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Fast train fever
Why renovated rail might work
but bullet trains won't

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Overview

Australians seem to love the idea of fast trains. And now that we're in a severe economic downturn caused by the coronavirus pandemic, the Prime Minister wants to fast-track construction where possible, arguing that transport infrastructure projects will help kick-start the economy. State governments agree.

We'd love to jump aboard too – but now, more than ever, we caution governments to pause. In this time of high uncertainty, Australia needs to make hard-headed assessments of the costs as well as the benefits to the community of new rail projects.

There's no doubt fast trains are popular. Every ten years or so, there's a grand new proposal; the latest is federal Labor's plan for a bullet train from Melbourne to Canberra, Sydney, and Brisbane. Federal and state governments also have a suite of more modest upgrades to existing services linking regional centres to Sydney, Melbourne, or Brisbane.

This report shows that while a bullet train may be a captivating idea, it's not realistic for Australia. Our population is small and spread over vast distances; the countries most like us – Canada and the US – don't have bullet trains either.

Nor would a bullet train be the climate saver we might imagine. Yes, once it was up and running it would emit far less than today's planes. But construction would take nearly 50 years and be enormously emissions intensive, hindering rather than helping efforts to reach net zero emissions by 2050. And even at the best of times, it's a big ask for every taxpayer in the land to stump up $10,000 primarily for the benefit of business travellers between the east-coast capitals.

The Federal Government's 'faster rail' plan may sound similar to the ALP's bullet train proposal, but it is actually quite different. What's on the table today are rail renovations: upgrades to existing regional lines to improve trip times, sometimes quite substantially.

Rail renovations may make sense in Australia, and may improve life for people in regional cities. But even so, they're unlikely to fulfil the overblown claims made for them: that they'd take pressure off crowded capital cities while at the same time boosting struggling regions. When the French TGV sped up connections between Paris and Lyon, it was Paris that benefited most. Australia's regional towns have more pressing infrastructure needs than faster rail, including better internet and mobile connectivity and freight links. And governments would help a lot more CBD commuters by improving transport options for people in the outer suburbs rather than the regions.

Fast-train advocates argue that, with unemployment rising, now is an ideal time to create jobs by building rail infrastructure. There's no doubt there are hard times ahead. But if Governments want to add to the over $260 billion they have already spent since the crisis began, they should do so in a way that sets us up for the future we'll actually have, not the one we imagined before COVID-19. When we simply don't know whether the population will be growing, or what future travel and work patterns will be like, it's smart to keep our spending options open.

Every proposed rail renovation project in Australia should be reviewed in light of the COVID-19 crisis. The costs and benefits of each one should be rigorously assessed, and those that don't stack up should be abandoned. There's never been a more important time to ensure public money is spent on projects that add to Australia's productive capacity: that's the real light at the end of the tunnel.

Recommendations

1. Abandon the idea of 'bullet trains'

Bullet trains are unsuitable for Australia. Governments should stop using public money to continually study proposals for bullet trains.

2. Test all proposals for 'rail renovations'

Governments should approve a rail renovation only if a transparent cost-benefit analysis shows it is worthwhile and is the best way to get the desired community benefits.

Table of contents

1   The allure of fast trains

There's a reason politicians periodically try to seduce us with visions of fast trains. Which of us can truly say we wouldn't want the chance to ride our very own Eurostar, Shinkansen, or TGV?

But most of what's on the table is *not* like the Eurostar, Japan's Shinkansen, or France's TGV. Most of the proposals under consideration in Australia are much more modest upgrades to existing lines, designed to increase speeds and reduce trip times.

This report is about both types of fast train: high-speed, or 'bullet' trains; and upgrades to existing regional passenger lines, which we call 'rail renovations' (Box 1 on the following page). We argue that bullet trains are not a realistic proposition for Australia, but that renovations may be – even though they are unlikely to achieve all that their advocates hope.

The rest of this chapter explains the two distinct visions for quicker trains in Australia: the Federal Government's regional rail renovation plan, which is underway, and the Federal Opposition's bullet train proposal, which looms large in the public imagination.

1.1   Two distinct visions for quicker trains

Politicians love the idea of fast trains. Federal Labor wants a bullet train between Melbourne, Sydney, and Brisbane. In 2014, when he was Shadow Minister for Infrastructure and Transport, Anthony Albanese argued it would benefit the cities and towns along its route:

> [A Melbourne-to-Brisbane bullet train] would revolutionise interstate travel, and would also be an economic game-changer for dozens of regional communities along its path.[1]

In 2020, Labor Opposition Leader Anthony Albanese and transport spokeswoman Catherine King renewed calls for the bullet train, arguing it would help the economy recover from the COVID-19 crisis.[2]

The Greens support this vision, with Janet Rice, transport and infrastructure spokeswoman, emphasising its sustainability benefits:

> [A Melbourne-to-Brisbane bullet train would] cut pollution, enhance business and passenger transport, and generate positive economic returns... [it would] unlock the elusive, long sought-after but never achieved Holy Grail of decentralisation in Australia and all the social and environmental benefits that go with it.[3]

The Coalition Government has a different idea for fast trains – connecting cities to regions – but its logic is very similar. The Minister for Population, Cities and Urban Infrastructure, Alan Tudge, argues:

> [Faster city-to-town trains] are designed to disperse the population and support our regional areas to grow and prosper... These changes are about easing population pressures in our biggest cities, while ensuring regional communities are given a much-needed boost.[4]

The Federal Government launched its Faster Rail Plan in 2019 and established a National Faster Rail Agency to deliver it in partnership with state governments.[5] The branding and messaging are very similar to the bullet train, but the proposals actually on the table are very different. They are almost all 'rail renovations' rather than 'bullet trains'.

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1. Albanese (2014).
2. Hunter (2020); and Norman (2020).
3. Rice (2018).
4. Tudge (2019a); and Tudge et al (2019a).
5. In addition, in late 2019, Minister Tudge asked the Standing Committee on Infrastructure, Transport and Cities to inquire into options for financing faster rail: DITRDC (2020a, p. 25).

Box 1: Two types of 'fast' train: bullet trains, and rail renovations

The terminology used to describe train speeds is confusing. The terms 'high-speed', 'fast', 'faster', and 'very fast' are sometimes used interchangeably. These aren't technical definitions, just a set of loose conventions.

In this report, we distinguish between two types of train projects.

The first is a fast train in the conventional sense – what we will call **bullet trains**. By this we mean trains running entirely or mostly on new tracks built to modern standards to facilitate speeds above 250km/h, and sometimes as high as 350km/h. This category includes many of the famous examples that most people think of when they discuss fast trains, such as the TGV in France and the Shinkansen in Japan.

The second is upgrades to existing rail lines to yield speed improvements – which we refer to as **rail renovations**. Upgrades of this kind may involve electrifying the track or removing bends and inclines, enabling speeds above 150km/h, and sometimes as high as 200km/h. This is about twice as fast as most regional trains in Australia. The Commonwealth Government calls these projects 'faster rail'. They are faster than current trains but not as fast as bullet trains.

This report does not investigate maglev trains, or the yet-to-be-realised hyperloop, because neither are serious candidates for construction in Australia.

Chapter 2 is about bullet trains, and Chapter 3 and Chapter 4 are about rail renovations.

1.2 The Federal Government plan is mainly for regional rail renovations, not a bullet train

The Faster Rail Plan proposes upgrades to tracks or signalling to reduce trip times between various regional cities and their capital, in NSW, Victoria, and Queensland (Figure 1.1 and Table 1.1 on the next page).

1.2.1 There are many candidate routes on the list

The Commonwealth is overseeing business cases for upgrades to routes from Newcastle to Sydney, Shepparton to Melbourne, the Sunshine Coast to Brisbane, and Toowoomba to Brisbane.[6] The Newcastle upgrade has been proposed by the NSW Government, and the Sunshine Coast upgrade by North Coast Connect, a consortium involving the property developer Stockland, engineering firm SMEC, and urban planning company Urbis. Both of these proposals meet our definition of rail renovations.

By contrast, the Shepparton-to-Melbourne proposal is more akin to a bullet train (see Section 1.3), while the Brisbane-to-Toowoomba proposal is likely to be for standard passenger rail and not a 'fast' train.

The Commonwealth has already promised $2 billion towards a renovation of the Melbourne-to-Geelong line, although the exact alignment is not yet determined.[7]

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6. Australian Government (2019, pp. 8–10).
7. Ibid (p. 6).

Figure 1.1: Rail routes being considered under the Commonwealth's Faster Rail Plan

Table 1.1: Status of Faster Rail Plan proposals

Route	Status
Melbourne to Geelong	Commonwealth has committed $2 billion to the project
Sydney to Newcastle Melbourne to Shepparton	Strategic business cases complete
Brisbane to Sunshine Coast	Business case complete
Sydney to Wollongong Sydney to Parkes Melbourne to Albury-Wodonga Melbourne to Traralgon Brisbane to Gold Coast	Commonwealth has committed funding to business cases, but these are yet to be completed
Brisbane to Toowoomba	Commonwealth has committed funding to business case for passenger rail services, not expected to be faster rail

Sources: Australian Government (2019), National Faster Rail Agency and Infrastructure and Project Financing Agency (2019) and Department of Transport and Main Roads (2020).

The Commonwealth intends to oversee a second tranche of business cases for rail renovations on routes to Wollongong from Sydney, Parkes from Sydney via Orange and Bathurst, Albury-Wodonga from Melbourne, Traralgon from Melbourne, and the Gold Coast from Brisbane.[8]

State governments have their own plans, only some of which overlap with Commonwealth interests.[9]

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8. Ibid (pp. 11–14).
9. Victoria and Queensland also have plans for other regional rail upgrades (Rail Projects Victoria (2020a) and DITRDC (2019)), but these do not appear to meet the speed criterion of our definition of 'rail renovations' and are therefore not discussed here.

The NSW Government is working on proposals for rail renovations on routes from Sydney to Port Macquarie, Parkes, Canberra (with the support of the ACT Government), and Nowra.[10] The first aim is to improve existing rail routes and rolling stock, with services to reach at least 200km/h. Longer term, the NSW Government has flagged an interest in dedicated high-speed rail to achieve speeds over 250km/h.

The Victorian Government is working on proposals that would integrate with the upgraded Melbourne metropolitan rail network. This includes plans to improve top speeds on the Geelong and Ballarat lines to more than 160km/h.[11]

1.2.2 The speed improvements will be incremental, but big enough to care

The proposed rail renovations would not reduce journey times as much as a bullet train would, but in some cases the reductions would still be significant because existing services are so slow.

Figure 1.2 shows travel times today on a number of the lines in question, and the travel times that governments and other proponents are seeking through rail renovations and upgrades.

Improvements in travel times vary because they depend not just on the assumed top speed of the train, but also stopping patterns and the nature of the line.

Figure 1.2: Rail renovations would improve travel times
Travel time to nearest state capital, minutes
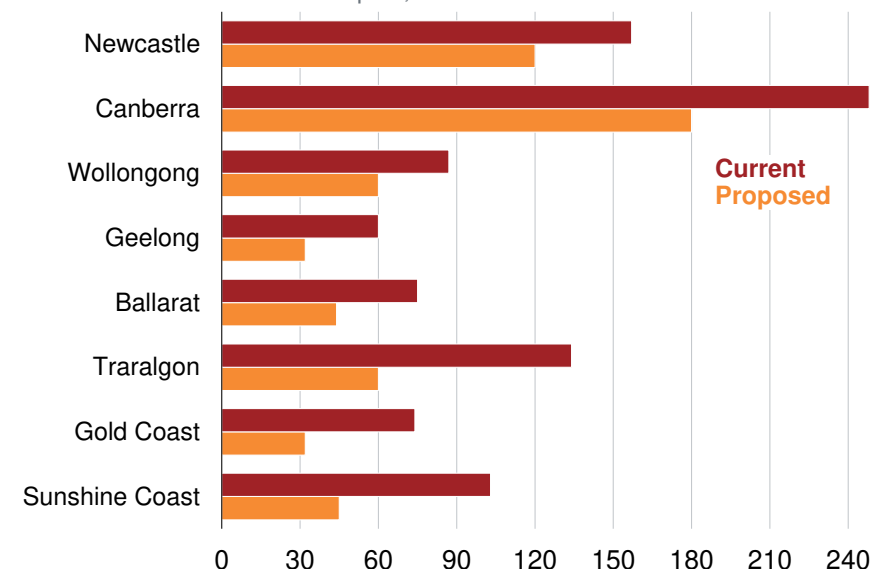
Notes: 'Current' travel time is fastest timetabled service arriving in the CBD around 9am on a weekday. 'Proposed' travel times are reported estimates of the travel times that will be achieved by rail renovations under Commonwealth and state government plans. Parkes and Albury-Wodonga excluded because proposed travel times could not be found. Proposed travel time for Ballarat (44 minutes) assumes same average speed (160 km/h) being targeted by Geelong rail renovation.

Sources: NSW Government (2018), Andrews (2019), Australian Government (2019), BITRE (2019, p. 110), Chester (2019), Prime Minister of Australia (2019) and Rail Projects Victoria (2020b).

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10. NSW Government (2018).
11. Rail Projects Victoria (2020b).

1.3 The bullet train still looms large

The fast train most of us probably think of – a bullet between Melbourne, Sydney, and Brisbane – is not the policy of any government at the moment, but the idea has not gone away. The Federal Opposition recently called on the Government to fund the bullet train, as an 'economic game-changer' in the post-COVID-19 recovery.[12]

The proposal was developed by Anthony Albanese between 2010 and 2013, when he was Minister for Transport (Figure 1.3). The now Opposition Leader has unsuccessfully sought parliamentary approval five times of his private member's bill to establish a high-speed rail authority to oversee construction.[13]

The ALP took to the 2019 election a proposal to spend $1 billion on beginning to preserve the corridor.[14] Infrastructure Australia has identified corridor preservation for a future bullet train as a 'high-priority initiative'.[15]

The Minister for Population, Cities and Urban Infrastructure, Alan Tudge, has been critical of this idea.[16] But the bullet train idea lives on in one Commonwealth-sponsored business case: the Commonwealth Government has provided $8 million to the Consolidated Land and Rail Australia (CLARA) consortium to develop a business case for a bullet train from Melbourne to Shepparton, including building new 'cities' at Shepparton and Nagambie.[17]

Figure 1.3: The proposed route and travel times for a Melbourne-to-Brisbane bullet train

Source: AECOM (2013a).

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12. Hunter (2020).
13. Most recently in October 2018: Albanese (2018).
14. Albanese (2019).
15. IA (2020, p. 20).
16. Tudge (2019b).
17. Davies (2019).

The consortium envisages that later stages would entail a high-speed rail connection all the way to Sydney, and that a further six new cities of 200,000 to 600,000 people each would be built along its route. It claims travel times between Shepparton and Melbourne could be reduced from about three hours to 32 minutes.[18] This implies an average speed of almost 380km/h, which would be almost unprecedented around the world.[19]

But a bullet train won't work in Australia, for reasons we explain in the next chapter.

18. Ibid.
19. The CLARA website includes a brief description of three types of high-speed rail, in Japan, France, and China: CLARA (2016a). The website does not specify what type of high-speed rail it envisages for Australia.

2   Bullet trains don't make sense in Australia

Who doesn't love the idea of a bullet train zipping along Australia's coastline? We like to imagine it would bring us in line with the rest of the world, help us meet our emissions-reduction targets, and give a boost to regional communities.

But none of these things is true.

Australia is different to other countries. Our population is small and spread over vast distances. The countries that look most like us – Canada and the United States – don't have bullet trains either. And even where countries do have extensive networks – Japan, China, and Europe – bullet trains generally need very large government subsidies even after they're built. The true global story is that good bullet trains are expensive and bad bullet trains are very expensive.

Nor are bullet trains the climate saver we might think. Yes, once they're up and running they emit far less than today's planes. But the train line would take almost 50 years to build, and the construction process is enormously emissions intensive. Building a bullet train would hinder rather than help Australia's efforts to reach net zero emissions by 2050.

It's true that a 2013 feasibility study concluded that the benefits of a Melbourne-to-Brisbane bullet train would greatly outweigh its costs. But it is unlikely that this would be the finding of a rigorous independent study now. That's because the 2013 result was skewed by a cherry-picked discount rate, by ignoring the question of how to pay the enormous costs of construction, and because the study was done before the decision was made to build a second Sydney airport.

As regrettable as it might be given the undeniable appeal of a Melbourne-to-Brisbane bullet train, we should put the idea to bed and move on.

2.1   Australia's small and dispersed population is not suited to bullet trains

Around the world, it is very rare for bullet trains to span a distance of 1,000km or more. When they do, they usually serve populations of at least 50 million. By contrast, the total population of the cities and towns on the proposed Melbourne-to-Brisbane bullet train route is about 15 million. The longest existing lines that serve a similar population are from Madrid to Barcelona, Turin to Naples, and Paris to Lyon and Marseille. Those lines are all about 800km, less than half the length of the proposed Australian line (Figure 2.1 on the next page and Figure 2.6 on page 20).

Even the Melbourne-to-Sydney segment would be the second-longest stretch of fast rail between two cities with a population larger than a million anywhere in the world. The longest is between Lanzhou and Ürümqi in China's north west.

And most bullet trains overseas required significant public subsidies to build, and often still require significant subsidies to operate.

2.1.1 Europe and Japan have clustered populations

Until the past decade, it was true to say most bullet trains were in Japan and Europe. Japan's first Shinkansen link, the Tokaido from Tokyo to Osaka, opened in 1964, and these days the network stretches from the southern-most island to the northern-most.[20]

The success of the Japanese system in gaining market share from air travel inspired a spate of European high-speed rail lines.[21]

France's TGV started with the Paris-to-Lyon route in 1983, and now includes routes to Marseille and Bordeaux. Spain's Alta Velocidad Española initially linked Madrid with Sevilla, and now links it to several cities across the country, including Barcelona. Germany's InterCityExpress has focused on improving links between pairings of cities with a combination of rail renovations and short stretches for bullet trains. Italy's high-speed network consists of a major line from Turin, south through Rome and beyond, and a partially-renovated section between Milan and Venice.[22]

Over time, the advantages of crossing national borders became evident, and the 1993 Maastricht Treaty called for a network of Trans European lines.[23] These now include the extension of the TGV to the Spanish and Swiss borders, links between the German and French systems, and the Eurostar, which connects London to Paris, Brussels, and Amsterdam (see Appendix A).[24]

Figure 2.1: A Melbourne-to-Brisbane train line would be one of the longest in the world, despite its small population catchment
Sum of population of cities serviced by continuous bullet train lines, millions
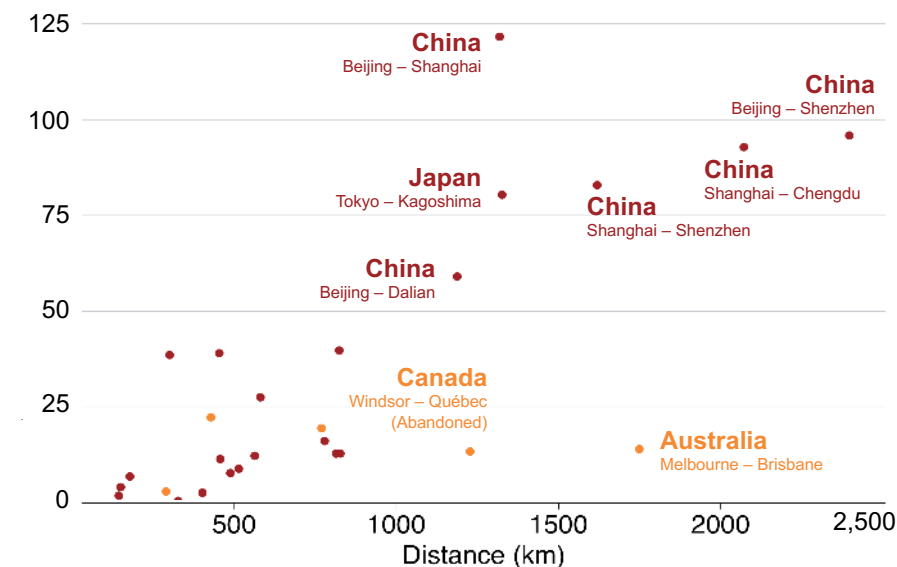
Notes: Red dots represent existing lines; orange represent proposed or previously-proposed lines. The population catchment for each line is the sum of the populations of the cities in which the bullet train stops.
Sources: Grattan analysis of UIC (2020), UN (2018), OSM (2020) and AECOM (2013a).

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20. UIC (2020).
21. Nash (2009, p. 3).
22. UIC (2020).
23. Nash (2009, p. 4).
24. UIC (2020).

