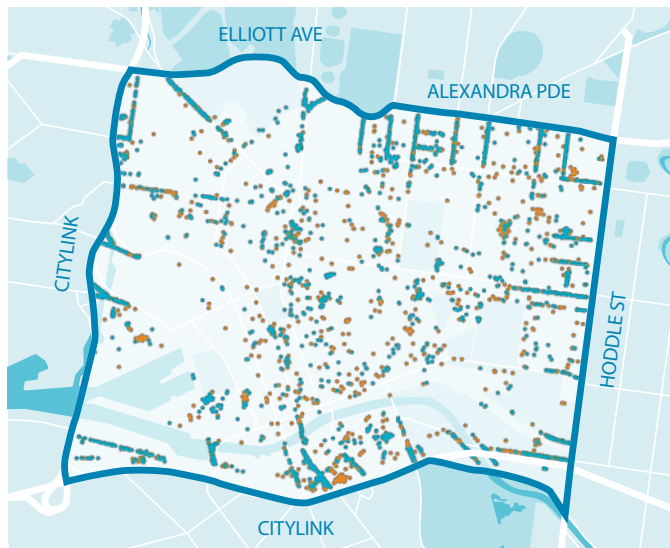


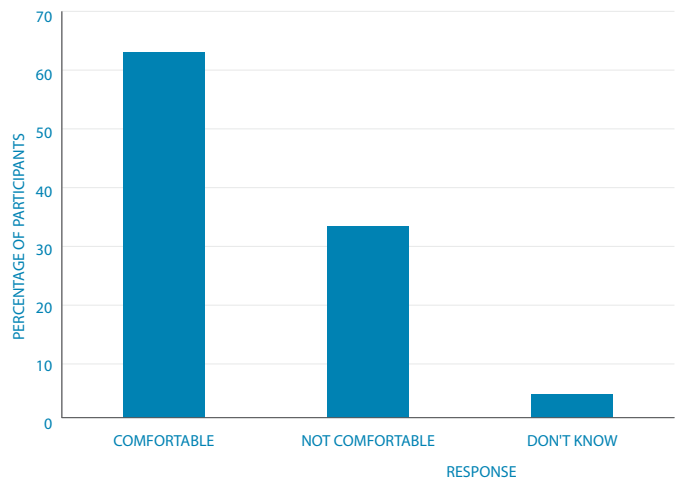
Figure 43 shows a summary of participant use of the cordon area during the baseline (represented by yellow dots) and charging (represented by blue dots) periods. Each dot represents the first transmission registered from the participant’s vehicle within the cordon area during peak periods. Clusters are evident on arterial roads crossing the cordon boundaries as participants entered (or exited) the cordon area. Dots inside the cordon area show the vehicles that were already in that area when the first transmission was sent as they moved within the CBD.

Sixty-three per cent of participants who trialled the cordon charge said they would be comfortable paying for road use in this way (Figure 44).

63% WHO TRIED CORDON CHARGING SAID THEY WOULD BE COMFORTABLE PAYING FOR ROAD USE THIS WAY

The results suggest that even those who travel often into the cordon area could be supportive of this option if they see the benefits. Forty-nine per cent of those who travelled most often (more than six times in the treatment period) into the cordon area said they would be comfortable paying for their road use in this way - although this represents only a low number of participants. Of those who gave reasons for their discomfort with cordon charging as a permanent system solution, being worried about additional costs was the most stated (25 per cent).

FIGURE 44. PARTICIPANTS' COMFORT WITH CORDON-CHARGING AFTER EXPERIENCING THE OPTION



TIME-OF-DAY CHARGING

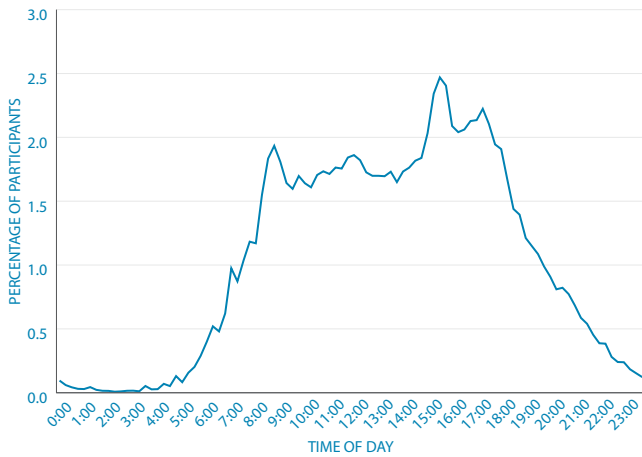
Figure 45 shows the start time of trips taken by participants in the time-of-day charging option during the baseline period. At an aggregate level, analyses of behavioural change showed that participants’ patterns and levels of road use in the presence of a time-of-day charge were largely consistent with those during normal driving periods. This result contrasts with the downward trends observed in the subset of participants trialling the cordon charge option.

51% WHO TRIED TIME-OF-DAY CHARGING SAID THEY WOULD BE COMFORTABLE PAYING FOR ROAD USE THIS WAY

In parallel with observing behavioural changes, the study also gathered information about participants’ attitudes and preferences towards the charging options presented. Fifty-one per cent of participants who tried time-of-day charging said they would be comfortable paying for road use this way (Figure 46).

Further investigation is required to understand the factors that have contributed to the behavioural change and attitudinal observations. A hypothesis is that the time-of-day charging signal as applied in the study was not well understood by participants. Specifically, there were four different components for participants to remember on the time-of-day charging

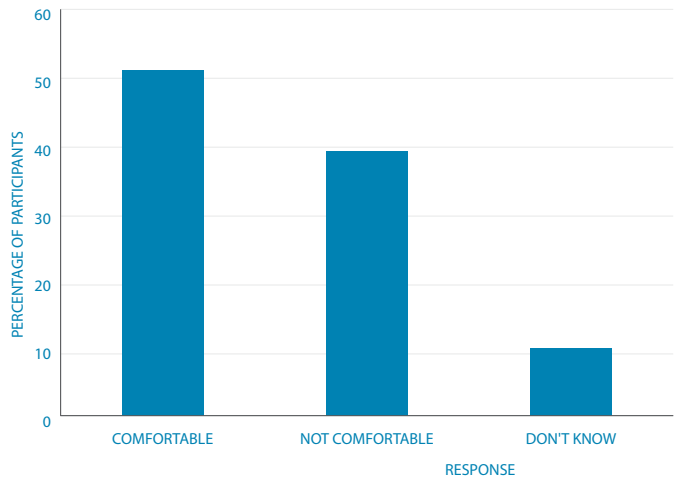
FIGURE 45. TIME-OF-DAY PARTICIPANTS, TRIP START BY TIME OF DAY (BASELINE)



option – peak charge, off-peak charge, morning peak period and afternoon peak period. Only 27 per cent of participants could recall the peak charge associated with the time-of-day option, compared with 46 per cent recalling the cordon access rate in that charging option.

