AUSTRALASIAN RAILWAY ASSOCIATION

Synergies ECONOMIC CONSULTING

PUBLIC TRANSPORT INVESTMENT

The Value of Action versus the Cost of Inaction

January 2014

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Key messages

- Congestion is now an everyday aspect of too many peoples' lives. The most effective way to address this problem is to invest in public transport.
- In particular, investment in passenger rail – both light and heavy rail – offers the best value for money solution as it can move large numbers of people quickly at a substantially lower cost than the equivalent investment in roads. Our analysis shows that in Brisbane and Perth, rail requires 57% and 38% less in investment than road (respectively) to achieve the same reduction in congestion.
- The detrimental impact of congestion on the liveability of our cities is well known. More importantly, it reduces productivity. Alleviating congestion by investing in public transport is therefore imperative to ensuring future productivity growth, as it is the most efficient way of connecting people with jobs in the high productivity nodes in our cities.
- If no action is taken to invest in public transport, by 2031 the annual cost of congestion is expected to reach $5.5 billion per annum in Brisbane (currently $2 billion per annum) and $3.8 billion per annum in Perth (currently $1.4 billion per annum)[1]. Most importantly, it will retard productivity, which is fundamental to the economic health of not only our cities but also the nation.
- Alleviating congestion also gives people more time. Currently, commuters in Brisbane and Perth forgo up to 11 million and 14 million hours per year of time respectively being delayed in traffic, which could be applied to work (increasing productivity) or leisure (increasing personal well-being, reducing stress and improving family cohesion). The average commuter in both cities gains around 73 hours per year – or nearly an additional two weeks annual leave each year.
- In addition, apart from alleviating congestion rail offers a number of other important advantages over road investment, with our analysis showing that rail investment would take around 127,000 cars off the road in Brisbane and 163,000 cars in Perth in each hour of the peak. These other advantages include:
  - improving social inclusion for all people within the community, including people with disabilities, those who cannot afford a car and those who would prefer not to own a car (noting the recent trend away from car ownership amongst the younger population);
  - improving safety. For example, a study by Deloitte Access Economics found that the costs of road crashes is about 965% more than the crash costs from rail (on a cents per

[1] Bureau of Transport and Regional Economics (2007). Estimating Urban Traffic and Congestion Cost Trends for Australian Cities, Working Paper No.71.

kilometre basis), meaning that transferring 1,000 people from cars to rail would reduce the costs of road crashes by between $650,000 and $760,000 per year, depending on the city[2];

- reducing emissions. Based on our analysis, assuming that all cars in the peak are equally contributing emissions, this will reduce the emissions generated from cars in peak hour by up to approximately 23% in Brisbane and 34% in Perth;
- stimulating growth and development along the rail corridor and rejuvenating local communities. There is evidence of these benefits in a number of cities internationally, including Portland, Madrid and Dublin. For example, in Portland, since the decision to build the MAX light rail system in 1980, $US10 billion has been spent on urban development near the MAX stations.[3] The potential for value capture also provides opportunity for innovative funding solutions.

- Productivity reform and continued economic growth requires the immediate attention of Government. A sustained and proactive approach to public transport investment, particularly passenger rail, is part of this necessary reform. A high degree of bipartisanship is essential, which in turn requires a well-accepted higher level goal and rationale for the investment that is broadly shared by governments and major political parties.
- Australia needs urban rail investment if our cities are to remain the important engines of our national economy. To manage congestion and maximise productivity gains, investment is needed in modern, efficient, high capacity rail networks. This is essential to the future economic and social health of our cities and the Australian economy as a whole.

[2] Deloitte Access Economics (2011). The True Value of Rail, Australasian Rail Association. Figures in 2010 dollars.

[3] TriMet (2013). Facts about TriMet. Available from: http://trimet.org/pdfs/publications/factsheet.pdf [Accessed 20 June 2013].

Executive summary

The problem: Australia's cities are congested

In today's world, cities need sustainable urban transport networks. Transport networks influence productivity, accessibility to work and leisure activities, the quality of the natural environment and health and safety. Where people choose to live and work is influenced by the city's transport networks and services.

Australia's major capital cities are experiencing the effects of inadequate investment in public transport infrastructure. Congestion is now an everyday aspect of too many peoples' lives. Brisbane and Perth have been focussed on as case studies for this report.

If no action is taken to invest in urban transport, the annual cost of congestion is expected to reach $5.5 billion per annum in Brisbane and $3.8 billion per annum in Perth by 2031. In present value terms, this equates to a total congestion cost of $48 billion for Brisbane and $33 billion for Perth between 2014 and 2031.

This further worsening of congestion costs has a major negative impact on the well-being of the citizens of both cities, including declines in liveability. More importantly, rising congestion also harms future productivity growth - the logic is inescapable. High skill, high wage and high productivity jobs are part of continued expansion of CBD employment in cities.[12] The ability of a city to move labour to high productivity nodes will be retarded by congestion. The result is that cities will be less productive and for an urbanised country like Australia this can mean only one thing - lower productivity and lower economic growth.

Addressing the problem: investing in public transport

Addressing these problems requires an integrated approach to transport planning and investment. Investment in passenger rail transport – including heavy and light rail - is a major part of the solution to unblock the congestion beginning to choke our cities. Rail has the ability to move large numbers of people quickly. It also delivers other social, environmental and safety benefits compared to road transport.

This report demonstrates this by comparing the costs of addressing the current congestion problems in Brisbane and Perth by either expanding the road network or investing in urban passenger rail. This necessarily high level approach examines the relative efficacy of road and rail in reducing congestion. The target level for reduction

in this report is 50% of current congestion. This is the level according to the BITRE where the cost of reducing congestion is equal to the benefit of reducing congestion.[4]

Rail offers significant advantages over roads in terms of value for money from urban investments. Allowing for future demand growth in each city, our estimate of the required investment in road and rail infrastructure in Brisbane and Perth is as follows.

Estimated investment required to achieve optimal congestion in Brisbane and Perth ($2014)

	Road	Rail (above and below rail)
Brisbane	$46 billion	$20 billion
Perth	$40 billion	$25 billion

Our analysis shows that in Brisbane and Perth, substantially smaller investment in rail will gain the same congestion reduction benefits as investment in roads – it would cost around 57% less in Brisbane and 38% less in Perth to achieve optimal congestion. Real congestion relief in Brisbane and Perth will require almost 2,300 additional lane kilometres in Brisbane and almost 2,000 lane kilometres in Perth.

The rail solution has a number of other important benefits compared to road that are not included in the above estimates because they are more difficult to reliably quantify. These benefits include improvements in social inclusion, safety, the environment and urban growth and renewal.

Rail investment on its own is not the answer - a fully integrated transport network accessible to all is the goal. This report confirms what the community has long suspected:

- Governments have continually underinvested in urban infrastructure and the catch up investment required would involve unprecedented investment in urban infrastructure. The extent of the underinvestment in rail is in the order of $20 billion in Brisbane and $25 billion on Perth.
- To meet the current and future challenges, investment in public transport - especially rail - is the most effective way of reducing congestion to efficient levels.

Policy actions required

Congestion is a worldwide problem. Our examination of lessons learned from overseas jurisdictions (including Portland, Madrid, Dublin and Toronto) revealed that:

[4] Bureau of Transport and Regional Economics (2007).

- A long term commitment to integrated transport and land use planning is essential.
- This commitment must be sustained, anticipating future population growth.
- Rail investment has the potential to stimulate growth and development along the rail corridor. This can also result in increases in land values as has been seen in Australia and elsewhere.
- Innovative funding solutions can be successfully implemented, including initiatives based on value capture. However, some government funding will still be required.
- Light rail has been an effective solution in a number of major cities, particularly where it integrates well with the existing transport network.

The key solution to Australia's congestion problems is investment in public transport. In particular, investment in passenger rail (heavy and light) offers the best value for money solution. It enables the movement of large numbers of people in peak periods, for around half the cost of the equivalent investment in roads.

However, this is just catch-up. As cities continue grow, and there is good economic sense in facilitating city growth, a new approach to managing transport demand is needed that addresses existing demand as well as future growth, recognising the long lead times for new investments. Today's reactive approach not only risks placing governments in a perpetual 'catch up' mode but also means that our communities, and the economy, suffer under the burden of worsening congestion.

The policy actions that are required to support this are:

1. **Proactive targeting of the problem via well developed planning frameworks.** While Australian governments are taking a more integrated approach to transport planning, they need to enunciate the transport problem that needs to be addressed, which is congestion, and articulate the strategies (including investment) that will alleviate the congestion. The measurement of outcomes should be based on targeted reductions in congestion.
2. **Implementation of plans based on a sustained national policy commitment and bipartisanship.** As challenging as this may be, this requires an ongoing commitment to fund transport investment based on the required growth profile for each city, recognising the lead times involved in new investments, independent of the political or budget cycle. While opportunities to raise revenue through these alternative funding mechanisms are available and should be pursued, implementation of necessary investment cannot continue to be stalled in

the hope that innovative funding solutions can be found. This is essential infrastructure that is fundamental to the economic and social well-being of our cities.

3. **Implementation and use of more effective project evaluation.** Project evaluation methodologies need to encompass the wider social and economic costs and benefits of alternative transport solutions. This includes:
   - ensuring that the externalities of road transport, which are currently borne by the community, are identified and evaluated;
   - establishing a framework for identifying and measuring Wider Economic Benefits, which will also enable a greater understanding of how transport networks impact agglomeration and productivity in cities.

   This could be implemented and managed by Infrastructure Australia, in cooperation with the State transport departments, which would also enable a nationally consistent framework for best practice project evaluation.

Australia needs public transport investment if our cities are to remain the important engines of our national economy. To manage congestion and maximise productivity gains, investment is needed in modern, efficient, high capacity rail networks should be a preferred solution. This is essential to the future economic and social health of our cities and the Australian economy as a whole.

We cannot afford not to invest. In short, the value of action – or the social and economic consequences of inaction - means that continued underinvestment in public transport commits current and future Australians to a lower quality of life.

Contents

Figures and Tables

1 Introduction

Synergies Economic Consulting and GHD have been requested by the Australasian Railway Association to examine the current transport challenges facing our cities and the consequences of continued under-investment in public transport, including in urban passenger rail.

As a nation, Australia has recognised that continuous improvement will provide the productivity to ensure future generations will not be left with a lower quality of life. In our cities, this means that a mass transport system - a public transport system - is a critical part of our social infrastructure that delivers productivity.

There is clear evidence of underinvestment in essential transport infrastructure in Australia as our capital cities become increasingly congested. Investment in public transport, particularly passenger rail, is key to reducing congestion. In particular, urban passenger rail (including heavy and light rail) has the ability to efficiently move large numbers of people in and out of the city at peak times.

The purpose of this report is to understand the nature of congestion in our cities and assess the possible future social and economic consequences if it fails to be addressed. It will focus on Brisbane as a case study, contrasting its situation with Perth. Brisbane has the second highest projected population growth of the Australian capital cities (behind Perth). It is therefore facing significant challenges in urban planning and transport development. While Perth is an example of a city that has benefited from efficient investment in passenger rail, as it continues to experience strong growth it is also facing congestion.

In addition to analysing congestion and its consequences, this report compares the cost of the equivalent road and rail investment in Brisbane and Perth required to restore each city to the optimal level of congestion. It will also draw on relevant international experience.

This report is structured as follows:

- section 2 describes the problem of congestion;
- section 3 examines the consequences of congestion;
- section 4 discusses why we are in this situation;
- section 5 compares the costs of inaction with the value of action;
- section 6 examines case studies in other jurisdictions; and
- section 7 proposes the policy solutions required to address congestion.