The section of the Eurostar that is within the UK is known as 'High Speed 1' or HS1. The UK is also building a new bullet train, known as HS2, to link London with Manchester and Leeds, despite some talk of abandoning the project.[25]

But just because bullet trains have been built doesn't mean they have been financially successful. Most do not recover their operating costs, let alone their construction costs. In fact, only two bullet train lines in the world have recovered their construction costs: the Tokaido Shinkansen between Tokyo and Osaka, and France's Paris-to-Lyon line.[26]

Operating bullet trains typically requires public subsidies, sometimes large. Up to half of construction costs of the Spanish system were funded by European Union subsidies, and ongoing subsidies are required to keep fares down.[27] The Eurostar won a significant share of the Paris-to-London air route, previously Europe's busiest, but its passenger numbers still fell well short of expectations.[28]

Britain has also had problems with its bullet trains. Passenger demand for HS1 has fallen far short of forecasts, according to the UK National Audit Office.[29] And HS2, connecting London to Manchester and Leeds via Birmingham, is already three times over budget despite being only at an early stage of construction.[30]

Japan's bullet trains are more financially viable, carrying more than 300 million passengers a year,[31] although the construction of lines other

than the Tokaido has caused financial headaches for the Japanese government.[32]

As two experts on high-speed rail put it:

> We have found that high-speed rail investment is difficult to justify when the expected first-year demand is below 8-to-10 million passengers for a line of 500km, an optimal length for HSR [high-speed rail] to compete with road and air transport.[33]

Japanese and European bullet trains cover much more modest distances than an Australian bullet train would, for populations that are huge in the case of Japan and large in Europe, as we show in the maps and figures in the following subsections.

2.1.2 China is the only large country to have built long-distance bullet trains

Since 2008, the world of bullet trains has changed dramatically, as China embarked on a spree of construction. It now has more than 25,000km of track – more than the rest of the world combined. It has the longest routes in the world, extending to most provinces.[34]

But other countries with big distances to cover and populations smaller than China's have rejected bullet train proposals.

Canada has contemplated bullet trains from Toronto to Montreal via Ottawa, and from Calgary to Edmonton; both proposals were abandoned, and a feasibility study for the Calgary to Edmonton line concluded it was not economically viable.[35]

25. Topham (2019a); and Topham (2019b).
26. ITF (2014, p. 57).
27. Albalate and Bel (2012, p. 342).
28. Smithers (2013).
29. NAO (2012).
30. Topham (2019a).
31. Albalate and Bel (2012, p. 338).

32. O'Toole (2008, p. 10).
33. Rus and Nombela (2007, p. 18). These authors rely on actual construction costs in Europe, average values of time, a reasonable range of potential travel time savings, and a discount rate of 5 per cent.
34. Lawrence et al (2019).
35. Legislative Assembly of Alberta (2014); and Jeffords (2019).

Similarly, several projects in the US have fallen over. A bullet train was planned from Los Angeles to San Francisco, but the Governor of California has announced that only the middle segment between Bakersfield and Merced in the Central Valley will be built.[36] A private consortium also plans to build a bullet train in Texas between Dallas and Houston by the mid-2020s, although it has struggled to acquire land for the project.[37]

Florida, Ohio, and Wisconsin all cancelled projects and returned federal funds after establishing that they were too expensive and not necessary.[38] The train between Boston, New York, and Washington DC, which is sometimes called 'fast', is sluggish by world standards.[39]

It is not surprising that China has built a bullet network while these other large countries haven't. China is like Australia, Canada, and the US in terms of geographical size, but its other characteristics are very different, particularly its vast population of 1.4 billion. Even given these favourable conditions, a World Bank study identified that segments of the Chinese network with 15-to-20 million people along a 400km stretch operated at a loss and were effectively cross-subsidised by the more populous segments.[40]

Australia's 1,750km bullet train proposal is more similar to those that have been considered in the US and Canada, although the proposed route is significantly longer. The 900km Melbourne-to-Sydney segment alone would be longer than any of the US proposals, and a similar length to the larger Canadian proposals. Routes that are longer than around 600km simply don't offer a quick enough trip time to draw large

numbers of people away from flying.[41] As well, in all three countries, the proposals would link populations much smaller than in China.

The following maps illustrate the key bullet train networks around the world. Europe's bullet train network supports relatively large and concentrated populations (Figure 2.2 on the next page). Asia's very extensive bullet train networks connect very large population catchments, even where the distances covered are very long (Figure 2.3 on page 17). By contrast, even though North America has some pockets of concentrated population, it does not have bullet trains (Figure 2.4 on page 18). Australia is most like the US and Canada, with relatively small and very dispersed population centres (Figure 2.5 on page 19).

36. Associated Press (2019).
37. Morrison (2019).
38. Nixon (2014).
39. Morrison (2019).
40. Lawrence et al (2019).

41. Rus and Nombela (2007); Nash (2009); and Albalate and Bel (2012).

Figure 2.2: Europe's network of bullet trains supports its fairly large and concentrated population

Notes: Dots represent cities with populations greater than 300,000. Cities with populations greater than 500,000 are labelled. The bigger the size of the dot and name, the bigger the population. Population figures represent continuous urban areas. In some cases, a continuous urban area includes multiple districts that are sometimes considered as separate cities. In these cases, the name of the larger city is used. For example, 'Leeds' includes Leeds, Bradford, and Huddersfield. Red lines show currently operational bullet train routes. Yellow lines show currently operational train routes that have been renovated to allow top speeds faster than 200km/h. The dark red dotted lines show the proposed route of the UK's 'High Speed 2' project.

*Source: Grattan analysis of UIC (2020), OSM (2020) and UN (2018).*

Figure 2.3: Asian bullet trains connect very large populations, even where distances covered are also very large
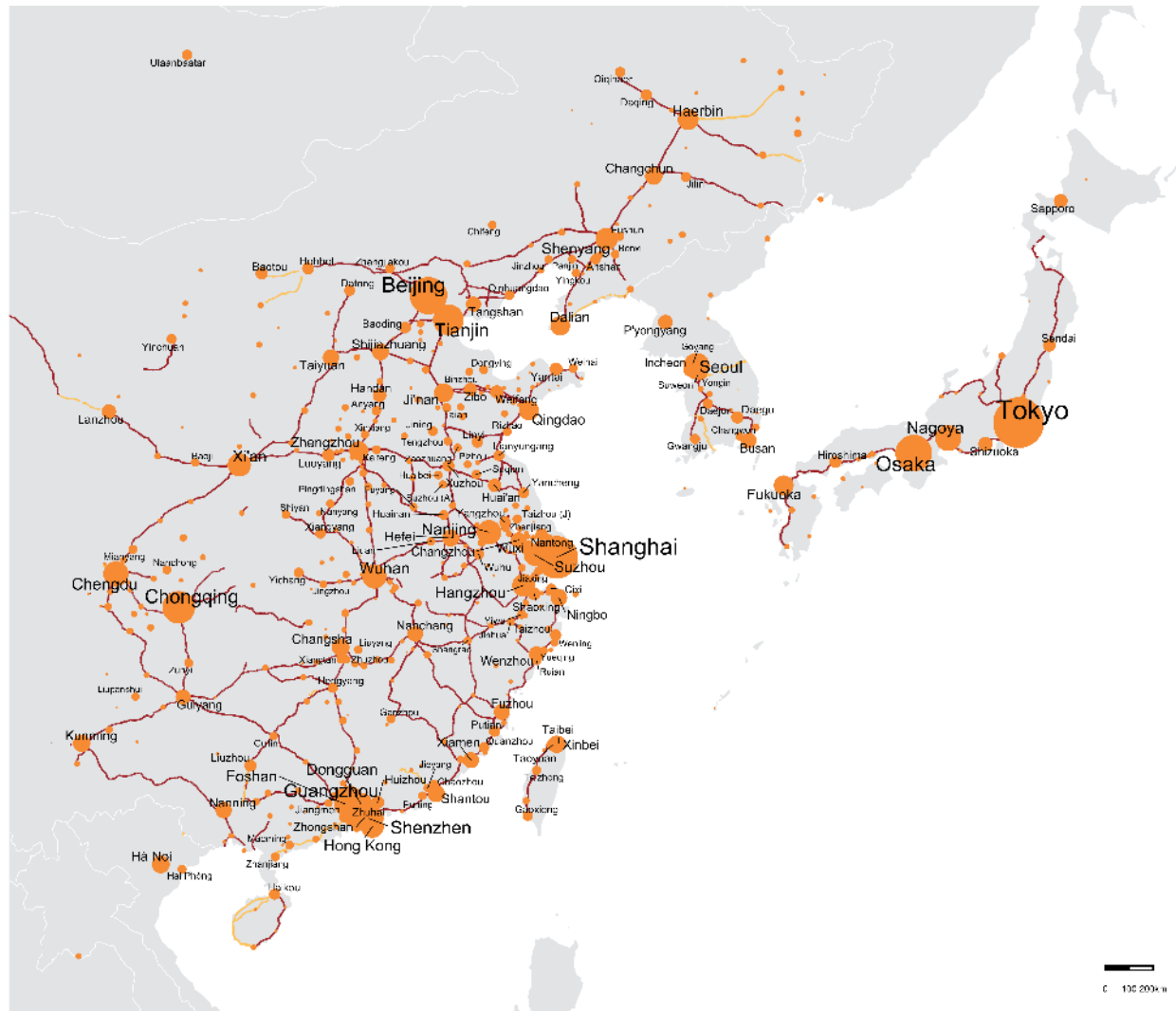
Notes: Dots represent cities with populations greater than 300,000. Cities with populations greater than 500,000 are labelled. The bigger the size of the dot and name, the bigger the population. Population figures represent continuous urban areas. In some cases, a continuous urban area includes multiple districts that are sometimes considered as separate cities. In these instances, the name of the larger city is used. For example, 'Osaka' includes Osaka and Kyoto. Red lines show currently operational bullet train routes. Yellow lines show currently operational train routes that have been renovated to allow top speeds faster than 200km/h.

Source: Grattan analysis of UIC (2020), OSM (2020) and UN (2018).

Figure 2.4: North America has some pockets of concentrated population, but does not have bullet trains
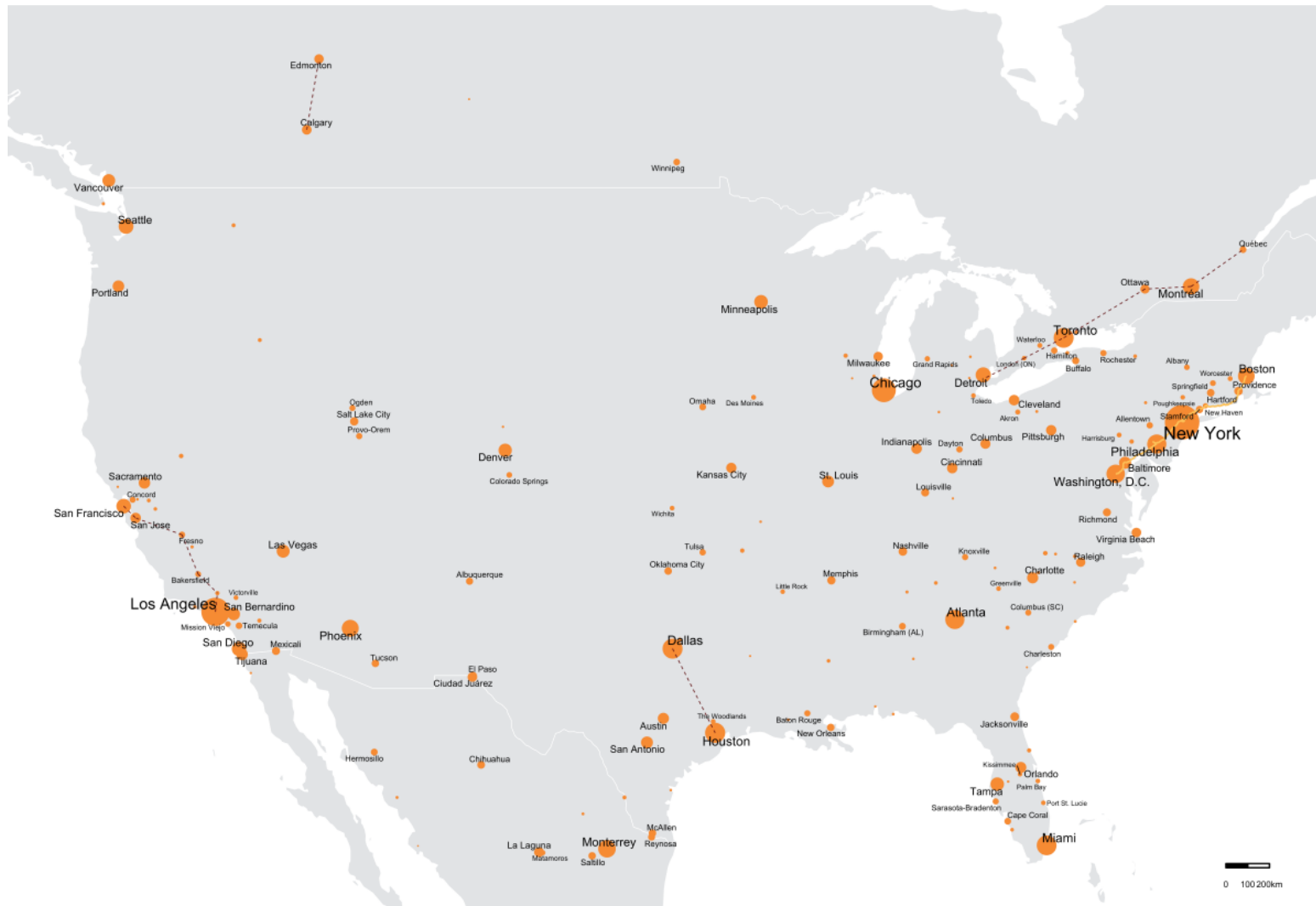
Notes: Dots represent cities with populations greater than 300,000. Cities with populations greater than 500,000 are labelled. The bigger the size of the dot and name, the bigger the population. Population figures represent continuous urban areas. In some cases, a continuous urban area includes multiple districts that are sometimes considered as separate cities. In these instances, the name of the larger city is used. For example, 'Dallas' includes Dallas and Fort Worth, and 'San Francisco' includes San Francisco and Oakland. The yellow line shows a train route that has been renovated to allow top speeds faster than 200km/h. The dark red dotted lines show a selection of current or previous proposals for bullet trains.

Source: Grattan analysis of UIC (2020), OSM (2020) and UN (2018).

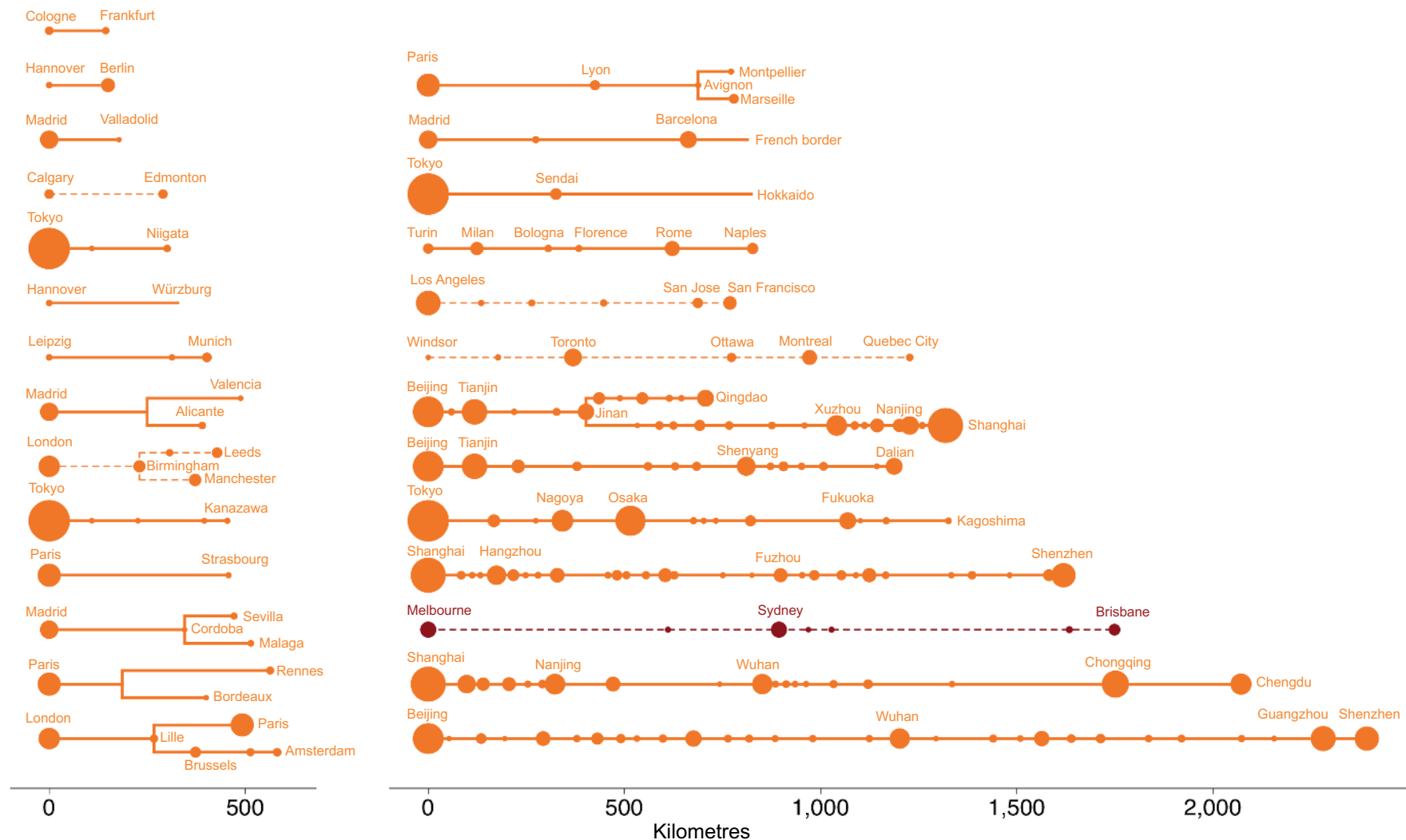**Figure 2.5: Australia has a small, sparse population that is poorly suited to bullet trains**

Notes: Dots represent cities with populations greater than 300,000. Cities with populations greater than 500,000 are labelled. The bigger the size of the dot and name, the bigger the population. The dark red dotted line shows the bullet train route proposed in AECOM (2013a).

Sources: ABS (2017) and UN (2018).

Figure 2.6: Australia's east-coast bullet train would be one of the longest continuous bullet train segments in the world, and even the Melbourne-to-Sydney segment would be one of the longest stretches between two large cities

Notes: Dots represent cities with populations greater than 300,000. The bigger the size of the dot, the bigger the population. Solid lines are operational and dotted lines are proposed.
Sources: UIC (2020), OSM (2020) and UN (2018).

International experiences suggest that bullet trains need strong demand at both the origin and the destination. They work best when there is significant congestion on existing road and air connections, because this creates a need for speed that businesses and individuals will be willing to pay for.[42] Australia does not meet these conditions.

The next section considers whether bullet trains really are a greener travel alternative to planes.

2.2   Bullet trains wouldn't help Australia to reach net zero emissions by 2050

All Australian states and territories have committed to reaching net zero emissions by 2050. For many people, it seems obvious that bullet trains have a role to play. Bullet trains could cause a reduction of at least 1.3 million tonnes (Mt) of carbon dioxide equivalent (CO_2e)[43] per year, according to a report for the Australian Greens;[44] others claim it could be almost three times this amount,[45] mainly by replacing air travel. Bullet trains would 'radically reduce emissions', according to a climate change think tank.[46]

But these claims should be treated with caution. While it's true that flying is a high-emitting form of travel, and a challenging area for emissions reduction, it's also true that domestic aviation contributes less than 2 per cent to Australia's CO_2e emissions per year. Domestic aviation accounted for only 9 Mt of Australia's 535 Mt of CO_2e emissions in 2017.[47]

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42. Rus and Nombela (2007); Albalate and Bel (2012); and Nash (2009).
43. CO_2e is the unit used to compare the effects of different greenhouse gases, by converting the quantity of a gas into the quantity of CO_2 with equivalent global warming potential.
44. Edwards (2012, p. 3).
45. Beyond Zero Emissions (2014, p. 6).
46. Bygrave (2016).
47. DEE (2019a, pp. xi, 43).

In this section we explain in more detail the impact a bullet train could have on emissions in Australia; first, during construction, and second, once the train was up and running.

2.2.1   During construction, a bullet train would increase emissions

The 2013 feasibility study on a bullet train along Australia's east coast estimated construction emissions of 11.4 Mt of CO_2e.[48]

This is likely to have been a significant underestimate due to two important omissions. Most significantly, the study excluded emissions involved in the production of materials for construction, especially the vast quantities of concrete and steel that would be required.[49] It also excluded emissions caused by the construction of other infrastructure.

The first of these, emissions involved in producing materials for construction, are called 'Scope 3' emissions (explained further in Box 2 on the next page). Scope 3 emissions are often excluded from large-scale assessments, such as a country's emissions, to avoid double counting. Australia's *National Greenhouse and Energy Reporting Act 2007* does not require their inclusion in assessing the emissions contribution of individual infrastructure projects.[50]

However, it is common international practice to include them, especially for large projects that create significant new demand for raw materials. The Infrastructure and Sustainability Council of Australia and the Greenhouse Gas Protocol both recommend including Scope 3 emissions.[51]

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48. AECOM (2013a, p. 125).
49. Construction materials such as steel might be produced with fewer emissions in the future, but this would be at a higher cost; see Wood et al (2020).
50. National Greenhouse and Energy Reporting Act 2007 (2019).
51. ISCA (2018); and Bhatia et al (2011).