This does not necessarily mean that time-of-day charging would not have application in Australia, but rather, that the charging signal needs to be clearer for users, and more specific in application before it can effectively address demand issues for targeted geographic zones or roads. Time-of-day charging has already been successfully implemented internationally.

FIGURE 46. PARTICIPANTS' COMFORT WITH TIME-OF-DAY CHARGING AFTER EXPERIENCING THE OPTION



OVERALL FINDINGS

The behavioural and attitudinal testing conducted as part of the study demonstrated that a user-pays system can provide a sustainable funding source. It also demonstrates the flexibility a user-pays system could offer in enabling a wide range of price signal options to help to manage demand. Furthermore, it found that Australians are open to discussing this as a viable alternative to the current system.

Setting clear objectives for a user-pays system in Australia will underpin its effectiveness. The extent to which addressing congestion is prioritised alongside the objective of restoring a sustainable funding base for Australia's road networks will be an important consideration for policymakers.

EFFECTIVE APPLICATION OF CONGESTION CHARGING – TWO EXAMPLES

Internationally, different forms of congestion charging have been successfully applied to manage demand and achieve other policy objectives, giving an indication that it could be an effective mechanism for Australia.

Transurban's dynamically priced 495 and 95 Express Lanes in the USA, provide real-world examples of how pricing signals and technology can be used to manage demand, deliver consistent service levels for motorists and achieve other policy outcomes in the busiest transport corridor in the East Coast. Based on a sophisticated algorithm, the toll-price increases and decreases depending on traffic density and ensures a minimum average speed of 55 miles per hour and 45 miles per hour for the 95 and 495 Express Lanes respectively.

During peak periods, traffic speeds on the 95 Express Lanes are on average 40 per cent higher than on the adjacent general purpose lanes.¹⁵

Singapore has successfully used peak/non-peak incentives to help manage demand in conjunction with a geography-based charging signal. Despite its population growing by 140 per cent and rapid expansion of its national fleet, traffic volumes travelling into the city during morning peak hours are less now than in 1975, when road pricing was first introduced. The city also enjoys some of the world's highest peak-hour traffic speeds.¹⁶

¹⁵ Transurban Investor Day presentation, 2016

¹⁶ Menon, A.P. and Loh, N., Singapore's Road Pricing Journey – Lessons Learnt and Way Forward, Journeys, 2015 (https://www.lta.gov.sg/taacademy/pdf/J15Nov_p18Menon_SingaporesRoadPricing.pdf)

STUDY PARTICIPANTS DISCUSS CONGESTION



Participants flagged their concerns with congestion as a reason for joining the study, and the idea of road charging as a means for controlling congestion was also raised by participants.

Trish, a retired nurse who lives in inner-city Burnley, would like to see congestion addressed. She says she deliberately avoids driving in her area during peak periods or she'll get "stuck" in traffic. "I've learnt," she says, "I don't take my car into the city. I've had a couple of bad experiences when I thought I'd luck it and it went all pear-shaped. So I'm way over taking my car into the city." Unlike most participants, prior to the study Trish says she was already "fairly conscious of only trying to use my car when I needed it" through means such as instigating "car-free days", and riding her bike or walking to local destinations.

Trish agrees road charging has the potential to ease congestion. "Look, I think (road charging) is sort of fair, especially if it has an impact where it's reducing a lot of congestion ... I think it's a good thing and I think it has been used in London and it's been quite effective or people are happy with it and it's changing people's behaviour. I think it's going to be, to some degree, maybe even inevitable in Melbourne ... that's a bit of a gut feeling."

Trish also says public transport is an essential tool in easing congestion. "You've got to have at least some adequate or efficient infrastructure, particularly public transport."



Lenore, a retiree living in Bentleigh, agrees. "My pie-in-the-sky hope is that, eventually, public transport gets to the stage that it actually fits the bill or suits people," she says. "Whether you'd be able to get enough public transport to make sure people could do it reasonably, without being left on stations and without having to stand up from one end of the trip to the other, I don't know."



Rob is a project manager living in Hampton with his wife. Self-employed, Rob says he enjoys some freedom in how he travels during the week but he still encounters his share of traffic when attending 9am client meetings.

Participating in the study served as a wake-up call for Rob who says his participation prompted him to make lasting changes in how he uses his car.

"I think (the study) was really illustrative," he says. "Travelling at certain times, if you don't need to, you are actually just adding to the congestion. I can make a conscious choice to avoid doing that."

STUDY LIMITATIONS

The Melbourne Road Usage Study is the first real world test of user-pays charging in Australia. The study sought to offer valuable insights for policymakers, industry and communities in considering long-term changes to road funding to achieve objectives including funding sustainability, fairness and flexibility to respond to changing and growing transport demand.

Like any real-world trial, the study possesses a number of characteristics that limit its ability to fully reflect the conditions that would be present under an actual, system-wide user-pays system. Thus, the study may not detect the full range of corresponding behavioural changes that may materialise under a broad-based scheme.

While participants' behavioural responses are a key element of the findings, the study was not designed to shift behaviours towards specific outcomes – unlike a change management program that would typically accompany a wholesale policy change implementation. Rather, the study provided opportunities for motorists to consider their current driving behaviours and identify opportunities for change without targeted prompting.

For many participants, the incentive to change would likely be greater if they were paying for their road use rather than missing out on potential incentive dollars in their travel account. Known as 'loss aversion', the theory is that people are more likely to change their behaviours if they are faced with a potential loss rather than the incentive of a potential gain.

As the charging options were not applied across the entire road-user base, experiential outcomes in response to behavioural changes made by participants could not be simulated in the study. For example, participants choosing to incur a cordon charge did not experience an improved, less-congested driving experience, as the rest of the road users were driving under normal conditions without a cordon charge applied. This may have served to reduce the impact of positive reinforcement for participants for their behavioural change.

Finally, the relatively short duration of the study may not have allowed enough time for participants to consider how to factor changes to their road use into their routines and lifestyles. Similarly, the practical delivery of alternatives and valid choices such as new public transport alternatives, and flexible working hours and access to services typically take time to implement.

Interestingly, despite the limited changes observed at an aggregate level for road usage charges, 30 per cent of participants reported changing their road use. Further work is recommended to explore factors that contributed to the differences in perception (stated) and actual (observed) behavioural changes and testing of areas not covered by this study.