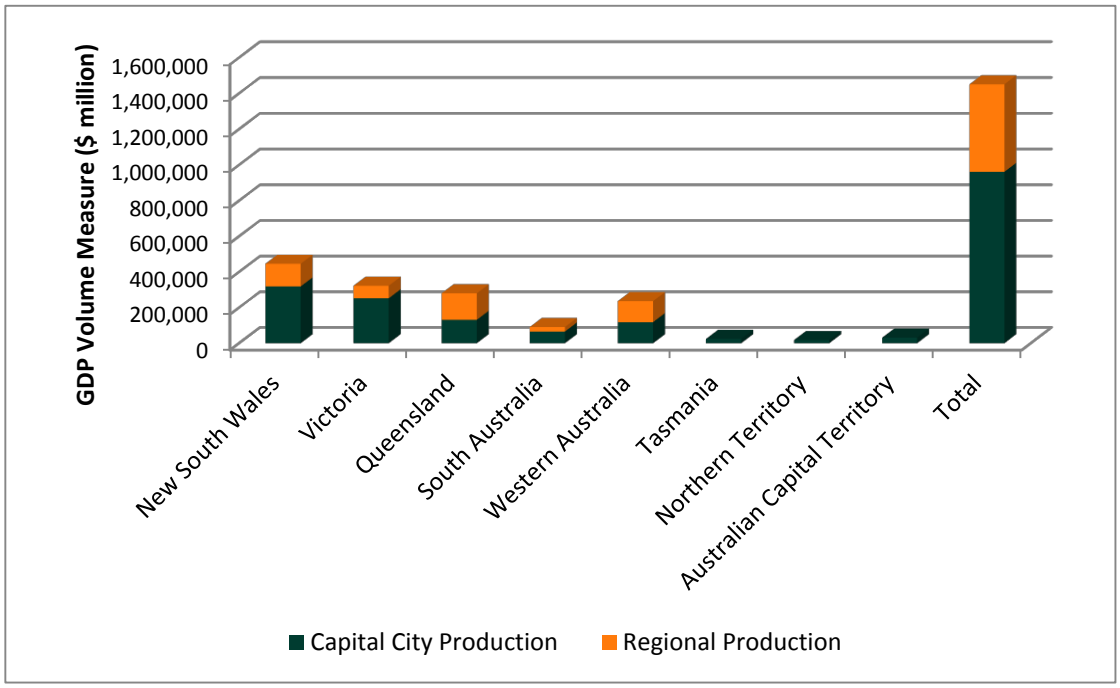
2 The problem: Australia's congested cities

2.1 Urbanisation in Australia

Australia is a highly urbanised country. In 2011, 77.3% of Australia's population lived in cities with more than 100,000 residents[5] and around 66% lived in a capital city[6]. In 2011-12, Australia's larger capital cities grew 50% faster than the rest of the country.[7] Many areas experiencing the strongest growth were located in the urban fringes, as well as inner city suburbs.[8]

Cities are also very productive spaces, accounting for around 66% of annual value of economic production as shown in Figure 1.

Figure 1 Gross Domestic Product 2011-12



Data source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics & Planning

As an economic hub for the South-East Queensland (SEQ) region, Brisbane accounted for 1.07 million jobs in 2011 (nearly 63% of the jobs in SEQ).[9] Employment growth

[5] Department of Infrastructure and Transport (2012). State of Australian Cities 2012, Commonwealth of Australia, p.10.

[6] Australian Bureau of Statistics (2013). Regional Population Growth, Australia 2011-12, Catalogue 3218.0.

[7] Department of Infrastructure and Transport (2013). State of Australian Cities 2013, Commonwealth of Australia.

[8] Australian Bureau of Statistics (2013).

[9] Brisbane City Council (2012).Brisbane Long Term Infrastructure Plan 2012-2031.

tends to remain concentrated in the CBD areas. Over the decade to 2011, employment grew by 282,000 in Brisbane, of which around 60% were located in the CBD. By 2031, 443,000 out of the 670,000 additional jobs in SEQ are expected to be located in Brisbane. Areas outside of the CBD are also expected to experience significant employment growth, reflecting different locational advantages such as proximity to major transport routes (air, land and sea), land size, cost and zoning.[10]

The population of Australia's capital cities grew by 17% between 2001 and 2011, faster than the remainder of Australia which grew by 11%.[11] Most of this growth has been on the urban fringes, although the density of inner city areas has also continued to increase. In the future, as the population of capital cities continues to expand, the city's structure will need to become more compact (that is, increased density of existing areas rather than continued urban sprawl). Close attention to indicators of liveability such as equality, health and safety, affordability, accessibility, amenity and community wellbeing will help to monitor quality of life and social inclusion for Australia's diverse urban communities.[12]

2.2 The challenge facing our cities

Australians like travelling in cars. During the morning and afternoon peaks in Australian cities more people prefer to travel by car than any other method. Commuters in peak periods will often put up with delays associated with traffic congestion rather than using public transport. Some of the reasons that people prefer to use their own car include convenience, comfort, independence and flexibility.[13]

Most Australians eligible to drive own a car, although consistent with international trends[14], young people are becoming less likely to hold a drivers licence[15]. There are currently 745 motor vehicles per 1,000 Australian residents.[16] In our case study city, Brisbane, as its population has grown and become increasingly dispersed, the share of travel by public transport has declined. In Brisbane alone, around 80% of trips are

10 Brisbane City Council (2012), p.15.

11 Australian Bureau of Statistics (2013).

12 Partners for Liveable Communities Australia. http//:www.livable.org.au.

13 Refer: GA Research (2011). National Transport Commission Smart Transport for a Growing Nation: Public Attitudes to Mobility and Access Social Research Report, June.

14 Seeing the Back of the Car. The Economist, 22 September 2012, http://www.economist.com/node/21563280. {Accessed 30 July 2013}

15 For example, refer: Raimond, T. and Milthorpe, F. (2010). Why are Young People Driving Less? Trends in Licence-Holding and Travel Behaivour, Australasian Transport Research Forum 2010 Proceedings, Canberra, 29 September – 1 October.

16 Australian Bureau of Statistics (2012). Motor Vehicle Census, Australia, 31 January 2012, Catalogue 9309.0.

made by private car and trips are forecast to increase from 9 million per day in 2006 to 15 million in 2031.[17]

Rising traffic congestion is a major problem in Australian cities. The Bureau of Infrastructure, Transport and Regional Economics (BITRE) has estimated that urban congestion costs the Australian economy $9.4 billion every year.[18] The BITRE's estimates encompass the following costs (reference is made to section 3 below for further discussion of the consequences of congestion):[19]

- additional travel time;
- increased variability in travel times (which can necessitate increases in allowed travel times);
- increased vehicle operating costs (primarily higher rates of fuel consumption); and
- poorer air quality.

Brisbane and Perth account for $1.2 billion and $0.9 billion of this sum, respectively. BITRE projects the cost of congestion within Australian capital cities to rise to $20.4 billion by 2020.

Brisbane's transport system is expected to face increasing pressure in the coming years due to population growth (particularly in its outer suburbs) and also in response to significant employment growth in the CBD and inner suburbs. It is assumed that most commuter travel will occur at peak periods, putting stress on the transport system to support a large numbers of trips made within a short period of time, generally in the same direction.

The RACQ notes that over the next decade, Brisbane is expected to have the highest congestion growth rate of any Australian capital city[20]. This figure is set to increase 90% to more than $3 billion per annum by 2020, or approximately $1350 per person, without appropriate investment in infrastructure.[21]

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17 Department of Transport and Main Roads (2011). Connecting SEQ 2031, An Integrated Regional Transport Plan for South East Queensland, Queensland Government.

18 Bureau of Transport and Regional Economics (2007). Estimating Urban Traffic and Congestion Cost Trends for Australian Cities, Working Paper No.71.

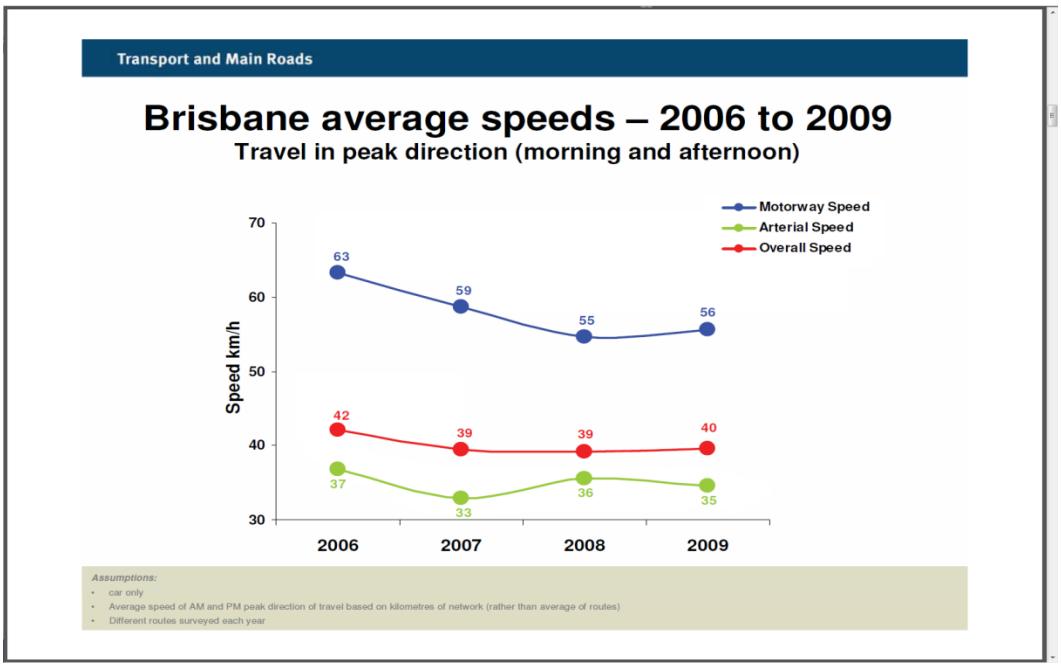
19 Bureau of Transport and Regional Economics (2007). p.10.

20 RACQ. Fact Sheet, Road Congestion in South East Queensland. http://www.racq.com.au/__data/assets/pdf_file/0004/44734/Road_Congestion_in_South-East_Queensland_Fact_Sheet.pdf

21 Bureau of Transport and Regional Economics (2007).

Symptomatic of this problem are increases in average car travel times. In its 2010 Travel Time survey, the RACQ found that traffic on almost all of the city's major routes slows to an average speed of less than 35 kilometres per hour during morning and peak periods.[22] On the worst routes, traffic moves less than 20 kilometres per hour and one kilometre takes more than three minutes to travel. The Department of Transport and Main Roads (DTMR) also undertook a comprehensive annual review of travel times, covering 1,420 kilometres of road network. The data, although now dated, shows declining motorway speeds and reasonably constant arterial speeds.

Figure 2 DTMR Review of Brisbane Average Speeds



Data source: Department of Transport and Main Roads (2010). Travel Time Survey 2009 Results.

Brisbane City Council employs its Brisbane's Strategic Transport Model to predict the outcomes of various future transport scenarios, based on existing household travel behaviour and forecasts of population and employment. It is envisaged that if no action is taken, traffic congestion will continue to worsen.[23]

The situation in Brisbane can be contrasted with Perth, which has been Australia's fastest growing city and is expected to remain so in the future.[24] In the ten years to

[22] RACQ (2010). Travel Time Survey 2010.

[23] Brisbane City Council (2008). Brisbane City Council Transport Plan for Brisbane 2008-2026, p.8.

[24] Australian Bureau of Statistics (2013).

2011, the largest population growth in Western Australia occurred in the outer suburban fringes of Greater Perth.[25]

Development in Perth, particularly on the urban fringe, is characterised by low density residential development, with limited land use diversity. These suburban areas have limited employment opportunities and most people have to commute long distances for work, with one in ten workers from the outer metropolitan areas commuting to the central area.[26] Currently, the central city area (including Northbridge, East Perth and West Perth) provides nearly 120,000 jobs. This represents 18% of all jobs in the metropolitan area.[27] By 2016 it is expected to reach at least 135,000 and 147,000 by 2031.[28]

Perth is often cited as an example of a city that has made timely, efficient and effective investment in rail infrastructure. Perth's success can be attributed to the use of fast heavy rail (average speed of over 90 kilometres per hour compared to 45 kilometres per hour in Melbourne for example), as well as the efficient integration between the various modes of public transport (90% of the Southern Rail patronage is bus transfer).

While Perth provides an example of a city that has reaped the benefits of investment in passenger rail networks, as Australia's fastest growing city it continues to face challenges in the future. Road congestion has been increasing. A RAC member survey found that three-quarters of motorists believed congestion had increased their travel time to work in the past 12 months.[29] Around 43% of those who drove to work each day said their travel time had increased by five to ten minutes, while 89% of regional drivers said they had experienced congestion during trips to Perth.

The survey also reports that public transport received the most support as a congestion solution, with 77% of those surveyed supporting more investment in public transport, including light rail. It is estimated that without substantial investment in transport infrastructure, the cost of urban congestion in Perth by 2020 will be $2.1 billion per annum.[30]

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25 Australian Bureau of Statistics (2013).