If Scope 3 emissions had been included, as we argue they should have been, the emissions estimates for the construction of the bullet train would have been 2-to-5 times higher.[52] This means that the true emissions associated with building the bullet train would be between 23 and 57 Mt of CO_2e.

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52. The estimate of Scope 3 emissions was derived in the feasibility study from international evidence as 50-to-80 per cent of total construction emissions (AECOM (2013a, p. 125)). This is consistent with estimates for other rail projects, such as HS2 in the UK, at about 70 per cent (HS2 Ltd. (2013, pp. 1–2)) and the Melbourne Metro Tunnel, at 75 per cent (AJM Joint Venture (2016, p. 44)).

Once Scope 3 emissions are included, the decision to build the bullet train would, for somewhere between 24 and 36 years, actually cause emissions to be higher than they otherwise would have been (Figure 2.7).

Figure 2.7: Construction emissions are a high up-front cost
Estimated net cumulative emissions, Mt CO_2e
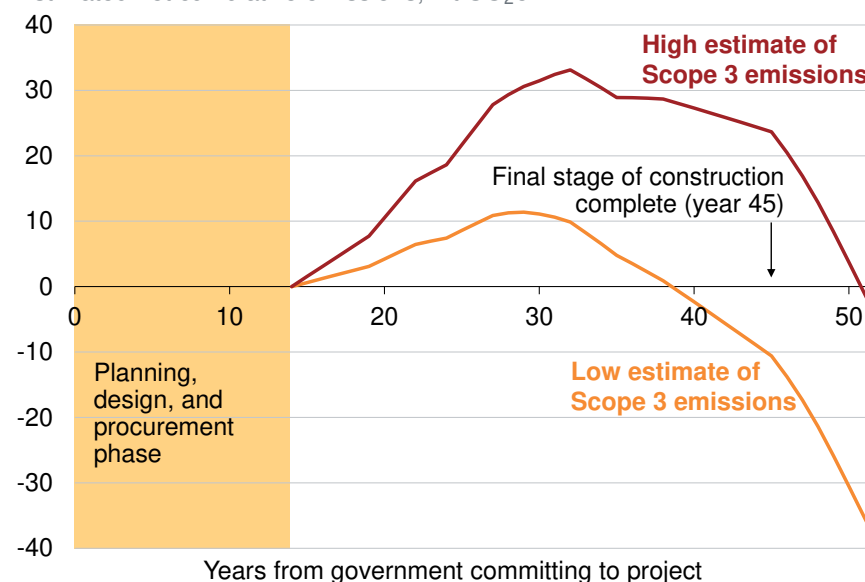
Years from government committing to project

Notes: Estimates derived from the 2013 feasibility study and other sources – see Appendix B. The feasibility study assumed that government would commit to the project in 2013.

Source: Grattan analysis of ABS (2019a), AECOM (2013a), AECOM (2013b), AEMO (2020), BITRE (2020a), DEE (2019b) and ICAO (2016).

The other important omission from the assessment of construction emissions in the 2013 feasibility study was those caused by the construction of infrastructure such as the track, stations, and depots.[53] The study's authors justified this on the basis that these emissions were

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53. AECOM (2013b, p. 4).

difficult to estimate and likely to be small compared to the emissions caused by other activities such as earthworks, bridge building, and tunnelling. But other evidence suggests these emissions might turn out to be significant, especially when Scope 3 emissions are considered. For the first phase of HS2 in the UK, the construction of track is estimated to account for about 21 per cent of all construction emissions, and stations and depots about 12 per cent.[54]

2.2.2 During operations, riding a bullet train would create fewer emissions than catching a plane

Once it was up and running, a trip by bullet train would cause fewer emissions than a trip by car or plane (Figure 2.8).[55]

But as well as diverting passengers from planes and cars, a new train would also encourage new passengers who would not otherwise travel ('induced demand'). These new trips would represent an increase in emissions.

It would take a long time for a bullet train to start lowering emissions. Only in the 22nd year after the government committed to fund it would the first segment open. Only then would there start to be some offset to the emissions from construction.

It would not be until somewhere between year 39 and year 51 that the bullet train would lead to lower emissions than if the train had not been built. Figure 2.9 on the following page illustrates this emissions path, assuming that electricity production was carbon-neutral after 2050.

Figure 2.8: Travelling on a bullet train creates fewer emissions than driving or flying
Grams of CO_2e per passenger-kilometre, Melbourne to Sydney
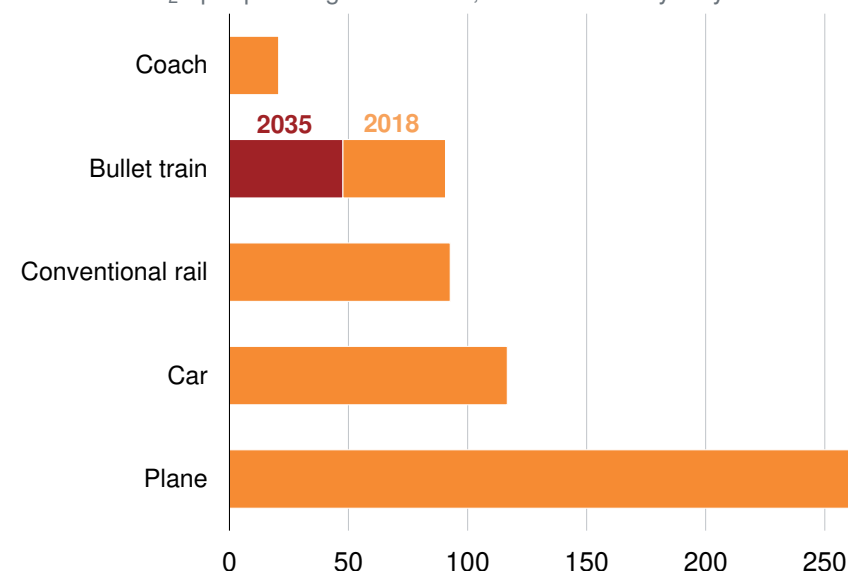
Notes: Estimates for coach, conventional rail, car, and plane rely on values of fuel efficiency from 2018. Estimates for the bullet train rely on electricity requirements published in the 2013 feasibility study and the emissions intensity of electricity generation: either actual emissions intensity in 2018 or projected emissions intensity in 2035 (the first year that bullet trains were planned to run in the 2013 feasibility study). Average occupancy estimates are 38.5 (coach), 320 (bullet train), 119 (conventional rail), 2.26 (car), and 151.96 (plane). Plane emissions include radiative forcing.

Source: Grattan analysis of ABS (2019a), AECOM (2013a), AECOM (2013b), AEMO (2019), AEMO (2020), BITRE (2020a), DEE (2019b) and ICAO (2016).

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54. HS2 Ltd. (2013, pp. 1–2).
55. This statement is true in respect of the fuels currently used by cars and planes. Over coming decades, the average emissions created by these modes of transport is likely to fall with the uptake of electric vehicles and developments in aviation fuels.

Even though a bullet train could ultimately contribute to emissions reduction, it would be a small contribution and it would take a very long time. And there would be no net reduction until after 2050; this means it could not contribute to global efforts to reach net zero emissions by 2050.

Even though emissions reduction made only a very small contribution, the 2013 feasibility study nevertheless concluded that benefits from building the bullet train would outweigh costs by a ratio of 2.3 to 1. In the final section of this chapter, we show that this finding was based on unrealistic assumptions, and that a very different conclusion would be reached if a similar study were done today.

Figure 2.9: A bullet train would be slow to reduce emissions
Estimated net cumulative emissions, Mt CO_2e
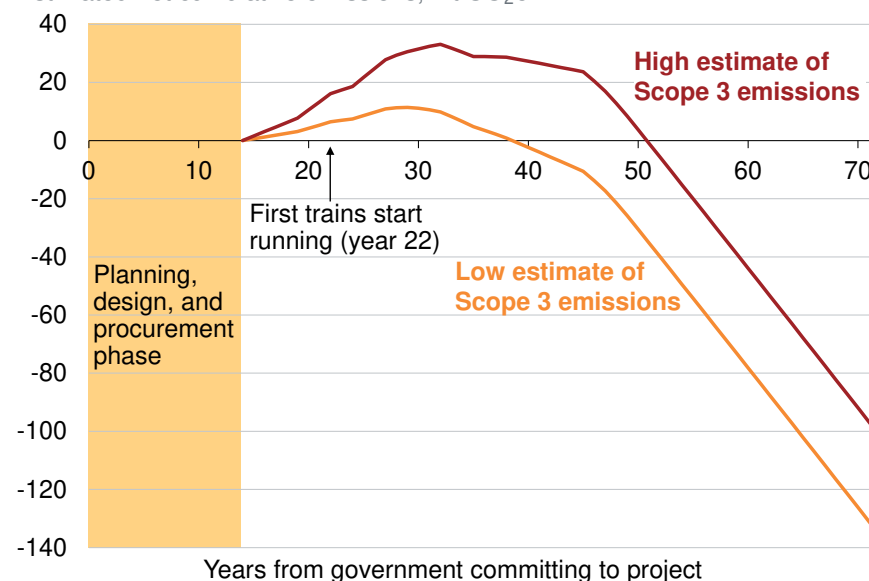
Years from government committing to project

Notes: Estimates derived from the 2013 feasibility study and other sources – see Appendix B. The feasibility study assumed that government would commit to the project in 2013.

Source: Grattan analysis of ABS (2019a), AECOM (2013a), AECOM (2013b), AEMO (2020), BITRE (2020a), DEE (2019b) and ICAO (2016).

2.3 The favourable 2013 feasibility study would not be positive seven years on

The 2013 feasibility study is the latest in a long line of studies of bullet trains in Australia, each of which was appealing on first blush, but not under closer scrutiny.

A proposal backed by BHP and Elders IXL for a fast train between Melbourne, Canberra, and Sydney was abandoned in 1991 when it became evident that the project had failed to secure tax concessions from the Commonwealth Government.[56] A 1998 tender for a fast train between Canberra and Sydney was awarded to the Speedrail consortium, on the basis that there would be no net cost to the taxpayer; the government terminated the proposal in 2000 due to fears it would require excessive subsidies.[57]

More recently, the Consolidated Land and Rail Australia (CLARA) consortium has proposed high-speed rail, funded by creating eight new inland cities, with populations of between 200,000 and 600,000 each, over the next 20 years. The plan relies on selling blocks of land in all eight cities for about $150,000 each.[58] The plan appears to rely on some kind of government intervention to enable the consortium to acquire all the necessary land from those landowners who are unwilling to sell at a pre-rail price, or at any price.[59]

Like its predecessors, the current incarnation of a bullet train looks attractive. The 2013 feasibility study estimated that, for every dollar of costs, both financial and non-financial, society would end up better off to the tune of $2.30. In other words, the benefit cost ratio (BCR) was estimated at 2.3:1.[60]

But like its predecessors, there are red flags on this railway proposal. If it were to be considered afresh today in a rigorous way, it is likely the results would be much less favourable for five reasons:

- The 2013 study ignored the important question of how to pay for the train.

- The BCR is very sensitive to the choice of discount rate, and the chosen discount rate is more generous than the Australian standard for infrastructure projects.

- The train's route was compromised to reduce costs, which also compromised its usefulness to regional areas.

- A second airport is now being built in Sydney, which would dampen demand for the train.

- The study assumed no cost overruns.

We explain these flaws in the following subsections.

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56. Williams (1998).
57. Laird et al (2001, pp. 32–33).
58. CLARA (2016b); CLARA (2016c); and Manning (2016).
59. Terrill and Emslie (2017, p. 8).
60. AECOM (2013a, p. 31).

2.3.1   The 2013 study didn't consider how to pay for the train

Although the 2013 study found the rail line would cost well over $130 billion in today's dollars to build, it was silent on the question of where the funds would come from. This meant that the study's assessment of costs and benefits did not include the economic loss that society would suffer as a result of raising sufficient tax to fund the scheme, known as the 'excess burden of tax'.

But in the real world, someone must pay. The choices are passengers or taxpayers, or some combination of the two. The Commonwealth Government's own handbook of cost-benefit analysis makes the point that an adjustment should be made for the excess burden of tax.[61]

In the real world, it would take a tax hike of about $10,000 for every personal taxpayer in Australia to fund the bullet train. Because the 2013 feasibility study omitted this, it's not surprising that it was able to find that travellers would enjoy significant benefits over and above what they'd actually paid for through their train fare.

Taxpayers in Western Australia and Tasmania might be particularly disgruntled when they realised that the main beneficiaries would be business travellers between Sydney, Melbourne, and Brisbane (Figure 2.10).

And taxpayers who might never ride the train might reflect unfavourably on what other infrastructure projects could have been built if the bullet train had not gone ahead (Figure 2.11 on the following page).

Figure 2.10: The bullet train would mostly benefit business travellers
Reported benefits of the Melbourne-to-Brisbane bullet train over the first 50 years of operation, $2019 billion
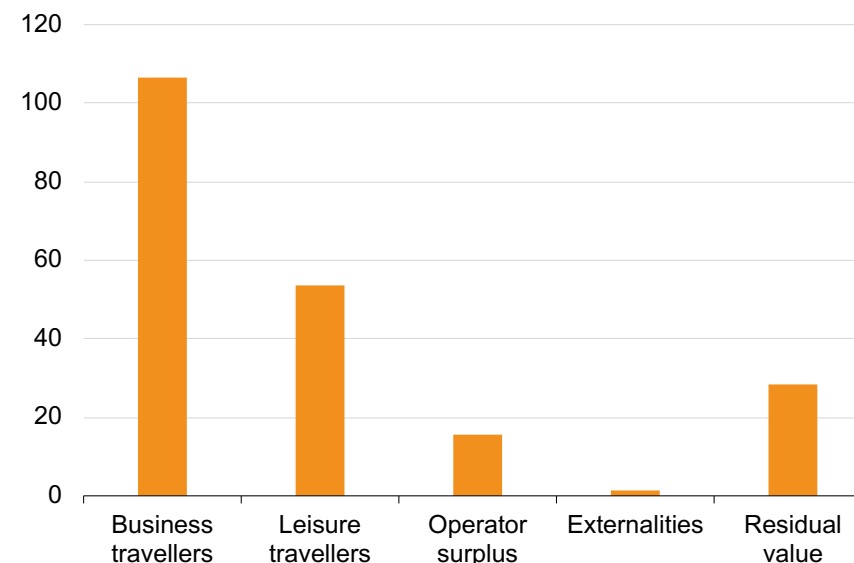
Notes: 'Externalities' refers to external benefits (i.e. benefits to third parties arising from, for example, less congestion or pollution). 'Residual value' refers to the discounted value of net benefits that are estimated to occur after the first 50 years of operation (less an annuity value for capital maintenance).

Source: Grattan analysis of AECOM (2013a).

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61. The 2013 feasibility study notes on page 368 that the Department of Finance and Deregulation handbook of cost-benefit analysis requires an adjustment for the excess burden of tax, but the report itself does not make such an adjustment: AECOM (2013a, p. 368).

Figure 2.11: $130 billion goes a long way
20 currently-funded infrastructure projects which, taken together, have the same price tag as a Melbourne-to-Brisbane bullet train, $ billion

National

1. Inland Rail

NSW

2. Western Syd Airport
3. WestConnex
4. Sydney Metro
5. NorthConnex
6. Nowra Bridge Project
7. M1 Pacific Hwy Upgrade

Victoria

8. North East Link
9. West Gate Tunnel
10. Melbourne Airport Rail
11. Murray Basin Rail
12. Regional Rail Revival
13. Monash Fwy Upgrade
14. Melbourne Metro Tunnel

Queensland

15. Brisbane Metro
16. Bruce Hwy Upgrade
17. Gold Coast Light Rail Stage 3A

South Australia

18. North-South Corridor

Western Australia

19. Perth Metronet

Tasmania

20. Midland Hwy Upgrade

Notes: This chart is intended to provide a point of reference for the scale of infrastructure spending required for the Melbourne-to-Brisbane bullet train. These projects are not presented as an alternative to the train. The projects in yellow all have active government funding commitments. Figures reflect total project costs, including private contributions. The figure for the Melbourne-to-Brisbane bullet train is expressed in 2019 dollars.

Sources: Grattan analysis of AECOM (2013a), ABS (2019b), Inland Rail (2020), DITRDC (2020b), DITRDC (2020c), NSW Government (2016), NorthConnex (2020), Transport for NSW (2020), DITRDC (2020d), Premier of Victoria (2019), Victorian Government (2020a), DITRDC (2020e), DITRDC (2020f), Victorian Government (2020b), DITRDC (2020g), Victorian Government (2020c), Brisbane City Council (2020), DITRDC (2020h), Queensland Government (2019a), Government of South Australia (2020), Piesse (2018) and DITRDC (2020i).

2.3.2 The favourable result in 2013 was almost entirely due to a cherry-picked discount rate

The 2013 study relied heavily on a discount rate of 4 per cent. But using a 4 per cent discount rate gave the project a major leg-up compared to rival projects – a leg-up that would not be permitted under current policy. Without this leg-up, the benefit cost ratio was estimated to be just 1.1:1; in other words, only by the slenderest of margins would the project be judged worthwhile. Discount rate policy in Australia leaves much to be desired,[62] but that doesn't mean project proponents should be able to cherry-pick a rate that suits their project.

It has long been Australian practice to use a discount rate of 7 per cent to appraise transport infrastructure projects.[63] Sensitivity testing at 4 per cent and 10 per cent is usual. Project proponents do not get to choose what discount rate to use: Infrastructure Australia requires a 7 per cent rate for any project valued at $100 million or more where the proponent is seeking a Commonwealth funding contribution.[64] State government agencies mostly take the same approach.[65] Infrastructure Australia officials have defended a 7 per cent discount rate,[66] and could be expected to do so again if a bullet train proposal were put to the organisation for evaluation.

The implication of using a 4 per cent rather than the usual 7 per cent discount rate is that it seeks to have this proposal appraised on a more favourable basis than other transport infrastructure proposals. That's because it discounts costs, and more pertinently benefits, that occur in the more distant future relatively lightly – and more of the bullet train proposal's benefits are in this more distant realm. Choosing a 4 per

cent discount rate made a huge contribution to the favourable overall assessment of the project, as Figure 2.12 on the next page shows.

Grattan Institute continues to make the case that a discount rate of 7 per cent is far too high when the cost of money is at record lows,[67] but nonetheless this penalty remains in place for all projects, not just east-coast bullet trains. Any major infrastructure project should be assessed in accordance with established practice, and subject to the same constraints as rival projects with similar levels of risk.

If the 2013 study had followed recommended practice, the discount rate alone would have rendered the bullet-train project line-ball.[68]

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62. Terrill and Batrouney (2018, p. 8).
63. Ibid (pp. 7–8).
64. IA (2018, p. 104).
65. Terrill and Batrouney (2018, pp. 11–13).
66. Bagshaw (2018).

67. Terrill and Batrouney (2018).
68. Using a 4 per cent discount rate, the costs are estimated at $79.3 billion in 2012 dollars, and the benefits at $180.6 billion. Using a 7 per cent discount rate, the costs are estimated at $58.9 billion and the benefits at $63.8 billion (AECOM (2013a, p. 31)).

2.3.3 The train's route would have limited value to regional areas

The feasibility study was published in two phases. The first considered a range of routes for the bullet train before a final route was chosen. This first phase report made it clear that one of the policy objectives of the project was to service regional populations. A central inclusion, for example, was a detailed study of commuter demand for a Newcastle-to-Sydney shuttle.[69]

But by the final report, this aspiration had been abandoned. The Newcastle-to-Sydney commuter service was dropped, and the authors acknowledged that the train had not been designed to be suitable for commuters.[70]

The reason was that it was too costly. To properly service regional towns, the train would need to stop in the centre of town, but this would involve more expensive land acquisition or more expensive tunnelling. Instead the proposed train route stopped kilometres outside each of the regional towns in its path. For example, the Newcastle station would be 20km from the Newcastle CBD, and the Gold Coast station would be inland near Robina to avoid built-up areas.[71] The cost of tunnelling under the Royal National Park also meant that Wollongong was not included in the route at all, despite being one of the largest regional population centres between Melbourne and Brisbane.

