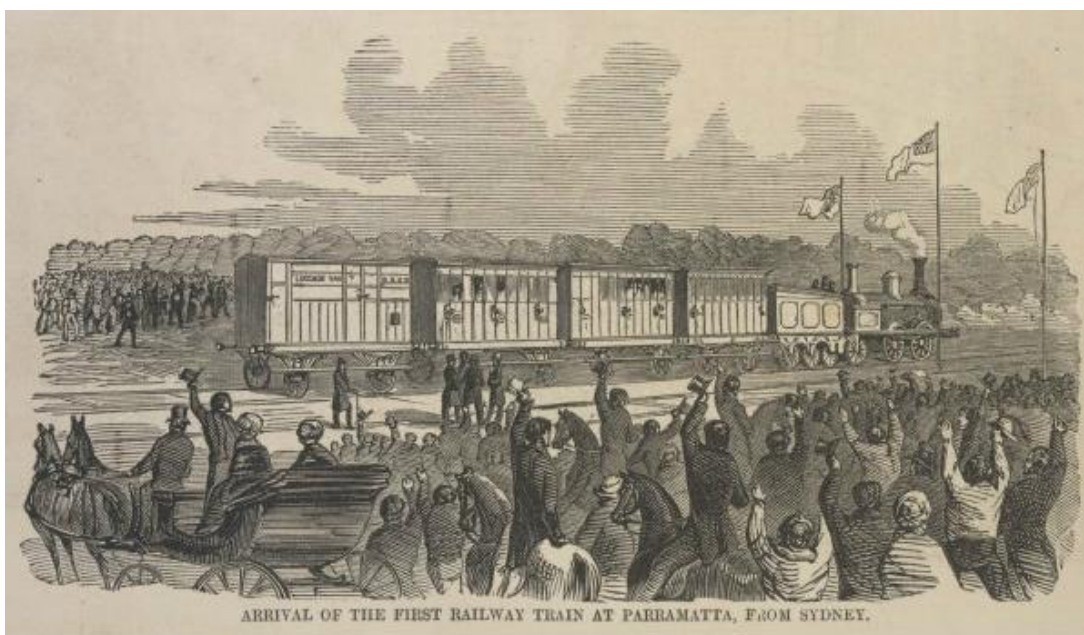


Can we afford to get our cities back on the rails?



Arrival of the first train at Parramatta (Walter G. Mason 1857)
Source: *National Library of Australia*

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Introduction

Some years ago, I came across an intriguing statistic in a transport newsletter. According to “engineer and rail enthusiast” Louis Fouvy, between 1854 and 1929 more than 750 kilometres of track were added to Melbourne’s rail system for every increase of one million people in the city’s population. If this rate of expansion had been maintained, Melbourne would now have 2,500 kilometres of rail line instead of fewer than 500 kilometres.¹

This got me thinking. How did we manage to build so much rail infrastructure at a time when the population and the economy were much smaller than they are today? Tunnels were dug and bridges built with construction technology far inferior to that available now. Yet as Infrastructure Australia concluded in a report to the Council of Australian Governments, in large measure Australian cities continue to draw on investment in rail made before the middle of the 20th Century.²

The history of rail in Australian cities can be divided into three broad periods – the colonial period, in which rail lines were built in advance of residential settlement; the period from federation until after World War Two, when rail lines and urban growth spread in tandem; and the auto era from the 1950s onwards, in which the suburbs left the rail network behind.³

There is now a renewed interest in urban rail as a mass transport option for Australian cities in the 21st Century. To consider the choices we face, it helps to understand the history behind the rail networks that we take for granted today.

1850-1900 Colonial railways

At a busy intersection on Melbourne’s Nepean Highway stands the imposing bronze figure of Sir Thomas Bent – a man some would contend was bent by nature as well as by name. From his stone pedestal, Bent surveys eight lanes of passing traffic. The din from cars and trucks means there are few pedestrians to stop and read the text on his plinth, which tells of a long political career. Bent was Premier of Victoria (1904-9), Speaker of the Legislative Assembly (1892-4), parliamentary representative for Brighton for 32 years and a councillor of Brighton and Moorabbin for 45 years.

In any case, these details obscure Tommy Bent’s more infamous achievements. In the early 1880s, his public role as Commissioner for Railways overlapped neatly with his private interests as a property speculator. Bent not only

Figure 1: Statue of Sir Thomas Bent, Brighton, Melbourne



¹ Fouvy (2010) Some lines built in the 19th Century were subsequently closed, such as the Outer and Inner Circle lines; others have been converted to light rail.

² Infrastructure Australia (2008) p. 45

³ Norley (2010)

promised to build railways to MPs' electorates in exchange for political support, he also pushed through suburban lines that directly boosted the value of his own subdivisions.⁴

Bent was not alone. The 1880s was the decade of the land boomers, when as historian Michael Cannon writes:

*Hardly a member of parliament whose vote could be bought went without his bribe in the form of a new railway, a spur line, or advance information on governmental plans to enable him to buy choice land in advance—the value of which was enormously enhanced when the line went through.*⁵

Given the naked self-interest of the times, it is remarkable how many of Melbourne's early railways turned out to be good long-term investments. As transport historian Robert Lee comments, despite waste and corruption, much of the network proved useful and bequeathed the city "a good radial suburban railway system" that brings "quite remote suburbs close to the city".⁶

Melbourne, says Lee, was "designed from the very beginning with rail traffic in mind".⁷ In 1837, when surveyor Robert Hoddle laid out his famous grid for a city on the banks of the Yarra, he proposed that it be linked by rail to the port. The world's first ticketed and timetabled railway service had opened in England just seven years earlier. Despite never having seen the Liverpool to Manchester railway – Hoddle had been living and working in the colonies since 1823 – the planner clearly recognised that the era of steam locomotion had arrived.

The Port Melbourne railway opened in 1854 and the route still operates (though it was converted to light rail in 1987). The establishment of the Port Melbourne line was followed by decades of railway building that profoundly influenced the shape of Melbourne as a city of suburbs.

By 1861 lines were operating to Hawthorn, Brighton Beach, Williamstown and Essendon. By 1862 rail linked Melbourne to Bendigo, Geelong and Ballarat. While these were inter-city, rather than suburban lines, they opened up destinations that now form part of Melbourne and its wider commuter belt.

In the land-booming 1880s lines were extended further, often to suburbs that had not been built.⁸ As Figure 2 shows, the bulk of Melbourne's existing rail network was established before the beginning of the 20th Century.⁹

⁴ Bate (1969)

⁵ Cannon (1976)

⁶ Lee (2010) p.208 The ill-fated Outer Circle line is a notable exception.

⁷ Lee (2007) p.4

⁸ Ibid. p.93

⁹ Cannon (1976) p.71

Figure 2: Melbourne's rail network by era



Source: Grattan Institute (adapted from Public Transport Victoria)

While not experiencing the same colonial rail building frenzy as Melbourne, other major Australian cities also rely to a significant extent on rail infrastructure established in the late 19th or early 20th Centuries.

As a city of the motor-age, Canberra is an exception, although it is worth remembering that Walter Burley Griffin and Marion Mahony Griffin did design local rail and tram networks for the national capital that were never built. That vision influences proposals for a light rail network under discussion in the ACT today.¹⁰

Sydney's first railway line opened in 1855 and ran to Parramatta. Subsequently railways were built to Newcastle and to Wollongong.¹¹ These were the initial steps in extending three main lines across the colony – west to the Darling River, south to the Murray at Albury and north to the Queensland border.¹² These routes would become part of the city's commuter network over time, but according to Lee, Sydney's first truly suburban railway was the Belmore line, which opened in 1896.¹³ The North Shore line opened three years earlier, but was originally built to carry produce rather than passengers.

The growth of rail was more modest in other Australian cities. In 1856 a steam railway opened between the city of Adelaide and its wharves at Port Adelaide, a route that today forms the basis of passenger services on the suburban Outer Harbour Line. In the 1880s extensions were added to reach the jetties at Grange and Semaphore and in 1873 a separate route was built from the city to the jetty at Glenelg (converted in 1929 to the tram line that still operates).