26 Department of Transport (Western Australia) (2012). Perth Central Business District Transport Plan 2012.

27 Department of Transport (Western Australia) (2011). Public Transport for Perth in 2031.

28 Department of Transport (Western Australia) (2012).

29 Royal Automobile Club of Western Australia (2013). Travel times increase for Perth motorists. http://rac.com.au/About-Us/RAC-eNews/2012/March-2012/Travel-times-increase-for-motorists.aspx

30 Bureau of Transport and Regional Economics (2007).

3 The consequences of congestion

Congestion poses some serious and immediate challenges for our cities. Our cities choke with congestion as workers move to high density employment regions in the CBD. However, these movements are critical to the continued growth of productivity in cities. Congestion impacts can be categorised into two main categories of costs: social and economic. These impacts are explored further below.

3.1 Social

Congestion imposes significant social costs on the community. The most immediate is the need for motorists to allow increased travel time (including allowing for uncertainty as to the likelihood and extent of a major delay), which will have differing impacts on individuals depending on a number of factors, including the nature of the journey and the consequences of delay. For example, having to systematically allow for increased commuting times in peak periods is most likely to erode personal, leisure and family time than working hours. This in turn could have implications for personal health and well-being, as well as family cohesion. It can also increase vehicle operating costs because of less efficient fuel consumption.[31]

The longer term impacts are potentially complex and have a number of sources.

3.1.1 Social inclusion

In addition to accessibility to work, the ability to access social, cultural, sporting and recreational activities, as well as education and health services, is extremely important.[32] Access to transport is fundamental to the ability to participate.

The ability to physically connect with others in the community has an important influence on individual and household well-being. Inequality of access to resources and life opportunities can widen the gulf between rich and poor, including the "suburbanisation of poverty" in middle and outer suburbs and the development of new advantaged communities.[33] A recent study also revealed that in Melbourne, Sydney and Brisbane, people with a disability are more likely to live in the outer suburbs.[34]

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31 Bureau of Transport and Regional Economics (2007).

32 This has also been recognised by the Commonwealth Government. Refer: Department of Infrastructure and Transport (2011), p.62.

33 Baum, S. (2008). Suburban Scars: Australian Cities and Socio-economic Deprivation, Griffith University, Urban Research Program, Research Paper 15.

34 Urbis (2013). Disability Care and Property. http://www.urbis.com.au/think-tank/white-papers/disabilitycare-a-major-milestone-for-policy-and-property. [Accessed 1 July 2013]

Research shows that there is a clear and significant association between trip/activity levels and risk of social exclusion, allowing for other factors that also influence this risk.[35] Congested cities with poor accessibility and inadequate transport networks can therefore result in individuals and families becoming socially isolated. This will exacerbate economic and social disadvantage and only serve to worsen the spatial inequalities described above. Once these patterns become more entrenched, they will become more difficult to redress.

3.1.2 Housing affordability

In the context of varying household budgets and dwelling size needs, housing choices take account of not only prices but also accessibility to employment and facilities. A congested transport network adds to the desirability of housing close to employment centres, so that the cost of transport (particularly commuting time) becomes capitalised into housing prices. The benefit of avoiding long congested commutes adds to prices near the centre, while at the fringe poor transport links to the centre can contribute to limiting both the demand for and the supply of housing.[36]

Conversely, the better the transport infrastructure, the more feasible it is to live further from the centre, where land and housing prices are lower and dwelling sizes can be larger. In Sydney the high cost of housing is considered a possible cause as well as an effect of the city's comparatively low population growth in the 2000s.[37] Along with other factors, including slow and restrictive local government planning processes, lack of transport infrastructure is seen as a cause of slow development on this city's fringe over the past decade.

3.1.3 Environment

Pollution is a well-documented consequence of congestion. For example, BITRE has estimated the health/damage costs of urban air pollution, finding that on average, urban traffic contributes around 3.6 cents per vehicle kilometre travelled to the total social costs of air pollution.[38] It also found that "interruptions due to road congestion

[35] Stanley, J., Hensher, D., Stanley, J., Currie, G., Greene, W., and Vella-Brodrick, D. (2011). Social exclusion and the Value of Mobility, Institute of Transport and Logistics Studies, University of Sydney Working Paper ITLS-WP-10-14. http://sydney.edu.au/business/__data/assets/pdf_file/0004/72913/itls-wp-10-14.pdf. [Accessed 26 June 2013]

[36] Applied Economics (2010). Residential Building Activity in Sydney: An Overview and Seven Case Studies Prepared for NSW Treasury http://www.treasury.nsw.gov.au/__data/assets/pdf_file/0004/18562/GIPA_11_21_Report_Building_Activity_Peter_Abelson_Sept_2010_dnd.pdf. [Accessed 24 June 2013]

[37] Applied Economics (2010).

[38] Bureau of Transport and Regional Economics (2007).

account for around 15 to 35 per cent of the emissions generated by urban motor vehicles, depending on the emission species, by increasing emission rates to higher than average levels during interrupted travel conditions"[39] and that this is projected to increase by 2020 as congestion worsens.

3.2 Economic

There are many factors that can contribute to the productivity of a city. Access to skilled labour, location to markets, access to infrastructure and lower transport costs make cities more productive than less populated areas. Improved productivity also arises from firms operating in close proximity. The daily manifestation of this latter factor is the continued expansion of central business districts in our larger cities, despite high land prices.

In cities business are co-locating in city centres because of the advantages from that location. While this is not the trend in all industries, this is particularly the case for the advanced services sector, which includes business services, information technology, finance, health services, education, arts, sport and culture (in contrast to the manufacturing sector, which often requires large blocks of land with good arterial road and in some cases rail freight connections).[40] The advanced services sector is becoming increasingly important to the economy and its future growth.

Recent research has demonstrated that Australian cities can capture agglomeration economies – economies of scale from business co-location – through infrastructure that facilitates the growth of central and other nearby or major employment areas.[41] The most recent *State of Australian Cities* report observes:[42]

> …economic value and by extension high-paying jobs are increasingly concentrating in city centres as part of the change from labour intensive industrial production to knowledge intensive transaction industries which rely on high job densities for their productivity. This is not a particularly Australian phenomenon; it is happening in the cities of developed nations all over the world…

[39] Bureau of Transport and Regional Economics (2007). p.80.

[40] For example, refer: SGS Economics and Planning (2012). Productivity and Agglomeration Benefits in Australian Capital Cities, Report for COAG Reform Council, http://www.coagreformcouncil.gov.au/sites/default/files/files/excellence/improvement/productivity_and_agglomeration_benefits.pdf. [Accessed 26 June 2013]

[41] SGS Economics and Planning (2012).

[42] Department of Infrastructure and Transport (2013). p.11..

The Department of Infrastructure and Transport has found that the industry sectors experiencing the most rapid growth are located in the city centres "and rely on increasing job densities to drive the productivity."[43] For example, it is estimated that every doubling of job concentration increases labour productivity by 5% to 13%.[44] It is therefore now recognised that employment concentration, not population size, is the main driver of increased productivity from agglomeration.[45]

While decomposing productivity impacts is an inherently complex task, increased congestion will adversely impact the productivity of our cities. Recognising that "the economic centre of gravity is moving to city centres where employment concentration is high"[46], businesses could find it increasingly difficult to source sufficient workers with the appropriate skills. Over time, increased congestion will force employees to move either residence or jobs (or both) in order to 'stay within' their travel budget. Firms will also move their location to be closer to their labour market. This in turn could compromise other key sources of agglomeration benefits, including:

- the ability to share high cost infrastructure and specialist input suppliers; and
- the innovation that comes from shared ideas and knowledge transfers.[47]

This could have a significant detrimental effect on competitiveness. Road traffic congestion could therefore serve as a brake on the spatial growth of cities, leading over time to greater dispersal of employment locations than would be optimal and limiting both agglomeration and productivity gains.

The NRMA's 2013 survey also found a link between congestion and small business productivity.[48] Feedback reported was that over the last twelve months, congestion had contributed to:

- increase in fuel costs (59%)
- increase in capital and running costs (39%)
- slowdown in overall productivity (33%)

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43 Department of Infrastructure and Transport (2012). p.68.

44 Melo et al (2009), cited in Department of Infrastructure and Transport (2012).

45 Department of Infrastructure and Transport (2012). p.73.

46 Department of Infrastructure and Transport (2012). p.76.

47 Department of Transport (2012). Job Density, Productivity and the Role of Transport, State of Victoria, p.7.

48 NRMA (2013). Congestion Making Us Sick, NRMA BusinessWise survey, http://www.mynrma.com.au/about/media/congestion-making-us-sick-nrma-businesswise-survey.htm. [Accessed 24 June 2013]

- increase in staff late to work (32%).

36% of businesses also said they had seen their operating costs increase by as much as $5,000 per annum, with each vehicle spending an extra 40 minutes in traffic each day due to congestion.

Impacts of the network unreliability that is characteristic of congestion are particularly severe for freight users. Notably, shippers place a value on on-time reliability in urban freight distribution that is three times the value assessed by transport operators,[49] indicating a flow-on impact that is greater than the direct transport impact. Additionally, more than 40% of businesses in Sydney have reportedly made changes to the way their business operates to address the effects of worsening congestion, notably changing employees' start and finish times and extending delivery times to ensure they could meet schedules.[50]

3.2.1 Estimating Wider Economic Benefits

Some of the social and economic benefits from investment in public transport are inherently difficult to quantify. However, there has been an increasing focus on the estimation of Wider Economic Benefits as part of project evaluation methodologies.

The UK Department of Transport is one of the more advanced jurisdictions in this area.[51] The four key benefits it analyses are:

- *the move to more productive jobs:* the additional output of new jobs that would be enabled in an economic cluster through a new transport initiative;
- *agglomeration:* the growth in productivity in a cluster as the density of employment around them increases;
- *output change in imperfectly competitive markets*: the impact of increased output due to lower transport costs;
- *labour supply impacts*: the impact of the increased incentives of individuals to work due to lower transport costs and hence the overall level of labour supplied in the economy.

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[49] Hensher, D. (2011). Valuation of Travel Time Savings, in de Palma, A. et al, A Handbook of Transport Economics, Edward Elgar Publishing, Cheltenham.

[50] NRMA (2012). Congestion Forcing Businesses to Change Operations, http://www.mynrma.com.au/about/media/congestion-forcing-businesses-to-change-operations.htm. [Accessed 26 June 2013]

[51] Refer: Department of Transport (2012). Wider Impacts and Regeneration, Transport Analysis Guidance, TAG Unit 2.8 August.

For example, agglomeration benefits are measured by estimating the:[52]

- change in the level of agglomeration from the transport initiative, based on the impact that the estimated change in user travel time and costs has on the accessibility of firms and workers to each other; and
- for the change in agglomeration identified above, the productivity impact (based on the change in Gross Regional Product per worker).

The key issue in quantifying these benefits is having access to quality data. For example, measuring agglomeration benefits requires information such as Gross Regional Product (disaggregated to the CBD level), the sensitivity of the supply of labour to changes in congestion and transport costs and an ability to isolate the impact of a transport initiative on agglomeration and productivity.

This can be addressed by establishing a framework for the systematic evaluation of these costs and benefits, including the collection of the necessary data to produce robust estimates. Australia has not focussed on the importance of capitals in its national economic data sets to date. Access to data will drive more research and through this a better understanding of potential economic benefits, which should be included in urban infrastructure decisions by governments.

[52] Department of Transport (2012). p.8.

4 Why are our cities congested?

One of the main reasons that congestion is threatening the social and economic health of our cities is because of sustained under-investment in public transport, particularly urban rail. While on-road transport remains important, including in helping to facilitate central area business and employment growth, only public transport, and in particular rail (including heavy and light rail) and busway infrastructure can ensure fast, reliable service for large numbers of people over longer as well as shorter distances. Busway infrastructure has the inherent disadvantages of putting more heavy vehicles on the road, noting that they can still add to congestion to the extent that they must connect with the shared road network (particularly in CBD areas) and will also contribute to vehicle emissions.

Simply put: higher density public transport, particularly rail, creates less social cost than low density car travel. The Department of Transport and Infrastructure has recognised:[53]

> The transport mode doing the heavy lifting for high agglomeration industries is rail. Our rail networks are largely legacy systems that were built with substantial extra capacity and are capable of absorbing significant increases in loading without major additional capital costs. It is now clear, especially in Sydney and Melbourne, that much of this surplus capacity has been taken up in recent years with population growth and mode switching (Brooker 2010, City Rail 2012). This indicates that productivity rates in cities will be increasingly constrained by the capacity of mass transit systems, particularly rail. How to deal with this reality is now being debated across our major cities.

