HIGH SPEED RAIL

A NEW APPROACH

POLICY PROPOSAL

Dr Garry Glazebrook

g.glazebrook@fastrackaustralia.net

JANUARY 2021

Fastrack Australia

Hybrid Talgo 250 Dual High-Speed Train [*i*]

Albury-Wodonga

Canberra [*ii*]

Coffs Harbur {*iii*]

Italian high speed train [*iv*]

Piggyback Intermodal Service [*v*]

TABLE OF CONTENTS

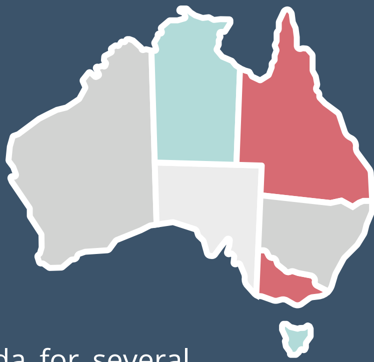
Version 8, January 2021

Author: Dr Garry Glazebrook

g.glazebrook@fastrackaustralia.net

Fastrack Australia

EXECUTIVE SUMMARY



INTRODUCTION

The idea of high-speed rail in Australia has been on the agenda for several decades. In that time, high speed rail has spread to 20 counties, with a four-fold increase in global patronage between 2010 and 2018.

A number of developments, from new rail technologies, to the impacts of the coronavirus on working patterns, suggest it is time to re-examine high-speed rail in Eastern Australia. This report:

- highlights the need for and benefits from a high speed rail system,
- examines recent developments which mean high-speed rail should to be re-considered now,
- details a new approach to high-speed rail, which starts with the current regional fast rail projects and builds a network for South-Eastern Australia in manageable stages. It also includes new route options and ways to move freight as well as passengers,
- concludes with recommendations for action to take advantage of the opportunities for this nation-building project.

Separate Technical Reports consider some of these aspects in more detail, including: population trends and decentralisation; high speed rail and freight transport; and new route alignments and operating arrangements, which can minimise the costs and maximise the benefits of the project.

THE NEED FOR HIGH SPEED RAIL

Population growth, congestion and housing affordability

Sydney, Melbourne and Brisbane were home to 13 million people in 2016, more than 50% of all Australians. They are on track to reach a combined population of 22 million by 2060, with a further 6 million in a single linear corridor between Geelong and the Sunshine Coast.

However, the current and increasing dominance of our three biggest cities within this region means that urban congestion has become a major problem. Congestion costs in Sydney, Melbourne and Brisbane reached over $12 billion in 2016, and are rising rapidly. As a result, State and Federal governments are spending $20 billion p.a. on road, rail and airport projects in the three capitals to cope with rising travel demand.

Meanwhile, a whole generation is facing difficulty achieving home ownership, particularly in Sydney and Melbourne, which are now the 3rd and 4th least affordable cities in the world. High speed rail could encourage decentralisation, reducing the growth rates of our big cities to more manageable levels, cutting congestion costs and making housing more affordable.

Decentralisation and regional development

The tyranny of distance has long bedevilled this country. While jet aircraft have reduced the problem for people living in the capital cities, the lack of fast surface transport is still a major problem. For example, it takes less time to fly from Sydney to Melbourne than to drive from Sydney to Newcastle, 150km away. Our current transport options thus reinforce the economic dominance of the big cities.

High-speed rail could dramatically alter this; for example, it could:

- reduce current travel times from Canberra to Sydney from 3-4 hours to 90 minutes
- reduce current travel times from Albury to Melbourne from 4 hours to under 2 hours
- reduce current rail travel times from Brisbane to Sydney from 12 hours to less than 4 hours
- put everyone in the East Coast corridor within two hours of one of the three biggest cities.

The combination of telecommunications and high speed rail could free many people to live outside the big cities, by making it much more feasible to make occasional trips to visit head office, clients, specialist services, or friends and relatives. High-speed rail can also support regional tourism and other industries, increasing jobs and opportunities outside the capital cities. It can support 2.5 million people living in regional cities rather than in the three major capitals by 2060. This will expand the economic, educational and other opportunities available outside the big cities, and as a nation-building project it could also help us recover from the economic impact of the virus.

Addressing climate change

The climate challenge is continuing to grow more pressing. Bushfires, coral bleaching on the barrier reef and shrinking ice caps in the Arctic point to even more dramatic changes ahead. Australia has one of the world's highest per capita emissions of CO_2, and our greenhouse emissions from transport have grown by 60% since 1990, as a result of rising consumption of liquid fuels. Our heavy reliance on cars, trucks and aeroplanes are a key factor in this.

Rail transport is roughly 3x more energy efficient than cars or planes for moving people, or than trucks for moving freight. Electrified high speed rail can utilise renewable energy, further reducing its carbon emissions to close to zero. Australia will be under international pressure to reduce emissions from all sources, including inter-city passenger and freight movement, and high-speed rail can help contribute to that objective.

Transport efficiency and capacity

With the expected growth in population in the East Coast corridor, passenger demand will increase by at least 50-60% by 2060, while on past trends freight transport could double. In addition to massive urban transport investments in Sydney, Melbourne and Brisbane, this could require a second airport in Brisbane, a third airport for Melbourne, and further upgrades to significant sections of the Hume and Pacific Highways. But none of those intercity investments will encourage a more balanced population distribution. Without a change in approach, we will not solve our problems of congestion, affordability, transport emissions or regional disparities in opportunity.

The most recent serious study of high-speed rail between Melbourne and Brisbane was completed in 2013 [*vi*]. This found that that a 1750 km high-speed rail corridor was viable, with a benefit-cost ratio of 2.3, a capital cost of $114 billion, and annual patronage of 83 million by 2065. It also found that the project would capture 40% of the expected future inter-capital city air travel market in 2065, and 60% of the air travel to and from regional cities.

This report has found a number of areas where the capital costs identified in the 2013 report could be reduced – for example by an alternative route through Sydney. It has also identified options for carrying high-speed freight utilising newly developing technologies overseas, and for expanding the catchment of high-speed rail services through connections to cities such as Geelong, the Sunshine Coast, Toowoomba, the Upper Hunter, the Riverina and Wollongong.

The high-speed rail network and operating scheme proposed in this report is estimated to have the capacity to carry at least 120 million passengers and 20 million tonnes of freight annually by 2060. Together with the Inland Rail and additional freight on the existing interstate rail line, 50% of the estimated north-south freight task in the Eastern Corridor could be handled on rail by then.

While high speed rail is undoubtedly expensive to build, so are the alternatives. Sydney's Westconnex project is costing $700 million per kilometre because it has to be built underground and requires complex interchanges with other motorways and roads. The Second Sydney airport and associated infrastructure is costing at least $28 billion. Upgrades to the Pacific Highway have already cost over $15 billion, with the future Coffs Harbour bypass alone estimated to cost $1.8 billion. Melbourne’s suburban loop metro is estimated to cost $50 billion, and Brisbane’s Cross River Rail is estimated to cost at least $5.4 billion. While needed to satisfy current demand patterns, none of these projects will reduce the current concentration of population in our major capitals.

If constructed over 30 years, an East Coast high-speed rail network should cost less than $5 billion p.a., with costs spread across the Federal Government, plus three State and the ACT governments, making it manageable.

RECENT DEVELOPMENTS

High speed rail is developing rapidly around the world, including in the UK, the USA, and in places like Sweden and the Baltic countries with much lower populations than Australia. Some high speed trains have also been developed with tilting technology, the ability to change rail gauge while moving, or the ability to operate on both electrified and non-electrified tracks. Japan and China are developing even higher-speed magnetic levitation trains, while several companies are developing experimental hyperloop trains (which operate in evacuated tubes). However, it is considered that conventional high speed trains are the most appropriate for Australia given the estimated demand and stopping patterns required.

There have also been developments with high-speed freight services, including trains carrying palletised freight at night on the Italian high-speed rail system, and the use of specialised intermodal trains in Europe which can carry road trailers and can load or unload an entire train in under an hour. China is already moving high-value freight on its extensive and growing high-speed rail network, and is planning major investment in this area.

A range of other recent developments also suggest this is now the right time to reconsider high speed rail in Australia:

- The Federal Government is funding business cases into regional fast rail projects linking the major capital cities to regional centres, and some projects have already been announced.
- Interest rates and inflation are at historic lows, making this an ideal time for governments to borrow for long-term infrastructure projects
- Growing urban development on the fringes of our cities will make it harder to build high speed rail links in the future unless the necessary corridors and station sites are secured.

A NEW APPROACH

The comprehensive 2013 High-speed rail report provides an excellent basis for considering high speed rail in the East Coast corridor. Both the need for such a corridor and its benefits have increased since then. But the recent developments noted above suggest a new approach is needed.

The purpose of high speed rail

High speed rail is not designed to produce dormitory towns or to encourage long-distance daily commuting. Nor is it intended to fully replace long-distance air travel between the capital cities. In contrast, in combination with changes in technology and work practices, it is designed to enable people and firms to relocate from the overdeveloped cities to the other cities and towns in the East Coast corridor, whilst retaining convenient, but occasional, access to the major capitals.

Similarly, while high-speed rail can accommodate a significant share of inter-capital city travel, its real benefit will be for travel between regional cities and capital cities or other regional centres, where it is likely to be much more competitive than either current regional air services or driving.

It can also free the existing interstate rail line for more freight services, and accommodate specialised higher-speed intermodal freight services, cutting current rail freight travel times between Sydney and Melbourne to 7-8 hours compared to 13-15 hours currently.

New route and alignment options

New route options through Sydney are suggested, which could save $6 billion in construction costs, enable services to be progressively upgraded, and provide better access to the Sydney region. Other alternatives to the alignments identified in the 2013 HSR study are also expected to be identified. These include new locations for stations or interchanges to take advantage of developments in public transport infrastructure in Brisbane, the Gold Coast. Newcastle and Canberra.