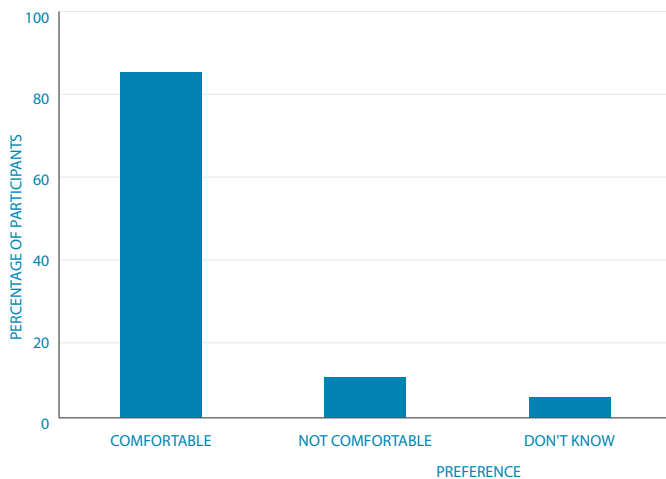
STUDY FINDINGS

SYSTEM DESIGN

Highlighting the power of information sharing and practical experience in building awareness, a series of attitudinal surveys conducted at key points during the study showed a considerable shift in participant preference towards a user-pays model over the current system of opaque fees and charges.

At the start of the study, 85 per cent of participants were comfortable with the current system (Figure 47). However after experiencing alternative ways of paying for their road use, 60 per cent said they preferred a user-pays system (Figure 48).

FIGURE 47. PARTICIPANTS' COMFORT WITH THE CURRENT SYSTEM BEFORE TRIALLING USER PAYS

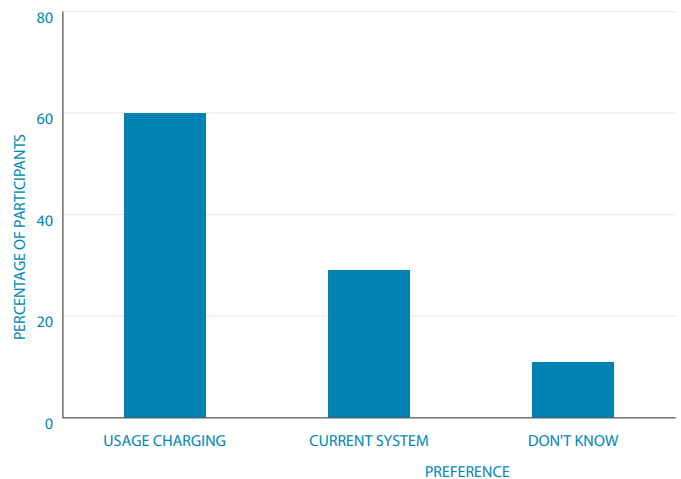


Study participants provided insights into important elements in system design and implementation that warrant further exploration, including:

- transparency and awareness
- choice
- fairness
- technology
- privacy and information security.

These areas are explored in more detail throughout the following sections.

FIGURE 48. PARTICIPANTS' PREFERENCES IN FUNDING SYSTEM AFTER TRIALLING USER PAYS



NATIONAL MARKET RESEARCH

When presented with descriptions of the usage-based charging options trialled in the Melbourne Road Usage Study, research respondents preferred the charge per kilometre option. Respondents said they evaluated each option on its fairness. Specifically, they wanted all road users to pay their fair share.

The congestion-based charging options trialled in the study were appealing to respondents with 45 per cent of respondents positive towards a cordon charge and 42 per cent positive towards time-of-day charging.

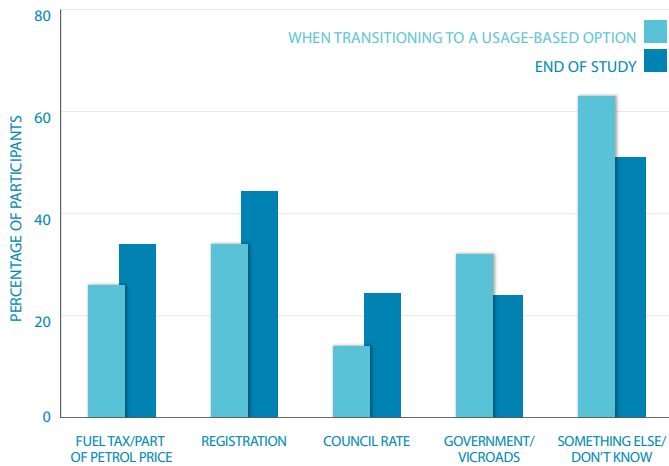
In the qualitative research, where discussion was more in-depth, many noted that cordon charging would need to incorporate some element of time-of-day charging to address fairness. For example, respondents indicated that it did not seem logical to charge people for driving into the CBD at 3am.

“ Where possible, I try and avoid driving during peak and will often stay late at work or come in early to do so. I like the idea that I might be able to be 'rewarded' with a discount for doing so. QLD





FIGURE 49. PARTICIPANTS' AWARENESS OF CURRENT FUNDING SOURCES



TRANSPARENCY AND AWARENESS

In line with results from national market research, participants had limited awareness of their road use, with only 20 per cent accurately stating how many kilometres they drove or trips they made each week, month or year.

Through involvement in the study and experiencing a more direct and transparent way of paying for roads, one in two participants reported they became more aware of their road use (47 per cent), compared with just 11 per cent of those who did not try a user-pays option.

In addition, over the course of the study, participants' understanding of the current road-funding system increased by 23 per cent with a higher proportion of participants able to identify major road-funding sources (Figure 49). With this understanding came a greater appreciation of today's challenges.

Some participants indicated they were not comfortable with the current system of paying for their road use. When asked for their reasons, those who had experienced both the usage and congestion-charging options were more likely to say they believed the system should be user-pays (40 per cent), compared with those who experienced just a usage-based charging option (23 per cent) or had not trialled a user-pays option (11 per cent).

COMMUNICATION CHANNELS

For the main part of the study, two communication channels – a monthly travel statement and an online portal – were provided to participants. These both contained the same summary information about their travel and account balance. In addition, the portal provided further details on individual trips made by the participant, along with a history of their travel and previous charges incurred.

Participants engaged more with the travel statements, which were delivered to them directly by post, than the online portal. Eighty-six per cent of participants who experienced a usage-based option, and 94 per cent who experienced both a usage-based and congestion-charging option indicated that they read their statements. Comparatively, just 32 per cent of participants said they visited the online portal.

Through these channels, participants said they gained the most knowledge about the kilometres they had travelled. Figure 50 shows feedback from participants about the type of information they found the most useful. These results indicate that over time, engagement and awareness increased.

INSIGHT: AWARENESS LEADS TO OPENNESS TO CHANGE

Over time and with exposure to appropriate information, participants indicated that they became more aware of their road use. By experiencing a direct and transparent way of paying for their road use, participants became more engaged and showed openness to shifting to a user-pays system.

FIGURE 50. MOST USEFUL INFORMATION PROVIDED IN THE TRAVEL STATEMENTS.