It is important to further understand why the necessary investment has not occurred. This is discussed below.

4.1 The profile of public transport investment

Investment in any major infrastructure tends to have a 'lumpy' profile, with periodic peaks in capital expenditure requirements as new capacity is installed or existing capacity is upgraded or replaced. This is similarly the case with public transport. As a city's population grows the risk of congestion increases, requiring timely investment in public transport infrastructure (recognising the lead times involved) before congestion problems emerge.

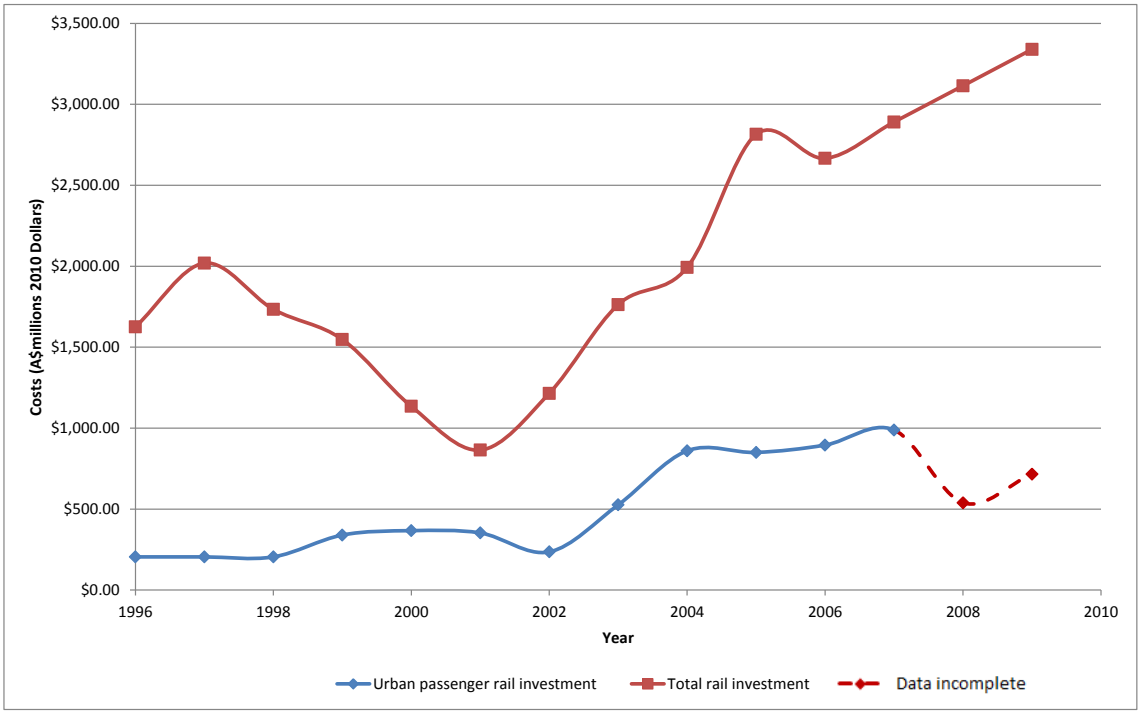
[53] Department of Infrastructure and Transport (2012). p.94.

That is, it requires a proactive, rather than reactive, response. It also requires a funding commitment that is independent of the political cycle. As soon as necessary projects are deferred due to budgetary pressures, other political priorities and/or the stage in the election cycle, the city risks being placed in perpetual 'catch up' mode as future investments address historical deficiencies rather than future population growth.

4.2 Barriers to investment in rail

Whereas rail freight investment was comparatively strong in the 1990s, urban passenger rail investment growth dates only from the early 2000s, as shown below.

Figure 3 Australian urban passenger rail and total rail investment



Data source: BITRE (2013) and GHD estimates based on Martin (2011).

After being relatively static, urban passenger rail investment nearly tripled over the last decade although clearly moderated (or perhaps stalled) towards the end. What is not known is how much of this investment – indeed if all – is catch-up investment reacting to bottlenecks in the network, as opposed to proactive investment in anticipation of future growth. Further, even with this three-fold increase, the value of urban passenger rail investment is still less than a third of total rail investment.

In urban public transport, the history has been, until recently, of an absence of clear national policy commitment to urban public transport improvement. At Commonwealth level, there have been periods of 'niche' policy goals – strengthening

non-CBD centres in the 1970s, assisting growth corridors and urban renewal in the 1990s – followed by periods of inattention.[54] In many cases the focus has been – and risks continuing to be – on getting individual transport projects (road or public transport) across the line, without considering which solution (or package of solutions) will most effectively address the problem, which is congestion.

The question of who funds (and how) remains one of the most common causes of inertia or delay in progressing necessary investment. User-pays funding is seen as a significant source of funding for major urban tolled road projects, albeit, following the failure of some PPP projects, no longer usually a wholly sufficient one. In contrast, internationally, fares generally do not cover the cost of providing high quality public transport services.[55] Moreover, at around 20 to 40% of operating costs, Australian public transport systems are at the lower end of the international range.[56]

Going forward, with increased budgetary pressures and an uncertain economic future, funding will continue to remain a major issue for all levels of government. Somewhat ironically, the concern regarding Australia's productivity is one of the key shadows over its economic and fiscal future, yet reluctance to fund needed investment in public transport will only further undermine any efforts to improve this.

4.3 Planning and implementation

Proposed policy solutions, including transport investment, will not improve the social and economic health of our cities if the underlying problem is not being effectively targeted. Until recently, there has been insufficient attention to coherent and robust strategic metropolitan planning frameworks. The frameworks are essential to ensure that land use plans are tailored to population and employment growth expectations and that transport infrastructure planning and land use planning are mutually consistent. With a general lack of alignment between jurisdictional responsibilities (at state level) and urban public transport system planning requirements (at metropolitan region level)[57], these planning frameworks are especially important.

[54] Potteron, P. (2012); Senate Rural and Regional Affairs and Transport Committee (2009). Investment of Commonwealth and State Funds in Public Passenger Transport Infrastructure and Services, August.

[55] International Transport Forum (2013a). Funding Urban Public Transport Case Study Compendium, OECD, Paris. http://www.internationaltransportforum.org/Pub/pdf/13Compendium.pdf. [Accessed 24 June 2013]

[56] Hale, C. (2011). Evolving Futures for Australian and International Passenger Rail, ATRF 2011 Proceedings, 28-30 September, Adelaide.

[57] Brisbane is the only major capital city where there is potential alignment, with the Brisbane City Council's jurisdiction covering the metropolitan area.

In December 2009, COAG agreed an objective for reform of capital city strategic planning, as a consequence of which all states and territories have now reviewed their capital city strategic planning systems against agreed criteria. In our case study city, Brisbane, a number of plans have recently been developed, including:

- Brisbane City Council, *Brisbane City Council Transport Plan for Brisbane 2008-2026* (2008)
- Brisbane City Council, *Brisbane Long Term Infrastructure Plan 2012-2031* (2012)
- Department of Transport and Main Roads, *Connecting SEQ 2031, An Integrated Regional Transport Plan for South East Queensland* (2011).

While the move towards these integrated plans is a welcome development, this is far from a case of 'problem solved'. There are a number of questions that need to be asked here.

First, are they effectively targeting the problem, which is congestion? Plans often include long term targets such as reducing the number of trips taken by car and increasing the modal share of public transport. However, targets should be specified in terms of congestion (measured in terms such as average travel times) as it is congestion that threatens the social and economic health of our cities. There may be some relationship between shifts in modal share and congestion (although this becomes more complicated when future population growth is overlaid) however even if modal share targets are achieved, to what extent is the city still experiencing congestion. If the city is still congested, the social and economic costs described above are still being incurred.

Second, to what extent are identified projects addressing current capacity bottlenecks compared to investments needed to cater for future growth? Even if investment succeeds in relieving these bottlenecks, this could be short-lived if there is insufficient capacity for future growth.

Third, is there evidence of a commitment to implement the plan? Gaps between planning and implementation can be significant. As noted above, planned investments are vulnerable to budgetary pressures and the political cycle. Urban transport projects are also typically vulnerable to disagreements between different layers of government as to whose responsibility it should be to fund. If there is no agreement as to fundamental responsibilities for delivery and funding, then there will be no commitment to resolve.

The challenges in securing funding for major infrastructure, including public transport, has long been an issue for governments and will continue to be so in future. However,

for the sake of the liveability and economic prosperity of our cities (and the broader community), this has be addressed. The recent report to COAG by Infrastructure Australia recognises that "bold reforms" are needed.[58] As will be shown below, given the costs of inaction the focus has to turn to timely and effective solutions.

[58] Infrastructure Australia (2013). National Infrastructure Plan, Commonwealth of Australia, June.

5 Analysis: value of action versus the cost of inaction

Governments have allowed social congestion costs to increase in Australian capital cities. The following analysis estimates the costs of reducing congestion to efficient levels in Brisbane and Perth. Given the evidence available there is no doubt that society would be better off with less congestion.

5.1 Overview of methodology

How should congestion be reduced? The option of congestion charging has not received any endorsement by Australian governments to date and for this reason it has not been considered.

The alternative is to directly invest in transport networks. As noted above, investment in passenger rail (heavy and light rail) is one of the most efficient mass transit solutions for our modern cities. For the purpose of this analysis, we have therefore explored the following three options:

1. do nothing
2. expand the road network to achieve optimal congestion
3. expand the rail network to achieve optimal congestion.

In reality, governments are likely to invest in some combination of road and rail infrastructure (and a number of such combinations could be feasible for each city depending on its circumstances). However, for the purpose of this analysis we consider it instructive to contrast investing in either road or rail in order to establish which option is more efficient from the community's (and government's) perspective.

The cost of inaction (the first option) is well known largely due to the work of the BITRE. What is not clear is the cost of investing in infrastructure to eliminate the economic burden of congestion on Australia. The methodology that has been applied to estimate the investment to reduce congestion to efficient levels uses the estimates of congestion costs produced by the BITRE.[59]

The estimates are based on a number of simplifying assumptions. Most importantly the estimates represent the cost to remove congestion to efficient levels as at 2014. Clearly this is not achievable because the level of investment implied by the estimates would conceivably take a decade to achieve. In this context, it is more appropriately

[59] Bureau of Transport and Regional Economics (2007).

considered as an estimate of the underinvestment in transport infrastructure that resulted in the large positive social cost of congestion experienced in Australian capital cities. An overview of the methodology and outcomes is provided below. Further information, including details of the assumptions used, is contained in Appendix A.

5.2 Background: the economics of congestion

Congestion cost analysis involves identifying and where possible, quantifying, the social and economic impacts of congestion on the community. If there is no congestion, the network is described as being in a 'free flow' state. That is, vehicles are able to travel at a free flow speed, which is the speed that could be travelled if there were no other vehicles on the network.[60] In a free flow state, there is no delay costs imposed on the community.

Congestion arises in periods of high demand (typically the morning and afternoon peak) and reduces the average speed that is travelled. This increases travel times and also uncertainty because the actual level of congestion on any given day and time will vary and cannot be predicted with certainty. It therefore becomes more difficult for users to predict how long a journey might take, which may necessitate making an additional allowance in individual travel times depending on the consequences of delay for each user. It also imposes other short term costs, including increased vehicle operating costs and pollution, as well as longer term impacts, which were described above.

Cost-benefit analysis is widely used in economics and social policy and is also applied in analysing and addressing congestion. It is unlikely to be physically or economically feasible for a city to develop and maintain a transport network that enables road users to travel at free flow speeds at all times, including in peak times. In analysing the impacts of congestion it is therefore necessary to be able to make some (at least approximate) comparison of the costs of congestion with the benefits of the travel that is being undertaken from the perspective of society as a whole.

In free flow conditions, the costs of congestion are nil. As congestion emerges and average speeds start to decline, congestion costs are imposed. These costs will continue to increase as the level of congestion increases. The point at which congestion becomes a problem for the community is where the costs of congestion are greater than the costs of removing the congestion.[61]

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[60] Bureau of Transport and Regional Economics (2007). p.4.