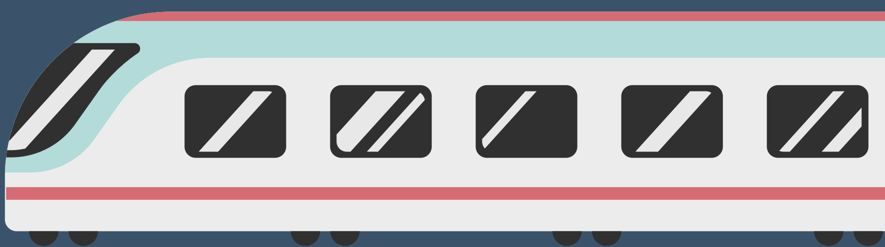
Building a long-term future

Maximising the benefits of high-speed rail in Australia will require a long-term vision. It also needs compatible systems in different States in terms of track and loading gauge, power supply and signalling. Failure to address these technical issues up-front could lead to a repeat of the "break of gauge" problems, which have bedevilled Australia's rail systems since the 1850's.

If a fully integrated system can be achieved, an East Coast high-speed network can make a major contribution to the quality of life for the two-thirds of Australians in the immediate corridor. With extensions of the core network to nearby cities and towns, including Wollongong, the Upper Hunter, the Goulburn Valley, the Riverina and Gippsland, the high-speed rail system can serve 30 million people, or 75% of Australia's future population, by the 2060's.

Making an early start

Rather than building a complete route in one go, high speed rail construction can be staged, starting with higher speed links between the major capitals to nearby regional cities. High speed rail services can begin with faster inter-urban services and build towards high speed inter-capital services, with the gradual introduction of the latest high speed trains.



CONCLUSIONS AND RECOMMENDATIONS

The economic, environmental, demographic and social case for investment in higher speed rail has never been stronger. While some efforts are already underway with faster regional rail, the lack of a long-term vision will result in an unnecessarily expensive and fragmented system.

To maximise the benefits of these investments, we need to establish a coordinated, intergovernmental taskforce to:

- Extend the work of the National Faster Rail Agency to incorporate the earlier work done on High Speed Rail,
- Integrate regional fast rail projects into a longer-term plan for an East Coast High Speed Rail, based on, but updated from, the 2013 HSR Study,
- Secure corridors and station sites as soon as possible,
- Include an integrated freight strategy for the East Coast, taking advantage of recent developments in intermodal freight technology and investment, and
- Build in a coordinated set of policies to encourage decentralisation from the three big capitals to other cities in the corridor.

1 INTRODUCTION

The first high speed train in commercial operation is generally considered to be the Japanese Shinkansen. This began operating in 1964, with a 515 km line between Tokyo and Osaka, and a top speed of 210 km/hr. The Shinkansen network has since expanded to 2,700 km, and has carried over 10 billion passengers without a single fatality.

High speed rail next spread to Europe. France's TGV system similarly started with a single line from Paris to Lyon in 1981. France's early TGV trains had top speeds of 270 km/hr, later increased to 330 km/hr, with a test train reaching 575km/hr. High-speed rail now operates in 20 countries in Europe, Asia, the Middle East, Africa and North America.

Figure 1: High speed rail in different countries

Japanese Shinkansen [*vii*]

European High Speed Rail Network [*viii*]

2013 Study

Australian interest in high-speed trains started in 1984 with a proposal by CSIRO to build a high speed line between Sydney and Melbourne. Subsequent proposals included the Very Fast Train proposal in 1986 and the Speedrail proposal in 1993 for a high-speed line between Sydney and Canberra, and the East Coast High Speed Rail study in 2010-2013 for a Corridor between Brisbane and Melbourne. More recently there has been a private sector proposal from the CLARA group for a high-speed line, to be financed from property development in new cities along the route [*ix*].

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The 2013 East Coast High Speed Rail Study undertaken for the Commonwealth Department of Infrastructure and Transport remains the most detailed study of high-speed rail in Australia. It found an overall benefit-cost ratio of 2.3 at a 4% real discount rate, a total capital cost in 2013 dollars of $114 billion, and a potential patronage of 84 million p.a. by 2065.

Thus far, no decision to proceed with high-speed rail in Australian has been made. Three common reasons given for this are Australia's low population density, the high capital costs of high-speed rail and the long distance between our major cities.

While Australia is a large country with a relatively low population, over half of our population live in just three cities – Sydney, Melbourne and Brisbane. In fact, 63% of all Australians currently live in a single linear corridor some 1900 km long between Geelong and the Sunshine Coast. If nearby cities such as Toowoomba, Maitland, Wollongong and Griffith which can be linked to the network are included, the proportion rises to 70%. On current trends this wider catchment will house 30 million people, by 2060, three-quarters of Australia's expected population by then.

For comparison, Spain, with a total national population of 47 million, has developed an extensive high-speed rail network totalling over 3,200 km, with further extensions under construction or planned. Sweden, with a total national population of 10 million is developing a high-speed rail network linking its three largest cities of Stockholm, Gothenburg and Malmo.

There were over 8,000 people per kilometre of the 1900 km route between Geelong and the Sunshine Coast in 2016, and this is expected to increase to over 14,000 by 2060. This compares to 8,400 for Sweden's planned high-speed corridors (including the population of nearby Copenhagen), and under 10,000 for Spain's high-speed network.

It is true that high-speed rail infrastructure is expensive, with a likely cost for an East Coast network less than $150 billion, allowing for inflation since 2013 and the links to Geelong and the Sunshine Coast. However, our State and Federal Governments are spending some $20 billion annually currently on urban freeways, interstate highways, mass transit systems and airports in the Eastern Corridor. A high-speed rail network built over 30 years would cost less than $5 billion p.a. and as discussed later, would reduce the expenditure required on alternative urban and interstate transport infrastructures.

Finally, there are now many overseas high-speed routes exceeding 800 km or travel times of 4 hours, such as Shanghai-Beijing (1300 km, 4.5-6 hours); Tokyo-Hiroshima (890 km; 4-5 hours); Torino-Napoli (980 km; 5.25-5.6 hours); Hamburg-Munich (610 km; 5.5 hours) or Paris -Barcelona (830 km; 6.25 hours). Longer distance international rail services in Europe were impacted by COVID, but are being steadily reintroduced, including overnight sleeper trains.

The common arguments against high-speed rail in Australia thus need re-examination.

The report is organised as follows:

- Chapter 2 describes the need for an East Coast high-speed rail system and its potential economic, social and environmental benefits,
- Chapter 3 considers recent developments with high speed rail and in other spheres, and concludes that now is the appropriate time to reconsider this for Australia,
- Chapter 4 suggests a new approach is needed to introducing high speed rail in Australia, which takes account of these recent developments, as well as the potential for reducing costs and widening the benefits compared to the approach adopted in the 2013 HSR report,
- Chapter 5 details how high-speed rail could be implemented, by starting with regional fast rail links and building them into a wider network,
- Chapter 6 looks at how we can start now by adopting appropriate standards, and finally
- Chapter 7 summarises the key conclusions from the study and sets out key recommendations.

2 THE NEED FOR HIGH SPEED RAIL

As discussed below, high-speed rail provides a game-changer for dealing with major issues in Australia, including:

- Our over-concentration of population in the three big cities of Sydney, Melbourne and Brisbane, and the associated problems of congestion and housing affordability,
- Climate change and the need to reduce greenhouse gas emissions from transport,
- The coronavirus and the potential for regional development, and
- Managing growing passenger and freight demand in the Eastern Corridor.

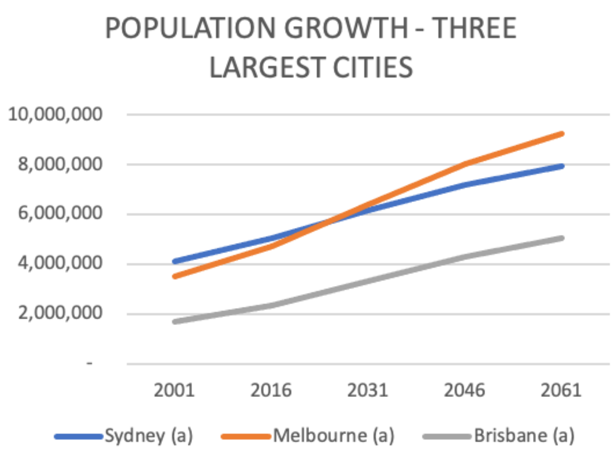
POPULATION GROWTH AND CONCENTRATION

While Australia is a large country with a low overall density, it is highly urbanised, and has one of the fastest population growth rates in the developed world:

- Currently 50% of our population live in Sydney, Melbourne and Brisbane, and the proportion is rising.
- 63% live in the core corridor between Geelong and the Sunshine Coast, and 70% in the wider corridor including nearby cities such as Toowoomba, Wollongong and Griffith.
- ABS forecasts using medium levels of migration, fertility and mortality suggest there will be 22 million living in Sydney, Melbourne and Brisbane by 2061, 28 million in the core corridor and 30 million in the slightly wider corridor, 75% of Australia's population.

As discussed later, this will mean continuing major investment will be needed in transport infrastructure to handle rising demand for both passenger and freight movement.

Figure 2: Population trends in major capitals 2001-2061



Population Trends in our three largest cities 2001 – 2061. ABS Forecasts with medium migration, fertility and mortality, and continuation of population shifts from 201-2016

Congestion in Sydney [*x*]

Sydney's Westconnex and associated Rozelle Interchange and West Harbour Crossing will cost over $30 billion

The over-concentration of our population combined with high population growth has major implications for our three biggest cities:

- Sydney is expected to double its 2001 population of 4 million to 8 million by 2061.
- Melbourne will increase two and a half times to over 9 million by then, overtaking Sydney by 2031.
- Brisbane will triple its population from 1.7 million in 2001 to over 5 million by 2061 (see Technical Appendix for detailed population analysis).

The rapid growth of the three largest cities is exacerbating congestion and housing affordability problems as discussed below. However, at the same time many of the smaller towns and cities in the corridor have been growing more slowly than the Australian average, as they fail to compete with the State capitals (Table 1). If these trends continue the range of opportunities outside the State capitals will continue to reduce in comparison to those in the big cities.