These design decisions made the final proposal cheaper, but compromised the bullet train's potential to service regional populations, a fact which was not accounted for in passenger number projections.[72]

Figure 2.12: Choosing a 4 per cent discount rate rather than the official 7 per cent made the bullet train proposal look much more favourable in a range of scenarios
Estimated benefit cost ratio of a Melbourne-to-Brisbane bullet train under a range of sensitivity tests
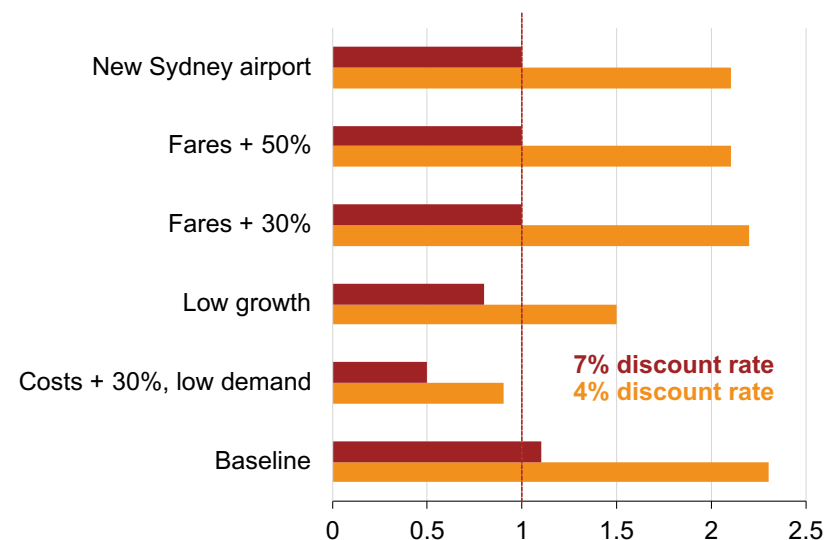
Notes: The baseline scenario (referred to as the 'reference case' in AECOM (2013a, p. 363)) uses median estimates for cost and demand. It also assumes that fares are set to be competitive with airfares and includes projections of economic growth and population growth. The 'low growth' scenario assumes per capita GDP growth rates are 0.3 per cent per year lower than in the baseline, and that population growth between 2010 and 2065 is 51 per cent, compared to 72 per cent in the baseline AECOM (ibid, p. 34).

Source: AECOM (ibid, p. 387).

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69. AECOM (2011, p. 45).
70. AECOM (2013a, p. 6).
71. Ibid (pp. 163, 177).
72. Decisions on station location would also have implications for land and property values in the area: Hensher et al (2012, p. 12).

As the feasibility study itself said:

> It should be noted that the [survey] respondents were commenting on a centrally-located station whereas, in the model test, most of the regional stations are not centrally located.[73]

2.3.4 A second Sydney airport will dampen demand for a bullet train

The 2013 study's favourable finding relied on an assumption that there would be no additional aviation capacity in Sydney.[74] But the situation has changed fundamentally since then. The Commonwealth has decided to go ahead with Western Sydney Airport, allocating an equity investment of $5.3 billion in the 2017 Budget.[75] It will build and own the airport, through the Western Sydney Airport Corporation.

The implication is that demand for an east-coast high-speed rail line has fallen. The 2013 study assumed, with no additional aviation capacity, that air journeys would become slower and less reliable, and an increasing number of passengers would use other means of travel or not travel at all.[76]

But from 2026, when the first planes are scheduled to take off from Western Sydney Airport, these constraints will be substantially lifted, and levels of unmet demand much reduced. Demand for long-distance travel more generally may be lower in the aftermath of COVID-19, as people find alternatives to travelling to meet in person.

2.3.5 The favourable result in the 2013 study assumed no cost overruns

The 2013 feasibility study for the bullet train calculated the costs of construction to be $130 billion in 2019 dollars. The report also included a 'worst case' estimate of $145 billion, and a 'best case' estimate of $116 billion.[77]

But cost overruns are common, and the characteristics of this project suggest the risks would be high. Most important is the scale and complexity of the project; large and more complex projects are more likely to overrun. Previous Grattan Institute analysis shows that a 10 per cent increase in a project's size (measured by cost estimate when first under construction) is associated with a 6 per cent higher chance of a cost overrun.[78]

This project also appears to have too little provision for 'worst case' cost outcomes. It has a worst case cost estimate just 11 per cent higher than its median cost estimate. But previous Grattan Institute analysis shows that the difference between median and worst case costs should be much larger, at 26 per cent.[79] The fact that there is only an 11 per cent difference indicates that either the median cost estimate is too high or – more likely – the worst case cost estimate is too low.

The report did consider the impact of a 30 per cent increase in costs and lower demand than expected, which would bring down the benefit cost ratio, using a 7 per cent discount rate, from 1.1:1 down to 0.5:1.[80]

If the feasibility study were repeated today with the source of funding included in the assessment, an Infrastructure Australia-mandated discount rate of 7 per cent, a more inclusive regional route, provision

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73. AECOM (2013c, p. 20).
74. AECOM (2013a, p. 392).
75. Treasury (2017, p. 4).
76. AECOM (2013a, p. 364).

77. Ibid (p. 17).
78. Terrill and Danks (2016, pp. 30–31).
79. Ibid (pp. 36–37).
80. AECOM (2013a, p. 398).

for a second Sydney airport, and a more realistic view of cost overruns, the benefits of a bullet train would almost certainly be well below the costs.

2.4 Conclusion

The arguments against a bullet train for Australia are strong. Our population is spread over very long distances. A bullet train would hinder rather than help efforts to reach net zero emissions by 2050. And a rigorous independent cost-benefit analysis conducted today would be unlikely to find net benefits to society.

However much a bullet train might have captured Australians' imagination, it is not a good use of public money. It should be abandoned.

The alternative vision, of boosting train speeds from capital cities to surrounding regions, is less expensive, less ambitious, and more promising – although it too would be unlikely to achieve much of what people hope it might, as we explain in the next chapter.

3 Rail renovations may be worthwhile, but they're unlikely to achieve all the goals set for them

Rail renovations are not as glamorous as bullet trains, more 'nation home improvement' than 'nation building'. Instead of laying thousands of kilometres of track, they seek to improve what is already there by electrifying, duplicating, and straightening out old track.

Governments are attracted to the idea that rail renovations could simultaneously take pressure off overburdened capital cities and boost struggling regions. As far back as 1973, the Whitlam government Minister for Urban and Regional Development, Tom Uren, talked of the 'pressing need to divert population away from overcrowded cities. . . Sydney and Melbourne particularly have felt this acute over-centralisation'.[81]

But the centrepiece of that plan – increasing Albury-Wodonga's population from 50,000 to 300,000 by the year 2000 – remains a dream; even in 2020, the twin cities are barely one third that size.[82] Of all the decentralisation efforts of the past century, the most successful has been Canberra, brought about in large part by a program of shifting entire government departments. But even Canberra undershot its population projections – strategic planning in the 1970s assumed the population would reach 500,000 between 1992 and 1996;[83] but even today, Canberra's population is below the half-a-million mark.[84]

Will this time be different? As we explain in this chapter, some current proposals may be worth doing, but they are unlikely either to take pressure off cities or boost regions.

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81. Uren (1973).
82. The other regional growth areas identified were Bathurst-Orange, Geelong, the Gladstone and Rockhampton area, Monarto in South Australia, and the Tamar region of Tasmania: Uren (ibid, pp. 307–308).
83. NCDC (1970, p. 143).
84. ABS (2020a).

3.1 Rail renovations won't take pressure off big cities

If people could live in a regional city or town while still keeping their capital city job, this could ease pressure on the capitals. It could reduce road congestion and make housing more affordable in the capitals. This is the logic behind the Federal Government's plan to use rail renovations to take pressure off cities and disperse the population.[85]

But of course, this is only relevant for regional cities and towns that are close enough to the capital for people to commute. And people's willingness to travel has its limits. Around the world and over time, people have shown that they're generally prepared to travel about an hour a day, or a little more.[86]

In Sydney, Melbourne, and Brisbane, half of commuters spend no more than half an hour travelling each way. A quarter spend no more than 15 minutes. These figures barely changed in the 18 years to 2018.[87]

Some people do spend longer commuting. In Melbourne and Brisbane, 10 per cent of commuters spend an hour or more each way, and in Sydney, 10 per cent spend 70 minutes or more.[88] But people whose commute is lengthy tend to tolerate it for only about a year,[89] before moving house or changing job to enable a shorter commute.[90]

Could regional rail renovations make it more attractive to commute to the capital city from a regional town or city? The next section

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85. Tudge (2019a).
86. Zahavi (1973); Zahavi (1979); Zahavi and Ryan (1980); Zahavi and Talvitie (1980); Marchetti (1994); Schafer and Victor (1997); Ausubel et al (1998); and Ausubel and Marchetti (2001).
87. Grattan analysis of HILDA (2019).
88. Terrill et al (2018, p. 13); and Terrill et al (2019a, pp. 7–8).
89. BITRE (2016, p. xxvi).
90. Ibid (p. v).

identifies the towns and regional cities from which it would be most feasible for people to commute to the capital. But a limiting factor is that it's really only CBD workers who commute into the capital by train (Section 3.1.2), and many of them are already as well or better served with public transport into the central city as people in outer suburbs (Section 3.1.3).

3.1.1 Some rail renovation proposals aren't even intended to take pressure off cities

A small but significant number of workers currently commute into the major capital cities from outside. The biggest daily influx to Sydney is from the Central Coast region, which is home to 25,000 Sydney workers. Another 19,000 come from the city of Wollongong. The biggest for Melbourne is from Geelong, from which more than 14,000 commute, and Melton (although Melton is often considered part of the city). For Brisbane, it's the 29,000 who commute from the Gold Coast (Table 3.1).

These regional cities are all being considered for rail renovations, but so too are Traralgon, Parkes, and Albury-Wodonga – cities and towns that are just too far away for people to commute to the capital.

The destinations where rail renovations would lead to the most feasible commutes are Wollongong, Geelong, and the Gold Coast. Ballarat would also become feasible for many people, and an upgrade of the Ballarat line would be good for commuters from Melton and Bacchus Marsh (Figure 3.1 on the next page).

Table 3.1: The most common commuter sources outside of capital cities
Number of regular commuters from a regional place into capital cities

Rank	Source	Capital	Commuters
1	Gold Coast/Tweed Heads	Brisbane	28,528
2	Central Coast	Sydney	25,059
3	Wollongong	Sydney	19,004
4	Melton	Melbourne	15,181
5	Geelong	Melbourne	14,467
6	Sunshine Coast	Brisbane	7,214
7	Gisborne/Macedon	Melbourne	5,224
8	Bacchus Marsh	Melbourne	4,070
9	Picton/Tahmoor/Buxton	Sydney	3,622
10	Douglas Park/Appin	Sydney	3,196
18	Newcastle/Maitland	Sydney	2,547
28	Ballarat	Melbourne	1,956
64	Toowoomba	Brisbane	743
65	Bendigo	Melbourne	700
66	Morisset/Cooranbong	Sydney	680
112	Traralgon/Morwell	Melbourne	301
131	Moe/Newborough	Melbourne	209
137	Albury/Wodonga	Melbourne	191
139	Bathurst	Sydney	189
140	Shepparton/Mooroopna	Melbourne	182

Notes: Sources are Significant Urban Areas (SUAs), (each comprised of several SA2s), and individual SA2s that are in no SUA. Capital cities also use the SUA definition. The commuter numbers include anyone whose regular SUA of employment is a capital city and whose usual residence is a different SUA or non-SUA SA2.

Source: ABS (2017).

Figure 3.1: Some regional rail renovations appear more likely than others to induce more people to commute to the CBD
Percentage of employed locals in each suburb who regularly commute to the CBD
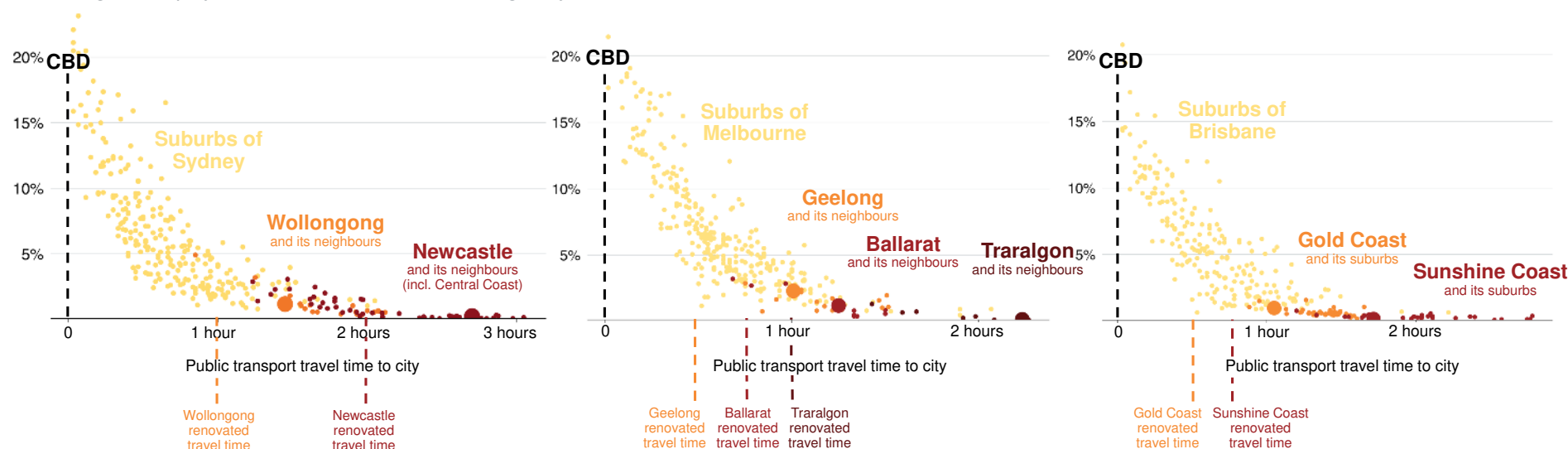
Notes: Renovated rail travel times are from Figure 1.2. Current travel times reflect the fastest timetabled service arriving in the CBD around 9am on a weekday. The yellow dots highlight the suburbs in the Sydney, Melbourne, and Brisbane SUAs respectively. The darker dots correspond to the regional cities as labelled. The largest dot for each regional city is the location of the main train station (e.g. Newcastle Station, Geelong Station). The other dots are either suburbs of the regional city, or places where the train stops before reaching the capital city (e.g. Melton and Bacchus Marsh for Ballarat, and the Central Coast for Newcastle). It is not possible to directly compare the travel times on these charts with the median commute length of 30 minutes derived from HILDA, because HILDA includes door-to-door travel time but these charts only include the time spent on public transport.

Source: Grattan analysis of ABS (2017), Transport NSW (2020), PTV (2020), TransLink (2020), Google Maps API (2020), Australian Government (2019), Tudge (2019a), Prime Minister of Australia (2019), Liberal Party of Australia (VIC) (2018) and Rail Projects Victoria (2020b).

Commuting from other destinations would be feasible for some people in some circumstances. Newcastle would still be a very long train ride away from Sydney, as would Central Coast towns on the same line. Difficult topography remains a significant barrier. Commuting to Brisbane might be feasible for people from southern parts of the Sunshine Coast, but not for people from northern parts. For many commuters from these regional cities and towns, commuting may continue to be infeasible by train, but feasible by car.

3.1.2 Where rail destinations are within a plausible commute, it's overwhelmingly CBD commuters who take the train

Most metropolitan jobs aren't in the CBD. In Sydney and Melbourne, about 15 per cent of jobs are in the CBD, and in Brisbane about 12 per cent. Most jobs are dispersed all over the city, with no suburb having more than about 3 per cent of the city's jobs.[91]

And that dispersion of jobs explains in large part why most people drive to work. While most CBD commuters take public transport, most commuters to anywhere else in the city drive to work.

It's the same for regional commuters. Most work in the suburbs, not the CBD. And people who are commuting from regional cities are only taking public transport if they work in the CBD (Figure 3.2).

Figure 3.2: Most regional public transport commuters are CBD workers
Number of commuters
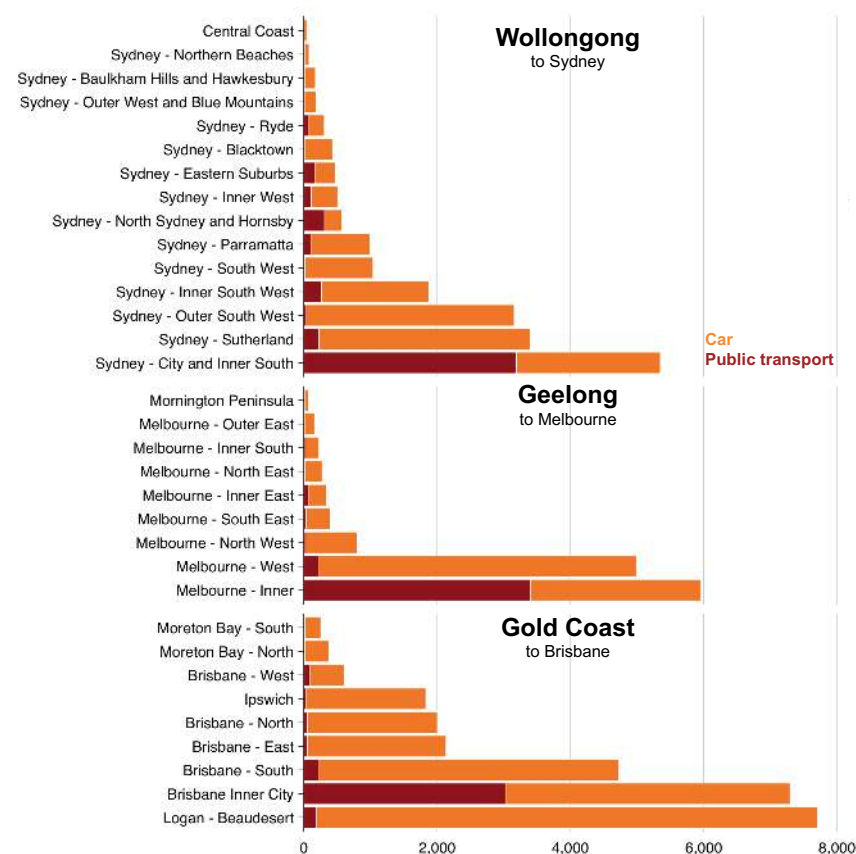
Notes: Includes anyone whose usual residence is in the Wollongong, Geelong, and Gold Coast SUA and whose place of regular employment is in one of the SA4s in the Greater Capital City statistical areas of Sydney, Melbourne, and Brisbane.

Source: ABS (2017).

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91. Terrill et al (2018, pp. 14–16).

While it could be that some non-CBD workers would switch from driving to taking the train if a faster commuter service was available, it's not likely that many would. That's partly because the greater the number of suburban stops, the slower the renovated rail would become. It's also because many people who work outside the CBD have ready access to parking, and the convenience of driving direct to the workplace and parking will often outweigh the convenience of a shorter time on a train. That's particularly true for people who have to carry tools and equipment, do school drop-offs, manage a disability, or simply prefer car travel.

Beneficial as rail renovations may be to CBD workers who live in regional centres that aren't too far away, the numbers of extra commuters are unlikely to be large.

- If the 3,200 people who currently commute by public transport from Wollongong to the Sydney CBD were to double, due to Sydneysiders moving to Wollongong but keeping their Sydney job, this would account for just 3.7 per cent of Sydney's population growth in 2018-19.

- If Geelong's 3,400 public transport commuters to the Melbourne CBD doubled, that would be just 3.0 per cent of Melbourne's population growth in a year.

- A doubling of the 3,000 currently commuting by public transport from the Gold Coast to the Brisbane CBD would account for 5.8 per cent of Brisbane's population growth in a year.[92]

Even if hundreds of thousands of people moved out of Sydney and Melbourne, it wouldn't be noticeable to those who remained. For instance, Victoria's population grew by 138,000 to 6.4 million in the year to June 2018 – and that's well over the entire population of Ballarat in a single year.[93]

3.1.3 More people would benefit from better public transport in outer suburbs

If rail renovations led to the trip times claimed, then some regional cities would have public transport trip times to the CBD that are comparable to those for many metropolitan travellers. This would be true for Wollongong, Geelong, Ballarat, and the Gold Coast, as the previous section explained.

In fact, these trip times would be shorter than those for many metropolitan travellers. There are quite a few areas of Sydney, Melbourne, and Brisbane where a trip to the CBD by public transport takes more than an hour, not counting the time at either end getting to the station or bus stop, or getting to the final destination.

These suburbs with CBD journey times of close to or even longer than an hour include:

- Fairfield, Penrith, Richmond, and parts of Campbelltown in Sydney;

- Frankston, Pakenham, Berwick, and parts of Casey in Melbourne; and

- Burpengary, Redcliffe, Beenleigh, and parts of Ipswich in Brisbane.

The public transport journey times into the CBD for these suburbs, and others like them, are illustrated in Figure 3.3 on page 38, Figure 3.4 on page 39, and Figure 3.5 on page 40.

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92. ABS (2020b); and ABS (2017).

93. IV (2019, p. 10).

As well as poorly connected outer suburbs, there are also black-spot suburbs closer to the city where commuters face longer public transport times than people in neighbouring suburbs. These black-spots include:

- Carlingford and Bankstown in Sydney;

- Manningham, Knox, and Keilor in Melbourne; and

- Centenary in Brisbane.