Similarly, the rail link established between Perth and Fremantle in 1881 was built primarily to facilitate the transport of goods to and from the port, including the export of agricultural and mineral products from outlying districts. Today, it too serves suburban commuters.

Brisbane's first railway opened in 1875, as an extension of the inland Ipswich-Grandchester line that had been built to the west ten years earlier. In the 1880s separate lines were built north and south of the river to connect Brisbane to Moreton Bay. Lines were also built north to Caboolture and south to the NSW border at Tweed Heads.¹⁴

1901-1955 Electric expansion

In the early 20th Century Melbourne's rail network expanded at a more sedate pace than during the land boom of the 1880s. Lines were built northeast to Hurstbridge (1912) and southeast to Glen Waverley (1930), in what would be the last outward extension of Melbourne's suburban rail network for eighty years.

However significant upgrades were made to the network. The major investment was electrification. First proposed in 1896 and the subject of two parliamentary inquiries and a Royal Commission, electrification was approved by parliament in 1912 and proceeded despite the outbreak of World War 1. At the time it was the largest

¹⁰ URS Australia (2012)

¹¹ Mason (2010)

¹² Lee (2010) p.142

¹³ Lee (2003)

¹⁴ Lee (2010) p.210

conversion of an existing railway ever undertaken in the world and required the construction of a 60,000kW coal-fired power station.

When electrification was completed in 1923, the final cost exceeded £6 million, but efficiencies were immediately apparent.¹⁵ Electric trains ran with far fewer staff and could add extra carriages, yet the power station needed only about half as much coal as steam engines.¹⁶

Adelaide and Perth did not electrify their rail lines but swapped instead to diesel engines, while Brisbane continued to run steam locomotives until the 1960s.¹⁷

Sydney did electrify and the project was even more ambitious than in Melbourne, because it also involved a significant expansion of the network and the creation of a harbour crossing.

In the early decades of the 20th Century, Sydney had a far less developed rail system than Melbourne and public transport was based primarily on trams. In 1907 Sydney trams carried three and a half times more passengers annually than Sydney trains, whereas in Melbourne patronage was split evenly between the two.¹⁸ As Lee puts it, Sydney was a tram city and Melbourne was a train city, the reverse of the situation today.¹⁹

As tram services converged on the city centre in the morning peak, Sydney's narrow streets struggled to cope and by 1910 it was clear that a comprehensive system of city and suburban railways was needed to ease congestion.²⁰ In the absence of a harbour crossing, there was also growing ferry congestion at Circular Quay, where up to 75 vessels an hour were docking or approaching the wharves.²¹

Proposals for a railway and for linking the city to the North Shore via a bridge or tunnel were subjected to detailed study. From 1891 onwards, there were three Royal Commissions,²² two inquiries by the Public Works Committee of Parliament,²³ various design competitions, international tenders, vigorous newspaper debate, public meetings and lobbying by interested players. As Peter Spearritt points out in his 'biography' of the Sydney Harbour Bridge, support for the project was fuelled by speculators who stood to make substantial gains from increased land values on both sides of the harbour.²⁴

¹⁵ Lee (2007) pp.176-178

¹⁶ Ibid. p.179 £6 million was about 0.85% of Australia's annual GDP in 1923. An equivalent share of GDP today would be more than \$11 billion

¹⁷ Lee (2010) p.221

¹⁸ Ibid. p.211 Sydney trams carried 148 million passengers per year and Sydney trains carried 41 million, while in Melbourne trains and trams carried about 60 million passengers each.

¹⁹ Lee (2003)

²⁰ Raxworthy (1989) p.61 Lee (2010) p.215

²¹ Raxworthy (1989) p.58 Spearritt (2011) p.25

²² Royal Commission on City and Suburban Railways, 1890-1; Royal Commission on Communications between Sydney and North Sydney, 1908-9, Royal Commission on The Improvement of the City of Sydney and its Suburbs, 1908-9;

²³ In Nov. 19011, parliament asked the Public Works Committee for a report on the need for a north shore railway tunnel and a report on the need for a north shore bridge for road, foot and tram traffic. Raxworthy (1989) p.61

²⁴ Spearritt (2011) p109-110; *ibid.*

In 1912 engineer J.J.C Bradfield was appointed to lead a new Sydney Harbour Bridge and City Transit division within the Public Works Department.²⁵ He would spend the next twenty years of his professional life trying to realise his dream of electrifying Sydney's railways, building an underground loop beneath the city, extending suburban rail lines to the eastern suburbs and linking lines north and south of the harbour via a bridge. It took until 1915 get a new City Railway Act approved by an upper house dominated by rural interests antithetical to the government spending money on Sydney projects. Soon after work started, the project was suspended due to financial pressures resulting from World War I. Work resumed in 1922, and the first electric and underground trains were running by the end of 1926. New suburban rail lines were opened to East Hills and Cronulla in the 1930s and subsequent decades brought further extensions of the network.²⁶

Legislative support for a bridge took longer. The Sydney Harbour Bridge Act was passed in 1922 and the "stupendous steel arch railway bridge – the largest arch railway bridge in the world" finally opened in 1932.²⁷ By this time the total investment in electrifying, expanding and linking Sydney's rail network across the harbour ran to about £30 million.²⁸

During the first half of the 20th Century passenger numbers in all cities fluctuated with economic and political fortunes – falling sharply during the depression years and rising again during the World War II, when petrol rationing stalled the growth in car travel. In the mid-1920s Melbourne was still Australia's dominant rail city with about 40 million more passenger journeys per year than Sydney. By the mid 1950s the situation had changed. While patronage in Melbourne had recovered to the same level as before the Depression (160 million passenger journeys per year), Sydney's network now carried almost double its pre-depression peak (260 million passengers annually).²⁹

From the mid 1950s onwards however, passenger numbers fell in every city as the private car began to dominate urban transport. In some places, railways would be shut down all together. Figure 3 shows the trends in passenger numbers over different periods.

²⁵ Raxworthy (1989) p.61

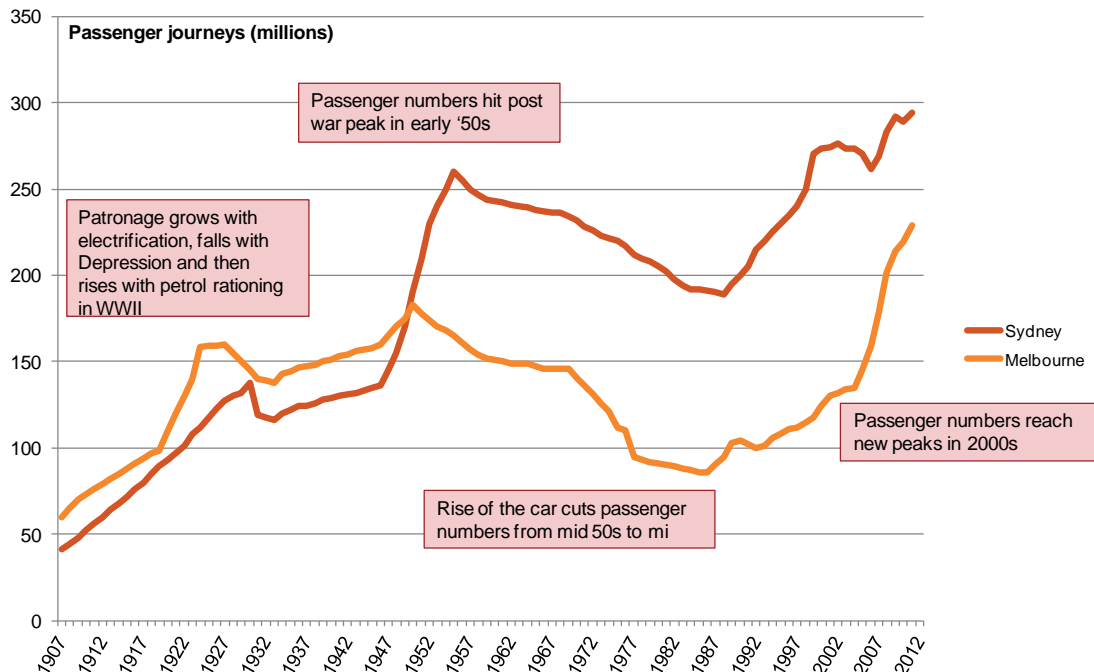
²⁶ Lee (2010) p.218

²⁷ Ibid. p.217

²⁸ Ibid. p.172

²⁹ Lee (2003)