Table 1: Share of national population in the East Coast Corridor 2001-2061

	Change in Share 2001-2016	2001	2016
Major Capitals	1.8%	48.2%	50.0%
Other Major Centres*	0.3%	9.7%	10.0%
Smaller Centres	-0.2%	3.3%	3.1%
Total East Coast Corridor	1.9%	61.2%	63.1%

(*) Gold Coast, Canberra, Lower Hunter, Sunshine Coast, Geelong and Central Coast.

While there is expected to be a negative impact on population growth from the restrictions on international travel due to COVID in 2020-2021, this is likely to be short-lived. Indeed, Australia's appeal will likely be enhanced by our successful management of the virus.

CONGESTION AND URBAN TRANSPORT RESPONSES

The annual cost of congestion in our major cities is now a major issue, estimated at $19 billion in 2019 and rising to $39 billion by 2031. Most of this is on roads in our three major capitals.

Table 2: Congestion costs in Australian cities

Model area	Cost	($ millions)	($ millions)	from 2015 Audit
Sydney, the Hunter and Illawarra	Public transport crowding	68	223	N/A
	Road congestion	8,038	15,693	14,790
Melbourne and Geelong	Public transport crowding	75	352	N/A
	Road congestion	5,485	10,379	9,006
Brisbane, the Gold Coast and Sunshine Coast	Public transport crowding	14	90	N/A
	Road congestion	2,084	5,969	9,206
Greater Perth	Public transport crowding	17	159	N/A
	Road congestion	1,525	3,620	15,865
Greater Adelaide	Public transport crowding	1	4	N/A
	Road congestion	1,444	2,619	3,747
ACT and Queanbeyan	Public transport crowding	1	8	N/A
	Road congestion	289	504	703
Total	Public transport crowding	175	837	N/A
	Road congestion	18,865	38,784	53,317
	Congestion and crowding	19,040	39,621	N/A

Source: Infrastructure Australia (2015) and Veitch Lister Consulting (2019)[6]

On these trends, the cumulative cost of congestion will reach $1 trillion by 2060. This has forced State Governments to build massively expensive motorway and rail projects. For example:

- New South Wales is spending $57 billion over the next four years alone on transport projects, mostly in Sydney, including Westconnex, Northconnex, the Chatswood-Bankstown Metro and Light Rail. Plans are now well advanced for the next two metros (Metro West and Western Sydney Metro) as well as more motorways (West Harbour Crossing and Northern Beaches Motorway), with indicative plans for further projects released, such as two new metros in South-Eastern Sydney.
- Melbourne is similarly building major new road and rail projects, including Melbourne Metro 1 and major motorway extensions, and has announced a series of other major transport projects, including an airport rail link, fast rail to Geelong, and the $50 billion metropolitan ring rail.
- Brisbane is building the $5 billion Cross-River Rail Link as well as major road expansions.

The total urban transport infrastructure spend in the three cities is currently running at around $20 billion annually. Some of the major motorway projects such as Westconnex are costing up to $700 million per kilometre because of their complexity; for example, Westconnex requires a three-level underground interchange at Rozelle. Despite these investments, congestion costs continue to rise. While there has been a small reduction in road traffic and a bigger reduction in public transport use during covid, this is likely to be only a short-term reprieve.

HOUSING AFFORDABILITY

Sydney and Melbourne have just been rated as the third and fourth least affordable cities in the world by Demographia, in its annual survey of 309 housing markets in eight countries [*xi*]. Median house prices are significantly lower in Brisbane, and in the secondary cities in the Corridor (Canberra, Gold Coast, Sunshine Coast, Geelong) and lower again in the smaller cities and towns, as illustrated below.

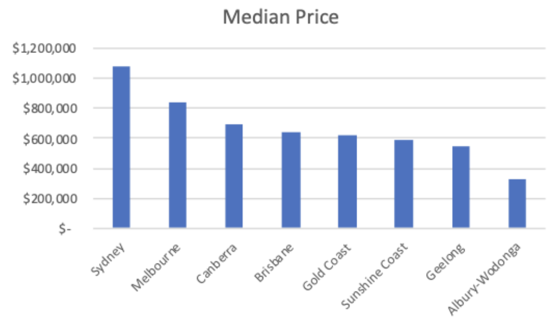
Although these cities generally have lower household incomes than in Sydney and Melbourne, the ratio of median house prices to median household incomes are in the range of 4.8 to 8.4, indicating superior affordability outside of Sydney and Melbourne.

Figure 3: Housing affordability and median housing prices

Intetnational housing affordability rankings

Rank	City	Ratio	Median Price	Median HH Income
1	Hong Kong	20.8	$ 1,368,978	$ 65,726
2	Vancouver	11.9	$ 1,032,435	$ 86,470
3	Sydney	11.0	$ 1,080,000	$ 97,900
4	Melbourne	9.5	$ 843,000	$ 88,700
5	Los Angeles	9.0	$ 1,040,467	$ 115,869
6	Toronto	8.6	$ 828,091	$ 96,725
7	Auckland	8.6	$ 794,145	$ 91,860
8	San Jose	8.5	$ 1,696,419	$ 199,105
9	San Francisc	8.4	$ 1,438,979	$ 172,230
10	London	8.2	$ 925,404	$ 112,794

Median house prices: Selected cities



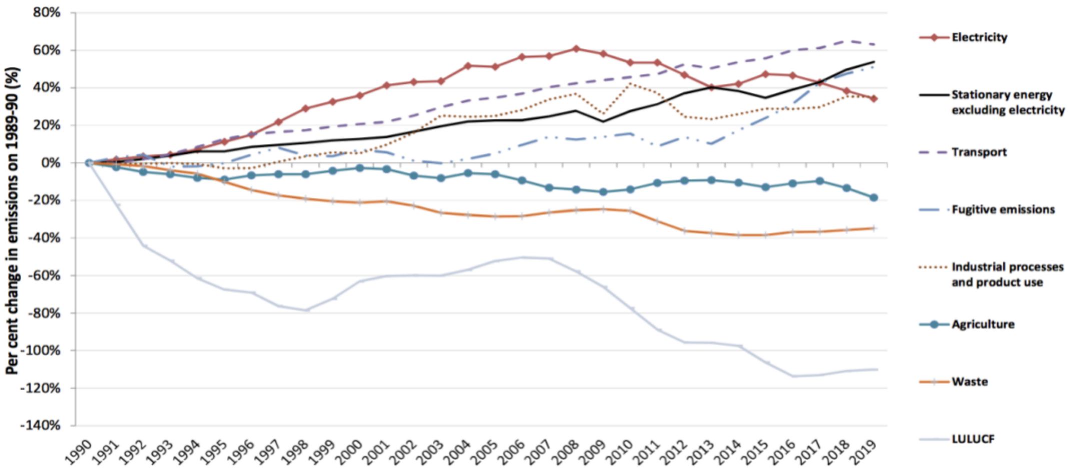
A key factor in the high cost of housing in the major capitals is the rapid population growth they have been experiencing, which pushes up land prices. Reducing the rate of population growth will reduce pressure on housing markets and improve overall affordability.

CLIMATE CHANGE

Global warming is worsening, as evidenced by the recent bushfires in Australia, the threats to the Barrier Reef, and continuing rise in global temperatures. The next UN Climate Change Conference in November 2021 will likely lead to increased pressure on all countries to do more, including Australia which has amongst the highest per capita emissions in the world.

While Australia's emissions from electricity generation are falling as renewables take over from coal, emissions from transport have risen 60% since 1990, the fastest for any sector, and continue to increase [*xii*] (Figure 4).

Figure 4: Changes in greenhouse gas emissions in Australia by sector: 2989-2019



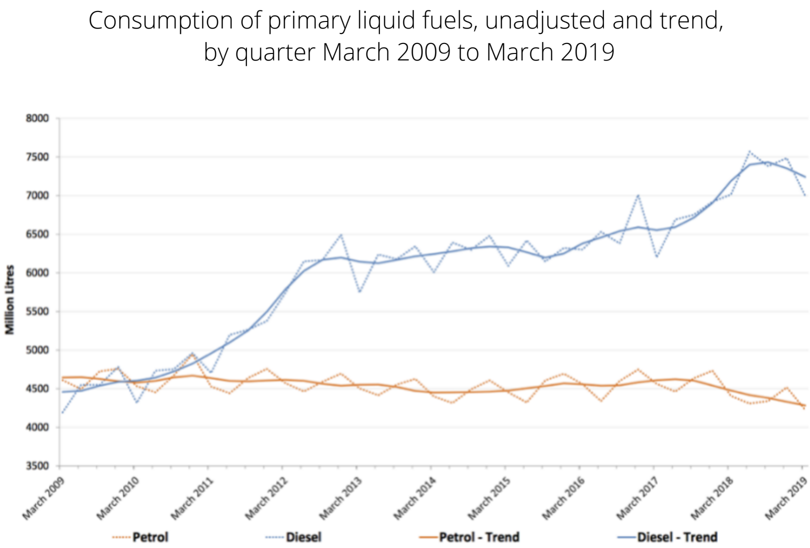
Source: Department of Industry, Science, Energy and Resources

This reflects growing use of liquid fuels, especially diesel, which has grown rapidly as a result of increasing use of trucks, as well as in aviation gasoline (prior to the COVID virus) (Figure 5).

Figure 5: Renewable energy and diesel/petrol consumption in Australia: 2009-2019

Companies like Iberdrola are investing in wind and solar in Australia [*xiii*]

Small-scale solar is also booming [*xiv*]



Source: Department of the Environment and Energy

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Rail is generally at least three times more energy-efficient than aircraft, cars or trucks and can utilise renewable electricity when electrified, making it even more effective in reducing greenhouse gas emissions. For example, a detailed comparison of energy use and emissions between high speed rail and air travel on seven inter-city routes in Europe [*xv*] found HSR produced only around 20% of the emissions of aircraft on average (Table 3).