Because of the numbers of people affected, improving outer-suburban public transport and suburban black-spots can make commuting to jobs beyond the local area more feasible for a much larger number of people than regional rail renovations. Improving metropolitan train lines can also benefit regional commuters, where regional and metropolitan services are separated and timetables are integrated. For example, the Melbourne Metro Tunnel will reduce journey times by up to 15 minutes for regional rail lines in Victoria.[94]

3.1.4 Conclusion

While regional rail renovations are intended to take pressure off capital cities, by enabling people to move to a regional city or town and keep their city job, there is little reason to believe that they will. That's because, even for those destinations within a plausible commute, rail commuting is predominantly for the small subset of regional commuters who work in the CBD. Meanwhile, some metropolitan commuters face equivalently long trips, and the numbers who could benefit from improvements are much higher.

Easing pressure on capital cities is one part of the rail renovation aspiration. Politicians also claim that the trains will transform the towns themselves. In the next section, we show why this is unlikely too.


94. Rail Projects Victoria (2018).

Figure 3.3: Many outer suburbs have long commutes into the Sydney CBD, in some cases comparable to Wollongong
Minutes taken on public transport to arrive in the CBD at about 9am on weekdays
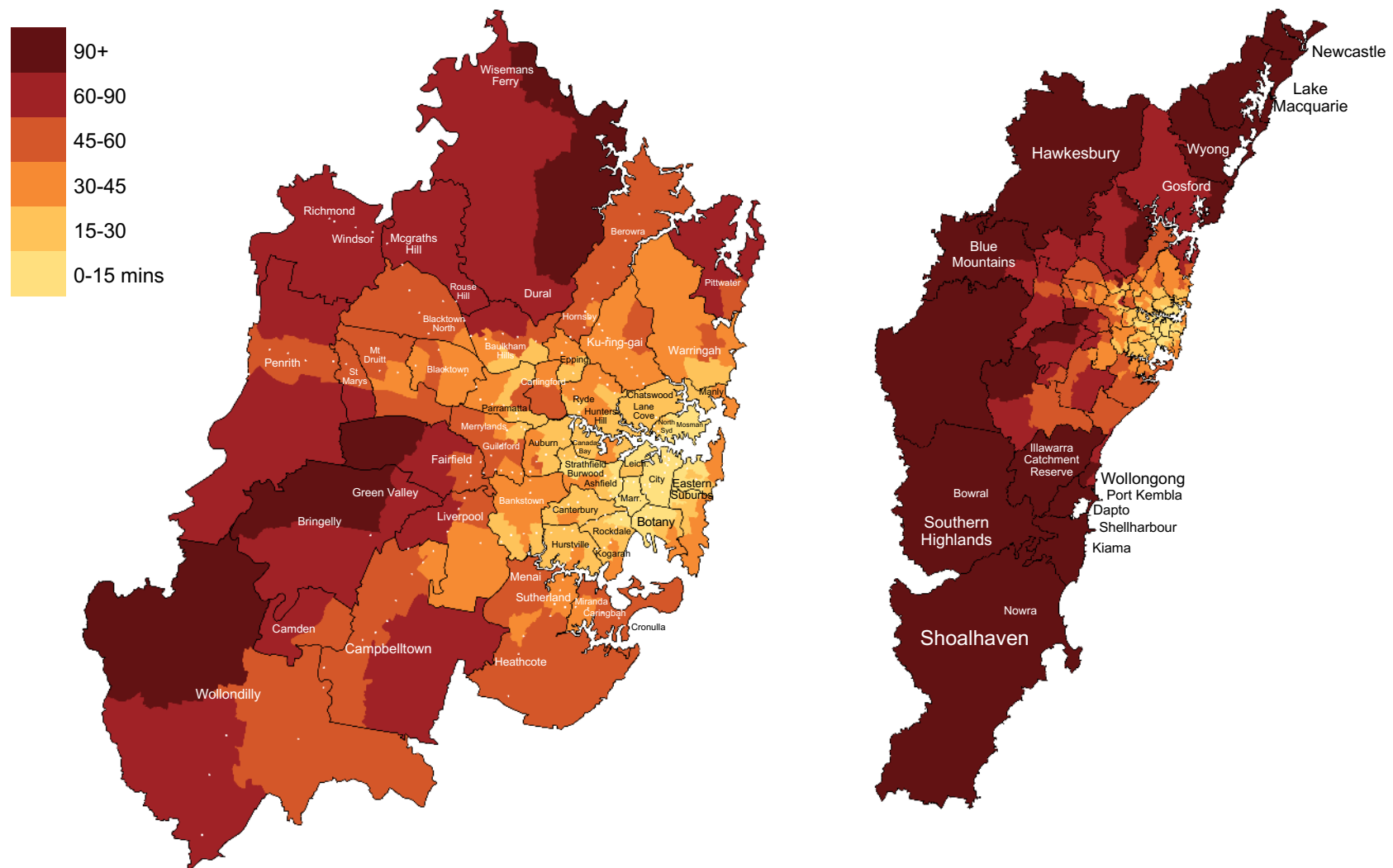
Notes: A unique travel time was calculated from each suburb to the 'Sydney – Haymarket – The Rocks' SA2. The travel time measures the time it takes to reach the city closest to 9am on weekdays using the fastest public transport mode available, according to the timetable. For suburbs with no direct-to-city services, driving time to reach the nearest suburb with a direct-to-city service was added. Dots show train stations. Black borders SA3s and labels show notable place names.

Source: Grattan analysis of Transport NSW (2020) and Google Maps API (2020).

Figure 3.4: Many outer suburbs have long commutes into the Melbourne CBD, in some cases comparable to Geelong and Ballarat
Minutes taken on public transport to arrive in the CBD at about 9am on weekdays
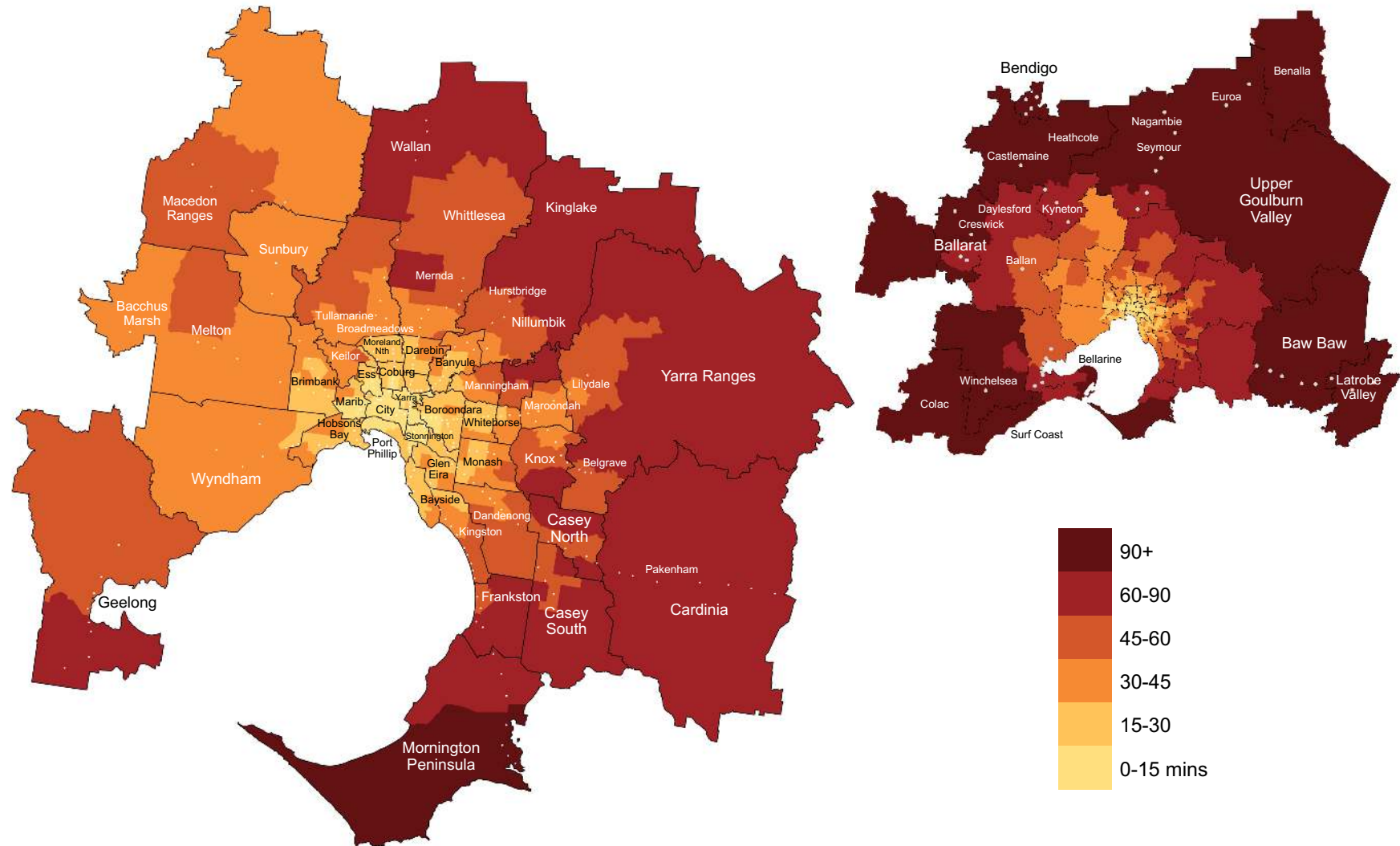
Notes: A unique travel time was calculated from each suburb to the 'Melbourne', 'Docklands', and 'Southbank' SA2s. The travel time measures the time it takes to reach the city closest to 9am on weekdays using the fastest public transport mode available, according to the timetable. For suburbs with no direct-to-city services, driving time to reach the nearest suburb with a direct-to-city service was added. Dots show train stations. Black borders SA3s and labels show notable place names.

Source: Grattan analysis of PTV (2020) and Google Maps API (2020).

Figure 3.5: Many outer suburbs have long commutes into the Brisbane CBD, in some cases comparable to the Gold Coast
Minutes taken on public transport to arrive in the CBD at about 9am on weekdays
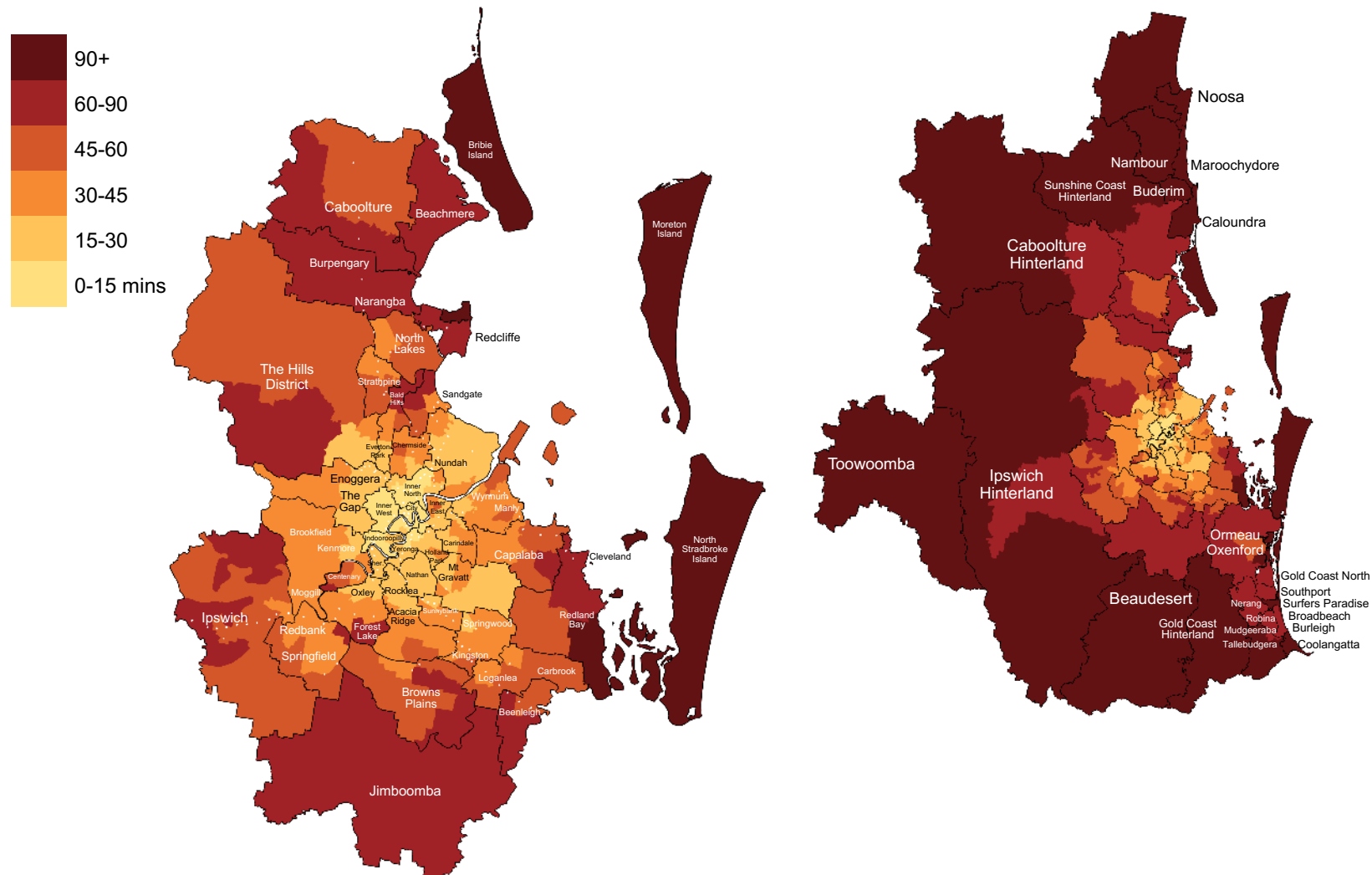
Notes: A unique travel time was calculated from each suburb to the 'Brisbane City' SA2. The travel time measures the time it takes to reach the city closest to 9am on weekdays using the fastest public transport mode available, according to the timetable. For suburbs with no direct-to-city services, driving time to reach the nearest suburb with a direct-to-city service was added. Dots show train stations. Black borders SA3s and labels show notable place names.

Source: Grattan analysis of TransLink (2020) and Google Maps API (2020).

3.2 Rail renovations aren't likely to boost regions

Politicians of all stripes are bullish about the potential of quicker rail connections to boost regional economies. They claim that faster rail connections to capital cities will 'provide a catalyst for greater investment in the regions',[95] 'revolutionise... regional development',[96] and could 'transform' regional towns.[97] Many stakeholders and academics agree.[98]

There's a particular question about the potential to boost economies in towns and cities that are too distant from the capital to be commuter dormitories. This includes places like Parkes, Albury-Wodonga and Traralgon.

While there's nothing wrong with better transport links, it's far from clear that faster passenger rail would boost towns and regional cities distant from the capital, or how it could.

Faster passenger rail is a puny force against 100 years of inexorable urbanisation (Section 3.2.1). The best evidence suggests the capital would be more likely to gain at the expense of the town or distant regional city, not vice versa (Section 3.2.2 on page 44). Improving internet and mobile connectivity and freight links would do more for towns and distant regional cities than speeding up passenger rail (Section 3.2.3 on page 44).

3.2.1 Rail renovations are a puny force against a hundred years of inexorable urbanisation

Since the existing regional rail network was rolled out in the 19th century to a then-thriving countryside and regional economy, there has been a steady population decline in the share of the population outside major cities, driven by powerful economic forces.[99] The strong trend has been to centralisation of population and activity, a decline in rural inland towns, and growth in coastal locations.[100]

Capital cities have grown massively, particularly in the first half of the past century, from about one third of the population in 1911 to two thirds today (Figure 3.6 on the next page). Regional cities have also become more important, more than doubling their population share from 8 per cent in 1911 to 17 per cent today. But the biggest change of all has been the place of regional towns and rural areas – in 1911 they once accounted for 54 per cent of the population; today it is only 16 per cent.[101]

An important force underlying these changes has been transport technology. There has also been a profound shift in industry mix, with reduced employment in traditional industries and less need to produce goods locally for local consumption. Factors determining where we choose to live have changed, both because greater wealth allows more choice, and also because it's a more complex decision in families where both partners in a couple are – or wish to be – in paid employment.[102]

95. Australian Government (2019, p. 1).
96. Albanese (2019).
97. Rice (2018).
98. For example, see McIntosh in Standing Committee on Infrastructure, Transport and Cities (2016, p. 30); Rail Futures Institute (2016); Holliday in Standing Committee on Infrastructure, Transport and Cities (2018, p. 94); Arup (2019, p. 2); Juturna (2019); and McNaughton (2019).

99. BITRE (2014, p. 2).
100. BITRE (2014, p. v); and Daley and Lancy (2011).
101. ABS (2019c).
102. BITRE (2014, p. 6); and SGS Economics and Planning Pty Ltd (2019a).

Cities are a magnet for people because they offer important advantages. There are higher-paid jobs available in the city, and if someone loses their job, they are more likely to find another one quickly. Working with other specialists helps people to further develop their own skills.[103] And there are more opportunities for informal learning where there is a greater density of people with overlapping interests.[104]

While jobs are fundamental, people are also lured to cities by other opportunities. There is a much greater range of cultural, leisure, and service options, meaning that not only mainstream but also niche interests can find a place. A larger centre is more able to sustain a doctor specialising in migraines, a Serbian-language church, or a weekend hackathon.

The other side of the coin is business. The reason businesses pay staff more, on average, in the city is that city workers are, on average, more productive. Sydney's contribution to GDP per capita is much higher than that of the rest of NSW (Figure 3.7 on the following page). The same is true of Melbourne and the rest of Victoria. Queensland is the exception: Brisbane's output per capita is only marginally higher than the rest of Queensland's, reflecting that state's more dispersed population and the significant mining output of some of its regions.[105]

Figure 3.6: Many people have left small towns for larger cities over the past 100 years
Percentage of population living in capital cities, regional cities, and regional towns and rural areas, 1911-2016
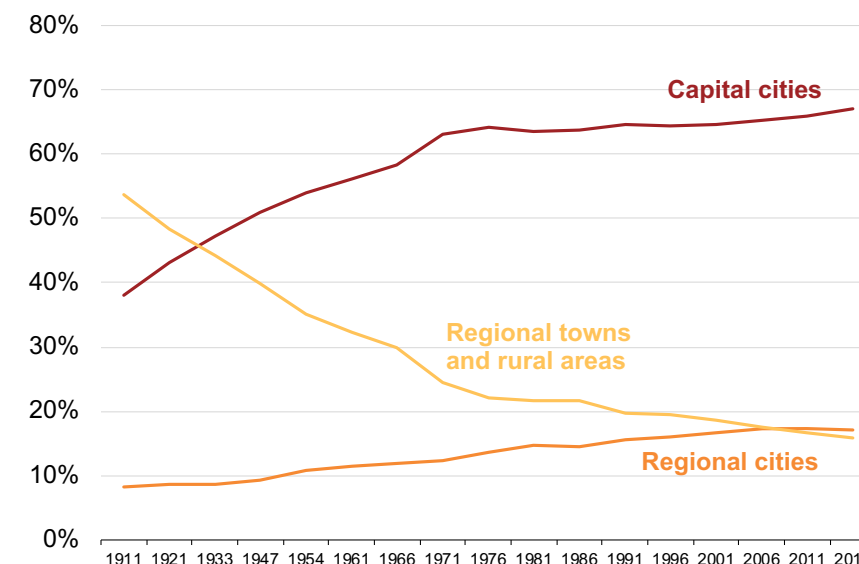
Notes: Regional cities refers to 'Other major centres' in the ABS historical population statistics 2019. These all had a population of at least 25,000 in 2016. The years on the horizontal axis reflect the dates for which ABS data was available, and therefore the intervals before 1961 are not consistent.
Source: Grattan analysis of ABS (2019c).

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103. Moretti (2012, pp. 126–127).
104. Duranton and Puga (2004); Rosenthal and Strange (2004); and Gibbons and Graham (2018).
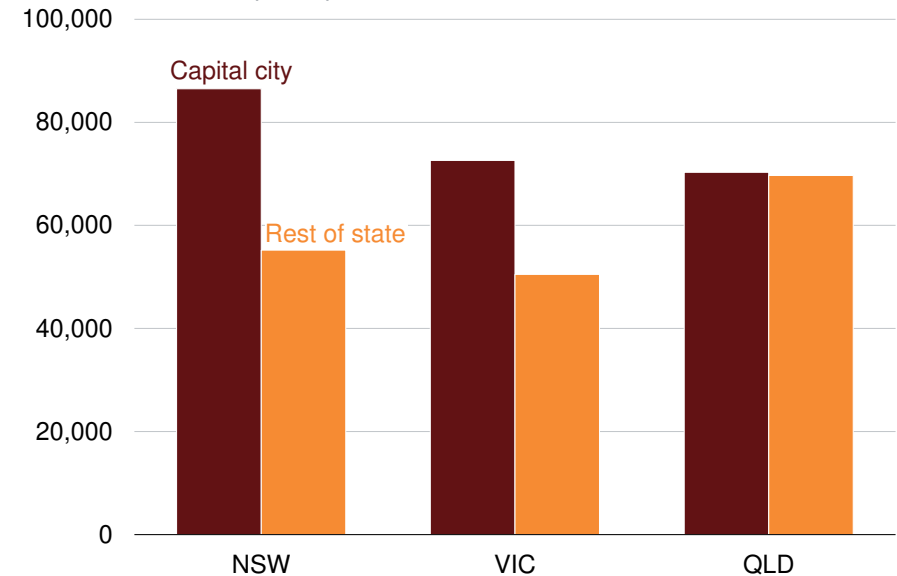105. SGS Economics and Planning Pty Ltd (2019b, p. 31).