Figure 3: Historic passenger trends 1907-2011 Sydney and Melbourne



Source: Grattan Institute using data from (Lee, 2007), (Lee, 2010), (Public Transport Victoria, 2012b) (Public Transport Victoria, 2012a) and City Rail (NSW) annual reports

Note: These series are estimates only, and are based upon incomplete data and known trends

1955-2001 the auto era

Even before World War II car ownership in Australia had been growing rapidly from a low base, but it really took off in the second half of the 20th Century. In 1955 there were almost seven times as many people as passenger vehicles in Australia. By 2001 there were fewer than two people for every car.³⁰

At the end of World War II, writes Graeme Davison in *Car Wars*, Melbourne was still the “recognisable child” of the land boom 1880s:

*Seen from the air, it looked like a giant hand, the palm representing the central business district and the core of closely settled industrial suburbs, and the fingers, the web of railway and tramway suburbs.*³¹

But the comfort and convenience of the car transformed urban transport and reshaped Australian cities. A new landscape emerged, in which homes were no longer within easy walking distance of a train station or a tram stop, high streets were replaced by shopping centres surrounded by car parks and new suburbs were connected by freeways instead of rail lines. The freeway, writes Davison, appeared

³⁰ ABS Motor Vehicle Census (series 9309). Statistics include sedans and station wagons but exclude motorbikes, trucks and light commercial vehicles (like utes and panel vans). Ratios for all motor vehicles are 234 vehicles/1000 people(1955); 510/1000 (1979); 645/1000 (2001)

³¹ Davison and Yelland (2004) p.74

to resolve “the competing systems of freedom and order”, permitting people to “go where and when they wished, without the imposition of timetables, speed restrictions or delays”.³²

Railways struggled to compete. In Melbourne, passenger numbers halved from their post war peak, dropping to just 86 million journeys per year in 1985-6, despite the city’s population almost doubling over the same period.³³ Patronage fell less dramatically in Sydney and numbers were still above 200 million in 1980.³⁴

As freeways became the focus of urban transport infrastructure, investment in rail also fell, although it did not cease completely.

While lines were not extended outward in Melbourne, there was considerable track duplication and electrification to more distant suburbs. The biggest investment in Melbourne’s network was the construction of a rail loop beneath the central business district, designed to boost patronage and ease congestion at the main Flinders Street Station by spreading passengers around the CBD. The loop was first talked about in the 1920s but construction did not commence until the 1970s and the project was only completed in 1985.³⁵

In Sydney the remaining components of JJC Bradfield’s rail vision were eventually put in place, with the completion of the loop line through to Circular Quay in 1956 and the opening of an Eastern Suburbs railway in 1979 (almost a century after it was first conceived).³⁶ In the same year the belated electrification of Brisbane’s city rail network was also completed.³⁷

Generally though, the auto decades were characterised by line closures and by plans not realised. The Queensland government closed the rail line to Southport in 1963 (just as the Gold Coast was taking shape as a tourist destination) and in 1979 buses replaced trains on the route between Perth and Fremantle.

In Melbourne new railway lines planned as part of the City Loop were never constructed.³⁸ Rail extensions to Doncaster (marked on maps for more than a century), Rowville and the airport were repeatedly proposed and postponed. In 2010, an independent public inquiry into Sydney’s transport future found that at least seven separate major plans promising “hundreds of kilometres of new railway lines” had been announced in the decades after World War II, but “only a fraction of the promises” were honoured. The failure to deliver was “particularly noticeable in western Sydney” where only 15 km of railway line and three railway stations were added in seven decades.³⁹ According to transport and logistics expert Kym Norley, it was a period of “equivocation and increasing prevarication in respect to rail expansion”.⁴⁰

³² Ibid. p.168

³³ Lee (2007) p.195

³⁴ Lee (2010) p.221

³⁵ Lee (2007)p190-193

³⁶ Lee (2010) p.218 Norley (2011)

³⁷ Lee (2010) p.330

³⁸ Low and Astle (2009)

³⁹ Christie (2010) p.83

⁴⁰ Norley (2010)

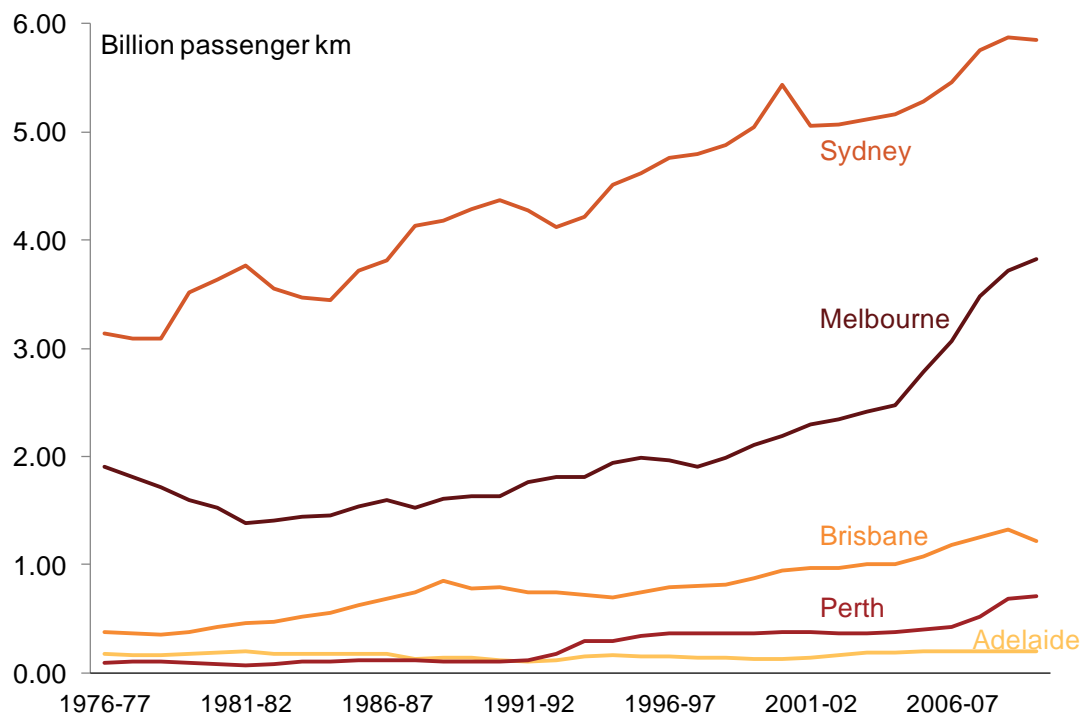
The 21st Century: a resurgence of rail?

After decades of stagnant or declining patronage, in most cities urban rail numbers began to turn around again in the 1990s and to win back a bigger share of the urban transport load (as can be see in Figure 4).

In Melbourne, initial passenger boardings almost doubled between 1998-99 and 2010-11 (from 118 million to 229 million).⁴¹ This growth coincided with a rapid increase in jobs in inner Melbourne.⁴² Other influences may have been road congestion and rising petrol prices, but these factors were common to Sydney where passenger growth was much slower. In Sydney, patronage increased from 271 million passenger journeys in 1998-99 to 302 million in 2009-1.⁴³

In Southeast Queensland total passenger journeys grew from around 40 million in the late 1990s to 65 million in 2008-2009.⁴⁴ This followed significant investment to re-create and then extend a line to the Gold Coast and to build a branch line to Brisbane airport.⁴⁵

Figure 4: Rail passenger/km travelled by city 1976-2010



Source: Grattan Institute using (BITRE, 2012) Tables T3.3a-3.3e

⁴¹ Public Transport Victoria (2012b)

⁴² BITRE (2012) p.18

⁴³ Rail Corporation NSW (2010); State Rail Authority of New South Wales (2002)

⁴⁴ Queensland Rail Annual Reports

⁴⁵ BITRE (2012) p.48

The most spectacular growth has been in Perth, where patronage has grown more than 500 per cent in two decades, reflecting major investment in new lines.