Table 3: CO2 emissions from high speed rail and air for European city-pairs

CITY PAIR	CO2 emissions gms/Pass-km		Rail as % of Air	Air/HSR Ratio
	High-Speed Rail	Air		
Paris-London	18	143	13%	7.9
Amsterdam-Frankfurt	33.6	116	29%	3.5
Amsterdam-London	24.9	124	20%	5.0
Paris-Amsterdam	15	133	11%	8.9
Frankfurt-Paris	20	111	18%	5.6
Frankfurt-London	25.6	102	25%	4.0
Rome-Milan	23.8	128	19%	5.4
AVERAGE	**23.0**	**122.4**	**19%**	**5.3**

Source: https://www.hindawi.com/journals/jat/2018/6205714/?limit=all

Studies in the US found unit coal trains were 4.5 to 5 times more energy efficient than the largest trucks allowed in the US; soda ash unit trains and non-unit trains were 4.9 and 3.2 times more energy efficient than trucks, and ethanol unit and non-unit trains were 4.8 and 3 times more energy efficient than trucks [*xvi*].

The ratios for CO2 emissions in the US would be similar given both road and rail freight in the US uses diesel power. However electrically powered freight trains would have an even bigger emissions advantage over trucks given the former can utilise renewable energy now, whereas the truck fleet has not yet begun the transition to electric power.

High speed rail could therefore make a major contribution to reducing our emissions from both intercity passenger and freight movement (see later discussion on high-speed freight opportunities).

THE CORONAVIRUS: CHALLENGE AND OPPORTUNITY

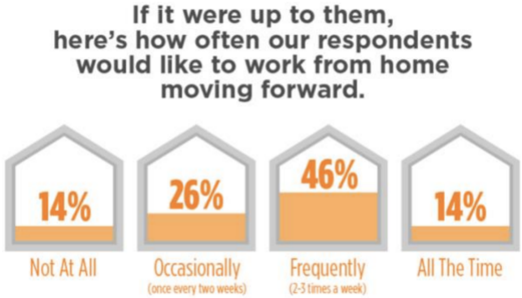
Need for longer-term economic stimulus

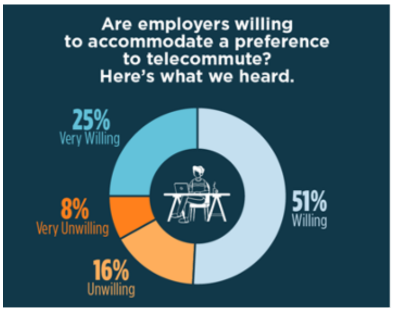
The corona virus pandemic of 2020 has been a dramatic change, resulting in major impacts on the economy, including the airline industry. While there is evidence the economy is bouncing back, there are likely to be some longer-term effects. Major short-term economic stimulus is being applied to the economy through schemes such as Job Seeker and Job Keeper. But a major national project like high speed rail could not only stimulate the economy over a longer period, but bring long-lasting benefits from 100-year infrastructure.

Telecommuting

The response to the coronavirus has taken the emergence of remote working to a business imperative which is now widespread. This move will never be fully reversed. Recent research suggests a growing willingness by both employers and employees to embrace working from home, at least for part of time. This suggests new options for decentralising some of the work, and some of the population, away from the big cities to smaller centres in the corridor, provided those centres were conveniently linked by a transport system for the occasions when face-to-face contact is important.

Figure 6: Willingness to telecommute





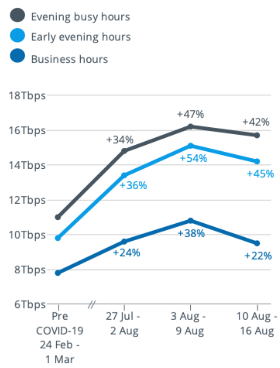
Results from a recent survey of employees (left) and employers (right) [*xvii*]

But how permanent will the changes brought about by the pandemic be? What will be the future of the office, and for that matter, the central business district itself? NBN data shows an increase of 38% in business hour traffic post-covid, and up to 54% in early evening hours. This indicates the impact of changes in communication patterns as a result of lockdowns and other covid-induced behavioural change. NBN demand appears to have fallen since the peak in early August, although not back to pre-covid levels.

Another indication of behaviour change is that an industry of supplying small, modular home offices has sprung up, which can be conveniently located in back yards [*xviii*] (Figure 7).

Figure 7: Working from home

Working from home [*xix*]



NBN demand [*xx*]

Modular home office design [*xxi*]

Certainly not every job is suitable for working remotely from a regional city, or from home. And not everyone would want to adopt those work patterns even if they were available. But people value choice and flexibility, and employers wanting to attract the best workforce will have to adapt.

Another clue is therefore to look at emerging work practices by leading companies. One such Australian company, Atlassian, has a policy of allowing employees to choose where they work. They are pushing ahead with plans for a new 30 story CBD office block right next to Central Station in Sydney (the world's tallest wooden structure), but are changing how the office space will be used, and also changing how work is organised (see quote below for their philosophy [*xxii*]).

People can work from home (including in a non-capital city) or from head office, or any combination thereof (Figure 8).

Figure 8: The future of the office?

Post-pandemic, office spaces would likely look more like "co-shared workspaces with larger amount of office spaces for collaboration activities", Mr Cannon-Brookes said.

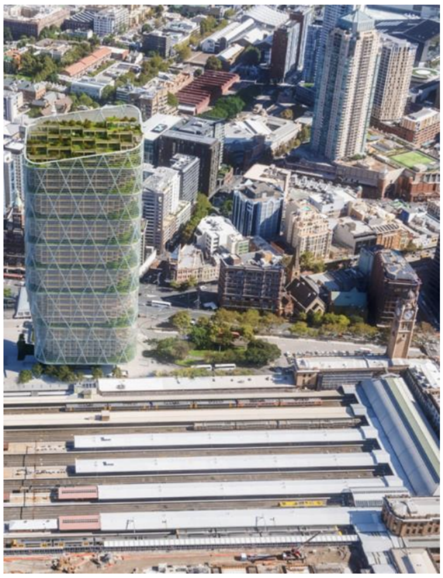
Both said they would be "re-tooling" their offices post-pandemic to reflect a reduced number of employees in physical attendance.

"We need to firstly change the 'how we work' in order to enable people to work where they want," Mr Cannon-Brookes said.

"So our policy has been very clear about communicating to employees and giving them as much notice as possible that where you work is going to be up to you, within some constraints of your teams and time zones and those sorts of things. But how we work has to be standardised."

The "team anywhere" approach would give employees the certainty they needed to make decisions about relocating to regional areas without having concerns about compromising the way they interacted with team members.

Interview with Mike Cannon-Brookes, Atlassian [*xxii*]



Atlassian's new CBD head office [*xxiii*]

Albury-Wodonga, one of the key regional cities in the East Coast Corridor [*xxiv*]

While the possibilities of remote working have been around for some time, the corona virus has made this practice much more widespread, and has lasted long enough to change expectations. It is therefore considered likely that some of the new work practices will continue, and that a significant number of people would choose to work from regional cities if they could maintain contact with head office by fast rail connections when needed. Others can successfully run their own business from a regional centre using fast transport to connect with clients as needed.

This could have a dramatic effect on settlement patterns. For example, if only 5% of the "office" jobs (professional, clerical/admin or managerial occupational categories) expected to otherwise be in Sydney, Melbourne and Brisbane in 2060 were shifted in that way to regional cities, this would create at least 300,000 employment opportunities in those regional cities.

This would support roughly another 450,000 jobs in service sectors (teachers, retail workers, health workers, hairdressers, home builders, local government employees etc), which would support a population of at least 1.5 million extra people in those cities (and 1.5 million fewer in the three State Capitals) when job multiplier and employment participation rates are considered. The potential impact of this for transport demand, and the role of high-speed rail in meeting this demand, is discussed later.

Tourism and other impacts of high speed rail

High speed rail could have other benefits for regional development and population distribution. For example, the tourism and hospitality sector in regional cities is affected by the time taken to reach them from major source markets.

In Australia particularly, the bulk of domestic and nearly all international tourism originates in the capital cities. Overseas studies [xxv] suggest that high speed rail has significant benefits in supporting tourism in centres on HSR networks, particularly in the smaller centres. The NSW Tourism and Transport Plan [*xxvi*] for example recognises the importance of transport links for regional tourism. High speed rail could significantly improve access to regional tourism compared with current regional air services or coach transport.

Figure 9: High speed rail and rural tourism

The NSW Central Coast, Queensland's Gold Coast and Victorian's Goulburn Valley are among areas which could benefit from high speed rail

Other sectors in regional cities which could benefit include higher education and manufacturing, where the ability to maintain contacts with colleagues, clients, suppliers and others is important. Inevitably many of these are located in the major capitals, but faster access could allow some organisations to relocate to regional cities whilst maintaining their networks and supply chains.

Together with the shift in office work noted above and an increase in retirees seeking lower cost housing and more relaxed lifestyles, the combined impact could mean at least 2.5 million fewer people crowded into the metropolitan capitals, and an equivalent number of extra people living and working in medium and smaller cities by 2060 (see Technical Appendix for more details).

Table 4: Potential for decentralisation

Component of Decentralisation	Primary Jobs	Employment multiplier	Total Jobs	Population Generated
"Teleworkers" Relocating	300,000	2.2	660,000	1,254,000
Government / Higher Education	45,000	2.0	90,000	171,000
Manufacturing / Specialised Services	70,000	2.0	140,000	266,000
Additional Primary Tourism Jobs	90,000	1.8	162,000	307,800
Additional Retirees				500,000
TOTAL POPULATION DECENTRALISED				2,498,800

Source: Author's estimates. "Teleworkers" include people running their own businesses, those in relocated businesses, and people working in regional areas for organisations with head offices in major capital cities.