[61] In economics, this inefficiency is also termed a 'deadweight loss. Deadweight loss is defined as the reduction in consumer surplus (or the difference between the value of a commodity and its price) and producer surplus (the difference between total revenue and the opportunity cost of production) that results from restricting output below

The aim is therefore not to remove all congestion (or restore the entire transport network to free flow conditions in the peak). Instead, the target for policy makers is to eliminate 'avoidable' congestion, which is the level of congestion at which the costs to the community of further reducing congestion outweigh its benefits, that is, there is a net cost, not a net benefit. BITRE has estimated avoidable congestion costs to be around 50% of total congestion costs (typically ranging between 35% and 55%).[62] This assumption has been applied in this analysis.

Assuming a strong positive relationship between congestion and congestion costs (which is considered a reasonable assumption to make), the question for this analysis is what level of investment is required to reduce congestion by around 50%.[63]

It is also possible that the reductions in congestion could stimulate additional demand that would not have otherwise occurred if network remained in a congested state (or 'induced demand'). However, it is extremely difficult to forecast the extent to which this could eventuate, or where it might come from. To the extent that investment is made in the rail network, this can also generate material benefits to the local economy by stimulating Transit Oriented Developments and increases in property values near the network. This has also not been factored in here. While these possibilities have not been included in this analysis they should be considered as part of a cost benefit analysis of proposed transport solutions.

5.3 Forecasting congestion costs

5.3.1 Projected future growth in demand and congestion costs

The first step in this analysis is to forecast the costs of congestion in Brisbane and Perth in 2031 if no action is taken to increase the capacity of the transport network. As each city's populations will continue to grow, this also needs to factor in expected growth in demand for road network usage. This is important for our analysis as investment to alleviate congestion needs to not only address any historical underinvestment in transport network capacity but also cater for future growth.

The BITRE's forecasts of demand have been applied here.[64] BITRE estimates of congestion costs have also been used. As noted above, this encompasses additional

its efficient level. Refer: McTaggart, D., Findlay, C. and Parkin, M. (1996). Economics, Addison-Wesley Publishing Company.

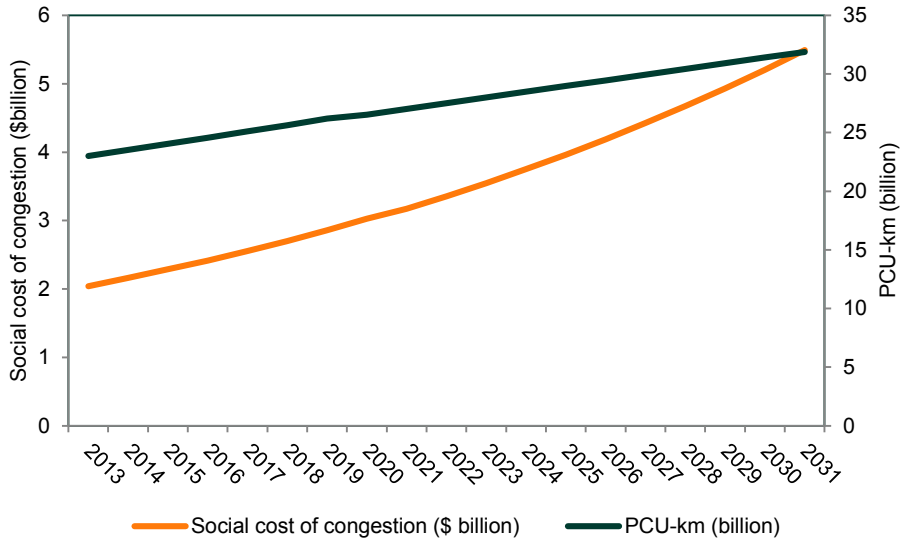
62 Bureau of Transport and Regional Economics (2007).

63 It is still informative to understand what free flow conditions would look like, as well as the capacity that would be required to restore the transport system to this state given projected demand. However, from a policy perspective, it is the optimal level of congestion (which eliminates avoidable but not all congestion) that should be targeted.

travel time, increased variability in travel times, increased vehicle operating costs and poorer air quality.[65]

The following graphs plot the expected growth in congestion costs against the expected growth in road network usage (which is measured in Passenger Car Unit (PCU)-kilometres) between now and 2031.

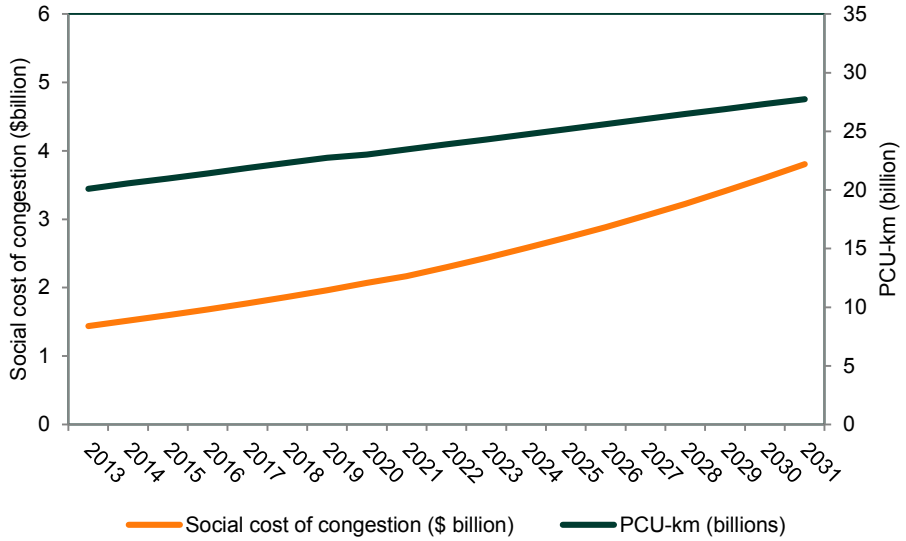
Figure 4 Brisbane: predicted annual social costs of congestion and PCU-km per annum (2013-2031)



64 Bureau of Transport and Regional Economics (2007).

65 Bureau of Transport and Regional Economics (2007). p.10.

Figure 5 Perth: predicted annual social costs of congestion and PCU-km per annum (2013-2031)



Note: PCU-km per annum has been projected using estimates provided by the BITRE model. As PCU-km is predicted to grow equivalent to the population growth rate of the capital city, BITRE data has been grown in accordance with capital city growth rate provided by the ABS. Social costs have been projected by multiplying the PCU-km predicted by the average costs of congestion calculated by BITRE grown in accordance with average growth rate observed from the ten years from 2010.

Data source: BITRE and Synergies Economic Consulting

The above graphs show steady projected growth in road network usage, increasing from around:

- 23 billion PCU-kilometres (2013) to 31.9 billion PCU-kilometres (2031) in Brisbane; and
- 20.1 billion PCU-kilometres (2013) to 27.8 billion PCU-kilometres (2031) in Perth.

The annual social cost of congestion is also expected to increase significantly over this time, reaching the following levels by 2031:

- Brisbane: $5.5 billion per annum (from around $2 billion currently)
- Perth: $3.8 billion per annum (from around $1.4 billion currently).

In 2014 dollars, continuing on the current policy path, the total congestion cost for Brisbane and Perth would be $48 billion and $33 billion respectively (in present value terms) between 2014 and 2031.[66]

[66] The total cost in 2014 dollars was calculated as the net present value of the annual congestion costs for each city from 2014 to 2031.

In summary, the above graphs show that demand for road network usage will continue to grow. If no action is taken to expand transport network capacity in Brisbane and Perth, congestion costs will also continue to grow.

5.3.2 The relationship between demand and congestion costs

It is necessary to understand the volume of traffic associated with the congestion costs for the purpose of analysing the level of road and rail investment required to achieve optimal congestion. While information was not available on peak hour congested PCU-kilometres, the BITRE has estimated the proportion of daily congestion costs for each hour of a typical day.[67] It is considered reasonable to assume that there is a strong positive relationship between hourly congestion costs and the hourly congested PCU-kilometres. Based on this assumption, the congestion cost data has been used as a proxy for the proportion of daily congestion kilometres.

The demand analysis identified that the hour that accounts for the greatest proportion of daily costs is the afternoon peak. It has the greatest volume of traffic and accounts for around 12.5% of daily congestion costs (based on BITRE data). This figure was then adjusted for the number of passenger cars as a proportion of total traffic, because other vehicles travelling on the network (such as buses, light commercial vehicles and trucks) will still need to use the road network at this time. The peak hourly congestion levels in each city, measured in PCU-kilometres, are:

- Brisbane:
  - total: 4.1 million
  - avoidable: 2.1 million
- Perth:
  - total: 3.6
  - avoidable: 1.8 million.

The avoidable estimates represent the peak level of congestion that investment will need to alleviate. The problem occurs on radial networks feeding into the city centre where employment concentration is greatest and accounts for a high proportion of total employment (which certainly characterises the current and likely future transport outcomes in Brisbane and Perth). It is reasonable to assume that if capacity is built to achieve the desired rate of flow at the highest hourly proportion of congestion, that rate of flow will be achieved at all hours across the network.

[67] Bureau of Transport and Regional Economics (2007).

5.4 Estimating the level of investment required to eliminate avoidable congestion

The next step in this analysis is to identify the level of investment required to achieve the optimal level of congestion, based on two alternative strategies: road network investment and rail network investment. As noted above, in the absence of sophisticated network models it is only possible to approximate the level of investment required in each city. It does not consider the physical and environmental constraints that might be imposed. For example, in the case of roads the only option may be to go underground. As noted above, it also assumes that the capacity is put in place immediately, and therefore does not consider the staging or timing of the design and construction works required to achieve the optimal congestion level. Overlaying these complexities could significantly add to the costs of the investment, which means that the estimates produced here are likely to be conservative or 'lower bound' costs.

An overview of the method used to estimate required road and rail investment is provided below. Reference is made to Appendix A for details of the assumptions made.

5.4.1 Road investment

Given the projected demand and congestion levels identified above, an estimate was made of the number of additional lane kilometres required. This in turn is a function of:

- the peak daily congestion factor (daily PCU-kilometres x 0.125); and
- the typical design rate or capacity of a road (900 vehicles per hour[68]).

The cost of a lane kilometre is assumed to be $20 million[69].

The total lane kilometres required to restore the road network to free flow conditions is adjusted by 50% to arrive at the number of lane kilometres of investment required to reach the optimal level of congestion (as explained in section 5.2, the optimal level of congestion is approximately 50% of current levels). This results in an estimated number of additional lane kilometres required in each city of:

- Brisbane: 2,280 kilometres
- Perth: 1,191 kilometres.

[68] Sourced from GHD

[69] Sourced from GHD

The total costs of road investment required (in 2014 dollars) to reach optimal levels of congestion are:

- Brisbane: $46 billion
- Perth: $40 billion.

Not surprisingly, these estimates are significant, even though they are more likely to represent lower bound estimates.

5.4.2 Rail investment

Identifying the equivalent rail investment needed to achieve the optimal level of congestion comprises two main steps. The first task is to estimate the number of people travelling in cars that could otherwise be carried by rail. This is relatively straightforward and is based on the peak daily congestion factor identified above. The target estimates for each city (based on achieving optimal congestion) are:

- Brisbane: approximately 152,000 passengers per peak hour
- Perth: approximately 195,500 passengers per peak hour[70].

The second task is to identify the above and below rail investment required to be able to carry this additional number of people. The above rail investment will simply be a function of the number of additional train sets required and the estimated cost per train set.

The more challenging task is identifying where below rail investment may be required and how much may be required, given the capacity of the network to carry the additional train sets is more likely to be driven by addressing key bottlenecks or congestion points rather than expanding the entire infrastructure. The approach that was used here for each city was to estimate a per passenger below rail cost for each new road user that must move to rail to reduce congestion. The estimates were based on the published cost estimates for the Cross River Rail project in Brisbane, which are the most comprehensive publicly available estimates at the current time.[71]

The total costs of rail investment required (in 2014 dollars) to reach optimal levels of congestion are:

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[70] The reason why the number of passengers in Perth is higher is because the average distance travelled by commuters in Perth is 11 kilometres, compared to 16.2 kilometres in Brisbane. This higher number of passengers will therefore also increase the level of rail investment required in Perth.

[71] Independent Panel. (2012). Independent Review of Cross River Rail. P 43.

- Brisbane: $19.8 billion
- Perth: $25.4 billion.

These estimates are materially below the equivalent investment required in the road network. In effect, this investment would take around 152,000 passengers, or 127,000 cars[72] off the road in each hour of the peak in Brisbane, and around 195,000 passengers, or 163,000 cars off the road in each hour of the peak in Perth. Around 200 and 260 six car trains will be required for Brisbane and Perth respectively in peak hours.