	Participants trialling a usage-based charging option	Participants trialling usage and congestion based-options
Information about my kilometres	36%	48%
Information about my trips	26%	9%
Information about my piggybank	23%	21%
Nothing really	13%	11%
Other comments (e.g. information about their driving such as how much and for how long they drove)	22%	31%

* Participants could select multiple options

NATIONAL MARKET RESEARCH

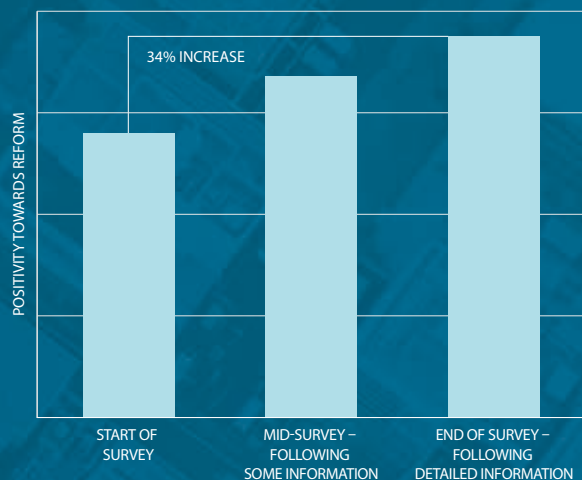
CHANGING ATTITUDES

Most Australians know how much it costs to fill their fuel tank, but our market research showed that 88 per cent of respondents have little or no knowledge about where their fuel money or vehicle registration fees go.

With such a low knowledge base, reform will need to begin with engaging the community to raise the level of understanding of today's funding approach and awareness of the need for change.

At the start of the market research, a small number of respondents felt positive towards road-funding reform. After reading information about the current situation, the number grew by 20 per cent. By the end of the exercise, the total number of respondents who felt positive about reform increased by 34 per cent (Figure 51).

FIGURE 51. IMPACT OF EXPOSURE TO INFORMATION ON POSITIVITY TOWARDS ROAD-FUNDING REFORM



Source: Newgate National Market Research, 2016

STUDY FINDINGS

CHOICE

Practical access to alternative transport modes emerged as a key factor in determining participants' ability and willingness to change their road use. Wider societal factors such as inflexible work times were also notable considerations.

Study participants were recruited from three geographical zones within the Greater Melbourne region, reflective of the public transport options available at different locations. Some participants living in inner-city Melbourne (Zone One), with ready access to frequent and multiple public transport options, reported their ability to choose between multiple modes of transport as an enabler in modifying their road usage.

In contrast, some participants living further from the city centre (Zones Two and Three), where public transport access is generally more limited and/or infrequent, reported that a lack of practical alternative transport choices limited their ability to change their driving behaviours.

Thirty per cent of participants said they changed their road use during the study. Of those who provided details, 31 per cent of participants who had experienced both the usage-based and congestion-charging options said they had changed their road use by "using their car less". This is compared with those who experienced just a usage-based charging option (25 per cent) or no user-pays options (5 per cent). In addition, participants who trialled the usage and congestion-based options reported greater use of alternative transport modes (Figure 52). Of those who provided details, 30 per cent said they had used more public transport and 23 per cent said they walked more.

The higher reported use of all alternative modes of transport for participants involved in both phases of the study likely supports a common belief that habits take time and practice to change.

INSIGHT: DRIVING OFTEN UNAVOIDABLE

Study participants indicated that they often drove for reasons they saw as unavoidable. Access to alternative transport modes and wider societal factors such as inflexible work times impacted how they used the roads and their ability to change their behaviours.

FIGURE 52. REPORTED WAYS OF CHANGING CAR USE – ALTERNATIVE TRANSPORT MODES¹⁷

	Control group	Participants trialling usage-based options only	Participants trialling usage and congestion based-options
Used more public transport	0%	21%	30%
Walked more	2%	17%	23%
Cycled more	0%	1%	5%
Ride share/ car pool	0%	9%	7%
Went by taxi	0%	0%	1%



¹⁷ Participants could provide multiple answers to this question

The success of road-funding reform would be heavily dependent on an effective and integrated planning approach that takes into account charging options for roads as well as access to genuine and affordable transport alternatives.

Beyond the availability of public transport alternatives, wider societal factors such as standard work hours, school operating hours and retail opening hours also influence the amount of choice road users have in when and where they drive.

Study participants highlighted how the obligations of everyday life made driving a necessity, influencing their ability to reduce or change their driving while trialling user-pays charging options. Addressing these factors would require the coordinated efforts of multiple government and industry contributors. Ensuring

Australians can make genuine choices about how and when they use the roads will be critical in meeting the demand-management objectives of any new system.



A lot of people wouldn't have much flexibility because they have to get to their job on time.

But if you didn't have a job, or were a pensioner like me, then I suppose you're a lot more flexible.

Zac | Doncaster



STUDY PARTICIPANTS DISCUSS CHOICE



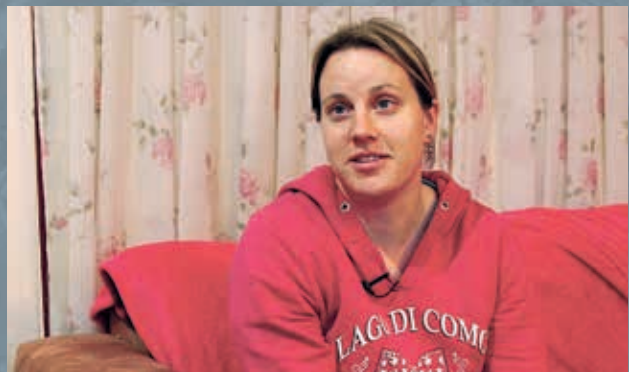
Participants interviewed for this report said that some flexibility was required before any changes in road usage were possible. For those who needed to be at specific places at specific times, change was difficult to accomplish. Those who worked long distances from their homes also found significant change challenging.

Cam, a train driver who lives in Whittlesea, said that driving to the station on his commute into work remained the best choice for him, as catching the bus would add an extra 40 minutes each way to his journey. Where it was practical, Cam did make changes in how he used his car. For example, he started grouping errands together to reduce his overall travel. In fact, he says this habit has stuck beyond the study period. "It's not only of benefit for the environment, but also for me as well," he says.

Linda from Carrum Downs says she also looked for opportunities to change, and where she had a choice, she did reduce her road use. Driving under the charge-per-trip option, she grouped multiple trips together to reduce the overall number; and under the time-of-day charge, she also looked for opportunities to change her driving in line with her charging option.

Linda said it was not possible to remove all travel during the peak charging period but she did try to limit it.

"I would stay at school longer than the usual drop-off time, to leave after 9am and save on that trip home. If I just socialised for 10 minutes, which doesn't cost anything, I could then travel home during the off-peak and save half the cost. But commuting to work, I didn't have that luxury. I couldn't say I'm not coming in until later because it's cheaper for me to come then."



FAIRNESS

Of participants who said they would be comfortable paying for roads in a new way, 15 per cent highlighted aspects relating to fairness that would need to be addressed in any future system.

When considering a real-life application of road-usage charging, study participants wanted to see benefits flow across the entire community and transport network. They said they wanted to see the existing road-related charges eliminated and the funding raised from road usage put directly towards transport projects and maintenance.