City firms tend to be more productive because they draw on a deeper pool of potential staff, including more specialists. People tend to change job more often in larger cities than in smaller centres, so people who have developed their skills with one employer spread that expertise to the next one more quickly. Businesses also reap the benefits of shared infrastructure such as ports, that tend to be higher-quality where there are more users.

Of course, there are some businesses where the advantages of a big city don't stack up. This might be because it's more important to that business to have plenty of space than it is to pay a premium to be closer to customers or suppliers. It could be that the business does not have a use for specialists, and is happy to work with a smaller local pool of labour. These businesses are probably already operating in regional centres, or considering doing so.

Every person and every business is different, but the simple fact is that far more prefer cities to regions, for a range of reasons, both in Australia and around the world. This means a successful attempt to decentralise would need to involve much more than a quicker passenger rail trip to the capital.

Figure 3.7: Output per person is higher in capital cities
Contribution to GDP per capita, $

Source: SGS Economics and Planning Pty Ltd (2019b, p. 12).

3.2.2 Trains go both ways, and the regions may lose more than they gain

Supporters of faster trains assume that the benefits will flow to the regional city or town. But it's actually more likely that the greatest benefit will flow in the opposite direction.

This is what has happened overseas. In France, the high-speed network benefited the second-tier cities of Lyon and Lille, but not by as much as it benefited Paris.[106] Even the headquarters of the railway company shifted from Lyon to Paris.[107] And those benefits that did accrue to Lyon and Lille came at the expense of smaller surrounding towns. Meanwhile, struggling mining towns such as Le Creusot suffered further declines after the train came to town. And while a town might have more tourists if there is a faster train, some places have had more day visitors but fewer overnight stays.[108]

More broadly, a report for the United Kingdom's HS2, linking London with Manchester and Leeds, concluded that 'most studies indicate that it would be unwise to pin much faith in new railways as an engine of growth'.[109] Many supporters of rail renovations,[110] government agencies,[111] and other commentators[112] acknowledge that fast trains

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106. Denham and Dodson (2019).
107. Tomaney and Marques (2013, p. 419).
108. Esteban Martin (1998); and Albalate and Bel (2012).
109. Gourvish (2010, p. 26). Similar findings are reported in Levinson (2012).
110. For example: Rail Futures Institute (2016), The Committee for Sydney (2018) and Arup (2019).
111. For example: National Faster Rail Agency and Infrastructure and Project Financing Agency (2019, p. 14) and Department of Infrastructure and Regional Development in Standing Committee on Infrastructure, Transport and Cities (2016, p. 31).
112. For example: AECOM in Standing Committee on Infrastructure, Transport and Cities (ibid, p. 31); Vickerman (2018); Button (2017); Dodson in Standing Committee on Infrastructure, Transport and Cities (2018, p. 74); and Denham and Dodson (2019).

won't make much difference on their own, emphasising the need for complementary regional development measures.

Even the authors of the 2013 feasibility study for a Melbourne-to-Brisbane bullet train said any regional development from the project was too uncertain to be considered in their cost-benefit analysis. In fact, they found that the project could damage towns along the route:

> The history of the impact of transport improvement in Australian towns is that they concentrate activity in the larger centres and create commuter towns lacking in higher-level services. Without concerted efforts to the contrary, this is also a likely outcome of the introduction of HSR [high-speed rail].[113]

The tendency when faster trains are built is for the cities that are already ahead to get further ahead, and those that are behind to fall further behind. That's because the productive advantages of cities are mutually reinforcing; the most productive areas are likely to provide a more competitive business environment, and have an advantage over weaker areas – an advantage that's more likely to be reinforced than countered by making it easier for people to seek goods and services elsewhere.[114]

3.2.3 Regions have more pressing needs than faster trains to capitals

Many of these regions and smaller cities have more pressing needs than faster rail connections to the capital.

Better internet and mobile connectivity and better freight links are two of the biggest needs, according to the long-term strategies of the infrastructure advisory bodies of NSW and Victoria.[115] Both strategies also point to poor transport links between regional centres

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113. AECOM (2013a, p. 460).
114. Lafourcade and Thisse (2008); and Puga (2002).
115. INSW (2018, p. 74); and IV (2016, p. 43).

and surrounding communities, and other deficiencies in basic services such as health and education.

And if large numbers of people did move out of the larger capital cities, it would put significant pressure on energy, water, and local transport infrastructure – as well as fundamentally changing the character of the regional cities and towns.[116]

The NSW strategy states that only very modest improvements are likely to be feasible on the lines between Newcastle, Sydney, and Wollongong without immense cost due to geographical constraints. It recommends instead that options for a new connection between Wollongong and western Sydney should be canvassed.[117]

The Victorian strategy recommends improving rail service capacity and extending services, rather than speeding up services. In particular, it recommends new stations along the Geelong-to-Melbourne line, and increased capacity on the Cranbourne, Pakenham, and Gippsland lines. It also recommends upgrading the rail link from Waurn Ponds to Geelong, and the section of rail north of Bendigo.[118]

Queensland's long-term infrastructure plan also places higher priority on rail frequency and new services than speed improvements. The plan's highest priority for south-east Queensland is better road connections. It also emphasises that Cross River Rail, when completed, will allow more frequent public transport services across south-east Queensland by removing a bottleneck in central Brisbane.[119]

3.3 Conclusion

Faster trains are unlikely to ease pressure on capital cities. They're unlikely to provide a significant economic boost to the regions either,

particularly places that are distant from the capital. Trains go both ways, and it's much more likely that the greatest benefits will flow towards big cities, because people and businesses tend to prefer cities. That's not to say that regional towns and cities don't have infrastructure needs, but that faster passenger rail to the capital city is not top of the list.

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116. IV (2019, p. 18).
117. INSW (2018, pp. 123–127).
118. IV (2016, pp. 150–154).
119. Queensland Government (2019b, pp. 42–43, 65–95).

4 How governments should decide whether to invest in rail renovations

Much of what is claimed for rail renovations is overblown. But that doesn't mean that none of those rail renovations would be worthwhile.

So how should governments decide what to do? First, they should clearly identify what problem they are seeking to solve. Second, they should identify the potential solutions to that problem. And finally, they should conduct a rigorous, like-for-like analysis of the feasible options, to establish which, if any, is most worthwhile.

4.1 What is the problem you are trying to solve?

The Commonwealth Government and the states don't agree on exactly what they want from rail renovations.

According to the Commonwealth, the primary purpose of rail renovations is to alter the distribution of population across the country.

> [Rail renovations] are designed to disperse the population and support our regional areas to grow and prosper...These changes are about easing population pressures in our biggest cities, while ensuring regional communities are given a much-needed boost.[120]

It envisages that faster rail:

> ...will connect satellite regional cities to our big capitals. This will enable people to reside in regional centres with its cheaper housing and regional lifestyle but still access easily and daily the major employment centres.[121]

It also envisages that people will go 'to the smaller cities and regional areas that are crying out for workers'.[122]

State governments' goals are similar, but more modest and incremental. The NSW Government's objectives are to better link regional centres to each other and to Sydney, giving people greater choice about where they live and how they commute to work. The NSW Government also wants to make it 'easier to invest, do business, build a lifestyle, and visit our regional towns'.[123]

The Victorian Government says rail renovations to Geelong and Ballarat are intended to 'meet unprecedented demand and enable regional Victoria to grow and be a destination of choice'.[124] Upgrades to the lines to Traralgon, Warrnambool, Bendigo, Wodonga, and Shepparton are intended to 'improve the reliability of the regional public transport network, enhance the passenger experience, and support local economies'.[125]

The Commonwealth and state objectives seem reasonably aligned, but the jurisdictions don't necessarily agree on how to meet them. For instance, while the Commonwealth and Victorian governments are committed to upgrading the passenger rail line between Geelong and Melbourne, media reports have suggested that they have different preferences as to what path the upgraded line should take.[126]

If there isn't clear alignment on the problem to be solved, it will be hard to judge whether a rail upgrade is a success.

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120. Tudge et al (2019b); and Tudge et al (2019a).
121. Tudge (2019c).
122. Ibid.

123. Premier of NSW (2018).
124. Rail Projects Victoria (2020b).
125. Victorian Government (2020b).
126. Jacks (2019a); and Jacks (2019b).

4.2 What options are available to solve that problem?

Many of the problems being targeted by governments could be tackled with more direct policies that do not involve the cost and disruption of major rail projects. Governments should explore and exhaust these alternative solutions before reaching for an infrastructure solution.

4.2.1 Congestion charging is the most effective way to reduce congestion

The Commonwealth proposes to use rail renovations to ease congestion in cities by making it easier for people to live in the regions and commute. But the most direct way to tackle congestion on roads and crowding on public transport is pricing reform. People who wish to use the most in-demand transport infrastructure at the most in-demand times should pay more.

Grattan's 2019 report, *Why it's time for congestion charging*, makes the case in detail for using congestion charging to manage our cities' busiest roads.[127] The companion report, *Right time, right place, right price*, shows how it could be done in Sydney and Melbourne.[128]

Charging is not only the most direct way to deal with congestion, it is the most effective. If new fast trains encourage some people to move out of the city, their places may simply be taken up by other people moving in. As Grattan's congestion charging reports showed, charging does not suffer this 'induced demand' problem.

4.2.2 Relaxing zoning restrictions would make housing more affordable

The Commonwealth sees rail renovations as a way of helping people move to cheaper housing in the regions while keeping their city jobs

and social connections. But the most direct way governments can make housing cheaper is by relaxing restrictive zoning regulation.

A huge part of the cost of a home is zoning regulation. In fact, zoning restrictions constitute a larger element of the cost of an average house in Sydney and Melbourne than either the physical land or the dwelling structure, according to the Reserve Bank of Australia.[129] In Sydney, the dwelling structure accounts for 34 per cent of the total, the physical land 24 per cent, and zoning regulations the remaining 42 per cent. The proportions are similar in Melbourne. For Brisbane, the dwelling structure accounts for 49 per cent of the price of an average house, the physical land 21 per cent, and the zoning regulations 29 per cent.

The implication is that zoning restrictions raise the price of the average house in Sydney by 73 per cent above the value of the structure and land; this amounts to almost an extra half-a-million dollars. In Melbourne, the price of an average house is 69 per cent higher because of zoning restrictions, and in Brisbane 42 per cent higher.

Zoning restrictions are a creation of governments. If governments relaxed zoning restrictions, more people could afford to live in our larger cities if they wished to.[130]

4.2.3 Metropolitan rail improvements are more likely to improve access to jobs for many more people

Faster rail between regional centres and capital cities could make commuting to the capital newly feasible for some people. But more people would benefit from improvements to public transport within the capital.

Metropolitan rail improvements such as the Melbourne Metro project can yield a much broader spread of connectivity benefits, including to

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127. Terrill et al (2019a).
128. Terrill et al (2019b).

129. Kendall and Tulip (2018, p. 10).
130. Terrill et al (2018, pp. 44–46).

people travelling on regional trains that link to the metropolitan network and especially for people seeking better access to jobs. In Chapter 3 we identified several outer suburbs and suburban black-spots that are poorly connected today.

4.2.4 Small can be beautiful

Rail renovations are not on the grand scale of bullet trains, but they are still big projects. And it's a truism of politics that big infrastructure projects are more exciting than small ones, to politicians and to the public.

But big projects are also more risky and more likely to exceed their budgets.[131] And the preference for big projects over small fails to recognise the highly dispersed nature of employment.[132]

Governments should do more to identify the myriad small projects with potentially high net benefits that may be dispersed all over the city. Examples include increasing bus services in areas of high demand,[133] removing level crossings, and alleviating pinch-points on the existing road network.[134]

4.3 Use cost-benefit analysis to assess whether any of the options are worthwhile

Governments have committed to prepare business cases for their proposed rail renovations. But ministers should not lead the public to believe that the decision to conduct a business case is a decision to proceed with the rail projects themselves.

Cost-benefit analysis is essential. It quantifies not only financial costs and benefits, but non-financial benefits such as a reduction in travel times.

A project would make the community as a whole better off if its benefits exceed its costs. If the costs exceed the benefits, or if there is another option with higher net benefits, then the government should not build the project. Instead, it should spend the money on any number of other priorities, such as other infrastructure, more hospital beds, or paying down debt.

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131. Terrill and Danks (2016).
132. Terrill et al (2018, p. 49).
133. IV (2018, p. 5).
134. INSW (2018, p. 16).

Appendix A: List of international bullet trains and rail renovations

The following table catalogues examples of bullet trains and rail renovations around the world. The list is based on a data base maintained by the International Railway Union UIC (2020). This is the most comprehensive international data base available but may not be exhaustive. A bullet train is defined as a rail line with a dedicated track built to facilitate speeds faster than 250km/h. UIC only catalogues renovations to existing rail lines that achieve speeds of at least 200km/h, so these are the only ones included in the table. The UIC list does not include rail renovation proposals in Australia on its list of proposed renovations.

'Planned' projects are either being built or have been approved for construction. 'Proposed' projects, denoted by an asterisk (*), have not been approved but have been studied by governments.

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
AFRICA				
Egypt			Alexandria – Cairo (210km) Luxor – Hurghada (300km)	Cairo – Luxor – Aswan (690km)
Morocco	Tangier – Kenitra (200km)		Kenitra – Rabat – Casablanca (139km) Rabat – Fes (204km)* Casablanca – Marrakech – Agadir (448km)*	
South Africa			Johannesburg – Durban (610km)* Johannesburg – Cape Town (1,300km)* Johannesburg – Zimbabwe border (480km)*	

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
ASIA PACIFIC				
Australia			Melbourne – Sydney – Brisbane (1,749km)*	
China	Extensive network connecting most major cities (27,527km) Largest hubs include: Beijing Changsha Chengdu Chongqing Fuzhou Guangzhou Guiyang Hangzhou Jinan Nanjing Tianjin Shanghai Shenyang Shenzhen Wuhan Xi'an Zhengzhou Concentrated in the Eastern half of the country with the exception of the Lanzhou – Ürümqi western link (1,785km)	Several connections complementing dedicated system (7,861km)	3,768km planned	2,457km planned with speed unclear

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
India			Mumbai – Ahmedabad (508km) Mumbai – Pune (185km)* Delhi – Jaipur – Jodhpur (530km)* Delhi – Patna – Kolkata (991km)* Delhi – Pakistan (480km)* Chennai – Hyderabad (720km)* Chennai – Kochi – Thiruvananthapuram (1,080km)*	
Indonesia			Jakarta – Bandung (142km)	Jakarta – Surabaya (715km)
Japan	Tokyo – Nagoya – Kyoto – Osaka – Hiroshima – Hakata – Kagoshima (1,326km) Tokyo – Fukushima – Sendai – Morioka – Aomori – Hakodate (824km) Tokyo – Takasaki – Niigata (270km) Tokyo – Nagano – Kanazawa (345km)		Hakata – Nagasaki (66km) Hakodate – Sapporo (211km) Kanazawa – Tsuruga (125km) Tokyo – Nagoya – Osaka (maglev, 438km)	
Kazakhstan			Astana – Almaty (1,011km)*	
Malaysia, Singapore			Kuala Lumpur – Singapore (335km)*	

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
South Korea	Seoul – Daegu – Busan (418km) Seoul – Gangneung (230km) (Seoul –) Osong – Gwangju (184km) Suseo – Pyeongtaek (61km)		Gwangju – Mokpo (49km)*	
Taiwan	Taipei – Kaohsiung (345km)			
Thailand			Bangkok – Nakhon Ratchasima – Vientiane (608km) Bangkok – Rayong – Trat (390km)* Bangkok – Hua Hin – Malaysia (976km)* Bangkok – Phitsanluok – Chiang Mai (668km)*	
Vietnam			Hanoi – Ho Chi Minh (1,600km)*	
EUROPE				
Austria		Vienna – Linz – Salzburg (218km partial)		Vienna – Slovakia (38km partial) Vienna – Czech Republic (47km partial) Innsbruck – Italy (46km partial) Graz – Slovenia (122km partial)

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
Belgium	Brussels – France (72km) (Brussels) – Leuven – Liège – Germany (101km) Antwerp – Netherlands (36km)			
Czech Republic		Prague – Pilsen (64km partial)	Prague – Germany (85km)* Prague – Poland (158km)* Prague – Brno (152km) Brno – Austria (58km)*	Prague – Pilsen (25km remainder) Prague – Germany (137km) Brno – Austria (58km) Brno – Poland (147km) Pilsen – Germany (58km)
Denmark		Copenhagen – Ringsted (56km)		
Estonia			Tallin – Latvia (213km)	
Finland		Helsinki – Oulu (673km) Helsinki – Turku (156km) Helsinki – Lahti – Luumaki (194km) Jämsänkoski – Jyväskylä (53km) Kinni – Mikkeli (44km)		

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
France	Paris – Germany (457km) Paris – Lyon – Marseille, Montpellier (806km) Paris – Bordeaux (632km) Paris – Lille – Brussels, London (598km) (Paris –) Dijon – Switzerland (146km partial) Perpignan – Spain (28km)		(Paris –) Dijon – Switzerland (50km remainder)* Paris – Lyon (483km)* Bordeaux – Toulouse (327km)* Paris – Orléans – Clermont Ferrand (540km)* Montpellier – Perpignan (155km)* Rennes – Redon (80km)* Paris – Normandy (59km)*	
Germany	Frankfurt – Cologne (144km) Leipzig – Ebensfeld (230km) Hannover – Würzburg (327km) Mannheim – Stuttgart (99km) Nuremberg – Ingolstadt (89km)	Hannover – Berlin (150km) Hamburg – Berlin (286km) Nuremberg – Ebensfeld (83km) Munich – Augsburg (62km) Karlsruhe – Switzerland (62km partial) Cologne – Belgium (39km partial)	Frankfurt – Würzburg (126km)*	Karlsruhe – Switzerland (81km remainder) Stuttgart – Ulm (85km)
Italy	Turin – Milan – Bologna – Florence – Rome – Naples – Salerno (856km) Milan – Brescia (40km)	Padua – Venice (25km)	(Milan –) Brescia – Verona – Padua (124km) Milan – Genoa (53km) Naples – Bari (150km)	
Latvia	–	–	Estonian border – Lithuanian border (265km)	

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
Lithuania			Latvian border – Polish border (252km) Kaunas – Vilnius (140km)	
Netherlands	Amsterdam – Rotterdam – Belgium (90km)			
Norway				(Oslo –) Drammen – Tønsberg – Skien (132km)* (Oslo –) Gardermoen – Hamar – Lillehammer (128km)* Oslo – Fredrikstad – Halden (73km)*
Poland		Warsaw – Katowice (224km partial)	Warsaw – Lodz – Wrocław (448km) Elk – Lithuania (80km) Warsaw – Gdansk (357km)* Wrocław – Czech Republic (148km)* Krakow – Katowice – Czech Republic (138km)* Poznan – Germany (171km)*	Warsaw – Białystok – Elk (277km)
Portugal			Lisbon – Spain (206km via east)* Lisbon – Porto – Spain (390km via north)*	

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
Russia			St. Petersburg – Moscow – Nizhny Novgorod (1,080km) Moscow – Sochi (1,549km)* Nizhny Novgorod – Yekaterinburg (1,300km)*	
Spain	Madrid – Lleida – Barcelona – France (814km) Madrid – Cordoba – Seville (471km) Cordoba – Malaga (169km) Cordoba – Granada (220km) Madrid – Valencia (362km) Madrid – Segovia – Valladolid (178km) (Madrid –) Albacete – Alicante (238k) Ourense – Santiago (85km)	Vigo – Santiago – A Coruña (156km) Seville – Cadiz (153km) Madrid – Toledo (21km) (Madrid –) Olmedo – Zamora (99km) Valladolid – León (166km) Valencia – Vandellós (– Barcelona) (219km) Zaragoza – Huesca (200km)	(Madrid –) Zaragoza – Pamplona (157km) (Madrid –) Zamora – Ourense – Vigo (284km) Valencia – La Encina (107km) Alicante – Almería (252km) Madrid – Plasencia – Badajoz (469km) Vandellós – Tarragona (47km) Valladolid – Burgos – Bilbao/San Sebastián (396km) Valladolid – Santander (201km) León – Oviedo (76km)	

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
Sweden			Gothenburg – Linköping – Stockholm (450km)* Malmö – Hässleholm – Jönköping (300km)*	
Switzerland		Bern – Zürich (52km partial) Gotthard base tunnel (Alps, 57km) Lötschberg base tunnel (Alps, 35 km)		Ceneri base tunnel (Alps, 15km)
United Kingdom	London – Channel Tunnel (114km)		London – Birmingham – Manchester/Leeds (550km)	
MIDDLE EAST				
Bahrain, Qatar			Doha – Manama (180km)*	
Iran			Tehran – Qom – Isfahan (375km)	Tehran – Mashhad (926km) Qom – Arak (117km) Isfahan – Shiraz (470km)* Isfahan – Yazd (284km)* Tehran – Hamedan (284km)* Tehran – Zanjan – Tabriz (613km)*
Israel				Tel Aviv – Haifa (85km)
Saudi Arabia	Medina – Jeddah – Mecca (489km)			

Turkey	Ankara – Polatli – Konya (212km) Ankara – Eskisehir – Bilecik – Istanbul (376km)	Ankara – Sivas (393km) Ankara – Izmir (508km) Ankara – Istanbul (34km partial) Istanbul – Bulgaria (229km)* Kayseri – Yeriköy (142km)*	Bergama – Agliaga (42km)* Bilecik – Bursa (106km) Sivas – Zara (74km) Konya – Karaman – Ulukişla (237km) Mersin – Adana – Başpinar (377km) Aksaray – Kirikkale – Samsun (527km)* Aksaray – Ulukişla – Yenice (533km)* Bandırma – Bursa – Gemlik (98km)* Bergama – Soma (42km)* Erzincan – Armenia (639km)* Erzincan – Muş (210km)* Erzincan – Sivas (168km)* Erzincan – Trabzon (248km)* Eskişehir – Antalya (423km)* Gölbaşi – Kahta (98km)* Istanbul – Gebze (118km)* Kahramanmaraş – Mardin, Mürşitpınarı (414km)* Kayseri – Aksaray – Konya – Seydisehir – Antalya (530km)* Kiraz – Ödemiş (30km)* Kurtalan – Siirt (36km)* Mürşitpınarı – Şanlıurfa (63km)* Nusyabin – Habur (133km)* Selçuk – Denizli (177km) Sivas – Malatya – Elaziğ – Mürşitpınarı (505km)* Tokat – Turhal (42km)*

Country	Bullet trains	Renovations	Planned or proposed bullet trains	Planned or proposed renovations
AMERICAS				
Brazil			Rio de Janeiro – São Paulo – Campinas (511km)	
Canada			Windsor – Toronto – Ottawa – Montreal – Quebec (1,061km)* Calgary – Edmonton (290km)*	Windsor – London – Toronto (332km)
Mexico			Mexico City – Querétaro (210km)*	
United States		Boston – New York – Philadelphia – Washington D.C. (735km)	Merced – Bakersfield Boston – New York – Philadelphia – Washington D.C. (735km) Houston – Dallas (385km) Los Angeles – San Francisco (1,032km)* Los Angeles – San Diego (269km)* (San Francisco –) Merced – Sacramento (180km)*	Las Vegas – Victorville (– Los Angeles) (270km)

Appendix B: Technical Appendix for Figures 2.7-2.9

Figure 2.7 and Figure 2.9 show the estimated net impact on emissions of a Melbourne-to-Brisbane bullet train over time. They show the emissions created and avoided on an annual basis, and how long it would take for a bullet train to cause a net reduction in emissions.