For those commuters continuing to travel by car, the elimination of avoidable congestion in peak hour will:

- increase average speeds and therefore reduce average travel times;
- reduce the variability in average travel times, which also reduces the extent to which commuters need to consistently allow for additional travel time in their daily journeys to and from work; and
- improve vehicle operating efficiency.

Other than having a significantly lower capital cost to achieve these same benefits, the rail solution has a number of other benefits over road investment, which are discussed below.

The following table compares the base case or 'do nothing' scenario against the road and rail investment scenarios. Both investment scenarios are targeted at achieving the optimal level of congestion, which eliminates avoidable congestion and reduces total congestion costs by 50%. These reduced costs are included under each scenario. The key difference is the relative costs of achieving this optimal level of congestion by investing in road and rail ('infrastructure costs'). All estimates are present values for the time horizon between 2014 and 2031, in 2014 dollars.

[72] Assumes 1.2 passengers per car. Estimates have been rounded.

Table 1 Summary: the value of action versus the cost of inaction 2014-2031 (2014 dollars)

	Do nothing	Invest in road	Invest in rail
Brisbane			
Congestion costs	$48 billion	-$48 billion	-$48 billion
Infrastructure costs	n/a	$46 billion	$20 billion
Productivity	Reduce productivity growth	Enable productivity growth	Enable productivity growth
Social inclusion	No change	Limited to no change	Improve social inclusion
Increased productive and leisure hours per annum	nil	11 million	11 million
Perth			
Congestion costs	$33 billion	-$33 billion	-$33 billion
Infrastructure costs	n/a	$40 billion	$25 billion
Productivity	Reduce productivity growth	Enable productivity growth	Enable productivity growth
Social inclusion	No change	Limited to no change	Improve social inclusion
Increased productive and leisure hours per annum	nil	14 million	14 million

5.4.3 The cost of inaction

The do nothing case predicts a future of worsening annual congestion costs. The present values over the period of this analysis (2014 to 2031) are very large, with Brisbane and Perth incurring costs of $48 billion and $33 billion respectively. This is a major negative impact on the well-being of the citizens of both cities. It will detract from the liveability of each city. Both cities recognise the importance of liveability to attracting high skill workers for the information and service industries, which will generate much of their future jobs.

Commuters in Brisbane and Perth also forgo up to 11 million and 14 million hours respectively, which could be applied to work (increasing productivity) or leisure (increasing personal well-being) rather than being delayed in traffic. The average commuter in both cities gains around 73 hours per year – or nearly an additional two weeks annual leave each year. Although dollar value estimates of congestion account for these costs, they also present as stress, less time spent together as family units and less time to spend on other pursuits (hobbies, sport, volunteering etc) which all affect the quality of modern life.

More importantly, rising congestion also harms future productivity growth. It is not possible to provide a reliable estimate of this impact but the logic is inescapable. High skill, high wage and high productivity jobs are part of continued expansion of CBD employment in cities. The ability of a city to move labour to high productivity nodes will be retarded by congestion. The result is that cities will be less productive and for

an urbanised country like Australia this can mean only one thing - lower productivity and lower economic growth.

5.4.4 The case for investment in rail

So then, what is the way forward? The above analysis explored two options investing in road infrastructure or investing in rail infrastructure. As outlined above, this approach is intended to examine the relative efficiency of road versus rail investment in achieving the same congestion outcome, which is restoring each city to optimal congestion levels.

The required investment in road would result in the largest road expenditure program ever undertaken in Brisbane or Perth at $46 billion and $40 billion respectively. For Perth, the road infrastructure costs exceed the reduction in congestion costs. In Brisbane the road infrastructure costs are marginally less than the reduced congestion costs.

The analysis of rail shares some similarities with road investment in that it would also require the largest investment program in urban rail ever rolled out in Brisbane and Perth - $20 billion and $25 billion respectively.[73]

The infrastructure costs are much lower than investing in road. These estimates also do not include operating and maintenance costs for either road or rail. Although this will include an annual subsidy component, which will be significant, it will not eliminate the $26 billion difference between the cost of road and rail investment in Brisbane or the $15 billion difference in Perth. Moreover, investment in rail opens more opportunities for other funding sourcing (increased fare revenue and value capture) not available from road investment (this is explored further below in the experience from other jurisdictions).

Similar to road investment it also has the associated benefit of increasing productivity. However, it also has a number of added benefits that the equivalent road investment will not. These benefits cannot readily be quantified and only further increase the advantage of rail over road.

First, rail investment has the added benefit of improving social inclusion as public transport has the benefit of enabling people in the community without ready access to a car or the ability to drive with greater mobility and the opportunities that this access can provide. This benefit could become more significant in future if the current trend

[73] The greater investment required for Perth is a product of the estimation methodology

amongst the younger population of reduced car dependency continues and indeed could further enable this if public transport is more readily accessible.

Second, taking cars off the road and putting people onto rail improves safety. Each year in Australia, road accidents kill approximately 1,400 people and hospitalise another 32,500.[74]In Queensland during 2011, 31.6% of fatalities occurred in major cities.[75] In 2010, 59.1% of hospitalised casualties from road crashes in Queensland were in major cities.[76]

While the linkage between congestion and road accidents is less clear, it is reasonable to expect that reducing the total number of cars on the road and putting people onto rail, which is the safest form of land transport, will reduce the social and economic costs of road crashes. For example, a study by Deloitte Access Economics found that the costs of road crashes is about road transport generates 965% more than the accident costs from rail (on a cents per kilometre basis), meaning that transferring 1,000 people from cars to rail would reduce accident costs by between $650,000 and $760,000 per year, depending on the city.[77]

In the United States, cities where rail is a major component of the transport system have a lower traffic fatality rate per 100,000 population than cities where it is a minor element (7.5 compared with 9.9 per 100,000) and lower again than cities with no urban passenger rail system, at 11.7 fatalities per 100,000.[78]

Third, reducing the number of cars on the road will reduce the amount of pollution caused by vehicles. The BITRE congestion cost estimates encompass air pollution but only as a consequence of congestion – it does not capture the additional benefit arising from transferring commuters from cars to rail.

The Department of Climate Change and Energy Efficiency reported that in 2011, transport emissions accounted for 15% of Australia's total carbon emissions.[79] Road transport contributed 85% of this, with private road transport accounting for around half of this. Rail, on the other hand, accounted for around 3% of the transport sector's total emissions.

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74 Australian Transport Council (2011). National Road Safety Strategy 2011–2020

75 Department of Transport and Main Roads (2012). 2011 Fatal Road Traffic Crashes in Queensland, A Report on the Road Toll, Queensland Government, p.31.

76 Department of Transport and Main Roads (2011). 2010 Year in Review Road Crash Report, Road Fatalities and Hospitalised Crashes, Queensland Government, p.28.

77 Deloitte Access Economics (2011). The True Value of Rail, Australasian Rail Association. Figures in 2010 dollars.

78 Litman, T. (2012). Rail Transit in America: A Comprehensive Evaluation of Benefits, Victoria Transport Policy Institute. http://www.vtpi.org/railben.pdf. [Accessed 24 June 2013]

79 Department of Climate Change and Energy Efficiency (2012). Transport Emissions Projections 2012.

We have estimated the number of vehicles that are travelling to work in the peak based on ABS estimates of the number of people in Brisbane and Perth that currently travel to work by car.[80] If we reduce the number of cars on the road based on our above estimates, there will be approximately 23% fewer vehicles on the road in the peak in Brisbane and 34% fewer in Perth. Assuming all vehicles equally contribute towards emissions, taking these cars off the road could therefore reduce their contribution of cars to carbon emissions by up to 23% in the peak in Brisbane and 34% in Perth.

Finally, evidence from across the world shows that rail can stimulate developments along the rail corridor and rejuvenate local communities. This benefits local businesses and residents. Examples of this are provided in the next section.

In conclusion, although the analysis is admittedly high level, the results confirm what the community has long suspected:

- Governments have continually underinvested in urban infrastructure and the catch up investment required would involve unprecedented investment in urban infrastructure. The extent of the underinvestment in rail is in the order of $20 billion in Brisbane and $25 billion on Perth.
- To meet the current and future challenges, investment in public transport - especially rail - is the most effective way of reducing congestion to efficient levels.

[80] ABS.Stat. http://stat.abs.gov.au/Index.aspx?QueryId=552. {Accessed 15 August 2013} This data is the number of people that travel to work by car as drivers and passengers. We have estimated the number of vehicles from this assuming 1.2 passengers per car. It is important to note that this assumes all of the vehicles are travelling in the peak.

6 Lessons from other jurisdictions

There are important lessons that can be learned from other jurisdictions that have had to address these issues and importantly, continue to experience challenges. Some examples are provided below.

6.1 Portland

Portland, Oregon, is known for its extensive public transit network and urban planning policies. The development of Portland's transit system was initiated in 1975 when the region moved away from freeway-dominated policies towards policies emphasising a balance between investments in highways and public transport.[81]

Public transport in Portland is provided by the Tri-County Metropolitan Transportation District (TriMet). Its integrated system comprises a light rail system (MAX), bus lines, commuter rail (which uses existing freight tracks) and a paratransit service for people with disabilities. The number of passengers boarding TriMet's services has outpaced population growth in the area, growing (on average) by 2.31% per year since 1999[82] compared with an annual population growth of 1.22% over the same period[83]. The number of passengers travelling with MAX has increased on average by 6.99% per annum since 1999.[84] There is also evidence supporting reduced car dependence in the region.[85]

While Portland continues to face its transport challenges, one of the key lessons that can be learned from here is its long term commitment to integrated planning. There has been an explicit linkage between transport planning and land use planning in the region's urban planning policies since the late 1960s.

The other thing that Portland has managed to do well is involve the private sector and stimulate Transit Oriented Developments. For example, Bechtel Enterprises financed

[81] Jun, M. (2008). Are Portland's Smart Growth Policies Related to Reduced Automobile Dependence? Journal of Planning Education and Research, 28, pp. 100-107.

[82] Trimet (2012a) TriMet Service and Ridership Information. Available from: http://trimet.org/about/performance.htm [Accessed 26 June 2013].

[83] Office of Economic Analysis, Department of Administrative Services, State of Oregon (2013). Long term Oregon State's population forecast, 2010-2050. Available from: http://www.oregon.gov/DAS/OEA/Pages/demographic.aspx [Accessed 26 June 2013].

[84] Trimet (2012a).

[85] For example, refer: Jun, M.J. (2008). Are Portland's smart growth policies related to reduced automobile dependence? Journal of planning education and research, vol. 28, pp. 100-107; TriMet (2011). The public health benefits of transit. Available from: http://trimet.org/pdfs/publications/public-health-transit.pdf [Accessed 20 June 2013].

22.6% of construction of the one of the light rail lines (the Red Line) and contracted to build the extension.[86] In return, it received development rights to a commercial site near the airport, owned by the Port of Portland. Local governments in Portland have also seen the construction of the light rail as a means to create liveable and vibrant communities. Station area development has been focused on pedestrian-friendly, mixed-use residential and commercial development. [87] Since the decision to build the light rail system in 1980, $US10 billion has been spent on urban development near the MAX stations.[88]

6.2 Madrid

Madrid is the largest city in Spain and the third largest in the European Union. The total population living in the area of the Madrid Region is approximately 6 million people, including Madrid City with a population of approximately 3 million. Madrid's population increased significantly between 2000 and 2010. The city centre population increased by 9.7%, population in the city's outer areas increased by 15.4% and population in the surrounding cities increased by 27.3%.

Public transport is the most widely used transport mode in the greater Madrid region (in 2004 the mode split was 43% public transport, 28% private vehicles and 29% pedestrian) with 70% of trips to and from the city centre by public transport and 30% by private transport. Transport demand tends towards private vehicle use further from Madrid's city centre. This is due to the compact space of central Madrid, allowing the implementation of denser public transport networks and shorter trip distances.

Since Madrid Metro's first line opened in 1919, steady expansion has taken place. Increased access to public transport has been seen as a key driver for the growing population and expanding residential development. Despite being the third largest city in the European Union, it ranks 52nd out of 59 European cities (1 being the worst ranking) on Tom Tom's 2012 Congestion Index.[89]

The total length of the Metro increased from 284 km with 283 stations in 2008 to 293km with 300 stations in 2013.[90] The 2003-2007 expansion program added a new means of

[86] TriMet (2012c). Airport MAX Red Line project fact sheet. Available from: http://trimet.org/pdfs/history/railfactsheetairport.pdf [Accessed 25 June 2013].