Participants reinforced the need for any new system to provide protections for vulnerable and disadvantaged community members. In considering differences between urban and regional road users, some noted that while regional Australians currently contribute to road funding via fuel excise and other charges, they see relatively little investment going into the roads they pay to use. Some living outside the inner city said they want to see their financial contributions provide benefits within their own communities.

Study participants imagined any new system would need to be fairer for all, with safeguards and measures to deliver enduring benefits for all the community, including:

- removing all current charges, including fuel excise, registration, licence fees and stamp duty
- putting funding raised towards construction and maintenance across transport networks
- taking a total transport network approach, including providing access to viable, efficient and cost-effective public transport alternatives for those in inner, middle and outer-urban areas and in regional Australia
- providing protection for the vulnerable in our communities
- looking at options for changing standard working hours and extending or changing essential services opening hours to create more freedom of choice in when and how people travel.

Taking the first steps in testing practical user-pays options, the study focused on motorists living in the Greater Melbourne region. Reflective of Melbourne's population demographics, the vast majority of participants lived in urban areas, with some living on the city fringes. This study acknowledges that any user-pays system could impact regional Australians in different ways to those living in cities. These impacts would need to be considered in the design and implementation of any new system.



If other charges were to be brought in such as dollars per kilometre, I believe then there should be rebates through other existing methods of funding roads at the moment. For instance it could be a discount in petrol prices or your car registration could be halved or something like that.

David | Forest Hill

Well, I think if you were paying money for each kilometre you drove then surely there would have to be some reduction in your registration I would imagine, otherwise it would work very well.

Lenore | Bentleigh

A user-pays system might be a little bit fairer. So the people that don't use their vehicles as often are not paying for those who use their vehicles a lot more.

Cam | Whittlesea

Road pricing is going to be a more direct cost for the road usage than the indirect costs and the indirect costs are going to disappear.

Frank | Dandenong North



INSIGHT: DELIVERING FAIRNESS

Study participants expected any new system to be fair and equitable for all users. They also expected that other taxes would be eliminated to make way for the introduction of a user-pays system.

STUDY PARTICIPANTS DISCUSS FAIRNESS

Participants who spoke in support of road-funding reform also wanted to know that any new system would be fairer than the current system, and that it would deliver tangible results.



Tohu works in the city and spends a lot of his weekends travelling around Melbourne to perform with his cultural group. He drives to work from Patterson Lakes most days, but says the train is also in close proximity to his office. Tohu says he likes the idea of offering a range of charging options to accommodate different driving requirements.

“I agree with having different varieties of (charging) plans available,” he says. “Not everyone does the same as me. So with the other options available, you can use what’s suitable for you and what’s more beneficial for you.”

He says any new road-charging system would need to be fully user pays, so those who drive infrequently get a fairer deal. “As long as it benefits all road users ... (without impacting on) people who may not even have a car. They shouldn’t be held responsible for road users. That’s my view. I don’t expect next door who doesn’t use a car to cover my taxes.”



Zac from Doncaster says he’d like to see other charges removed as part of implementing a new road-charging system. If other charges remained, he would be less enthused by the idea of reform.

“If they bring out pay-per-kilometre, they could take away the other various charges you have to pay for the maintenance of the roads, like registration and petrol – a decent amount of petrol tax,” Zac says.

Meg, an airline worker from Essendon, would like to see more focus on public transport infrastructure spending, and less on roads.

“I get that people are wanting to get places quickly, and they might think getting on a freeway is the best way to do that. But for me, I’d prefer we concentrate more on public transport,” she says.



Meg’s interest in public transport stems from her concerns about the environment. “I wish everything would get a little bit more green,” she says. “We all should have solar on the roof; we all should have wind power and all that stuff, you name it. More public transport so we’re off the roads.”

Meg also believes, if any new road-pricing system were introduced, changes to existing fees would be necessary. She suggests deducting usage charges from other road-revenue sources, such as council rates and would like to see fuel excise abolished.

“I have a strong view that if something like this (user-pays charging) did come into fruition, then all those other taxes need to be withdrawn – so user pays,” she said.



NATIONAL MARKET RESEARCH

WIDER BENEFITS

Research respondents pointed out the need for a system that provided wide-reaching benefits for the whole community, including those living in regional Australia.

They also indicated consideration needed to be given to those who use public transport and those who would use public transport if it were accessible, as well as service operating hours and normal business hours.



Living in rural/remote Australia, we don't receive a good and fair return for our money from revenue for road funding. We pay the same fuel taxes, but haven't really seen any road repairs or upgrades in my area for quite a while. SA

Encourage more use of public transport instead of a whole bunch of cars with one person in each, all heading the same way. Carpool, people! QLD



We pay for the roads. General road funding comes out of our taxes. Petrol tax and road tax does not pay for our roads -they just contribute to general revenue - the big bucket the funding for everything comes out of. NT

I think you would need to see tangible outcomes. A ten minute reduction in the time to travel across town would be a good outcome... To have the main roads around the city flow quickly would be a good outcome. SA

Availability of USEFUL public transport needs to be factored in, too. Encourage me to drive less by providing alternate options that are USEFUL for me. ACT

If you don't have flexibility, then you are stuffed, basically. NSW



TECHNOLOGY

Advances in technology present solutions to enable a modern-day road-charging system. Creating a practical technology suite to support the field-testing of the road-charging options involved assembling several technology components that were fit for purpose. More work needs to be done to establish an operational and scalable solution that meets the needs of Australia’s national vehicle fleet.

PARTICIPANTS’ RESPONSE TO TECHNOLOGY

Participants showed openness to trialling new technologies, including in-vehicle GPS technology. Eighty-four per cent were comfortable with the device in their vehicle and many said they forgot about the device. In addition, 82 per cent of participants agreed that the GPS devices used in the study accurately measured their road usage (Figure 53).

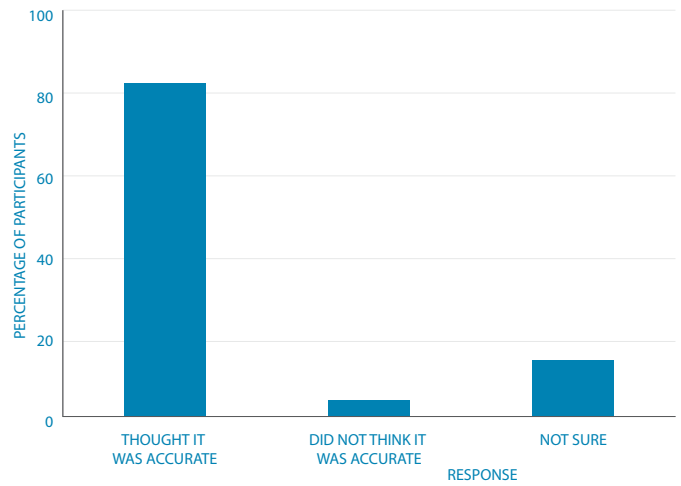
Of the two types of devices used, participants with the OBD-II installed felt more positively towards the device (87 per cent) than those with the plug-in device (76 per cent) (Figure 54). The plug-in device, which was used for (primarily older) vehicles that were not equipped with an OBD port, had visible wires and an antenna on the dashboard. The device’s lack of aesthetic appeal likely impacted participants’ positivity towards it. This device also presented a higher risk of inadvertent dislodgement. Participant feedback on the plug-in device included that it should be smaller, wires should be less visible and other installation or aesthetic factors.