ACCOMMODATING GROWTH IN TRANSPORT DEMAND

Passenger

Until the coronavirus, passenger movement in Australia was growing faster than population. Currently travel demand is significantly suppressed as a result of the restrictions on movement, with air travel and public transport particularly affected. However recent data from China shows a significant upturn in travel as the country opens up and the economy recovers. Assuming vaccines are developed, it is likely that the same will apply around the world, although economic activity and air travel, particularly international travel, may take some years to fully recover.

However, given the expected population growth in the East Coast between Geelong and the Sunshine Coast, longer-distance passenger traffic volumes in the corridor are likely to increase by at least 50-60% by 2060. The Sydney-Melbourne and Sydney-Brisbane air routes were already amongst the busiest in the world before the Corona Virus. Whilst Sydney is building its second airport at Badgerys Creek, Melbourne and Brisbane may well need major upgrades to their existing airport facilities, or even additional airports, to relieve the likely pressure on air traffic. In addition, there would have to be substantial further capacity enhancements on the Hume, Pacific and Bruce Highways to cater for rising car and truck movement between the cities.

The 2013 High Speed Rail study estimated that a high-speed line would handle 84 million passenger movements in the corridor by 2065, capturing around 40% of the anticipated inter-capital city air market, 60% of the regional city air market and a significant share of intercity car movements.

Freight

Freight traffic could increase even faster, potentially doubling by 2060. For example, Port Botany is planning for a doubling of container movement through the port between 2016 and 2045, with a range of measures designed to increase the rail share from 17.5% to 40% over that time (Table 5).

Table 5: Port Botany container freight forecasts

Year	2016	2021	2036	2045	Long Term
Container Tonnes (m)	14.4	17.2	25.6	30.6	43.2
Rail Share	18%	28%	38%	40%	40%
Rail Tonnes (million)	2.5	4.8	9.7	12.3	17.3
Road Tonnes (million)	11.9	12.4	15.9	18.4	25.9
Total Rail Containers (TEU *)	440,000	840,889	1,698,540	2,139,937	3,000,000
Total Containers (TEU *)	2,500,000	2,986,111	4,444,444	5,319,444	7,500,000

(*) Twenty-foot equivalent units. Source: https://www.nswports.com.au/rail and author's calculations

New rail infrastructure is being built to handle short distance freight from Port Botany, including upgrades to the Botany and Southern Sydney Freight lines, and additional intermodal terminals. Similar measures are planned for Melbourne. But if no new longer-distance intercity rail infrastructure is built, most of the intercity freight demand growth will need to be handled by our highways. The Hume Highway is already handling up to 10,000 trucks a day, and there are 5,000 trucks a day on the Pacific Highway. Doubling these volumes would be unacceptable as well as inefficient.

A suitably designed high speed rail corridor could also provide significant additional freight capacity, both in higher speed freight trains (see later discussion) and by creating more capacity on the existing interstate rail line by shifting passenger trains to the high-speed line.

It is estimated that the combination of the existing interstate rail lines, the inland rail line currently under construction, and a high-speed line could increase the share of north-south freight in the Eastern corridor from 20% now to 50% by 2050 (see detailed analysis in Technical Appendix).

Benefits from a high speed rail network
Unlike investment in airports or highways however, high-speed rail would not only handle increased traffic but would improve the accessibility of the regional cities and towns in the corridor, in particular their accessibility to each other and to the major capital cities.

As described later, higher speed rail services can also be extended to other cities and towns in a wider corridor, such as between Brisbane and Toowoomba; Newcastle and the Upper Hunter; between Wagga Wagga, Shepparton and the Riverina; between Melbourne, Ballarat and Bendigo; and in the Melbourne-Gippsland-Canberra corridor. This would extend the benefits of high speed rail to 75% of the Australian population. This will further help manage population growth, as indicated by the potential decentralisation strategy discussed earlier.

The capacity provided by a high-speed rail system would therefore significantly reduce expenditure on air and road infrastructure over at least the next forty years. Indeed, as discussed later, a high-speed rail network could have significantly greater passenger, as well as freight capacity, than that estimated in the 2013 Study, and would provide a key part of the transport backbone for three in four Australians well into the 21st Century.

SUMMARY

For the last sixty years at least, Australia has increasingly relied on aircraft, cars and trucks to move intercity passengers and freight. However, these modes have had the effect of concentrating people in our major capital cities, with many smaller centres unable to compete through lack of convenient access. It is faster to get from one capital city to another than to get from many of the smaller cities and towns in the East Coast corridor to the nearest capital city.

This in turn has exacerbated congestion and housing affordability problems in the big cities. Current trends indicate these issues will become even more problematic in the future. The main solution to the former problem is increasingly expensive motorways and metros in our biggest cities, while little has been done to successfully address high housing costs.

A high speed rail network in the East Coast could alleviate some of these issues by enabling a significantly better management of future population growth in the corridor, particularly in the wake of the changes in work practices brought about by the corona virus. It would also help reduce greenhouse emissions from transport, which have risen 60% in the last thirty years in Australia. Travel demand in the corridor will increase in any event. Failure to take the opportunity to build high speed rail will simply mean more airport and road infrastructure will be needed instead. This needs to be remembered when considering the cost of investing in high speed rail.

3 RECENT DEVELOPMENTS

HIGH SPEED RAIL NETWORKS

The growth of high speed rail globally has been dramatic, especially since 2010:

- Travel on high speed trains increased from 230 billion passenger-km in 2010 to 950 billion passenger-km un 2018, more than quadrupling in 8 years.
- High-speed rail networks have increased from 10,000 km in 2010 to 52,000 km in 2019, with a further 11,500 km currently under construction.
- The number of high-speed trainsets in operation has now grown to 6,000 [*xxvii*].

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Current plans in China and Europe in particular suggest high speed rail networks will expand to 100,000 km by 2035, ten times their extent in 2010. High speed rail now operates in 20 countries in Asia, Europe, North America, the Middle East and Africa, including Turkey, Saudi Arabia and soon in South Africa [*xxviii*].

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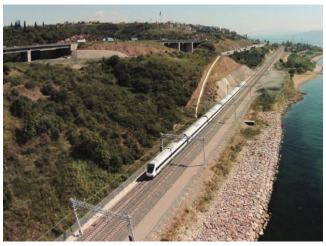
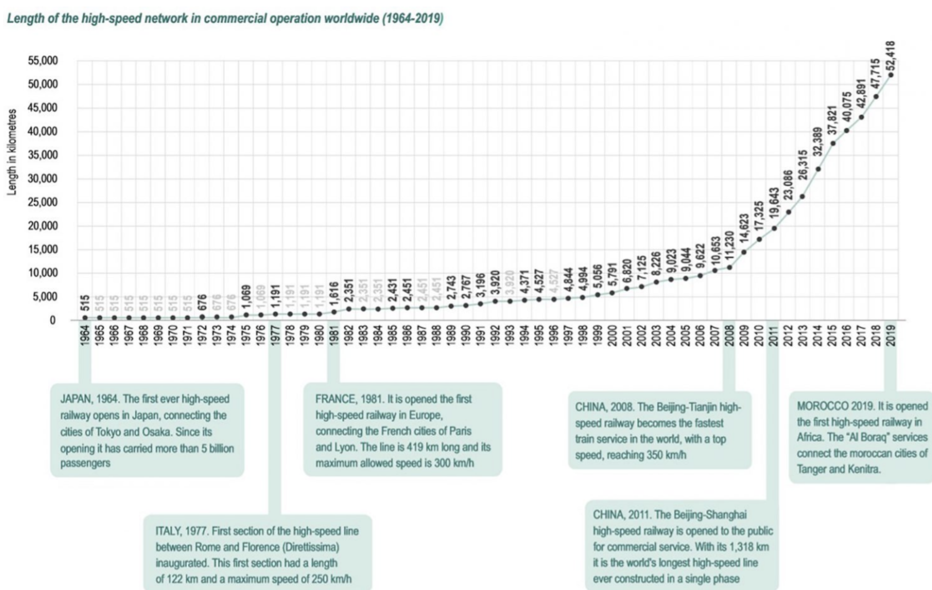
Figure 10: High speed rail developments

China's high speed rail network



High speed rail
in Turkhey

High speed rail
is planned for South Africa



Global high speed rail has grown rapidly, espcially since 2010. Source: UIC

In the **United States** although progress with the San Francisco-Los Angeles high speed line has been slow, there have been a number of recent developments in high speed rail from private companies [*xxix*], including:

- Private operator Brightline has introduced high speed (200 km/hr) services in Florida, while Virgin Trains USA is building a 270 km extension to the Brightline high speed line between and West Palm Beach and Orlando.
- Virgin is also planning a high speed (320 km/hr) line between Victorville, California and Las Vegas, with a planned opening in 2023, while Brightline is also planning a Las Vegas-California high speed line and has recently received funding approvals [*xxx*].
- Texas Central is planning a high-speed line which will cover the 400 km between Houston and Dallas in 90 minutes, using Japanese Shinkansen technology. Expected ridership is 6 million p.a. by 2029, and 13 million p.a. by 2050. There are now plans for high speed lines in other parts of the US as well [*xxxi*].

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In addition, Amtrak is replacing its current ACELA trains on the North-East Corridor with new Alstom trains with one-third greater capacity and 300 km/hr capability, compared with 220 km/hr currently. These will be able to take advantage of new upgraded alignments when completed, and will be America’s first true high-speed train when they enter service in 2021/22. They will also largely be built in the US, indicating the beginning of a manufacturing capacity for high speed trains.