[87] TriMet (no date). MAX: a transportation transformation. Available from: http://trimet.org/pdfs/publications/MAX_A_Transportation_Transformation.pdf [Accessed 20 June 2013].

[88] TriMet (2013). Facts about TriMet. Available from: http://trimet.org/pdfs/publications/factsheet.pdf [Accessed 20 June 2013].

[89] TomTom (2013). TomTom European Congestion Index.

[90] Urban Rail, Madrid, 2011, http://www.urbanrail.net/eu/es/mad/madrid.htm [Accessed 14 June 2013]

transport to the already extensive Madrid metro network, the 'Metro Ligero'. The Metro Ligero is a network of modern light rail lines, operated with low-floor tramway rolling stock, running on separate right-of-way and with long underground sections, especially on line ML1 in the northern outskirts of Madrid. The expansion project included the construction of three new rail lines designed to support the existing train systems that entered into service in 2007.[91] The new light rail lines were built as a public private partnership, characterised by:

- concessions for construction and operation of the transport infrastructure conferred to a successful bidder;
- private land value capture generated by new urban development 'affected' by the new transport infrastructure (it is reported that 33% of the cost was funded by land value capture[92]);
- Public-private collaboration whereby private companies pay for part of the infrastructure that directly services their work-centres or activity areas (a form of developer contribution)[93].

The Madrid Metro is an example of building on an already extensive network and responding to the urban sprawl of a large urban region with an existing population. Importantly, the expansion was designed to maintain rail's already significant modal share, particularly for journeys to work. The Metro projects have acted as key influencer of residential developments and as means of better integrating public transport systems across the region. Population around stations in the Metro Ligero corridors have grown significantly and at rates above those of similar areas without urban rail.[94] For example, population density on Line 1 has increased by 48.3%[6].

6.3 Dublin

The population of the Greater Dublin area was 1.273 million in 2011 (based on census data), which represented a 7% increase from the 2006 census. In 1994, a Dublin Transport Initiative report recommended the construction of a light rail transit (LRT) system linking major suburban areas to the city centre. The Irish Government approved the LRT project in May 1998. In September 2000, the Dublin Transport Office

[91] Calvo, F. (2012). The Light Rail Transit Experience In Madrid: Effects On Population Settlement And Land Use.

[92] Young, T. http://www.applrguk.co.uk/files/lr%20applrg%20tony%20young%2004%2011%2008.pdf. [Accessed 24 May 2013]

[93] European Metropolitan Transport Authorities (2010). Madrid Financing/Pricing data http://www.emta.com/spip.php?article134 [Accessed 14 June 2013]

[94] Calvo, F. (2012).

produced a strategy called "A Platform for Change", which outlined a vision for an integrated transport system in Dublin to be completed between 2000 and 2016.

The Luas LRT has two tram lines (the Red and Green Lines), which opened in 2004, with extensions implemented in 2009, 2010 and 2011. The Green Line utilises a disused rail line for part of its alignment in the inner city. Work on a seven kilometre connection between the Red and Green lines has also commenced in 2013.

In a city where car ownership had grown rapidly in the 1990s and early 2000s, the government's main driver for the Luas LRT was to shift transport users from cars to public transport. Luas was built to maximise the land development usage, link established town-lands to each other and to the city centre, as well as offering a fast, reliable and more environmentally friendly transport solution for Dublin. The Luas system also connects with other modes of transport including park and ride, cycle and ride, Dublin bus, DART Irish Rail and coach and bus services. The system was also designed in consultation with disability groups. It was developed under a public private partnership with Connex (now Veolia Transdev Ireland). The operator concession involved novation of infrastructure, systems and rolling stock maintenance to Connex, with the government bearing most of the patronage risk.

Passenger numbers for the LAUS LRT have exceeded even the most optimistic forecast from the first year of operation and have remained high even during a deep recession, averaging around 80 000 passengers a day. The key goal of the project, being modal shift, was therefore successfully achieved. The system has also been a catalyst for urban regeneration in the surrounding areas, with increased density in the form of infill development providing activity and surveillance in areas that have been prone to vandalism and anti-social behaviour. New frontage development has also been facilitated, improving physical and visual integration between the existing residential areas and the newly developed areas. New extensions of the Luas have been 'developer lead' to support development of major employment nodes.

Residential property and land values have also increased, due to a positive "Luas effect". Studies indicated that those properties within a five minute walk of a Luas station have seen higher increases in value than other comparable properties with no immediate access to the tram system.[95]

[95] The Douglas Newman Good Annual Review 2004 & Outlook 2005.

6.4 Toronto

Toronto is the largest city in Canada with approximately 6 million people. The Greater Toronto Area (GTA) is one of the fastest growing regions in North America, increasing its population by approximately 100,000 people – and 50,000 cars – every year.[96]

Toronto has been described as two separate cities: the traditional, largely mono-centric, reasonably dense, transit-oriented city; and a late-twentieth century, low-density, auto-oriented, suburban city. There is a clear disparity between the City of Toronto and the outlying suburban communities and travel patterns are evidence of this difference.[97] The city has experienced considerable urban sprawl contributing to traffic congestion and declining use of public transit.

Toronto has had a long term commitment to Transport Oriented Development and integration with land use planning. However, more recently issues have emerged that contradict this, resulting in unprecedented transportation pressures. This includes delays in implementing projects included in *The Big Move* 25 year regional transport plan. The $50 billion[98] *The Big Move* plan envisages a seamless, coordinated and user-centred regional transportation system. The plan proposes over 1,200 kilometres of rapid transit, tripling what exists now, so that over 80% of residents in the region will live within two kilometres of rapid transit.[99]

Currently, the region's congestion problems are amongst the worst of any major urban centre in the world and getting worse. It is currently one of the worst performers in Canada in terms of congestion, ranking sixth out of 59 cities in North America in 2012.[100] Commuting in the Greater Toronto area currently takes 32% longer than it would in free-flowing conditions, which by 2031 will rise to 40%.[101] A September 2011 Toronto Region Board of Trade poll revealed that 63% of residents described congestion to be at crisis levels, and in April 2012 the number had climbed to 88%.[90]

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96 Newsroom: MoveOntario2020 (2007). http://news.ontario.ca/opo/en/2007/06/moveontario-2020.html Accessed 19 June 2013

97 Miller, E. and Soberman, R. (2003). Smart Growth Issue Papers: Travel Demand and Urban Form. Accessed 19 June 2013.

98 All dollar values are Canadian dollars

99 Toronto Region Board of Trade (2013). Discussion Paper A Green Light To Moving The Toronto Region: Paying For Public Transportation Expansion.

100 TomTom (2013). TomTom North American Congestion Index.

101 Newsroom: MoveOntario2020 (2007). http://news.ontario.ca/opo/en/2007/06/moveontario-2020.html Accessed 19 June 2013.

The economic impacts of these problems are significant. Congestion costs the Toronto economy an estimated $6 billion a year in productivity, which is expected to rise an estimated $15 billion a year by 2031 should no action be taken.[102]

Once considered a positive example for other jurisdictions, particularly in Transit Oriented Developments, Toronto is clearly falling behind other similar cities. The continued stalling of implementation of the *The Big Move*, which has primarily been due to funding issues, will only see congestion worsen.

Implementation of the plan has commenced, although the first progress report (due earlier this year) is yet to be released. In response to a requirement under its legislation, Metrolinx recently completed an Investment Strategy for government identifying revenue generation tools to fund projects under *The Big Move*.[103] The recommendations include: (1) a one percentage point increase in the Harmonised Sales Tax; (2) a regional fuel and gasoline tax of five cents per litre; (3) a business parking levy on all off-street non-residential parking spaces; and (4) development charges.

Since the mid 90s, Madrid, only slightly smaller than the Toronto region, has built more rapid transit facilities during the past decade than all of Toronto's subway and light rail lines combined.[104] Investment in the transport system has not reflected population growth. Construction of rapid transit, which averaged approximately 135 kilometres per decade from 1960s to 1980s, has effectively halted over the past two decades.

One of the key lessons for the Toronto case is a sustained commitment to timely investment in public transport. It paints a clear picture of the potential consequences for a city if this commitment is not maintained.

6.5 Summary of lessons learned

The lessons learned from the above for Australia are as follows:

1. A long term commitment to integrated transport and land use planning is essential.
2. This commitment must be sustained, anticipating future population growth. The Toronto region provides an example of a city that has successfully implemented integrated transport strategies but is now suffering from the delayed

[102] Toronto Region Board of Trade (2013).

[103] Refer: http://www.metrolinx.com/en/regionalplanning/funding/investment_strategy.aspx

[104] Toronto Region Board of Trade (2013).

implementation of the next big wave of necessary investment, which has primarily been due to funding issues.

3. Rail investment has the potential to stimulate growth and development along the rail corridor and rejuvenate local communities. This can also result in increases in land values.

4. Innovative funding solutions can be successfully implemented, including initiatives based on value capture. However, some government funding will still be required.

5. Light rail has been an effective solution in a number of major cities, particularly where it integrates well with the existing transport network.

7 The solution to congestion in our cities

As the preceding analysis shows, action is urgently required to address congestion in our cities. In Brisbane and Perth alone, the cost of congestion between now and 2031 has been estimated to be $44 billion and $33 billion respectively (in present value terms).

If no action is taken, the arteries of our cities will clog and, although it may take some time, the health of our cities' hearts will decline. The analysis in this report shows that governments in Australia have continually underinvested in urban infrastructure and the catch up investment required would involve unprecedented investment in urban infrastructure.

7.1 The solution is investment in public transport, particularly passenger rail

Productivity reform and continued economic growth requires the immediate attention of Government.

The main issue is how the movement of workers to jobs is efficiently managed. Pricing, investment, planning and regulation are the major policy instruments available to deal with this problem. Congestion charging for roads is a reform with great merit but as a matter of practice no government has shown great enthusiasm to introduce it (noting that if this is successful, it will further stimulate demand for public transport). Planning reforms of themselves can only deliver tangible outcomes in the long term. For the immediate future, the only practical option is investing in public transport.

With space being of critical constraint in urbanised cities, mass transit systems become the only viable option. Most suited to this task is rail due to its space-efficiency. Rail networks have the ability to transport masses of people without adding to congestion as bus networks do. Train networks were built with substantial extra capacity and are capable of absorbing significant increases in loading without major additional capital costs.[105]

This is clearly demonstrated in the analysis summarised above, which compares the cost of the equivalent road and rail investment in Brisbane and Perth required to restore each city to the optimal level of congestion. The cost of rail investment is around 57% less than the equivalent road investment required in Brisbane and around 38% less in Perth. In addition to the core economic benefits in terms of productivity, the other benefits of rail investment that are not captured in the above estimates are:

[105] Department of Infrastructure and Transport (2012).

- improving mobility, allowing the community to access health, education and recreational activities, reducing the risk of social exclusion. This is also particularly important for people with disabilities;
- providing important safety and environmental benefits. For example, in the United States, cities where rail is a major component of the transport system have a lower traffic fatality rate per 100,000 population than cities where it is a minor element (7.5 compared with 9.9 per 100,000) and lower again than cities with no urban passenger rail system, at 11.7 fatalities per 100,000;[106] and
- facilitating improvements to the 'public realm', or the liveability of the urban environment. Projects such as the Melbourne Metro embody this approach, which is backed by research into the willingness to pay for improved public realm.

As noted above, these costs can also be seen as a proxy for the extent of sustained underinvestment in transport infrastructure in each city, which has resulted in the congestion problems that are now being experienced.

In urban public transport, an explicit link is drawn between investing in public transport, including securing corridors and buffers, and enhancing national productivity. This would provide a basis for fuller enunciation of the role of public transport in building a stronger economy, drawing on:

- the importance of dedicated public transport infrastructure in supporting the growth of central city employment areas;
- the increasing importance of these locations, which are heavily utilised by the advanced service sector, to the national economy;
- the importance of dedicated public transport infrastructure in supporting affordable housing that is accessible to jobs in central and other areas of the city. Through careful integration with other modes, rail can provide a highly effective solution even in the low density outer suburbs that characterise Australian cities, as evidenced by the success of Perth's Mandurah line;[107] and
- the consequences of under-investment in urban rail transport, i.e. increased road traffic congestion in the short term and reduced employment growth and

[106] Litman, T. (2012). Rail Transit in America: A Comprehensive Evaluation of Benefits, Victoria Transport Policy Institute. http://www.vtpi.org/railben.pdf. [Accessed 24 June 2013]

[107] Rail Express (2010). Mandurah Line a Clear Winner, October 20. http://www.railexpress.com.au/archive/2010/october/october-20-1010/other-top-stories/mandurah-line-a-clear-winner [Accessed 26 June 2013]

investment in central areas in the long term, as jobs migrate to those cities (and countries) that offer a less congested and more hospitable environment.