In 1982 there were just 48 route-km of railway in Perth. The prevailing advice in the 1970s was to close down the network entirely, because the capacity of rail was “well above” requirements and buses offered greater flexibility.⁴⁶ The public however, did not accept this expert view or behave accordingly. When buses replaced trains on the route to Fremantle public transport use on the corridor dropped by 30 per cent.⁴⁷ Despite being more frequent, buses were slower and less reliable.

An effective protest campaign and the election of a new government in 1983 brought a change in policy. Over the next decade, the rail link between the city and Fremantle was reopened, the network was electrified and a new line was built north to Joondalup. In the 1990s decisions were made to extend the northern line and build another route south to Mandurah.

Within three months of the Mandurah line opening in late 2007, two and a half times as many passengers caught trains each day as had used the buses operating the route previously.⁴⁸ Perth’s suburban tracks now stretched more than 100 km up and down the coast and the total route capacity had almost quadrupled to 172 km. By 2010-11 total passenger boardings were approaching 60 million per annum, up from fewer than ten million in 1991.⁴⁹ Increased patronage has not come at the expense of bus travel, which has also increased in Perth since the Mandurah line opened.⁵⁰

As can be seen from Figure 5, Adelaide is the exception to the rule of growing urban rail patronage – and makes a stark contrast to Perth. In the early 1990s the networks of both cities had fewer than 10 million journeys per year. Two decades on, with no significant investment in rail, Adelaide’s passenger numbers are still below 10 million. Despite population growth, patronage in 2010-11 was almost unchanged from 1993-94.⁵¹

⁴⁶ Martinovich (2008b)

⁴⁷ Newman (2012)

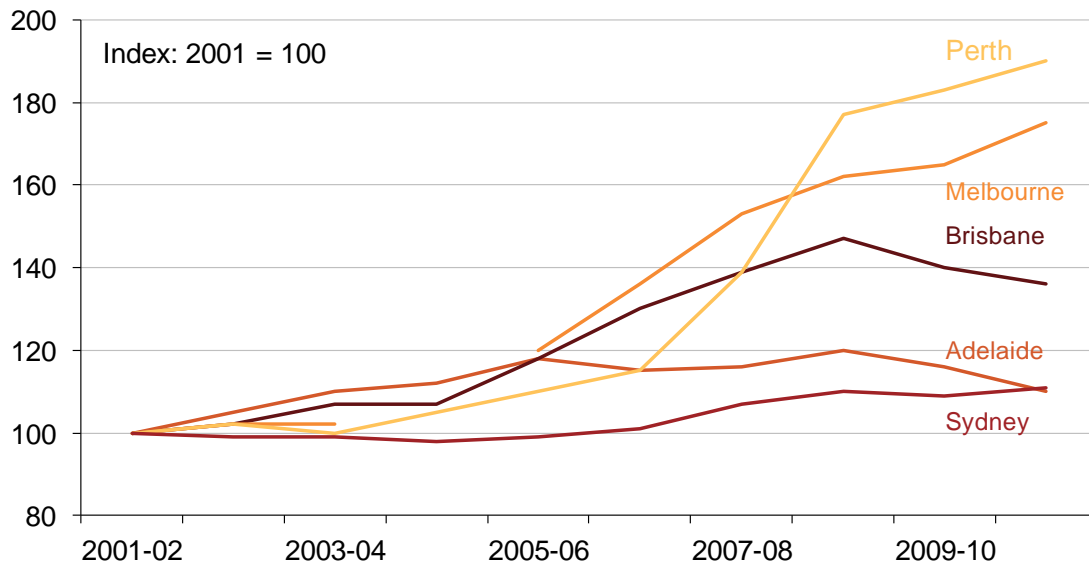
⁴⁸ Lee (2010) p. 333

⁴⁹ Martinovich (2008a); Public Transport Authority WA (2011)

⁵⁰ BITRE (Bureau of Infrastructure) (2012) Table T 3.3e Total passenger kilometres travelled by capital city — Perth

⁵¹ 8.72 million in 1993-94 v 8.78 million in 2010-11 Infrastructure Australia (2012) Ergas and Robson (2009)

Figure 5: Index of growth in urban rail passengers since 2001



Source: Grattan Institute using (BITRE, 2012) Tables T3.3a-3.3e

In its 2008 report to COAG, Infrastructure Australia argued that major new investment in rail infrastructure was needed to sustain our cities through coming decades: “Increased network capacity is required to meet population driven patronage growth and to provide the scope for significant mode shift from private vehicles to public transport.”⁵²

Some of that investment is underway, thanks in part to federal support. In 2010, more than half the investment recommended by Infrastructure Australia (\$4.6 billion in total) was for urban rail (both heavy and light). Projects underway include the Regional Rail Link to separate regional and metropolitan trains in Melbourne,⁵³ the Adelaide Rail Revitalisation program⁵⁴ and 5.7km extension to Seaford,⁵⁵ the 13.6km branch line to Springfield from Brisbane,⁵⁶ the 11.4-kilometre Southwest Rail Link from Glenfield to Leppington in Sydney⁵⁷ and the 7.5km extension of Perth’s Joondalup north to Butler.⁵⁸ Investments in light rail include the Gold Coast rapid transit system.

Many more rail projects are in planning, under evaluation or on wish lists. They include the North West Link, the Epping-Parramatta line and a new harbour crossing in Sydney; the Doncaster, Rowville, Avalon Airport and Metro Tunnel proposals in Melbourne; Brisbane’s Cross River Rail and the Perth Airport Link.⁵⁹

⁵² Infrastructure Australia (2008) p. 45

⁵³ <http://www.regionalrailink.vic.gov.au/home>

⁵⁴ <http://www.infrastructure.sa.gov.au/RR/>

⁵⁵ http://www.infrastructure.sa.gov.au/seaford/seaford_rail_extension

⁵⁶ <http://www.queenslandrail.com.au/NetworkServices/ConstructionUpgrades/MajorInfrastructure/CurrentProjects/DarratoSpringfield/Pages/DarratoSpringfieldTransportCorridor-Stage2.aspx>

⁵⁷ <http://www.transport.nsw.gov.au/projects-southwestrailink>

⁵⁸ <http://www.pta.wa.gov.au/Projects/ButlerExtensionProject/tabid/245/Default.aspx>

⁵⁹ Layard and Glaister (1994) p.91

The problem is that rail is very expensive. State and federal governments lack funds and are averse to taking on debt. So does the past provide any guidance as to how rail might be funded in the future?

How did we pay for the rail we've got now?

A private company built and financed Australia's first rail line to Port Melbourne, albeit assisted by generous land grants for stations, workshops and the route itself.⁶⁰ The business proved profitable. The Melbourne and Hobson's Bay Railway Company soon opened a branch line to St Kilda and then amalgamated with another private railway to develop a network in the city's south and east.⁶¹

However the initial success of private rail investment in Australia proved the exception to the rule. The Sydney Railway Company went broke before its line to Parramatta opened in 1855.⁶² When the NSW Government took it over NSW became home to "the first government owned railway in the British Empire".⁶³ Soon after the Victorian Government acquired the troubled Mt Alexander and Murray River Railway Company and the failing Melbourne Geelong Railway.⁶⁴ As economic historian N.G. Butlin put it, Australia's transport problem "was firmly back in the laps of colonial governments".⁶⁵

The problem has remained in government laps ever since. In the colonial era railways did not attract private investment because other sectors such as mining, commerce, shipping and agriculture offered much better returns.⁶⁶ The situation is little different now.

Supporters of expanded public transport often argue that government should simply bite the bullet and borrow more money to invest in rail. This is, after all, how we established the assets that benefit our cities today. But this ignores a big part of the story. The substantial public debt accumulated to build rail assets also had damaging social, economic and political consequences.