This appendix explains our methodology. It explains what information was in the 2013 feasibility study of the proposed Australian east-coast bullet train (referred to in that study as the 'High Speed Rail' or HSR line), and the additional assumptions and data that we brought to the analysis.

This appendix explains how we estimated emissions created and avoided on an annual basis, information which wasn't readily available in the 2013 study. We updated some assumptions made in that study, where newer and better information has become available.

For these figures, we needed to calculate the following:

- Emissions created through constructing the HSR line.

- Emissions created through operating the HSR line.

- Emissions avoided through travellers taking HSR instead of alternative options (e.g. plane, car, coach, and conventional rail).

B.1   Construction emissions

Construction emissions for each segment are found in appendix 5G of the 2013 feasibility study.[135] We calculated annual construction emissions by dividing total emissions for each segment of the line by the years of construction, assuming annual emissions were constant, and taking into consideration the staged commencement of

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135. AECOM (2013b).

construction of different route segments. As explained in Section 2.2, these emissions include only Scope 1 and Scope 2 emissions; they leave out Scope 3 emissions. Assuming the latter constitute between 50 per cent and 80 per cent of total emissions, we calculated the range of construction emissions at any given point by dividing the reported emissions by 0.5 and 0.2.

B.2   Operational emissions

We calculated operational emissions by multiplying the HSR line's electricity usage with the emissions intensity of electricity for a given year. We took electricity usage for the operation of HSR and associated infrastructure from the 2013 feasibility study.[136] To calculate emissions, we used Australian Energy Market Operator (AEMO) projections, provided until 2042.[137] After 2042, we assumed that the emissions intensity of electricity gradually decreases to reach zero by 2051.

B.3   Avoided emissions

To calculate avoided emissions through modal shift, for each mode of travel we needed to know:

- How many passengers would switch to HSR.

- How many 'services' (flights, car trips, etc.) could be avoided due to this switch.

- How many emissions would have been caused by these avoided services.

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136. AECOM (2013d, p. 2) for electricity requirements of operating trains, AECOM (ibid, p. 5) for stations, AECOM (2013b, pp. 18–20) for other infrastructure.
137. AEMO (2020).

Passengers

We took estimated annual HSR passenger numbers from the 2013 feasibility study, which divided trips into three categories:[138] short regional (shorter than 250km), long regional (longer than 250km), and intercity (trips between the six major cities, excluding Sydney-to-Canberra, Sydney-to-Newcastle, and Brisbane-to-Gold Coast). We used the proportions from the feasibility study's travel matrix[139] to estimate annual passenger numbers for individual origin-destination pairings. When a new section of the line becomes operational, we took into consideration a demand ramp-up phase of five years.[140]

To calculate how many passengers shift from each mode to HSR, we multiplied the passenger estimate for individual origin-destination pairings by the feasibility study's estimates of the proportion of HSR passengers originating from each source, which depends on the trip category.[141]

Services

The number of services avoided depends on the average occupancy. Dividing the total number of passengers switching to HSR from each mode by the respective average occupancy indicates how many flights, car trips, coach trips, and conventional rail trips could be avoided.

For **planes**, we obtained the average occupancy for different airport pairings in 2019 from the Bureau of Infrastructure, Transport and Regional Economics (BITRE).[142]

For **cars**, we assumed an average occupancy of 2.26 people, which is a weighted average of business and leisure car-trip occupancies stated in the 2013 feasibility study.[143]

For **coaches**, we assumed an average occupancy of 38.5 people, as per the 2013 feasibility study.[144]

For **conventional rail**, we assumed HSR would entirely replace existing long-distance trains between Sydney and Melbourne, Sydney and Canberra, and Sydney and Brisbane/northern NSW. We obtained the frequency of these trains (i.e. the 'avoided services') from the Transport for NSW website. We also assumed that HSR would reduce some conventional commuter services between Sydney and Newcastle, and Brisbane and the Gold Coast. For these services, we assumed an average occupancy of 119 people, as per the 2013 feasibility study.[145]

Emissions

The emissions created depend on fuel consumption. For each mode, we converted fuel consumption in litres to CO_2e emissions using data from the National Greenhouse Accounts Factors.[146] We calculated annual avoided emissions by multiplying the emissions per service by

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138. Figure 2-7 'Reference case demand forecasts for HSR by market segment', AECOM (2013a, p. 87). Due to inconsistencies with all other passenger forecasts found in the feasibility study, we take into consideration that the colour coding in this figure is incorrect, showing 'intercity' trips as 'long regional' trips and vice-versa.
139. Ibid (p. 89).
140. AECOM (ibid, p. 83). The demand ramp-up assumes that 40 per cent of potential demand is achieved in the first year, increasing to 100 per cent in the fifth year.
141. AECOM (2013c, p. 27).

142. BITRE (2020b).
143. AECOM (2013b, p. 15) states 1.4 passengers for business and 2.4 for leisure trips. We constructed the weighted average according to the proportion of modal shift from cars originating from business and leisure trips.
144. Ibid (p. 15).
145. Ibid (p. 15).
146. DEE (2019b, p. 16).

the number of avoided services for each mode and origin-destination pairing.

We obtained fuel consumption for **planes** from the International Civil Aviation Organisation's (ICAO's) carbon calculator for each of the airport pairings with commercial flights along the HSR route.[147] We multiplied this fuel consumption by 1.25 to convert it from kilograms to litres.[148] We multiplied the emissions by two to account for radiative forcing (the enhanced global warming effect of aeroplanes because they release emissions closer to the atmosphere).[149] We assumed fuel efficiency would improve by 1.5 per cent per year.[150]

We obtained fuel consumption per 100km for **cars** from the ABS Survey of Motor Vehicle Use.[151] We constructed a weighted average for diesel and petrol cars. We obtained distances for each origin-destination pairing from Google Maps. We assumed fuel efficiency would improve by 1 per cent per year.[152]

We obtained diesel fuel consumption per 100km for **coaches** from the ABS Survey of Motor Vehicle Use. We obtained distances for each origin-destination pairing from Google Maps. We assumed fuel efficiency would improve by 0.5 per cent per year.[153]

We obtained diesel fuel consumption for **conventional rail** from the 2013 feasibility study. We obtained distances for relevant origin-destination pairings from Wikipedia or rome2rio.com. We assumed fuel efficiency would improve by 0.5 per cent per year.[154]

Finally, we created an annual net emissions profile by adding construction and operational emissions and subtracting total avoided emissions through modal shift. We constructed the cumulative net emissions profile in Figure 2.7 and Figure 2.9 by adding together these annual figures.

B.4   Additional calculations for Figure 2.8 (emissions per passenger-kilometre)

To construct Figure 2.8, we made some additional calculations:

- We based the bullet train figures on electricity requirements of the Melbourne-to-Sydney train, which we obtained from the 2013 feasibility study. For the 2018 figure, we obtained from AEMO the actual emissions intensity of electricity generation.[155]

- We assumed the average occupancy for the bullet train was 320 passengers,[156] and for planes 151.94 passengers.[157] All other occupancies were as described previously.

- We obtained the air distance between Melbourne's Tullamarine (MEL) and Sydney's Kingsford Smith (SYD) airports from the ICAO carbon calculator.[158]

- We divided the calculated emissions for each mode on the Melbourne-to-Sydney route (using the same method as described

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147. ICAO (2016).
148. Standard aviation fuel density (0.8kg/litre), according to IATA (2019, p. 21).
149. This value of two is adopted in the 2013 feasibility study and recommended elsewhere (e.g. Jungbluth and Meili (2018)).
150. AECOM (2013b, p. 14) adopts this figure until 2020, without explaining why fuel efficiency shouldn't improve afterwards. We see no reason to think improvements in aviation fuel efficiency shouldn't continue beyond 2020. In any case, the assumption does not appear particularly important to our results; we considered the scenario where there were no improvements to aviation fuel efficiency after 2018, and this brought forward the date at which the project begins to create a net reduction in emissions by only five years.
151. ABS (2019a).
152. This is the long-term average reported in BITRE (2009).
153. AECOM (2013b, p. 14).

154. Ibid (p. 14).
155. AEMO (2019).
156. AECOM (2013b, p. 18) (Appendix 5B).
157. BITRE (2020b).
158. ICAO (2016).

previously) by the route length (emissions per kilometre) and subsequently by the average occupancy. The result was emissions per passenger-kilometre.

Bibliography

ABS (2017). *Census of population and housing*. TableBuilder Pro. Cat. 2073.0. Australian Bureau of Statistics. https: //www.abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder.

—————— (2019a). *Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2018*. Cat. 9208.0. Australian Bureau of Statistics. https://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0.

—————— (2019b). *Consumer Price Index, Australia, Dec 2019*. Cat. 6401.0, Table 1. Australian Bureau of Statistics. https://www.abs.gov.au/ausstats/abs@.nsf/mf/6401.0.

—————— (2019c). *Australian Historical Population Statistics, 2016*. Cat. 3105.0.65.001. Australian Bureau of Statistics. https://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3105.0.65.001.

—————— (2020a). *Australian Demographic Statistics, Sep 2019*. Cat. 3101.0. Australian Bureau of Statistics. https://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0.

—————— (2020b). *Regional Population Growth, Australia, 2018-19*. Cat 3218.0. Australian Bureau of Statistics. https://www.abs.gov.au/ausstats/abs@.nsf/mf/3218.0.

AECOM (2011). *High Speed Rail Study: Phase 1 Report*. https://www.infrastructure.gov.au/rail/publications/high-speed-rail-study-reports/files/HSR_Phase1_Report.pdf.

—————— (2013a). *High Speed Rail Study: Phase 2 Report*. https://www.infrastructure.gov.au/rail/publications/high-speed-rail-study-reports/files/HSR_Phase_2-Main_Report_Low_Res.pdf.

—————— (2013b). *High Speed Rail Study: Phase 2 Report – Appendix 5G Energy Use and Carbon Emissions*. Appendix Group 5: Economic, Social and Environmental Appraisal. AECOM Australia Pty Ltd. https://www.infrastructure.gov.au/rail/publications/high-speed-rail-study-reports/files/HSR_Phase_2_Appendix_Group_5_Economic_social_and_environmental_appraisal.pdf.

—————— (2013c). *High Speed Rail Study: Phase 2 Report – Appendix 1E Demand Forecasting Procedures*. Appendix Group 1: Travel Markets. AECOM Australia Pty Ltd. https://www.infrastructure.gov.au/rail/publications/high-speed-rail-study-reports/files/HSR_Phase_2_Appendix_Group_1_Travel_markets.pdf.

—————— (2013d). *High Speed Rail Study: Phase 2 Report – Appendix 4C Operating and Maintenance Cost*. Appendix Group 4: Cost and Program. AECOM Australia Pty Ltd. https://www.infrastructure.gov.au/rail/publications/high-speed-rail-study-reports/files/HSR_Phase_2_Appendix_Group_4_Cost_and_program.pdf.

AEMO (2019). *Carbon Dioxide Equivalent Intensity Index: Summary Results File 2018*. Australian Energy Market Operator (AEMO). https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/settlements-and-payments/settlements/carbon-dioxide-equivalent-intensity-index.

—————— (2020). *Draft 2020 ISP Generation outlooks*. Australian Energy Market Operator (AEMO). https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp.

AJM Joint Venture (2016). *Melbourne Metro Rail Project: Greenhouse Gas Impact Assessment*. Aurecon Jacobs Mott MacDonald in association with Grimshaw. https://metrotunnel.vic.gov.au/__data/assets/pdf_file/0016/51091/MMRP-Technical-Appendix-V-Greenhouse-Gas.pdf.

Albalate, D. and Bel, G. (2012). "High-speed rail: Lessons for policy makers from experiences abroad". *Public Administration Review* 72.3, pp. 336–349.

Albanese, A. (2014). "No ifs, no buts: Australia needs high-speed rail". *The Guardian*. https://www.theguardian.com/commentisfree/2014/apr/18/transport-australia-high-speed-rail.

_____ (2018). *High Speed Rail Planning Authority Bill 2018 Second Reading Speech*. https://parlinfo.aph.gov.au/parlInfo/genpdf/chamber/hansardr/6ccbbe32-1ca9-4f18-9c5b-6292fc478150/0039/hansard_frag.pdf;fileType=application/2F.pdf.

_____ (2019). *Labor will get High Speed Rail back on track*. Media release. https://anthonyalbanese.com.au/media-release-labor-will-get-high-speed-rail-back-on-track-friday-10-may-2019.

Andrews, K. (2019). *Interview with Julie Clift - ABC Gold Coast Radio 91.7*. https://www.karenandrewsmp.com.au/transcripts/interview-with-julie-clift-abc-gold-coast-radio-91-7/.

Arup (2019). *Submission to inquiry into options for financing faster rail*. https://www.aph.gov.au/DocumentStore.ashx?id=678adcc7-b0bc-471a-8a74-598017194b62&subId=674467.

Associated Press (2019). "California scales back plan for high-speed train between Los Angeles and San Francisco". https://www.theguardian.com/us-news/2019/feb/12/california-high-speed-rail-la-san-francisco-cancelled.

Australian Government (2019). *Faster rail plan*. https://www.nfra.gov.au/sites/default/files/documents/faster_rail_plan.pdf.

Ausubel et al (1998). Ausubel, J., Marchetti, C. and Meyer, P. "Toward green mobility: the evolution of transport". *European Review* 6, pp. 137–156.

Ausubel, J. and Marchetti, C. (2001). "The evolution of transport". *The Industrial Physicist*, pp. 20–24.

Bagshaw, E. (2018). "Infrastructure Australia chief blasts plan to make dud projects easier to justify". *Sydney Morning Herald*. https://www.smh.com.au/politics/federal/infrastructure-australia-chief-blasts-plan-to-make-dud-projects-easier-to-justify-20180918-p504ea.html.

Beyond Zero Emissions (2014). *Zero Carbon Australia: High Speed Rail*. Beyond Zero Emissions. http://media.bze.org.au/hsr/HSR_web_01_medium.pdf.

Bhatia et al (2011). Bhatia, P., Cummis, C., Brown, A., Rich, D., Draucker, L. and Lahd, H. *Corporate Value Chain (Scope 3) Accounting and Reporting Standard*. World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD). https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf.

BITRE (2009). *Fuel consumption by new passenger vehicles in Australia 1979–2008*. Information sheet 30. Bureau of Infrastructure, Transport and Regional Economics. https://www.bitre.gov.au/sites/default/files/is_030.pdf.

_____ (2014). *The evolution of Australian towns*. Report 136. Bureau of Infrastructure, Transport and Regional Economics. https://www.bitre.gov.au/sites/default/files/report_136.pdf.

_____ (2016). *Lengthy commutes in Australia*. Bureau of Infrastructure, Transport and Regional Economics. https://www.bitre.gov.au/sites/default/files/rr_144.pdf.

_____ (2019). *Trainline 7, Statistical Report*. Bureau of Infrastructure, Transport and Regional Economics. https://www.bitre.gov.au/sites/default/files/publications/train_007.pdf.

_____ (2020a). *Domestic aviation activity: December 2019*. Bureau of Infrastructure, Transport and Regional Economics. https://www.bitre.gov.au/sites/default/files/documents/domestic_aviation_december_2019.pdf.

BITRE (2020b). *Domestic aviation activity 2019*. Bureau of Infrastructure, Transport and Regional Economics. https://www.bitre.gov.au/sites/default/files/documents/domestic_aviation_activity_annual_2019.pdf.

Brisbane City Council (2020). *About Brisbane Metro*. https://www.brisbane.qld.gov.au/traffic-and-transport/public-transport/brisbane-metro/about-brisbane-metro.

Button, K. (2017). *High-Speed Railways: Do They Produce Economic Growth?* Mercatus Center at George Mason Universtiy. https://www.mercatus.org/system/files/mercatus-button-high-speed-railways-v1.pdf.

Bygrave, S. (2016). "Why are we still waiting for high-speed rail between Sydney, Melbourne and Brisbane?" *The Guardian*. https://www.theguardian.com/sustainable-business/2016/mar/11/why-are-we-still-waiting-for-high-speed-rail-between-sydney-melbourne-and-brisbane.

Chester, D. (2019). *Chester welcomes fast train plan for Gippsland*. Media release. https://darrenchester.com.au/chester-welcomes-fast-train-plan-for-gippsland/.

CLARA (2016a). *High Speed Rail*. Accessed on 18 February 2020. http://www.clara.com.au/high-speed-rail.html.

_____ (2016b). *The CLARA plan*. Accessed on 18 February 2020. http://www.clara.com.au/the-clara-plan.html.

_____ (2016c). *Funding the CLARA plan*. Accessed on 18 February 2020. http://www.clara.com.au/funding-the-clara-plan.html.

Daley, J. and Lancy, A. (2011). *Investing in regions: Making a difference*. Report No. 2011-4. Grattan Institute. https://grattan.edu.au/report/investing-in-regions-making-a-difference/.

Davies, A. (2019). "Too good to be true? Australia's high-speed rail dream leaves a bitter taste". *The Guardian*. https://www.theguardian.com/australia-news/2019/aug/05/too-good-to-be-true-australias-high-speed-rail-dream-leaves-a-bitter-taste.

DEE (2019a). *National Inventory Report 2017 - Volume 1*. Department of the Environment and Energy. https://publications.industry.gov.au/publications/climate-change/system/files/resources/gas-group/national-inventory-report-2017-volume-1.pdf.

_____ (2019b). *National Greenhouse Accounts Factors - August 2019*. Department of the Environment and Energy. https://publications.industry.gov.au/publications/climate-change/system/files/resources/cf1/national-greenhouse-accounts-factors-august-2019.pdf.

Denham, T. and Dodson, J. (2019). "Regional cities beware – fast rail might lead to disadvantaged dormitories, not booming economies". *The Conversation*. 16 July. https://theconversation.com/regional-cities-beware-fast-rail-might-lead-to-disadvantaged-dormitories-not-booming-economies-119090.

Department of Transport and Main Roads (2020). *North Coast Connect Project*. https://www.tmr.qld.gov.au/Projects/Name/N/North-Coast-Connect-Project.

DITRDC (2019). *Toowoomba to Brisbane Passenger Rail Business Case*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=097134-17QLD-NRP.