Comments related to privacy matters are discussed in detail in the Privacy and Information Security section.

INSIGHT: TECHNOLOGICAL SOLUTION EXISTS

The study demonstrated that technology is not a barrier to the implementation of a usage-based charging system. The rapid progression of vehicle and infrastructure technology presents opportunity to explore practical considerations for widespread implementation.

FIGURE 53. PARTICIPANTS’ VIEWS ON ACCURACY OF THE DEVICE



TECHNOLOGY PERFORMANCE

Regular GPS device screenings were conducted throughout the study to test the device performance and data validity. These screenings were designed to identify trip data that was invalid such as illogical trip durations and incomplete or inconsistent data. In line with participant expectations, 99.7 per cent of the confirmed travel data was considered valid.

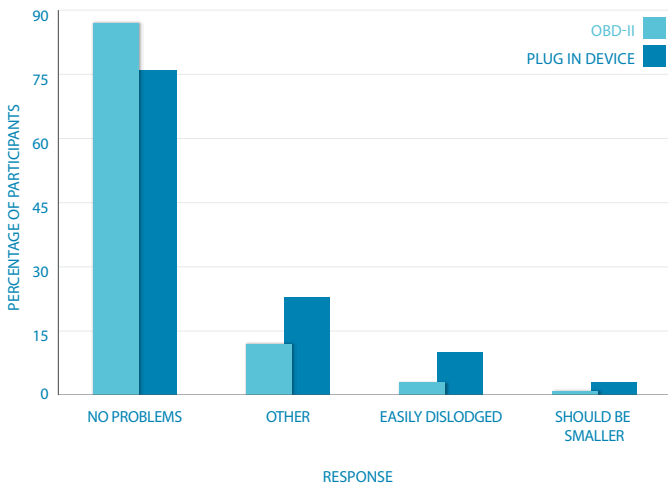
The screenings also identified when a device appeared to have been removed or stopped transmitting trip data. In these instances, follow-up processes were undertaken to make contact with the participant and ascertain the potential causes.

Only 0.3 per cent of devices (five devices) were found to be malfunctioning by the manufacturer, requiring replacement. Other device issues, which impacted only eight per cent of devices, related to installation or software configuration. Both of these results are within the expected norms of study conditions.

The study highlighted the types of logistical and practical considerations that will be important in a broad-scale implementation, such as:

- the positioning of the device in the vehicle
- embedding of the device by the manufacturer or approved installers to reduce installation issues
- adherence to the agreed communications protocol by all manufacturers.

FIGURE 54. PARTICIPANTS' COMFORT WITH THE GPS DEVICES USED IN THE STUDY BY DEVICE TYPE



In cases where the device was confirmed as not having been installed or working correctly for a known period of time, appropriate exclusions were made to ensure the study's analysis only incorporated valid travel data. For the purpose of the study, the amount of excluded data was 2.7 per cent of the total participant days.

Technology available today presents solutions that would enable a road-charging model to be implemented. Considerations such as choice, scalability and compatibility with a wide range of vehicles will require the cooperation of stakeholders in many sectors including automotive, technology and telecommunications.



I've had the car serviced and the mechanic takes it out and I just plug it back in. It's easy; it's not a difficult device to have in the car.

Penny | Cranbourne West

My concern was connecting the actual unit into my car – would that affect my car's computer chip? That was my only issue, other than that it was fine. (After a few months there was) no impact in the car and I've had it for a few months now, I think.

Tohu | Patterson Lakes

I've got a (GPS) device attached to the vehicle. It doesn't seem to worry me. It's very small, it plugs into the cigarette lighter. It just does what it does, and I don't need to worry about it. I don't know how it works, the information's transmitted back to (the study administrator). They sort the account details out through the info they receive. They assured me that they would contact me if it wasn't working properly.

Meg | Essendon



PRIVACY AND INFORMATION SECURITY

While participants indicated that they were generally comfortable with the systems used in the study, they reinforced the importance of personal information security in any system transition.

Privacy is an issue that is top-of-mind for many Australians, especially in relation to the collection of their personal information and application of new technologies. Similarly, throughout the study, issues relating to privacy and data security were mentioned by some participants.

During recruitment, the majority of people who declined to participate in the study did not offer a reason for doing so. For those who did, four per cent mentioned concerns relating to privacy.

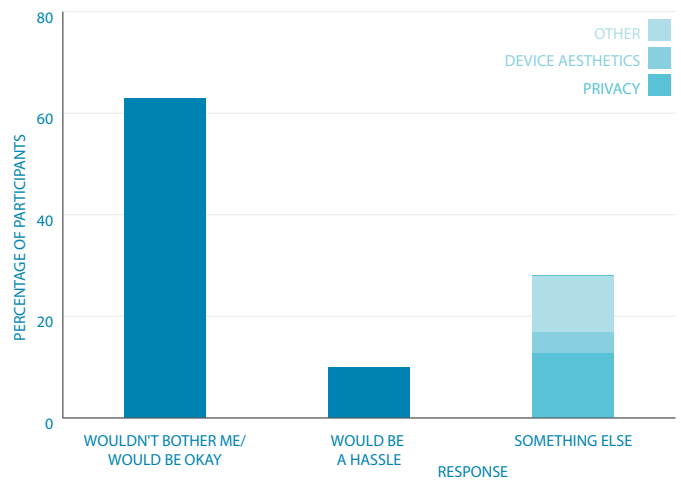
Following the practical experience of the study, 63 per cent of participants said they would be comfortable with the devices being in their car indefinitely (Figure 55), while 13 per cent noted that issues relating to privacy and information handling would need to be considered prior to the implementation of a broad-based system. Of the concerns raised, many were regarding data management and handling, and how participants' information may be used. Also of particular interest to participants was the collection of locational data.

While privacy and data handling matters are very important, with proper systems and procedures in place, they are manageable and could be addressed through considered system design. Collecting GPS coordinates is not a prerequisite for an effective user-pays system. For example, distance-based charging (such as the charge per kilometre option tested in the study) does not require locational data only the number of kilometres travelled. Similarly, under cordon charging, the system needs only to record that the vehicle entered the cordon area, not the location where this entry was made. The majority of in-vehicle GPS devices in use today have the flexibility to transmit only specified types of information, helping to address privacy and data security concerns.

INSIGHT: PRIVACY PROTECTIONS

Participants indicated they were generally comfortable with the technology system used in the study and reinforced the importance of personal information security in any system transition.