Government-backed bonds sold in London funded Victoria's spectacular burst of rail construction in the 19th Century, but the income from these investments fell short of expectations. Rail's operating costs grew from 50 per cent of railway revenue in the 1860s and 1870s to almost 70 per cent of revenue in the 1880s. The remaining profit was insufficient to service the growing debt.⁶⁷

In the mid 1880s, investment in railways was equal to six per cent of Australia's national product and between 1875 and 1892 the colonies' combined public debt quadrupled from £54 million to £198 million.⁶⁸ As a share of gross domestic product, debt jumped from less than 40 per cent of GDP in 1870 to more than 100 per cent of

⁶⁰ Lee (2007) pp 11-17

⁶¹ Ibid. p.21

⁶² Jeans (1972)

⁶³ Burke (1995) p.10

⁶⁴ Butlin (1976) p.302 Lee (2007) pp. 28-31

⁶⁵ Butlin (1976) p. 302

⁶⁶ Ibid. p.302

⁶⁷ Lee (2007) p.93

⁶⁸ Cannon (1976) p.38 It should be noted that these figures include investment in rural as well as suburban lines.

GDP in the 1890s.⁶⁹ These borrowings were for rail lines in rural districts as well as city and suburban networks, but return on capital appeared to play little part in investment decisions in either situation.⁷⁰

When British financiers withdrew their capital the boom went bust. Butlin concludes that over-investment in rail played a leading role in the balance of payments crisis and the decade long depression of the 1890s.⁷¹

Victoria was left with a legacy of heavy and growing debts. According to Cannon, the growing interest bill on capital costs and accumulated losses “crippled Victorian budgets for decades” and “the incubus of the railway boom of the 1880s” was still weighing heavily on the taxpayer in the 1960s.⁷²

Funding the ambitious expansion and electrification of Sydney’s rail network was more carefully considered. For example, one third of the cost of the Sydney Harbour Bridge was to be paid by a “betterment tax” imposed on landholders both north and south of the harbour whose holdings were likely to rise in value as a result of the bridge. The levy was imposed for 15 years at a rate of “a halfpenny in the pound (0.2 per cent) on the unimproved capital value of the ‘lands to be benefited’”.⁷³ The other two thirds of the cost of the bridge was to be repaid from the railways budget, with the Railways Commissioners originally planning four tracks and predicting a profit of £250,000 in the first year of operation.⁷⁴ The NSW Government raised borrowings in London to fund the expansion of Sydney’s rail system, with “repayment predicated on the increased profits the electrified suburban railways would generate.”⁷⁵

Profits, however, failed to materialise: the Great Depression cut passenger numbers and trains were facing intense competition as road transport increased and “unregulated private buses picked the eyes out of the most lucrative urban transport markets”.⁷⁶

By the time Premier J.T. Lang was cutting the ribbon on the Sydney Harbour Bridge in 1932, the debt situation was so bleak that he was “desperate enough to consider a moratorium on loan repayments” and “six weeks later the governor dismissed the premier because he suspected Lang’s measures to meet the financial crisis were illegal”.⁷⁷

⁶⁹ Di Marco, *et al.* (2009)

⁷⁰ Butlin (1976) p.291

⁷¹ *Ibid.* p.369

⁷² Cannon (1976) p.74

⁷³ Spearritt (2011) p.109

⁷⁴ *Ibid.* p.111

⁷⁵ Lee (2010) p.172

⁷⁶ *Ibid.*

⁷⁷ *Ibid.*

Figure 6: The Morning After: Dummy takes up his burden, Virgil Reilly, Smith's Weekly, 26 March 1932



Source: National Library of Australia

Transport historian Robert Lee argues that this event has inhibited public transport spending ever since:

The year 1932 has cast a huge shadow over Sydney's urban transport ... and no subsequent government has been willing to make the necessary investments to cope with ongoing growth, so scarified have they been by the fate of the second Lang Government.⁷⁸

The £30 million spent between 1922 and 1932 to electrify Sydney's railways, build the underground city circle and construct the harbour bridge, represented a massive investment, equal to about four per cent of Australia's annual gross domestic product for the era. An equivalent investment now would be in the realm of \$50 billion.⁷⁹

Today, residents of Sydney and Melbourne benefit from the imprudent spending, political corruption and miscalculations of earlier generations and it is hard to imagine either city without its existing rail network. A conservative back of the envelope calculation suggests that the current cost of replicating the existing suburban rail networks would be prohibitive. In Sydney construction costs alone would be in the order of \$45 billion.⁸⁰

⁷⁸ Ibid. p.173

⁷⁹ Gross domestic product in the decade 1923-1932 varied between £550 million and £820 million. I have used an average for the decade to arrive at the 4% figure. Vamplew (1987) p.133

⁸⁰ Assumes construction costs of \$39 million per track km as per NSW Legislative Council (2012), \$5 million per route km for electrification and \$30 million per station (both in line with recent experience)

If Sydney did not have railways, then in order to complete the same journeys they make now, residents would need to travel an additional 5.85 billion passenger-vehicle-km per year by other means. If buses took three quarters of this load, then the current passenger task of Sydney's metropolitan bus service would be tripled and those buses would be weaving their way through significantly increased car traffic.⁸¹ Since rail currently accounts for 44 per cent of journeys to work in the CBD, a large proportion of those extra buses would be trying to cram into the narrow streets north of Town Hall during peak hour, replicating the tram jam of early 20th Century.⁸² The implications for congestion are horrendous and it is hard not to conclude that central Sydney would be a far less pleasant place than it is today.

Of course such historical conjecture, while interesting, is hardly scientific or conclusive. If J.J.C Bradfield had failed to achieve his vision of an electrified railway with an underground city loop and a harbour tunnel, then Sydney would be a different city. Perhaps it would be less centralised than it is today with jobs more evenly distributed across the metropolitan area. On the other hand it might have fewer people and a smaller economy because the conditions for growth had not been realised.

"Transportation technologies have always determined urban form", notes urban economist Edward Glaeser.⁸³ So when we consider investments in transport systems in coming years, we need to think about much more than the financial cost and potential returns – important as these are. We also need to consider what type of cities we want in the future and how different transport choices will shape them in different ways. We need to determine our priorities too: do we invest in transport in order to lift productivity and efficiency, to redress spatial inequality or protect the environment? These different aims are not always compatible and rail would not always be the best option, even if there were no budgetary restraints on spending.

Do we need more rail in 21st Century Australian cities?

Since World War Two, the car has shaped Australian cities. The growth in private automobile travel has facilitated low-density residential developments on the suburban fringe. However there are clear signs that this model is fast reaching its use-by date.

Like other developed nations, Australia appears to have reached a saturation point at which driving (vehicle kilometres travelled per capita) has begun to decline despite increasing per capita GDP.⁸⁴

The cost of traffic congestion on reduced productivity and wellbeing are acknowledged to run into the billions of dollars, even if exact numbers are debated.⁸⁵ It is widely (though not universally) accepted that we cannot build our way out of congestion by constructing more urban freeways, since new road capacity will induce

and \$10 billion for harbour crossing (as per ball park estimates of the cost of recent proposals for a second harbour crossing). Does not include land costs or costs of rolling stock. Excludes services beyond the metropolitan boundary (to Newcastle, Wollongong and Lithgow).

⁸¹ The assumption of a 75/25 split between buses and cars in this counterfactual scenario follows Cervero and Guerra (2011)

⁸² Infrastructure NSW (2012) p.107

⁸³ Glaeser (2011) p.12

⁸⁴ Newman and Kenworthy (2011) BITRE (2011)

⁸⁵ Loader (2012)

a proportional increase in driving.⁸⁶ It is increasingly apparent that the comfort and convenience of car-based travel has contributed to expanding waistlines and growing rates of chronic illness, and that greater public transport use – and the incidental walking that goes with it – would have significant public health benefits.⁸⁷ We also need to dramatically cut greenhouse gas emissions from transport if Australia is to meet its ambitious target of reducing overall emissions by 80 per cent by 2050.