_____ (2020a). *Australian Government response to the House of Representatives Standing Committee on Infrastructure, Transport and Cities report: Building Up Moving Out*. Department of Infrastructure, Transport, Regional Development and Communications. https://www.infrastructure.gov.au/department/ips/files/government-response-hor-building-up-moving-out-may-2020.pdf.

_____ (2020b). *Western Sydney Airport*. Department of Infrastructure, Transport, Regional Development and Communications. https://www.westernsydneyairport.gov.au.

DITRDC (2020c). *WestConnex*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=048726-12NSW-NP.

_____ (2020d). *Pacific Highway Upgrade*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=056876-15NSW-PKG.

_____ (2020e). *Melbourne Airport Rail Link*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=097136-17VIC-NRP.

_____ (2020f). *Murray Basin Freight Rail Project*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=062827-15VIC-PKG.

_____ (2020g). *Monash Freeway Upgrade*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=062632-15VIC-NP.

_____ (2020h). *Bruce Highway*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/key_projects/road_and_rail_delivery/bruce_highway.aspx.

_____ (2020i). *Midland Highway Upgrade*. Department of Infrastructure, Transport, Regional Development and Communications. https://investment.infrastructure.gov.au/projects/ProjectDetails.aspx?Project_id=053705-14TAS-PKG.

Duranton, G. and Puga, D. (2004). "Micro-foundations of urban agglomeration economics". 4. Ed. by J. V. Henderson and J. F. Thisse.

Edwards, N. (2012). *High Speed Rail: Benefits that Add Up*. A report for the Australian Greens. https://adam-bandt.greensmps.org.au/sites/default/files/hsrbenefitsreport.pdf.

Esteban Martin, V. (1998). "'High speed rail in the European Union. Urban impact in France and Spain". *Geographicalia* 36, pp. 19–32.

Gibbons, S. and Graham, D. (2018). *Urban capacity and economic output*. Report for the National Infrastructure Commission. http://cep.lse.ac.uk/pubs/download/special/cepsp36.pdf.

Google Maps API (2020). *Google Maps Platform - Directions API*. https://developers.google.com/maps/documentation/directions/start.

Gourvish, T. (2010). *The High Speed Rail Revolution: History and Prospects*. Report for HS2 Ltd. https://webarchive.nationalarchives.gov.uk/20100409200445/http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/historyandprospects/pdf/report.pdf.

Government of South Australia (2020). *Adelaide's North-South Corridor*. Department of Planning, Transport and Infrastructure. https://dpti.sa.gov.au/infrastructure/nsc/northsouthcorridor.

Hensher et al (2012). Hensher, D., Li, Z. and Mulley, C. "The impact of high speed rail on land and property values: a review of market monitoring evidence from eight countries". *Roads and Transport Research* 21.4.

HILDA (2019). *Survey of Household Income and Labour Dynamics Australia*. Note: This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author and should not be attributed to either DSS or the Melbourne Institute. https://www.melbourneinstitute.com/hilda/.

HS2 Ltd. (2013). *HS2 Phase One environmental statement volume 5: climate - Summary carbon calculation outputs*. volume 5 appendix CL-002-000, ES 3.5.0.3.2. High Speed Two (HS2) Limited. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/259613/Volume5_Climate_Summary_carbon_calculation_outputs_CL-002-000.pdf.

Hunter, F. (2020). "Labor backs 'economic game-changer' high-speed rail as part of pandemic recovery". *Sydney Morning Herald*. https://amp.smh.com.au/politics/federal/labor-backs-economic-game-changer-high-speed-rail-as-part-of-pandemic-recovery-20200418-p54l24.html.

IA (2018). *Assessment Framework: For initiatives and projects to be included in the Infrastructure Priority List*. Infrastructure Australia. https://www.infrastructureaustralia.gov.au/publications/assessment-framework-initiatives-and-projects.

——— (2020). *Infrastructure Priority List*. Infrastructure Australia. https://www.infrastructureaustralia.gov.au/sites/default/files/2020-03/2020_infrastructure_priority_list_low_resolution_-_updated.pdf.

IATA (2019). *An Airline Handbook on CORSIA*. International Air Transport Association (IATA). https://www.iata.org/contentassets/fb745460050c48089597a3ef1b9fe7a8/corsia-handbook.pdf.

ICAO (2016). *ICAO Carbon Emissions Calculator*. International Civil Aviation Organization (ICAO). https://www.icao.int/environmental-protection/Carbonoffset/Pages/default.aspx.

Inland Rail (2020). *Inland Rail: The solution to Australia's freight challenge*. https://inlandrail.artc.com.au/keyfacts.

INSW (2018). *Building Momentum: State Infrastructure Strategy 2018-2028*. Infrastructure New South Wales. https://insw-sis.visualise.today/documents/INSW_2018SIS_BuildingMomentum.pdf.

ISCA (2018). *ISv2.0 Energy and Carbon Guideline*. Infrastructure Sustainability Council of Australia (ISCA). https://www.isca.org.au/getmedia/bde23c66-7ce6-4d2c-b575-fbc1e9646da8/ISv2-0_Energy_and_Carbon_Guideline_Rev_0.pdf.aspx.

ITF (2014). *The Economics of Investment in High-Speed Rail*. International Transport Forum.

IV (2016). *Victoria's 30 year infrastructure strategy*. Infrastructure Victoria. https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/03/IV_30_Year_Strategy_WEB_V2.pdf.

——— (2018). *Five-year focus: Immediate actions to tackle congestion*. Infrastructure Victoria. https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Five-year-focus-Immediate-actions-to-tackle-congestion-April-2018.pdf.

——— (2019). *Growing Victoria's potential*. Infrastructure Victoria. https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Growing-Victorias-Potential-April-2019.pdf.

Jacks, T. (2019a). "Tunnel link mulled for Geelong fast trains". *The Age*. https://www.theage.com.au/national/victoria/tunnel-link-mulled-for-geelong-fast-trains-20191218-p53l9o.html.

——— (2019b). "Victorian government urged to ignore cut-price airport rail option". *The Age*. https://www.theage.com.au/national/victoria/victorian-government-urged-to-ignore-cut-price-airport-rail-option-20190830-p52mhd.html.

Jeffords, S. (2019). "Ford government pauses high-speed rail funding, looking to enhance current services". https://globalnews.ca/news/5169522/ontario-high-speed-rail/.

Jungbluth, N. and Meili, C. (2018). "Recommendations for calculation of the global warming potential of aviation including the radiative forcing index". *The International Journal of Life Cycle Assessment*, pp. 404–411. DOI: 10.1007/s11367-018-1556-3.

Juturna (2019). *Stronger, Together: A practical Victorian fast regional commuter rail network, bringing sustainable growth, liveability and opportunity to Melbourne and the regions*. Report for the City of Greater Geelong. https://www.geelongaustralia.com.au/fastrail/documents/item/8d6ee4c64efeefb.aspx.

Kendall, R. and Tulip, P. (2018). "The effect of zoning on housing prices". https://www.rba.gov.au/publications/rdp/2018/pdf/rdp2018-03.pdf.

Lafourcade, M. and Thisse, J.-F. (2008). "New economic geography: a guide to transport analysis". Working Paper 2009-02. https://halshs.archives-ouvertes.fr/halshs-00586878/document.

Laird et al (2001). Laird, P., Newman, P., Bachels, M. and Kenworthy, J. *Back on track: rethinking transport policy in Australia and New Zealand*. University of New South Wales Press.

Lawrence et al (2019). Lawrence, M., Bullock, R. and Liu, Z. *China's High-Speed Rail Development*. The World Bank. http://documents.worldbank.org/curated/en/933411559841476316/pdf/Chinas-High-Speed-Rail-Development.pdf.

Legislative Assembly of Alberta (2014). *The Feasibility of Establishing a High-Speed Rail Transit System in Alberta*. Standing Committee on Alberta's Economic Future, Legislative Assembly of Alberta. https://s3.amazonaws.com/s3.documentcloud.org/documents/1173385/high-speed-rail-transit-system-in-alberta-final.pdf.

Levinson, D. (2012). "Accessibility impacts of high speed rail". *Journal of Transport Geography* 22, pp. 288–291. https://conservancy.umn.edu/bitstream/handle/11299/180027/EconomicDevelopmentImpactsOfHSR.pdf?sequence=1&isAllowed=y.

Liberal Party of Australia (VIC) (2018). *High Speed Rail for Victoria*. https://vic.liberal.org.au/News/2018-10-03/high-speed-rail-for-victoria.

Manning, P. (2016). "Green fields and blue sky". *The Monthly*. https://www.themonthly.com.au/issue/2016/december/1480510800/paddy-manning/green-fields-and-blue-sky.

Marchetti, C. (1994). "Anthropological invariants in travel behavour". *Technological forecasting and social change* 47.1, pp. 75–88.

McNaughton, A. (2019). *The Geography of Time: How faster rail changes the economic and social landscape*. https://www.youtube.com/watch?v=A293ixpN9wo.

Moretti, E. (2012). *The new geography of jobs*. HMH Books.

Morrison, G. (2019). "Is high-speed rail in the US ever going to happen?" *cnet*. https://www.cnet.com/news/is-high-speed-rail-in-the-us-ever-going-to-happen/.

NAO (2012). *The completion and sale of High Speed 1*. National Audit Office UK. https://www.nao.org.uk/wp-content/uploads/2012/03/10121834.pdf.

Nash, C. (2009). "When to invest in high-speed rail links and networks?" OECD/ITF Joint Transport Research Centre discussion paper 2009-16. https://www.itf-oecd.org/sites/default/files/docs/dp200916.pdf.

National Faster Rail Agency and Infrastructure and Project Financing Agency (2019). *Submission to inquiry into options for financing faster rail*. https://www.aph.gov.au/DocumentStore.ashx?id=e992fd55-d5d4-484d-994e-f66efa2eef7c&subId=674455.

National Greenhouse and Energy Reporting Act 2007 (2019). https://www.legislation.gov.au/Details/C2019C00263.

NCDC (1970). *Tomorrow's Canberra: Planning for Growth and Change*. National Capital Development Commission (NCDC).

Nixon, R. (2014). "$11 Billion Later, High-Speed Rail Is Inching Along". *The New York Times*. https://www.nytimes.com/2014/08/07/us/delays-persist-for-us-high-speed-rail.html?_r=0.

Norman, J. (2020). "Anthony Albanese calls for Scott Morrison to reshape Australia's economy in wake of coronavirus pandemic". *ABC News*. https://www.abc.net.au/news/2020-05-11/anthony-albanese-labor-coronavirus-economy-insecure-work-covid19/12232654.

NorthConnex (2020). *NorthConnex: Frequently Asked Questions*. https://www.northconnex.com.au/community/faqs.

NSW Government (2016). *$12 billion in budget for metro rail revolution*. Media release. https://www.nsw.gov.au/media-releases/12-billion-budget-for-metro-rail-revolution.

——— (2018). *A fast rail future for NSW*. https://www.nsw.gov.au/projects/a-fast-rail-future-for-nsw.

OSM (2020). *Railways*. OpenStreetMap contributors.
https://wiki.openstreetmap.org/wiki/Main_Page.

O'Toole, R. (2008). "High-Speed Rail: The Wrong Road for America". *Cato Institute*. Policy Analysis.

Piesse, E. (2018). "Metronet Perth train project could be derailed by a national skills shortage of rail workers". *ABC News*.
https://www.abc.net.au/news/2018-07-10/metronet-rail-workers-in-demand-as-skills-shortage-takes-grip/9957992.

Premier of NSW (2018). *Fast rail network to transform NSW*. Media release.
https://www.nsw.gov.au/your-government/the-premier/media-releases-from-the-premier/fast-rail-network-to-transform-nsw/.

Premier of Victoria (2019). *World's Best Builders Compete To Build North East Link*. Victorian Government. https://www.premier.vic.gov.au/worlds-best-builders-compete-to-build-north-east-link/.

Prime Minister of Australia (2019). *Geelong to Melbourne travel cut in half - part of 20-year fast rail plan*. Media release.
https://www.pm.gov.au/media/geelong-melbourne-travel-cut-half-part-20-year-fast-rail-plan.

PTV (2020). *Data Vic: PTV Timetable and Geographic Information - GTFS*.
Public Transport Victoria. https://discover.data.vic.gov.au/dataset/ptv-timetable-and-geographic-information-2015-gtfs.

Puga, D. (2002). "European regional policies in light of recent location theories". *Journal of economic geography* 2.4, pp. 373–406.

Queensland Government (2019a). *Gold Coast Light Rail Stage 3A: Project update December 2019*. Queensland Government Department of Transport and Main Roads.
https://www.tmr.qld.gov.au/Projects/Name/G/Gold-Coast-Light-Rail-Stage-3A.

——— (2019b). *State Infrastructure Plan - Part B: Program - 2019 update*.
Queensland Government. https://www.dsdmip.qld.gov.au/resources/plan/sip/sip-part-b-2019.pdf.

Rail Futures Institute (2016). *Intercity: How regional rail can re-balance population growth and create a "state of cities" in Victoria*. https://www.railfutures.org.au/2016/08/intercity-how-regional-rail-can-re-balance-population-growth-and-create-a-state-of-cities-in-victoria/.

Rail Projects Victoria (2018). *Benefits for your train line*. https://metrotunnel.vic.gov.au/about-the-project/benefits-for-your-train-line.

——— (2020a). *Regional Rail Revival*.
https://bigbuild.vic.gov.au/projects/regional-rail-revival.

——— (2020b). *Western Rail Plan*.
https://bigbuild.vic.gov.au/projects/western-rail-plan.

Ranganathan et al (2004). Ranganathan, J., Corbier, L., Bhatia, P., Schmitz, S., Gage, P. and Oren, K. *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*. Revised edition.
World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD).
https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf.

Rice, J. (2018). "Janet outlines the Greens' support for high-speed rail".
Speech transcript. https://janet-rice.greensmps.org.au/articles/janet-outlines-greens-support-high-speed-rail.

Rosenthal, S. S. and Strange, W. C. (2004). "The micro-empirics of agglomeration economies". Prepared for the Blackwell Companion to Urban Economics.

Rus, G. de and Nombela, G. (2007). "Is investment in high speed rail socially profitable?" *Journal of Transport Economics and Policy* 41.

Schafer, A. and Victor, D. (1997). "The past and future of global mobility".
Scientific American 227, pp. 36–39.

SGS Economics and Planning Pty Ltd (2019a). *Gender equity in employment*.
Report prepared for the City of Whittlesea.
https://www.sgsep.com.au/assets/main/SGS-Whittlesea-Council_-Gender-equity-in-employment-REVISED-FINAL-200305.pdf.

SGS Economics and Planning Pty Ltd (2019b). *Economic performance of Australia's cities and regions, 2018-2019*. https://www.sgsep.com.au/publications/insights/gdp-report-economic-performance-of-australias-cities-and-regions.

Smithers, R. (2013). "Eurostar passes 10m passengers a year". *The Guardian*. https://www.theguardian.com/business/2013/dec/30/eurostar-passes-10-million-year.

Standing Committee on Infrastructure, Transport and Cities (2016). *Harnessing Value, Delivering Infrastructure*. Inquiry into the role of transport connectivity on stimulating development and economic activity. https://www.aph.gov.au/Parliamentary_Business/Committees /House/ITC/TransportConnectivity/Report_1.

_____ (2018). *Building Up & Moving Out*. Inquiry into the Australian Government's role in the development of cities. https://www.aph.gov.au/Parliamentary_Business/Committees/House/I TC/DevelopmentofCities/Report.

Terrill, M. and Danks, L. (2016). *Cost overruns in transport infrastructure*. Report No. 2016-13. Grattan Institute. https: //grattan.edu.au/report/cost-overruns-in-transport-infrastructure/.

Terrill, M. and Emslie, O. (2017). *What price value capture?* Grattan Institute. https://grattan.edu.au/wp-content/uploads/2017/03/888-What-price-value-capture.pdf.

Terrill, M. and Batrouney, H. (2018). *Unfreezing discount rates: transport infrastructure for tomorrow*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2018/02/900-unfreezing-discount-rates.pdf.

Terrill et al (2018). Terrill, M., Batrouney, H., Ha, J. and Hourani, D. *Remarkably adaptive: Australian cities in a time of growth*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2018/10/909-Remarkably-adaptive-Australian-cities-in-a-time-of-growth.pdf.

Terrill et al (2019a). Terrill, M., Moran, G. and Ha, J. *Why it's time for congestion charging*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2019/10/923-Why-its-time-for-congestion-charging.pdf.

Terrill et al (2019b) _____ . *Right time, right place, right price: a practical plan for congestion charging in Sydney and Melbourne*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2019/10/924-Right-time-right-place-right-price-low-res.pdf.

The Committee for Sydney (2018). *The Sandstone Mega-region: Uniting Newcastle – The Central Coast – Sydney – Wollongong*. https://www.sgsep.com.au/assets/main/The_Sandstone_Mega-region_Final_Web.pdf.

Tomaney, J. and Marques, P. (2013). "Evidence, policy, and the politics of regional development: the case of high-speed rail in the United Kingdom". *Environment and Planning C: Government and Policy* 31.3, pp. 414–427.

Topham, G. (2019a). "Co-author of leaked HS2 report demands his name is removed". *The Guardian*. https://www.theguardian.com/business/2019/nov/12/co-author-of-leaked-hs2-reports-demands-his-name-is-removed.

_____ (2019b). "HS2 could be scrapped as critic given role in independent review". *The Guardian*. https://www.theguardian.com/uk-news/2019/aug/21/hs2-review-launched-over-whether-rail-project-should-proceed.

TransLink (2020). *TransLink GTFS*. Queensland Government. https://translink.com.au/about-translink/open-data.

Transport for NSW (2020). *Nowra Bridge project - Prince Highway upgrade*. NSW Government. https://www.rms.nsw.gov.au/projects/nowra-bridges-shoalhaven-river/index.html.

Transport NSW (2020). *Open Data: Timetables Complete GTFS*. Transport New South Wales. https: //opendata.transport.nsw.gov.au/dataset/timetables-complete-gtfs.

Treasury (2017). *Budget 2017-18: Budget speech 2017-18*.
https://archive.budget.gov.au/2017-18/speech/Budget_speech.pdf.

Tudge, A. (2019a). "Planning for Australia's Future Population". https:
//www.population.gov.au/downloads/planning-future-population.pdf.

_____ (2019b). *Labor's Fast Rail Won't Even Get You Out of Melbourne*.
Media release. https://www.liberal.org.au/latest-
news/2019/05/10/labors-fast-rail-wont-even-get-you-out-melbourne.

_____ (2019c). *Better managing Australia's future population growth*. Media
release. https://minister.infrastructure.gov.au/tudge/media-
release/better-managing-australias-future-population-growth.

Tudge et al (2019a). Tudge, A., Morrison, S., Coleman, D., McKenzie, B. and
Tehan, D. *A plan for Australia's future population*. Media release.
https://minister.infrastructure.gov.au/tudge/media-release/plan-
australias-future-population.

Tudge et al (2019b). Tudge, A., Tehan, D. and Coleman, D. *Better managing
Australia's future population growth*. Media release.
https://minister.infrastructure.gov.au/tudge/media-release/better-
managing-australias-future-population-growth.

UIC (2020). *International High-speed Railway Database*. International Railway
Union. https://uic.org/passenger/highspeed/article/high-speed-
database-maps.

UN (2018). *World Urbanization Prospects 2018*. File 22. United Nations.
https://population.un.org/wup/Download/.

Uren, T. (1973). *New Cities Program: Ministerial Statement*. https:
//parlinfo.aph.gov.au/parlInfo/genpdf/hansard80/hansardr80/1973-08-
23/0045/hansard_frag.pdf;fileType=application%2Fpdf.

Vickerman, R. (2018). "Can high-speed rail have a transformative effect on the
economy?" *Transport Policy* 62, pp. 31–37.

Victorian Government (2020a). *West Gate Tunnel*. Victoria's Big Build.
https://bigbuild.vic.gov.au/projects/west-gate-tunnel.

_____ (2020b). *Regional Rail Revival*. Victoria's Big Build.
https://regionalrailrevival.vic.gov.au.

_____ (2020c). *Metro Tunnel: Frequently Asked Questions*. Victoria's Big
Build. https://metrotunnel.vic.gov.au/about-the-project/faq.

Williams, P. (1998). *Australian Very Fast Trains - A Chronology*. Parliamentary
Library. https://www.aph.gov.au/About_Parliament/Parliamentary_De
partments/Parliamentary_Library/Publications_Archive/Background_
Papers/bp9798/98bp16.

Wood et al (2020). Wood, T., Dundas, G. and Ha, J. *Start with steel: A
practical plan to support carbon workers and cut emissions*. Grattan
Institute. https://grattan.edu.au/report/start-with-steel/.

Zahavi, Y. (1973). "The TT-relationship: a unified approach to transportation
planning". *Traffic engineering and control*, pp. 205–212.

_____ (1979). "The "UMOT" project".

Zahavi, Y. and Ryan, J. M. (1980). "Stability of travel components over time".
Transportation Research Record 750, pp. 1–26.

Zahavi, Y. and Talvitie, A. (1980). "Regularities in travel time and money
expenditure". *Transportation Research Record* 750, pp. 13–19.