7.2 Policy mechanisms to support this

The following policy mechanisms can ensure that adequate investment is made at the right time and in the right place.

7.2.1 Planning frameworks need to effectively target the problem

There is clear evidence in Australia of a more integrated approach to transport planning. As outlined above, these plans need to clearly enunciate the transport problem that needs to be addressed, which is congestion, and articulate the strategies (including investment) that will alleviate the congestion. The measurement of outcomes should be based on targeted reductions in congestion.

7.2.2 Plans need to be implemented, based on a sustained national policy commitment

Assuming we get the planning frameworks right, they need to be implemented.

In order to marshal public sector funds for significant and sustained investment in urban public transport, the evidence of other transport sectors, suggests that national-level policy commitment is required over an extended period.[108] This is also clearly evidence in jurisdictions such as Toronto and Perth, who have undertaken highly successful investments in the past but where congestion problems have re-emerged as growth outstrips existing network capacity.

As challenging as this may be, this requires an ongoing commitment to fund transport investment based on the required growth profile for each city, independent of the political or budget cycle. The delivery of this core social infrastructure is a clear government responsibility.

A range of options exist to fund urban rail transport investment, most of them linked ultimately to the increase in land value likely to result from the improved accessibility that is associated with a successful, well patronised urban rail investment. Options include 'beneficiary', as distinct from user, funding alternatives, such as increments to local government rates and increments to payroll taxes, as applied in Paris and Portland.

[108] Potterton, P. (2012). 30 years of Australian Transport Policy: What Makes for Success? Australasian Transport Research Forum 2012 Proceedings, 26-28 September, Perth.

A further option is to offer the infrastructure provider land ownership opportunities adjacent to the infrastructure development, thereby incentivising core infrastructure provision with the potential for a greater total return. In effect, this approach has been implemented with Australia's network of privatised airports that have achieved strong 'non-airside' financial returns while also investing strongly in aviation infrastructure.[109] It has also been successfully in the Madrid Metro case, for example.

Overcoming institutional, cultural and measurement barriers is likely to be important to pursuing these options. At the same time, tax revenue is likely to flow 'passively' to government, even without any change to the existing taxation framework. With rising property values, as for example, with the Epping to Chatswood line which opened in 2009[110], local government rates revenue, state government stamp duties and Commonwealth Government capital gains tax revenues, will all be higher than otherwise.

Here the challenge is mainly one of reliable accurate forecasting and measurement, so that the expected impact can be taken into account at the infrastructure planning stage. It is notable, however, that in many cases where these 'beneficiary funding' strategies are successfully pursued in the urban rail context, a portion of funding is still likely to be required from the general taxpayers, through transport grant programs[111].

Importantly, while opportunities to raise revenue through these alternative mechanisms are available and should be pursued, implementation of necessary investment cannot continue to be stalled in the hope that innovative funding solutions can be found. This is essential infrastructure that is fundamental to the economic and social well-being of our cities.

With periodic changes of government at both Commonwealth and State levels in a federal system, a high degree of bipartisanship would appear essential, which in turn requires a well-accepted higher level goal and rationale for the investment that is broadly shared by governments and by major political parties. A number of areas of transport policy have seen sustained and significant investment over many years around a goal linked to economic growth and productivity: aviation and airports, the national road network (benefitting the road freight sector) and rail freight. One area, road safety, has seen comparable attention in pursuit of a public health goal.

[109] Productivity Commission (2012). Economic Regulation of Airport Services, Inquiry report.

[110] Ge Xin, J., Macdonald, H., and Ghosh, S. (2012). Assessing the Impact of Rail Investment on Housing Prices in North-west Sydney, 18th Annual Pacific-Rim Real Estate Society Conference, Adelaide.

[111] International Transport Forum (2013a).

The key issue, in effect, is to manage urban structure proactively so that productivity gains and agglomeration economies are maximised, rather than to allow the urban form to be shaped reactively in response to the pressures of congestion.[112] Urban rail investment is critical to the proactive shaping of cities to manage congestion and maximise productivity gains. This is essential to the future economic and social health of our cities and the Australian economy as a whole.

7.2.3 Project evaluation methodologies need to encompass the wider social and economic costs and benefits

It is imperative that cost-benefit analysis of individual projects comprehensively identifies and assesses all of the potential costs and benefits, including the wider economic and social consequences. As discussed above, one of the reasons we propose has led to underinvestment in rail is that the significant ongoing costs of road transport are largely borne by the community. These externalities need to be addressed as part of the cost benefit analysis.

As noted above, while data limitations constrain the ability to develop robust estimates of Wider Economic Benefits in Australia at the current time, this can continue to be developed by establishing a framework for data collection and subsequent analysis. Analysis of the Wider Economic Benefits may enable a greater understanding of how this impacts agglomeration and productivity.

This could be implemented and managed by Infrastructure Australia, in cooperation with the State transport departments, which would also enable a nationally consistent framework for best practice project evaluation.

[112] SGS Economics and Planning (2012). Productivity and Agglomeration Benefits in Australian Capital Cities, Report for COAG Reform Council, http://www.coagreformcouncil.gov.au/sites/default/files/files/excellence/improvement/productivity_and_agglomeration_benefits.pdf. [Accessed 26 June 2013]

A Modelling approach

The following details the steps taken and assumptions applied for the three key stages of the analysis, being:

1. Forecasting future demand and congestion
2. Estimating the road investment required to eliminate avoidable congestion
3. Estimate the rail investment required to eliminate avoidable congestion.

Avoidable congestion is estimated to be approximately 50% of total congestion[113]. The objective is to eliminate avoidable congestion, which achieves the optimal level of congestion (where the benefits of the travel still outweigh the costs).

A.1 Forecasting future demand and congestion

The objective of this stage is to estimate future congestion in each city in 2031. This is then used to identify the level of investment needed to eliminate avoidable congestion. This involved the following steps.

1. A forecast of future demand is required. This is measured in terms of Passenger Car Units (PCU)-kilometres (being the number of cars multiplied by the number of kilometres travelled). The BITRE's estimates have been used.[114]
2. As the demand forecast is in annual terms, the average daily PCU-kilometres equivalent is calculated by dividing the annual data by 365. The obvious disadvantage of this approach is that it assumes that peak congestion occurs seven days a week instead of five. However, based on the data available it was not possible to reliably adjust for this.
3. A daily congestion factor is required in order to calculate the approximate additional road space that needs to be built so that roads can operate at free flow 24 hours a day. Using BITRE's analysis of daily congestion[115], the eight hours of night/early morning can be considered free flow. The daily congestion PCU-kilometres can be therefore calculated as two-thirds of the average daily PCU-kilometres (i.e.16 hours of the 24 hour day).

[113] Bureau of Transport and Regional Economics (2007). This assumes a strong positive relationship between congestion costs and the level of congestion.

[114] Bureau of Transport and Regional Economics (2007).

[115] Bureau of Transport and Regional Economics (2007).

4. An estimate of peak hour congested PCU-kilometres for each day is then required. While information was not available on peak hour congested PCU-kilometres, the BITRE has estimated the proportion of daily congestion costs for each hour of a typical day.[116] It is considered reasonable to assume that there is a strong positive relationship between hourly congestion costs and the hourly congested PCU-kilometres. Based on this assumption, the congestion cost data has been used as a proxy for the proportion of daily congestion kilometres. The hour that accounts for the greatest proportion of daily costs is the afternoon peak. Based on the BITRE data it accounts for around 12.5% of daily costs. This has then been adjusted for the number of passenger cars as a proportion of total traffic. This is because other vehicles travelling on the network during the network (such as buses, light commercial vehicles and trucks) will still need to use the road network at this time.

This step establishes the 'peak' level of congestion, which investment in rail or road needs to alleviate. That is, it is assumed that if we build capacity so we can achieve the desired rate of flow at the highest hourly proportion of congestion we will achieve that rate of flow at all hours across the network.

A.2 Estimating required road investment

Based on the forecast peak level of congestion for each city in 2031, the level of road investment required has been estimated based on the following steps.

1. The additional road capacity, measured in lane kilometres, is a function of:
    - the assumed design rate for a road (in vehicles per hour); and
    - the peak daily congestion factor identified above (daily PCU-kilometres x 0.125).
2. The cost of this capacity is estimated based on an average cost per lane kilometre, which is $20 million (this estimate has been provided by GHD).
3. This provides an estimate of the costs required to restore the system to free flow conditions. This estimate is therefore adjusted to achieve the optimal level of congestion, which is 50% of total congestion.

The key inputs are detailed in the following table.

[116] Bureau of Transport and Regional Economics (2007).

Table A.1 Inputs: estimating required investment in roads

Input	Brisbane	Perth	Notes
Investment required to address total congestion			
Total annual PCU-km	23,530 million	20,550 million	
Daily PCU-km	64.5 million	56.3 million	Assumes congestion occurs on each day of the year.
Daily congested km	43.2 million	37.7 million	Assumes that 16 hours per day is below free flow.
Peak hourly congested km	5.4 million	4.7 million	The hour which accounts for greatest proportion of daily costs is in the afternoon peak. It accounts for around 12.5% of daily costs. It is assumed that this hour also has the greatest volume of traffic and also accounts for 12.5% of total daily congested kilometres.
Passenger hourly congested km	4.1 million	3.6 million	Adjusts the peak hourly congested km for the proportion that are assumed to be occupied by passenger cars. This proportion is 76% (BITRE estimate).
Required lane km	4,559	3,982	Assume that the capacity of a lane kilometre is 900 passenger cars an hour (GHD estimate).
Total cost (2014 dollars)	$91,183 million	$79,635 million	Assumes a cost per lane kilometre of $20 million.
Investment required to address avoidable congestion			
Avoidable hourly passenger congestion km	2.1 million	1.8 million	The BITRE estimates that around 50%of total congestion costs are avoidable.
Required lane km	2,280	1,991	
Total cost (2014 dollars)	$45,592 million	$39,818 million	

A.3 Estimating required rail investment

Based on the forecast peak level of congestion for each city in 2031, the level of rail investment required has been estimated based on the following steps.

1. From the peak hour congested passenger kilometres it is possible to estimate the number of people that are travelling in cars that could otherwise be carried by rail. Taking the number of PCU-kilometres and assuming an average trip length in the peak, it is possible to convert this into the number of passengers, assuming an average car occupancy of 1.2 per PCU.

2. The number of additional train sets required to carry this number of passengers is then estimated.

3. The estimated costs of below rail network investment were based on the per passenger estimates for the Brisbane Cross River Rail project.

The key inputs are detailed in the following table.

Table A.2 Inputs: estimating required investment in rail

Input	Brisbane	Perth	Notes
Investment required to address total congestion			
Passenger hourly congested km	4.1 million	3.6 million	See above table.
Passengers	303,944	390,936[a]	Underlying assumptions are: • average commuting distances: 16.2 km Brisbane[b], 11 km Perth[c] • 1.2 passengers per vehicle.
Number of train sets	405	521	Capacity of a 6 car unit train: 472 seated and 720 standing (estimates from Brisbane Cross River Rail)
Investment required to address avoidable congestion			
Avoidable hourly passenger congestion km	2.1 million	1.8 million	The BITRE estimates that around 50%of total congestion costs are avoidable.
Passengers	151,972	195,468	
Number of train sets	203	261	
Required above rail investment (2014 dollars)	$3,654 million	$4,700 million	
Required below rail investment (2014 dollars)	$16,130 million	$20,746 million	
Total cost (2014 dollars)	$19,784 million	$25,446 million	

a The reason the number for Perth is higher is because the average commuting distance is shorter.

b Bureau of Infrastructure, Transport and Regional Economics (2013). Cities: Population Growth, Jobs Growth and Commuting Flows in South East Queensland, Research Report 134, Department of Infrastructure and Transport.

c Bureau of Infrastructure, Transport and Regional Economics (2010). Cities: Population Growth, Jobs Growth and Commuting Flows in Perth, Research Report 119, Department of Infrastructure and Transport.