A switch to electric vehicles *might* help reduce emissions (depending on the source of the electricity), but it won't ease congestion or improve health. Nor will electric vehicles end the isolation and exclusion experienced by some people in cities where personal mobility relies almost entirely on driving and owning a car.

The inescapable conclusion is that we need a step change to far higher levels of public transport use to improve urban efficiency, public health, environmental protection and spatial equality. The anticipated growth in our urban population adds urgency to the situation. The number of people living in Melbourne and Sydney is projected to increase by at least fifty per cent in the next four decades, while the populations of Perth and Brisbane could more than double.⁸⁸ Added to this, the movement of freight on city roads is anticipated to continue growing much faster than passenger traffic (at average rates of 3.5 per cent per year until at least 2030).⁸⁹ If the urban dwellers of the future drive at the same rates as city residents today, then we will need to massively increase the space devoted to cars, which means more lanes of roadway, more parking places and ever spreading cities. The challenge is to take Australian cities back to the future, to an era when the private car was far less dominant than it is today.

In part we can do this by using our existing public transport systems more efficiently through better networking and incremental upgrades. In 2009 transport planner Edward Dotson told a Victorian parliamentary select committee on train services that it should be possible to “progressively raise the maximum practical, reliable capacity” of all Melbourne’s rail lines to a target frequency of “no less than 24 trains an hour” (or one train every 2.5 minutes).⁹⁰ Infrastructure NSW notes that today’s CityRail express service from Newcastle to Sydney is slower than the pre-war “Newcastle Flyer” steam train – suggesting significant room for improvement.⁹¹ Similarly, in peak periods Sydney’s trains carry far fewer passengers than many railways overseas.⁹² In part this is because they use two-door, double-deck carriages, which transport between 50 and 150 percent per cent fewer passengers per hour than three-door single-deck carriages. (Double-deck carriages have more seats but less standing room and are much slower to load and unload at stations, which significantly reduces operating frequency.)⁹³ Such problems are not simple to fix, but they do not generally require billions of dollars.

The question is whether entirely new rail lines are also a necessary part of our urban transport future. To what extent do we need to replicate the massive investments of the late 19th and early 20th Centuries?

⁸⁶ Duranton and Turner (2011)

⁸⁷ Department of Infrastructure and Transport (2012)

⁸⁸ Australian Bureau of Statistics (2012)

⁸⁹ Major Cities Unit (2011) p.64

⁹⁰ Dotson (2009)

⁹¹ Infrastructure NSW (2012) p.113

⁹² Ibid. p.110

⁹³ Ibid.p.111 Mason (2010)

Figure 7: Train crossing Sydney Harbour Bridge



Source: Russell Street, Flickr

There are many arguments in favour of rail.

High-capacity automated urban rail systems (like subways) can carry five times the capacity of a four-lane freeway (50,000 people per hour versus 2,500 per hour per freeway lane).⁹⁴ While not as advanced as the most up-to-date metros in other countries, Australia's newest urban rail infrastructure – the Joondalup and Mandurah lines stretching north and south of Perth's central business district – have more than three times the capacity of the parallel three-lane Mitchell and Kwinana freeways.⁹⁵

As well as offering the potential for high frequency, high-speed, high capacity services fully segregated from road traffic, rail can offer the attributes of reliability, safety and passenger comfort. Rail has a smaller carbon footprint than private car travel: a commuter driving alone in peak-hour Melbourne traffic produces roughly three and a half times the carbon dioxide emissions of a train traveller covering the same distance.⁹⁶ People are generally willing to walk longer distances to access rail than other forms of public transport, like buses or trams, because trains will take them further, faster, thus increasing its potential public health benefits.⁹⁷

However, rail has disadvantages too: it takes a long time and a lot of money to build and is difficult to change. It requires land to be set aside or acquired. It is much quicker and easier to deploy or alter a bus route than it is to lay train tracks or dig underground tunnels and increased bus use could achieve similar reductions in greenhouse gas emissions to increased train patronage.

⁹⁴ Infrastructure Australia (2008) p.46

⁹⁵ Martinovich (2008a)

⁹⁶ 298 v 83 grams CO₂-e per person km Newton, *et al.* (2012 in press)

⁹⁷ Walker (2012a)

Rail is generally better suited to radial travel in and out of a city centre than to travel between neighbouring suburbs, yet in Australia's dispersed cities only about 20 per cent of jobs are located in central city areas. Therefore most workers do not commute to and from the CBD.⁹⁸ For example, while 44 per cent of journeys to work in Sydney's CBD are made by train, rail comprises only 5.3 per cent of all journeys in the Sydney region.⁹⁹

Many trips are made for purposes other than employment – such as social and leisure activities, shopping and access to education or health services. The majority of these trips do not require travel to the city centre, but are much more local in nature. Often, rail is not an effective response to such travel needs and buses are a better and more immediate way of expanding transport options for residents of the growing suburbs on the edges of Australian cities.

In its strategy for the two decades to 2032, Infrastructure NSW argues that investment in new heavy rail lines is not justified by future demand projections and that buses “remain the most appropriate public transport mode for most of Sydney over the next two decades”.¹⁰⁰ It proposes rationalising bus routes to create “a primary network of fast, frequent and direct services” that have the speed and reliability to compete with car travel. In practice this means fewer bus stops spaced further apart, as well as greater priority for buses on city roads (e.g. separate bus lanes and signals). Essentially, it is an attempt to get buses to operate more like trains.

Melbourne's *SmartBus* system attempts to do this by creating trunk routes into the CBD and orbital routes along arterial roads that link the radial arms of the rail network. These buses operate more often and with fewer stops than established services and have enjoyed greater patronage growth as a result.¹⁰¹

But different bus users have different needs. A peak-hour commuter probably wants the bus to take a direct route with as few stops as possible, whereas a retiree who doesn't drive may want to access the shopping centre one day, a bowls club the next and a hospital every now and again. (In Melbourne more than two thirds of bus users do not have a driver's licence.¹⁰²) In other words, the retiree may need a bus service that stops at as many places as possible, even if this involves a slower, more circuitous route.

When buses provide universal access in this way they risk being relegated to the status of “service of last resort” – a residual mode of transport for people who have no other options.¹⁰³ Faced with such a bus route, most other travellers will abandon public transport and drive.

The challenge for buses is to balance community needs with efficiency and speed – to provide both “mass transit” and “social transit”.¹⁰⁴ One expert view is that the ideal urban bus network uses gridded bus lines to offer both speed and flexibility of travel

⁹⁸ Major Cities Unit (2011) p.67

⁹⁹ Infrastructure NSW (2012) p.107

¹⁰⁰ Ibid. p.94

¹⁰¹ Loader and Stanley (2009)

¹⁰² Ibid.

¹⁰³ Infrastructure NSW (2012) p.103

¹⁰⁴ Loader and Stanley (2009)

by creating shorter, well-connected, higher frequency routes.¹⁰⁵ There is evidence from Florida in the United States that this type of network can work well in dispersed urban environments like the outer suburbs of Australian cities.¹⁰⁶

But even if new and better bus services can meet anticipated growth in travel demand over the next twenty years or so, the experience of the Mandurah line in Perth suggests investment in urban passenger rail could potentially do something qualitatively different. Rail could not only drive a more rapid shift from car travel to public transport, it could also induce new travel that had not been previously anticipated. This could result in higher levels of workforce participation, as people find it easier to access employment, and in greater productivity as workers' skills are better matched to jobs.

These are some of the benefits of agglomeration. If we accept that knowledge-intensive industries will drive employment and productivity in coming decades then agglomeration is particularly important, because proximity matters more in the knowledge sector than in other industries, despite the rise of new communication technologies. Glaeser calls this “the central paradox of the modern metropolis – proximity has become ever more valuable as the cost of connecting across long distances has fallen”.¹⁰⁷ Improving agglomeration economies means reducing the distance between people and firms – in other words concentrating larger numbers of people in urban centres. Given its capacity and speed, rail is the most effective way to do this.