Figure 11: High speed rail developments oin the US

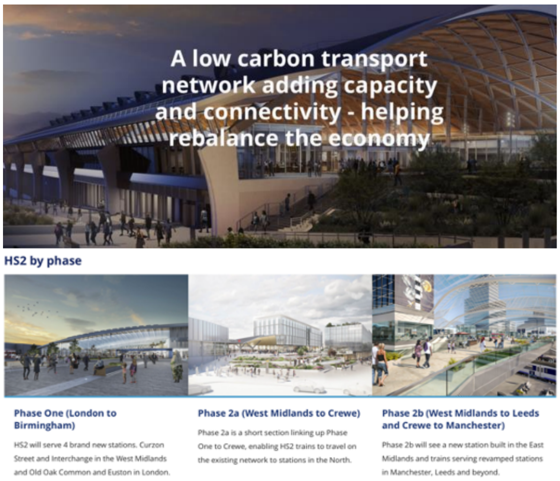
Brightline Train on test run at the new Miami Station

Texas Rail’s Houston-Dallas HSR Project EIS was published by the FTA in May 2020 [*xxxii*]

First of Amtrak's new Acela train on test

The **United Kingdom** is now building the first phase of HS2 between London and Birmingham, with further extensions planned [*xxxiii*]. This builds on the Eurostar between London and Europe, which has captured much of the London-Paris air market and has been extended to other cities.

Figure 12: HS2 in the UK



The UK’s HS2 project between London and the Midlands, with connections to more than 25 cities.

Countries like **Algeria**, **Russia** [*xxxiv*], and **India** [*xxxv*] are building and planning new high speed rail networks, while countries with existing networks are expanding their networks or services [*xxxvi*]. For example, both **Spain** and **France** have introduced new, lower cost services using modified rollingstock, to attract more budget-conscious travellers and to compete with coaches and low-cost airlines.

Figure 13: High speed rail in other countries

High speed rail developments in Saudi Arabia, India, and Italy

High speed rail is also extending to countries and cities with smaller populations. For example:

- **Sweden**, with a national population of 10 million, is building a high speed rail network in stages between Stockholm, Gothenburg and Malmo.
- The 870 km Rail Baltica project will link **Poland** to the **Baltic countries** with high speed passenger and freight services.

Figure 14: Case studies in low population countries

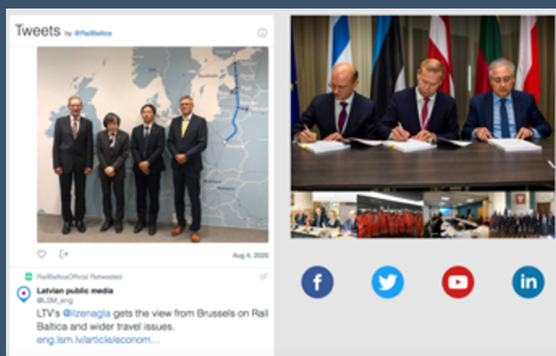
High speed rail in Sweden

Demand on rail in Sweden has doubled in the last 25 years. A new high-speed rail network with speeds up to 320 km/hr is to be built in stages by 2035, linking the three largest cities as well as key cities along the routes. The first three stages will be built outwards from Stockholm, Gothenburg and Malmo (below) [*xxxvii*].

Sweden's High speed rail network plan [*xxxviii*]

Rail Baltica

This project will link Poland with Latvia, Estonia and Lithuania, which have combined populations of only 6.2 million. It will operate 250 km/hr passenger trains between 7 cities, and 120 km/hr freight trains between three multimodal terminals [*xxxix*].



The Rail Baltica Project is well underway [*xl*]

A recent study of the **impact of the coronavirus on travel patterns** in Europe and China found that high speed rail will continue to gain mode-share from airlines in the post-covid period [*xli*], and that business travellers were more open to rail travel times of 3-4 hours, and leisure travellers up to 5-6 hours, compared with earlier estimates of 2-3 hours.

Figure 15: High speed rail in a post-covid world

Impact of covid on high speed rail [*xlii*]

Air-rail impacts in Europe [*xliii*]

Such changes in behaviour are already causing changes in service offerings. For example, Swedish Rail is planning overnight sleeper services from Malmo to Cologne which connect with high speed rail services to Germany, Paris and London xliv, while Austria now has an extensive sleeper train network.

HIGH SPEED RAIL TECHNOLOGY

High speed rail technology is also developing rapidly (Figure 16). Innovations include:

- New "hybrid" or "dual" powered trains and locomotives, which can operate on both electrified and non-electrified lines. This allows high speed trains to be introduced gradually, and extends the range of high speed networks.
- Tilting trains, some operating around 250 km/hr, also allow higher-speeds on conventional track.
- Some high speed trains can even change gauge, for example from standard gauge to broad gauge, while moving.

Figure 16: Innovation in high speed passenger trains

Talgo's 250 Dual has tilting and gauge-changing ability, and operates at up to 250 km/hr on electrified, and 180 km/hr on non-electrified lines [*xlv*]

Alstom's Pendolino High-Speed tilting Train also operates at up to 250 km/hr [*xlvi*]

Magnetic Levitation trains are under development in Japan and China, which will be able to operate at speeds of 600 km/hr or faster, while **Hyperloop** technology with magnetic levitation trains operating in tubes with most of the air evacuated promise speeds in excess of 750 km/hr in suitable locations.

Figure 17: Magnetic levitation and Hyperloop technology developments

Japan's Magnetic Levitation Train establishing a world rail speed record of 603 km/hr in 2015 on test [*xlvii*]

Hyperloop One Test Track in Nevada [*xlviii*]

Finally, there are also significant developments in **rail freight technology**, including:

- "Rolling Highway" and "CargoBeamer" technologies developed in Europe, which allow trucks to be carried on special trains, with whole trains unloaded in as little as 30 minutes
- New high-powered dual locomotives which can haul both passenger and freight trains at up to 160 Km/hr, and have three times the power of conventional diesel locomotives when operating under electric power.

Figure 18: Innovation in high speed freight rail technology

Stadler "Electrodual" locomotive with freight train

"Modalohr" system for "Rolling Highway" intermodal operation

These innovations offer new approaches to introducing and operating high speed rail, with significant implications for Australia, provided the most appropriate technologies are adopted.

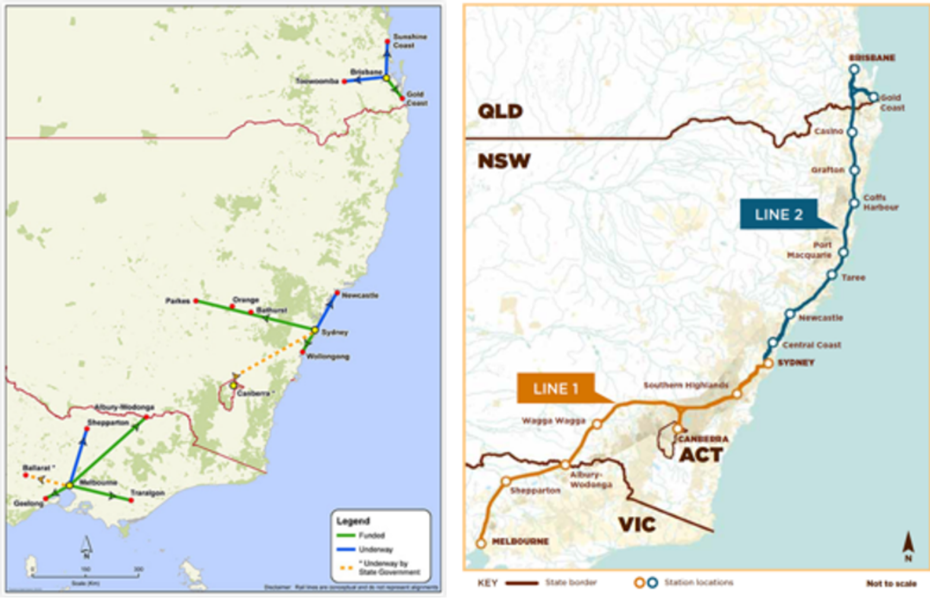
FASTER REGIONAL RAIL

The dominance of our State capitals means that until recently, governments have focused on urban rather than inter-urban transport needs. However, in 2019 a National Faster Rail Agency was established, reporting to the Federal Minister for Population, Cities and Urban Infrastructure, to examine faster rail connections between regional cities and metropolitan capitals.

$2 billion has been allocated to the Melbourne-Geelong high speed rail corridor, and business case studies have been undertaken for Sydney-Newcastle, Melbourne-Shepparton and Brisbane-Sunshine Coast corridors. Victoria has introduced faster rail services to regional cities from Melbourne, while New South Wales is also investigating faster regional rail links from Sydney.

Figure 19: National faster rail corridors (left) and East Coast high speed rail corridor (right)

National Faster Rail corridors under investigation [*xlix*]



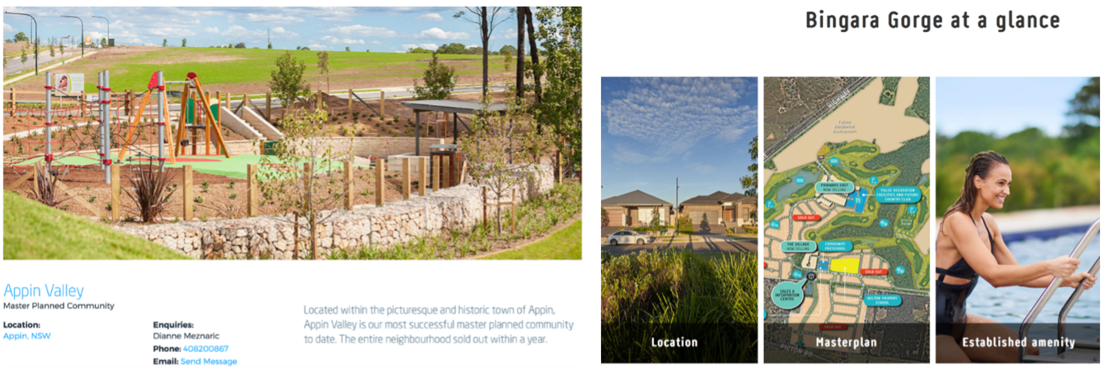
Source: High Speed Rail Study: Phase 2 report

These projects are important initiatives. But they would have much greater long-term value if designed to create the first stages of an ultimate East-Coast High Speed Rail Network.

CORRIDORS UNDER THREAT

Continuing urban development around Australia's capital cities over the last decade is threatening to impact on potential corridors for regional fast rail or high-speed rail lines, especially south of Sydney, where part of the corridor identified in the 2013 HSR study is now being developed.