FIGURE 55. PARTICIPANTS' THOUGHTS ON HAVING THE DEVICES IN THEIR CAR INDEFINITELY*



* Participants could provide multiple answers

While this discussion has focused on privacy and information security in relation to in-vehicle technology, other elements such as account and payment management, travel statements and website access are also important and will require consideration and administration.



(The GPS device) tracks where you are, it knows where you are. I think this system would be very good at eradicating vehicle theft because vehicles could be found very quickly through the system. So there's an added advantage in that, although a lot of people could possibly see that as a disadvantage.

Frank | Dandenong North

I didn't get in the car and think; all right we've got the little black box, its recording and all that. I just did (the driving) I needed to do. But it did make you think a little bit about how you used the vehicle.

Cam | Whittlesea



STUDY PARTICIPANTS DISCUSS THE IN-VEHICLE GPS DEVICES

Participants were generally comfortable with having a GPS device installed in their vehicle and, in some cases, were interested in seeing if the devices' functionality could be enhanced in the future. However, many also acknowledged the idea of having a tracking device installed in a private vehicle may concern some members of the community.



Garry, a theatre performer living in Ashwood, was one participant who saw further potential in the device.

"It's an interesting thing. In some respects, I find it could be a good tool if it could be linked to the police, somehow. So if you lose your car, it is being tracked. So you should know (where it is). But apparently, it was explained that option wasn't available during the study."

David, a counsellor living in Forest Hill, was similarly unconcerned by the technology used during the study.



"(The GPS device) has been quite convenient," he says. "I'm not very technical but I guess it transmits back to a depot. It would indicate how many trips we use, we go on, and what kilometres we travel and possibly even what time of the day it is. I'm not sure about that one. Some sort of tracking."

Sales rep David from Burnley said that while he wasn't thrilled at the idea of being tracked, he didn't find the technology an imposition once it was installed.

"I didn't notice the device from one day to the next," adding, "I had some problems with the engine management system and I asked them if that could be part of the problem. They assured me it was simply an inspection port ... where they got information from the engine and no amount of interference could come from there. So it's irrelevant to me. I don't notice it. I'm not aware of it in the car."



For Simon, a volunteer firefighter, the idea of being tracked for the study was not as concerning as the potential time commitment involved in participating in the study.

"(The study recruiter and I) had a chat about (my participating), and what it was for and I thought 'Yeah, all right, it's not going to impact on me in any way'. So I thought, 'Look if they just want to track the car and get data then that's fine. It was a really easy study to do. They want to track the movements of my car, for whatever reason at the time. No extra stuff for me to do – and it's helping."



The background of the page is a blue-tinted aerial photograph of a city street grid, likely Melbourne. Overlaid on this is a white network diagram consisting of various sized circles (nodes) connected by thin lines. Some nodes are larger and more prominent, while others are smaller. The lines form a complex web across the top and middle of the page, suggesting connectivity and a network structure.

NEXT STEPS

It is clear that the path to reform needs to begin with building a common understanding of how road users currently use and pay for roads.

As in the case of most reforms, we appreciate the path ahead will be challenging. In spite of this, we have a unique opportunity to take advantage of imminent transport technology developments as a catalyst for creating a sustainable, fair and flexible funding future.

INFORMATION AND AWARENESS

The study showed that transparency of appropriate information and awareness building are key to generating community support for reform.

A practical measure could be to have fuel excise charges itemised on petrol and diesel dockets. Similar information-sharing measures could also be applied to registration and licence fee receipts. The Australian Automobile Association has advocated change of this nature and we agree. As an industry, we need to work together to improve the transparency of road-related charges.

We believe these potential measures could help raise Australian road users' awareness of the road-related charges they already pay, as well as the inequity and sustainability challenges inherent in the existing system. For our part, we will first look for ways to engage with our customers on this important topic.

CREATING A CLEAR PATH FOR REFORM

With all three levels of government involved in transport infrastructure funding and planning, a cooperative and collaborative approach to reform discussion is critical to long-term success. We believe that a staged approach to implementing reform, allowing the existing system to progressively phase out in parallel with the gradual introduction of the future model, would deliver an effective transition to a funding future that supports Australia's growth and changing needs.

In the area of heavy vehicles, the Council of Australian Governments, through the Transport and Infrastructure Council, has been making progress on the reform pathway. The ultimate aim of the initiative is to improve productivity by turning provision of heavy vehicle road infrastructure into an economic service where feasible.

We look forward to the creation of a practical framework at a national level that allows for the need to balance nationally-consistent objectives with state and local area-specific requirements.

SYSTEM DESIGN – FAIRNESS AND EQUITY

As our study participants highlighted, there are a number of areas that will require intensive investigation to ensure the fairness and equity of any new system. Part of this is in identifying the vulnerable groups within our communities and designing a range of suitable protections. In addition, deep understanding of the unique transport practices and needs of different road users, across metropolitan and rural areas of our country, will be crucial to developing informed views in system design.

TECHNOLOGY

With the arrival of new transport technologies, we have an opportunity to design and lay the foundations for the kind of transport system that will support our communities.

Transurban worked with industry specialists in designing and operating the practical technology and operations specifically used in the field-test of the Melbourne Road Usage Study. Our study participants provided positive indication that they are willing to try these new technologies and interact with road charging information, as long as they have adequate protection for information security and privacy.

The study demonstrated that technologies available today present solutions to support a broad-based user-pays road-charging system. Scaling up the capabilities and preparing for broad-based implementation will require the coordinated efforts of stakeholders in various industries including automotive, technology, and telecommunications to ensure appropriate standards and application for Australia.

NATIONAL MARKET RESEARCH

Two thirds (67 per cent) of market research respondents were interested in seeing government take action on transport and funding reform. Most respondents indicated that they believed responsibility for addressing the issue was spread across Australian local, state, and federal governments.

Many respondents indicated that they were keen to see road-funding issues start to be addressed now, through trials or further research. People wanted assurance that any proposed solution had been thoroughly researched and trialled successfully.

In the qualitative research, respondents indicated that examples of other countries dealing with similar issues increased their confidence in an alternate system.

CONCLUSION

As the first practical study into user-pays road charging in Australia, we believe the Melbourne Road Usage Study has delivered insights into how Australians would respond to a new road-charging model. The study has shown Australians are willing to try different ways of using and paying for roads.

The study positively demonstrated that a road-charging model based on user-pays could work in Australia. It showed a usage-based model could help address our funding challenges today and generate a sustainable funding stream that keeps pace with Australia’s growing demand and enables investment in the networks we need for the future. An example of how a user-pays model could keep pace with road-usage demand is illustrated in Figure 56.

In addition, the study demonstrated the flexibility a user-pays system could offer in enabling a wide range of price signal options to help manage demand and modify behaviours, and in so doing, help address issues such as traffic congestion and optimising network usage. This would add an effective tool to the suite available to policymakers to manage demand, including change management and communication programs, and the provision of alternative transport modes.