This is one of the major arguments for the proposed Melbourne Metro – a nine-kilometre rail tunnel with five new underground stations running under the inner city and linking into the existing suburban network. A report by consultants SGS Economics and Planning concludes that by increasing access to the inner city, the Melbourne Metro will enable businesses to achieve “higher productivity through economies of scale and scope”, with the most sectors of the economy benefitting.¹⁰⁸ The metro would enable workers in these sectors to “more rapidly accumulate skills and knowledge”.¹⁰⁹ This is agglomeration at work: in a “thicker” labour market – that is, one with more job openings and more employees clustered together – workers have access to a deeper pool of jobs and more opportunities to develop their skills. Equally, businesses are more likely to find an employee with the specific skills to match a particular position. There are benefits too from “knowledge spillovers” as individuals and companies learn from one another. In the wake of major transport investments, firms and households will change location to take advantage of the agglomeration economies that arise.¹¹⁰

This brings us again to the argument that transport technologies shape the city – a point acknowledged in the Infrastructure NSW strategy even though it does not mention agglomeration. The strategy notes that South- Eastern Sydney remains “relatively less developed than might be expected given its proximity to the CBD and

¹⁰⁵ Walker (2012b)

¹⁰⁶ Thompson, *et al.* (2012)

¹⁰⁷ Glaeser (2011) p.6

¹⁰⁸ SGS Economics & Planning (2011) The benefits flow to insurance and finance, construction, education, retail and wholesale trade, hospitality and services of all types (property, business, personal, cultural, recreational, health and community). Only manufacturing and transport and storage would experience adverse impacts.

¹⁰⁹ *Ibid.*

¹¹⁰ SGS Economics & Planning (2012) p.2

coastal position” and recommends extending the Eastern Suburbs rail line to “support significant urban consolidation in locations likely to be appealing to the housing market”.¹¹¹ Melbourne’s City Loop provides another example of city-shaping: before the Loop opened in 1985, retail outlets and office space was clustered around Flinders Street Station in the south of central Melbourne. The Loop not only distributed passengers around the CBD, it helped to spread business activity further north and to enliven previously dormant parts of the city. In this regard, rail’s inflexibility has an upside – because locations are fixed it provides a more certain carrot for attracting developers and finance.¹¹²

Recognising the desirability of more rail is one thing. Working out how to pay for it is another. If it becomes possible to build the wider economic benefits of agglomeration into robust transport appraisals, as well as fully capture the health and social gains, then governments could borrow with greater confidence that increased revenue will fund repayments. This is the approach being taken with London’s £14.8 billion Crossrail project.¹¹³ And while the history of rail funding in the late 19th and early 20th Century serves as a warning against amassing high levels of government debt, there are other lessons from history too. The Sydney Harbour Bridge was in part funded by a “betterment tax” to capture some of the windfall gains flowing to landowners as a result of linking the city and the North Shore. In Melbourne a special levy was imposed on city rates to help fund construction of the City Loop.

If we are to build more urban rail in the 21st Century, then it is reasonable that funds should be re-couped from those who stand to benefit either directly or indirectly. Property owners are an obvious example, but it might also be worth considering increased fares, particularly since the subsidies for public transport disproportionately benefit inner city workers in well-paid jobs. Smart cards could enable the introduction of time and direction based fares that would command premium rates for travel during the peak and create incentives to shift the passenger load to other times of day or to encourage counter flow travel.

It might be assumed that drivers should also pay since they stand to gain when new rail lines reduce the pressure on roads. In fact the relationship between transit and traffic is contested. There is some evidence that roads are less congested in cities with large, well-established rail systems than in comparable cities without railways.¹¹⁴ There is also data suggesting that new public transport at least reduces the rate of growth of vehicle traffic.¹¹⁵ The counter argument is that latent demand for road space is so great that even if a new rail line encourages some drivers to catch the train, others will quickly take their place behind the wheel.¹¹⁶ If this is true then the logical policy response is to manage demand with a pricing system, such as congestion charging. Government’s could sell or lease urban freeways to private operators and allow them to introduce time and direction based tolls. The capital raised could be devoted to new rail lines.

None of these measures are politically easy but there is evidence that voters have a big appetite for change in urban transport. In a 2011 survey for the National Transport Commission close to half the population agreed they would “like to be able

¹¹¹ Infrastructure NSW (2012) p.115

¹¹² Newman (2012)

¹¹³ Crossrail Ltd (CRL) (2012)

¹¹⁴ Litman (2012)

¹¹⁵ Bhattacharjee and Goetz (2012)

¹¹⁶ Duranton and Turner (2011)

to drive less” and more than four in five agreed that the government should develop more public transport services to give people a realistic alternative to driving.¹¹⁷ With political leadership and a clearer linking of costs and benefits, new urban rail lines might yet have a place in our future transport mix.

Perhaps the most obvious lesson of history is that urban passenger rail is a long-lived asset that can benefit a city more than a century after it is built. As J.J.C Bradfield wrote about the Sydney Harbour Bridge: “Future generations will judge our generation by our works.”¹¹⁸

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References

- Australian Bureau of Statistics (2012) *Year Book Australia, 2012*. Canberra. 1301. [http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by Subject/1301.0~2012~Main Features~Population projections~48](http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Population%20projections~48).
- Bate, W. (1969) 'Bent, Sir Thomas (1838–1909)', *Australian Dictionary of Biography Volume 3*. Canberra, Australian National University.
- Bhattacharjee, S. and Goetz, A. R. (2012) 'Impact of light rail on traffic congestion in Denver', *Journal of Transport Geography*. 22: 262–270.
- BITRE (2012) *Australian Infrastructure Statistics Yearbook*. Department of Infrastructure and Transport,, Commonwealth of Australia. Canberra.
- BITRE (Bureau of Infrastructure, T. a. R. E. (2012) *Australian Infrastructure Statistics Yearbook*. Department of Infrastructure and Transport, Commonwealth of Australia. Canberra.
- BITRE, B. o. I., Transport and Regional Economics) (2011) *Traffic Growth: Modelling a Global Phenomenon Report 128*. Department of Infrastructure and Transport,, Commonwealth of Australia. Canberra.
- BITRE, B. o. I., Transport and Regional Economics) (2012) *Understanding Australia's Urban Railways Report 131*. Bureau of Infrastructure, Transport and Regional Economics, Commonwealth of Australia. http://www.bitre.gov.au/publications/2012/report_131.aspx.
- Burke, D. (1995) *Making the Railways*. Sydney, State Library of New South Wales Press
- Butlin, N. G. (1976) *Investment in Australian Economic Development 1861-1901* Canberra, Department of Economic History, ANU, .
- Cannon, M. (1976) *The Land Boomers*. Melbourne, Nelson.
- Cevero, R. and Guerra, E. (2011) 'To T or Not to T: A Ballpark Assessment of the Costs and Benefits of Urban Rail Transportation ', *Public Works Management Policy* 16(2): 111–128.
- Christie, R. (2010) *Independent Public Inquiry into a Long-Term Public Transport Plan for Sydney: Final Report*. Sydney Morning Herald, 26 May. Sydney. 572.
- Crossrail Ltd (CRL). (2012) 'Crossrail'. Retrieved 20 November. 2012, from <http://www.crossrail.co.uk/>.
- Davison, G. and Yelland, S. (2004) *Car Wars: How the car won our hearts and conquered our cities*. Sydney, Allen&Unwin.
- Department of Infrastructure and Transport (2012) *Walking, Riding and Access to Public Transport: Draft Report for Discussion*. **Department of Infrastructure and Transport,,** Commonwealth of Australia, October. Canberra.
- Di Marco, K., Pirie, M. and Au-Yeung, W. (2009) *A history of public debt in Australia*. Economic Roundup, . Treasury. Commonwealth of Australia, 1, Canberra, 1-15. http://www.google.com.au/url?sa=t&rct=j&q=&source=web&cd=1&ved=0CCIOFjAA&url=http%3A%2F%2Farchive.treasury.gov.au%2Fdocuments%2F1496%2FPDF%2FER_Issue_1_2009_Combined.pdf&ei=wNSRUMX_O_H3mAX62YDoCw&usq=AFOjCNFOjpOGUYb8RPRhA5CKSOJJALEDNw.