Figure 20: Urban developments encroaching on high speed rail corridors



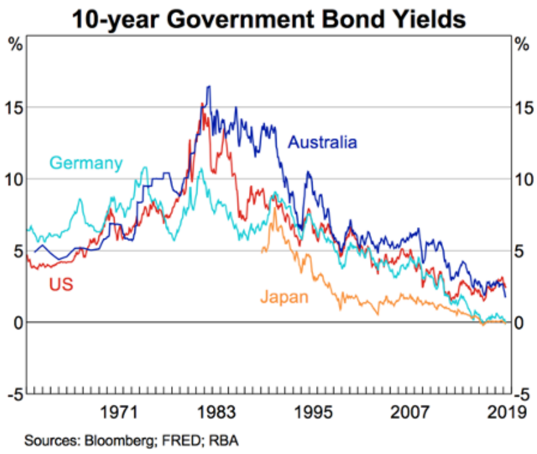
Unfortunately, finding suitable corridors or regional fast rail or high-speed rail lines can be difficult given the requirements for large-radius curves and moderate gradients, and the desire to minimise noise and other impacts. Furthermore, opportunities for government to capture some of the value created by high-speed rail depend on early purchase of land around potential stations.

BORROWING COSTS

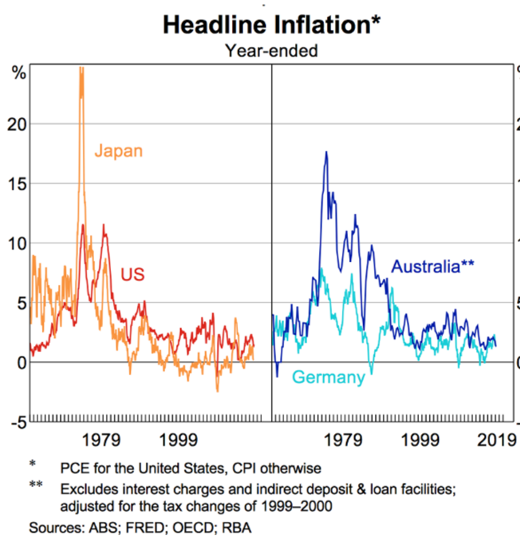
As a capital-intensive project, the economic case for high-speed rail is affected by interest rates. Currently both absolute and real interest rates are at record lows, not only in Australia but globally. In November 2020, the Reserve Bank further lowered interest rates in Australia to record low of 0.1%, and indicated they were likely to stay low for at least the next three years.

In addition, the low inflation environment means that this is the ideal time to invest in long-term projects. Furthermore, the discount rate used in benefit-cost evaluations should be reduced to reflect the macro-economic environment, which has the effect of increasing the value placed on future benefits.

Figure 21: Borrowing costs are at record lows



Bond yields 1960-2020



Inflation in various countries

SUMMARY

Since the last major attempt to introduce high-speed rail in Australia in 2013, the pace of high speed rail development has picked up around the world, while new technology provides flexibility for staging construction of high-speed rail and for introducing high speed freight services.

In addition, the Federal and State Governments are now actively implementing selected faster regional rail links, and examining further opportunities for linking our major capital cities to regional cities. These could form the beginning of a future high speed rail network if suitably designed.

However, some of the corridors which can be used for these links and for a future high speed rail network are under threat from urban development. Any further delays in preserving high speed rail corridors and station locations risks making investments more expensive in the future and reduces opportunities for land value capture.

At the same time, record low borrowing costs make this an ideal time to consider major long-term capital-intensive projects. **The time to invest in high speed rail is now.**

4 A NEW APPROACH

VERY HIGH SPEED RAIL OR BUST?

Previous attempts to introduce high speed rail into Australia mostly focused on completely separated very high-speed inter-capital city services (350 km/hr), used only for passengers. The international and national developments discussed earlier suggests a new approach is needed when considering high speed rail in Australia. This approach needs to:

- Consider not only the easily measurable benefits such as savings in travel time, but the much wider and more strategic benefits from re-shaping population patterns, especially since the experience with the coronavirus on work-life choices.
- Take advantage of recent developments in rail technology, including in freight as well as passenger transport, but select the most appropriate technology for the East Coast Corridor.
- Identify ways to start building high speed rail quickly, while fitting into a longer-term plan.

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HOW HAS HIGH SPEED RAIL BEEN IMPLEMENTED OVERSEAS?

There are three broad options for introducing high speed rail:

- As a **stand-alone system**, but using conventional (wheel on rail) rollingstock. This option was proposed in the High-Speed Rail (2013) study, with trains capable of 350 km/hr,
- As an **integrated system**, using existing railway infrastructure where necessary,
- Using completely new **magnetic levitation** or **hyperloop** technology. This requires totally dedicated and separate infrastructure.

Figure 22: Approaches to integrating high speed rail

Japanese "Free Gauge Track" high speed train

Gare du Nord station in Paris [*l*]

High speed rail has evolved differently in different countries:

- **Japan** initially built a completely **stand-alone system** from its existing railway network. This was necessary as the latter was narrow gauge and heavily utilised. Taiwan, Korea and some other countries have also built stand-alone systems. Recently however, Kawasaki has been developing a "Free Gauge Track" high speed train for Japan which can change from standard to narrow gauge track while moving [*li*]. Spain's Talgo trains already achieve change of gauge while on the move.
- **France** took a different route, and utilised **existing rail corridors into its key stations**

in Paris and other cities. This not only saved costs, but provided excellent interchange with metros and other urban rail systems. For this reason, TGV trains use the same track and loading gauge as conventional slower-speed trains, although they do use more advanced signalling systems and separated alignments in rural areas.

- **Sweden**, **Spain** and **other countries** have adopted even more **integrated approaches**, and introduced **tilting trains** capable of faster travel on slower speed lines. Spain has also utilised **hybrid locomotives and trains** to allow high speed on non-electrified lines.

MIXING PASSENGER AND FREIGHT

In addition, high-speed passenger trains share tracks with freight trains in certain circumstances, such as in the Channel Tunnel, the Swiss Base Tunnels, or on main line corridors such as the new Rail Baltica corridor.

The Gotthard tunnel in Switzerland and the Channel tunnel, both over 40km in length, operate freight and passenger traffic during the same periods of the day, and achieve high capacity by using careful operational management. For example, the Gotthard Base tunnel operates high-speed freight trains at 3-minute headways, and is designed to carry over 200 freight trains a day in addition to up to 40 international passenger trains. This compares with around 40 freight trains and 60 passenger trains per day on the Main South Railway line in Australia in its busiest section (Moss Vale to Mittagong).

Switzerland now moves 70% of its international freight traffic via rail, mostly on piggy-back trains, through its new Base tunnels. Other countries such as Austria mix high speed international passenger trains with freight trains where necessary, for example where separate high-speed passenger lines are not available.

Figure 23: High speed freight and passenger services in Europe can share tracks

Freight and passenger traffic outside Gotthard Base Tunnel [*lii*]

Italy's "FAST" freight service travels at up to 180 km/hr on high speed lines [*liii*]

Truck Shuttle (left) and Eurostar high speed passenger service (Right) emerge from the Channel Tunnel

More recently Italy has introduced **high speed freight services** at night, using modified high speed passenger trains on their high speed passenger rail network. This recognises the European goal of shifting freight from road to rail where possible.

China intends to do the same, and has already been using high speed passenger trains to transport freight. This year it intends using 1000 bullet trains to transport e-commerce goods to more than 80 cities during its 20 day "shopping spree". This is part of a much larger plan to improve its logistics capability using special freight trains on its high-speed rail network, especially at night when demand is otherwise low.

Figure 24: China's high speed freight rail plans

Special railway logistics services for online shopping event to last 20 days

More bullet trains are being used to help improve logistics capacity during China's 20-day Singles Day shopping spree in response to growing demand.

To cater to the needs of the logistics market, railways plan to provide special services to boost e-commerce from Nov 1 to 20, China Railway Corp, the national railway operator, said on Saturday.

It started providing special logistics services during the shopping spree in 2016. This year, they will last for 20 days-10 days longer than in the past.

The company said it will arrange more than 600 railway routes and 1,000 bullet trains to transport e-commerce goods to more than 80 cities, operate Fuxing bullet cargo trains between Beijing and Wuhan, Hubei province, organize cold-chain storage delivery and provide chartered train services to logistics and e-commerce enterprises.

China Daily, November 2020

China planning high-speed rail freight network to help e-commerce sector

- The country already has an extensive high-speed passenger network and is now looking to develop new goods trains
- Rail bosses believe demand from online retailers will help drive the development of the network

Matt Ho
Published: 8:00am, 23 Aug, 2020

Why you can trust SCMP

SCMP, August 2020

MAG-LEV OR HYPERLOOP?

While both stand-alone and integrated approaches are used with "conventional" high speed rail, the Magnetic Levitation systems being developed both in Japan and China are unable to be integrated with conventional trains. They therefore require totally dedicated corridors, including into city centres.

These systems are capable of speeds in the order of 600 km/hr but are expected to be significantly more expensive than conventional high speed systems per kilometre. However, they are designed to parallel and supplement two of the busiest high speed rail corridors in the world - Tokyo to Osaka and Beijing to Shanghai, and will add capacity as well as speed.

In addition to the above magnetic levitation systems, Hyperloop is a magnetic levitation system involving the movement of people or goods in pods through an evacuated tube. The concept was developed by Elon Musk, who has encouraged its development by licensing the technology to a number of firms [*liv*].

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The key to Hyperloop is the reduction in wind resistance and hence energy consumption as a result of the evacuated tube technology. Several companies have been formed to develop their own versions of the concept. For example, Hyperloop Transportation Technologies has built a test track in France, while Virgin Hyperloop 1, originally formed in 2014 but renamed after investment by Richard Branson's Virgin, is planning full test track operation in 2021. Initial tests have achieved speeds of 380 km/hr and the claimed top speed could be in the realm of 1200 km/hr.