Setting clear objectives for a user-pays system will underpin its effectiveness. The extent to which addressing congestion is prioritised alongside the objective of restoring a sustainable funding base for Australia’s road networks will be an important consideration for policymakers.

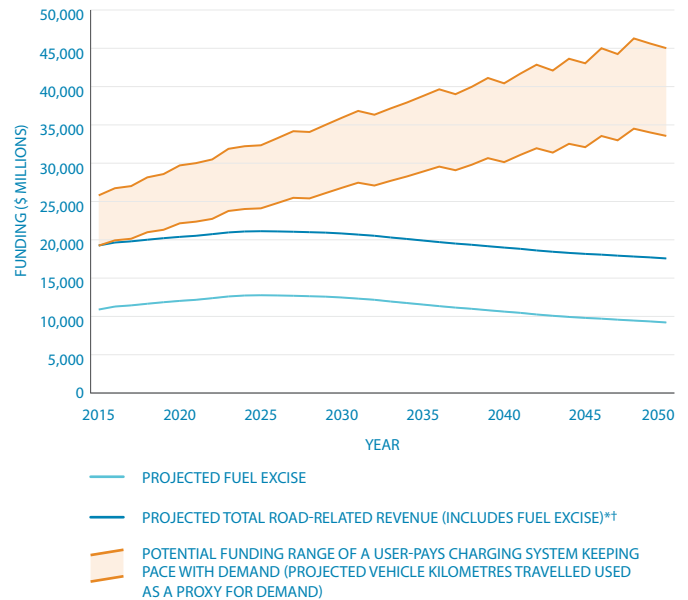
While the primary focus of the study was on road charging, the learning extended to other areas of infrastructure planning. The study highlights the need for a coordinated approach across the different modes of transport that provide Australians with the choice they need to initiate change.

Finally, the study emphasised the importance of bringing the wider community into the discussion. We believe the more time Australians have to understand the issues we face in transport, the more motivated they become to see change.

Through building an understanding of the challenges in the existing system and gaining first-hand experience in user-pays road-charging options, many of our participants developed an appetite for a funding future that is fair, flexible and sustainable.

As the study showed, Australians are willing to start talking about funding reform and we should all be ready to listen.

FIGURE 56. POTENTIAL FUNDING FROM A USER-PAYS SYSTEM COMPARED WITH EXISTING FUEL EXCISE



Source: Transurban analysis; Bureau of Infrastructure, Transport and Regional Economics, Australia Infrastructure Yearbook 2015; CSIRO (report for the NTC), Projecting future road transport revenues 2015–2050, May 2015

* Taxes and duties for specific purposes such as GST, fringe benefit tax, tolling revenue, luxury car tax or passenger vehicle customs duty not included.

† Assumes real revenues other than fuel excise remain constant.



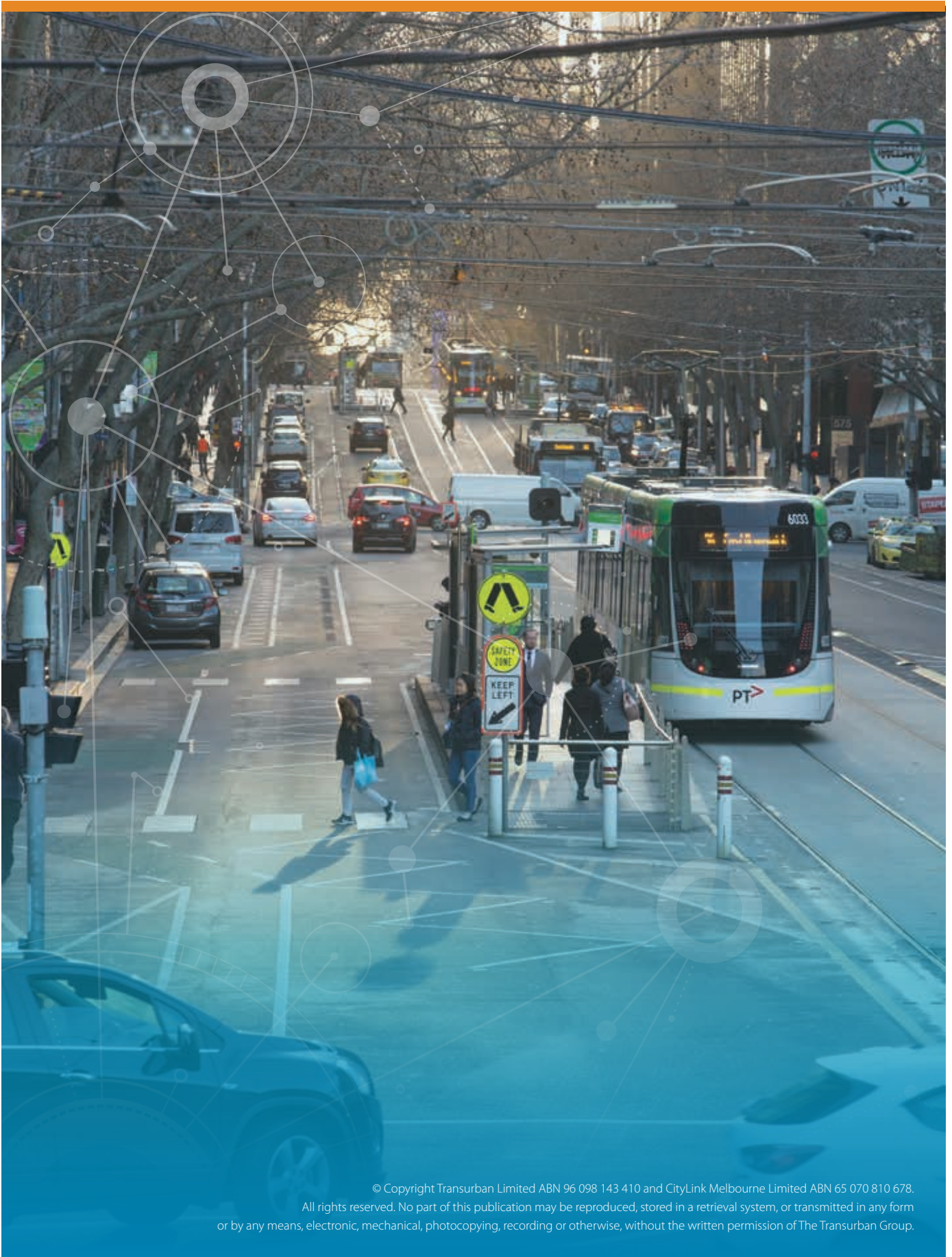
I've been driving now for 50 years and a lot has happened in those 50 years in terms of road usage. Melbourne is the world's most liveable city so I think to maintain that we've got to do something about our transport.

David | Forest Hill

The changes I've made to my driving patterns are going to be longer-term, even when this is over. It's something that I've now become aware of; do I need to add to the congestion on the roads? The answer is no, I don't.

Rob | Hampton





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