¹¹⁷ Hoye, *et al.* (2011)

¹¹⁸ Raxworthy (1989) p.74

- Dotson, E. (2009) *Evidence to Select Committee on Train Services*, , Legislative Council of Victoria,, 22 September. Melbourne.
- Duranton, G. and Turner, M. A. (2011) 'The Fundamental Law of Road Congestion: Evidence from US Cities', *American Economic Review* 101(6): 38.
- Ergas, H. and Robson, A. (2009) *The social losses from inefficient infrastructure projects: recent Australian experience*. Productivity Commission Round Table: Strengthening Evidence-Based Policy in the Australian Federation, 17-18 August 2009.
- Fouvy, L. (2010) *Life Blood of a City*. Transport Newsletter, 20 April.
- Glaeser, E. (2011) *Triumph of the city*. New York, The Penguin Press.
- Hoye, J., Andreadakis, I. and Vercoe, S. (2011) *Public Attitudes to Mobility and Access Social Research Report*. GA Research for the National Transport Commission, June. Melbourne.
- Infrastructure Australia (2008) *A Report to the Council of Australian Governments*. Infrastructure Australia, Australian Government, December. Sydney. 84.
- Infrastructure Australia (2012) *Guidelines for making submissions to Infrastructure Australia's Infrastructure Priority List using the Reform and Investment Framework*. Infrastructure Australia. Infrastructure Australia, Guidelines for making submissions to Infrastructure Australia's Infrastructure Priority List using the Reform and Investment Framework. http://www.infrastructureaustralia.gov.au/reform_investment/files/Better_Infrastructure_Decision_Making_Guidelines_v5.pdf.
- Infrastructure NSW (2012) *First things First: The State Infrastructure Strategy 2012-2032*. Infrastructure NSW,, Sydney.
- Jeanes, D. N. (1972) *An Historical Geography of NSW to 1901*. Sydney, Reed Education.
- Layard, R. and Glaister, S., Eds. (1994) *Cost Benefit Analysis*. Cambridge, Cambridge University Press.
- Lee, R. (2003) 'Linking a Nation: Australia's Transport and Communications 1788 - 1970 (Chapter 6: Transport and the Making of Cities, 1850-1970)'. Retrieved 14 June. 2012, from <http://www.environment.gov.au/heritage/ahc/publications/commission/books/linking-a-nation/chapter-6.html>.
- Lee, R. (2007) *The Railways of Victoria 1854-2004*. Melbourne, Melbourne University Press.
- Lee, R. (2010) *Transport: An Australian history* Sydney, UNSW Press.
- Litman, T. (2012) *Rail transic in America: a comprehensive evaluation of benefits*. Victoria Transport Policy Institute, , 16 January
- Loader, C. (2012, October 25) 'Are congestion costs going to double? An analysis of vehicle kms in Australian cities'. Retrieved 1 November 2012, from Road Traffic Growth in Australia.
- Loader, C. and Stanley, J. (2009) 'Growing bus patronage and addressing transport disadvantage—The Melbourne experience', *Transport Policy*. 16(3): 106-114.
- Low, N. and Astle, R. (2009) 'Path dependence in urban transport: An institutional analysis of urban passenger transport in Melbourne, Australia, 1956-2006', *Transport Policy*. 16(2): 47-58.
- Major Cities Unit (2011) *State of Australian Cities 2011*. Department of Infrastructure and Transport,, A. Government. Canberra.
- Martinovich, M. P. (2008a) *The Integration of Rail Transit and Land Use in Western Australia*. Conference on Railway Engineering 2008, Perth, Engineers Australia.
- Martinovich, M. P. (2008b) *Southern Suburbs Railway expands the Perth network*. Railway Gazette International, March. 164, 24-27.
- Mason, R. (2010) *An Integrated Rail Plan for Sydney: Improving the passenger journey*. Conference on Railway Engineering 2010. Engineers Australia, 12-15 September. Wellington.
- Newman, P. (2012) *The Perth Rail Transformation: Some political lessons learned*. Light Rail 2011 Conference. Curtin University Sustainability Policy Institute,, 6th April. Sydney.
- Newman, P. and Kenworthy, J. (2011) "Peak Car Use": Understanding the Demise of Automobile Dependence', *World Transport Policy and Practice*. 17(2): 11.
- Newton, P., Pears, A., Whiteman, J. and Astle, R. (2012 in press) 'The Energy and Carbon Footprints of Housing and Transport in Australian Urban Development: Current Trends and Future Prospects', *The Unintentional City*. R. Tomlinson. Melbourne, CSIRO.
- Norley, K. (2010) *The role of the rail system in the Sydney journey to work - a geospatial analysis* Australasian Transport Research Forum, 28 September - 1 October. Canberra. <http://www.atrf.info/papers/2010/index.aspx>.
- Norley, K. (2011) *Urban rail infrastructure the path from comprehensive transport plans to the recent experience*. Australasian Transport Research Forum,, 28-30 September. Adelaide. <http://www.atrf.info/papers/2011/index.aspx>.
- NSW Legislative Council (2012) *Rail infrastructure project costing in New South Wales*. NSW Parliament, March.
- Public Transport Authority WA (2011) *Annual Report 2010-11*. Government of Western Australia. Perth.
- Public Transport Victoria (2012a) *Melbourne Public Transport Patronage Long Run Series 1945-46 to 2010-11*. Public Transport Victoria,, Melbourne.

- Public Transport Victoria. (2012b) 'Track Record annual results - Metropolitan and regional patronage 2010-11'. Retrieved 13 June. 2012, from <http://corp.ptv.vic.gov.au/managing-victoria-s-public-transport-network/track-record/track-record-annual-results-metropolitan-and-regional-patronage-2010-11/-trains>.
- Rail Corporation NSW (2010) *Annual Report 2009-10*. NSW Government,. Sydney.
- Raxworthy, R. (1989) *The Unreasonable Man: The life and works of J.J.C. Bradfield*. Sydney Hale & Iremonger.
- SGS Economics & Planning (2011) *Agglomeration Benefits of the Melbourne Metro*. Department of Transport, Government of Victoria.
- SGS Economics & Planning (2012) *Productivity and Agglomeration Benefits in Australian Capital Cities*. COAG Reform Council.
http://www.coagreformcouncil.gov.au/agenda/docs/cities/productivity_and_agglomeration_benefits.pdf.
- Spearitt, P. (2011) *Sydney Harbour Bridge: A Life* Sydney, University of New South Wales Press.
- State Rail Authority of New South Wales (2002) *Annual Report 2001-02*. NSW Government. Sydney.
- Thompson, G., Brown, J. and Bhattacharya, T. (2012) 'What Really Matters for Increasing Transit Ridership: Understanding the Determinants of Transit Ridership Demand in Broward County, Florida', *Urban Studies*. 19(1). <http://usj.sagepub.com/content/early/2012/05/03/0042098012443864>.
- URS Australia (2012) *City to Gungahlin Transit Corridor: Concept Design Report*. ACT Environment and Sustainable Development Directorate,, April. Canberra.
http://www.google.com.au/url?sa=t&rct=j&q=Canberra+Burley-Griffin+%22light+rail%22+reservation&source=web&cd=3&ved=0CDYQFjAC&url=http%3A%2F%2Fwww.transport.act.gov.au%2Fstudies_projects%2FCity%20to%20Gungahlin%20Concept%20report.pdf&ei=f32pUIjOIMaNiAe43YHACA&usq=AFOjCNFIDMeHp34aXYLtnKOJD8OxWW7EA.
- Vamplew, W. (1987) *Australians: Historical Statistics*. Sydney, Fairfax, Syme & Weldon Associates,.
- Walker, J. (2012a) 'Basics: Walking distance to transit', *Human Transit*. Retrieved 11 October 2012. 2012, from <http://www.humantransit.org/2011/04/basics-walking-distance-to-transit.html>.
- Walker, J. (2012b) 'The power and pleasure of grids', *Human Transit*. Retrieved 6 December. 2012, from <http://www.humantransit.org/2010/02/the-power-and-pleasure-of-grids.html>.