However, in addition to questions surrounding the likely cost, and the potentially long time for commercial development of hyperloop systems, there are questions about station infrastructure and capacity for Hyperloop. The "Pods" currently being designed have relatively small capacity – around 20-30 passengers, which means they will need to run at very short headways to achieve reasonable capacities – perhaps as low as every 30-60 seconds. Furthermore, loading and unloading at stations will be complicated by the fact that they are operating in a vacuum tube. Accordingly, station concepts being proposed suggest multiple parallel loading bays which could be very space intensive, as shown below.

Figure 25: Hyperloop station concepts

Hyperloop Station Concept. External view (left) showing raised guideway and station. Internal view (right) showing pods emerging from evacuated tubes [*lv*]

Given Australia's relatively low population density compared to Japan or China, it is not considered likely that Mag Lev Trains would be viable here for many decades. In the very long term, Hyperloop technology may be suitable for the Perth-Adelaide-Sydney corridor, which has long distances, flat terrain (except for the Blue Mountains), very few intermediate towns, and relatively low demand.

AN APPROACH SUITED TO AUSTRALIA

The situation in South-East Australia has some unique features. Inter-capital city distances are relatively long (850km) but distances between regional cities are shorter (typically 50-120 km). Train densities are lower than in than Europe or Asia. Melbourne and Brisbane also have broad gauge and narrow-gauge rail systems respectively, which means high speed trains will need their own tracks in those States unless some of the more advanced gauge-changing trains are utilised.

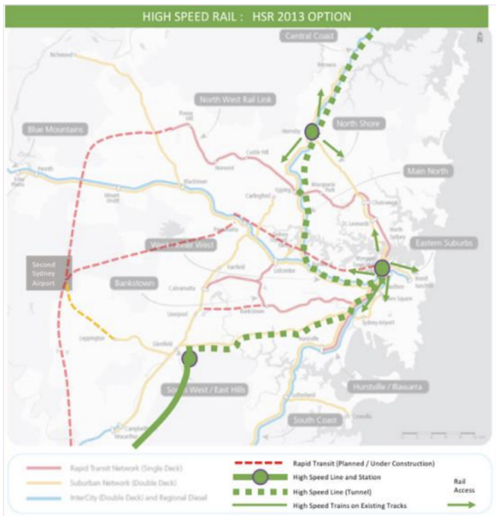
If the key objective of high-speed rail in the East Coast corridor is to better manage population growth, congestion, housing affordability and transport emissions, it will need to:

- service both the large capital cities and the regional towns and cities in the corridor,
- help with the movement of freight as well as passengers,
- be affordable, and
- be capable of being effectively built in stages.

NEW ROUTE OR ALIGNMENT OPTIONS

The 2013 HSR Report examined potential routes, alignments and station locations for a high-speed line between Melbourne and Brisbane in significant detail. In general, the final proposed route is considered optimal. However, there are some options for the route through the Sydney metropolitan area which could be reconsidered. Figure 26 shows the original proposed route in the HSR study, together with two alternative options B and C.

Figure 26: Alternative routes through Sydney



Original route through Sydney

The 2013 HSR study proposed a tunnel from the Hawkesbury River to an underground northern HSR station at Hornsby, then a tunnel to Central.

A major re-build of Central would be needed, with 10 high speed rail platforms on two levels, as all HSR trains from both the North and South would terminate there.

The proposed route to the south included a tunnel from Central to Glenfield, from where the high speed line would continue on a new alignment east of the current line to the Southern Highlands, thence to Canberra and Melbourne.

Alternative via Parramatta

Option B would replace the northern Sydney HSR station at Hornsby with one at Epping, with some HSR trains continuing on the surface to Central using existing tracks, and others to Parramatta, Liverpool and Glenfield using a new underground line.

This line would operate a high-speed shuttle for Sydney commuters (stopping also at Liverpool), as well as longer distance HSR trains.

Trains from the south would similarly split at Glenfield, some continuing to Central on the East Hills line, and some continuing north via Parramatta.

Alternative via Olympic Park

Option C would similarly provide a north-south direct HSR route through Sydney, but via Olympic Park and Bankstown, with new underground stations at those locations.

As with Option B, some HSR trains would operate into Central from both the North and South, using existing surface tracks, while others would use the new bypass line via Olympic Park.

Similarly, because only some of the HSR trains would use Central, the cost of the High-speed station there would be much less than the original 2013 proposal.

Both Options B and C would mean longer travel times to Central station compared with the original 2013 alignment. However, they would have other advantages including:

- Significantly less tunnelling, providing cost savings estimated at least $5-6 billion,
- Much better access overall for the Sydney region,
- Excellent connections with the heavy rail and metro networks,
- Strengthening Sydney as a multi-centred city, in line with the Metropolitan Plan,
- Opportunity to include a new north-south shuttle service for internal travel within Sydney, greatly improving the capacity and connectivity of the entire public transport network, and
- Much greater ability to stage construction and operations and to delay expenditure. For example, in the early stages of the East Coast HSR network HSR trains would operate to Central. As patronage and services build up, the north-south bypass route would be built.

A separate technical report details the full implications of alternative routes through Sydney. In addition, changes to public transport infrastructure in Brisbane, the Gold Coast, Newcastle, Canberra and Melbourne since the 2013 report was completed provide opportunities for modified routes or alignments. These are detailed in separate technical reports.

SUMMARY

Australian inter-city rail networks are still largely based on 19th century alignments, which imposes very low speeds. The rest of the world is rapidly moving to introduce high speed rail.

Whilst Australia is obviously different to countries like Japan or China, the East Coast corridor shares some features with countries like France, Spain or Sweden. We can learn from these countries and take advantage of recent developments. With careful design, it is considered possible to build a conventional high-speed network which can:

- be constructed in stages, starting with higher speed regional links from the major capitals
- utilise existing tracks and infrastructure where necessary or desirable, and progressively accelerate services as new sections of high-speed rail are completed
- utilise high speed lines at night for suitable freight traffic.

The following Chapter discusses how this could be achieved, and how high-speed rail could be integrated with other developments in the East Coast Corridor.

Figure 27: Next generation of inter-city travel

The Next Generation Intercity Train for NSW (left) will be more comfortable, but no faster than the steam hauled Flyer from Newcastle to Sydney of 50 years ago (middle), until something is done about the current difficult alignment between the two cities, including the crossing of the Hawkesbury River (right).

5 BUILDING TOWARDS HIGH SPEED RAIL

INTEGRATING WITH NEW FAST REGIONAL RAIL LINKS

As noted earlier, the Federal and State Governments are currently examining fast regional rail links from Melbourne, Sydney and Brisbane to nearby regional cities. Several of these links have the potential to be integrated into an East Coast High Speed Rail Corridor in the longer term, provided they are designed appropriately.

Figure 28: Regional rail projects currently under investigation

Planning for high speed to Geelong is underway [*lvi*]

Potential travel times from Sydney

The delivery of fast rail has the potential to slash travel times by up to 75 per cent. A selection of approximate travel times could be:

Journey	Current rail time	Faster rail <200km/h	High-speed rail >250km/h
Sydney to Canberra	4:07 hours	3:00 hours	1:00 hours
Sydney to Goulburn	2:31 hours	1:45 hours	0:30 hours
Sydney to Newcastle	2:35 hours	2:00 hours	0:45 hours
Sydney to Gosford	1:19 hours	1:00 hours	0:30 hours
Sydney to Wollongong	1:25 hours	1:00 hours	0:30 hours
Sydney to Nowra	2:39 hours	2:00 hours	0:45 hours

NSW is developing a Fast Regional Rail Program focusing on achieving progressive travel time savings on key regional links [*lvii*]

Helensvale North Station, one of three new stations proposed for the Gold Coast Line [*lviii*]

Many of these corridors have been examined in the past and are being re-examined; others are being examined for the first time. Some are part of an active program of works. For example:

- The **Melbourne to Shepparton** line is about to be upgraded to operate broad-gauge Vlocity trains, but with the capability for easy conversion to standard gauge.
- The **Melbourne to Wodonga** line is also being upgraded to operate standard-gauge Vlocity trains.
- The **Melbourne to Geelong** corridor is currently under investigation for ways to increase speeds and capacity. The final route is still being considered.
- The **Sydney to Southern Highlands** corridor has been under study for decades, especially given the desirability of developing a new higher-speed route which can eliminate the indirect and slow alignment at present via Picton.
- The **Sydney to Newcastle** corridor is also under study. Previous options for faster services in this corridor have focused on tunnels to avoid the slow climb up from the Hawkesbury River to Hornsby.
- The **Brisbane to Sunshine Coast** link has been under investigation for some time and certain works to duplicate the existing narrow-gauge line from Beerwah to Nambour are already in hand.
- The **Brisbane to Gold Coast** corridor is being upgraded with three new stations planned for Helensvale North, Pimpama and Merrimac, as part of the $5.4 billion Cross-River Rail Project, which has recently started construction.

INTEGRATING WITH OTHER RAIL PROJECTS

In addition to the projects above, there are a number of other rail projects in the East Coast Corridor, either under construction or in the planning stages, which have implications for high speed rail. These include:

Melbourne

- Melbourne is currently building the **Melbourne Metro**, which will significantly increase capacity on its already large suburban network, and restructure service patters.
- A **Melbourne Airport Rail link** has also been announced.
- **Sunshine** is set to become a major new interchange on the network, both with suburban and with fast regional rail services.
- **New freight terminals and an outer ring rail/road** are also under investigation in the Northern Suburbs.
- A long-term **Melbourne Ring Metro** is also in planning, starting with the South-East sector.

Sydney

- The **North-West Metro** has been completed and is in operation between Cudgegong Road and Chatswood. This crosses the Main Northern line at Epping with an integrated, underground station, making Epping a more strategic location than Hornsby for any Northern Sydney High Speed Rail station.
- The metro is being extended south through the CBD to Sydenham, and on to **Bankstown**, with potential further extension to Liverpool. This will remove the current heavy rail suburban services between Central and Sydenham, freeing up these tracks for high speed rail services (see later discussion).
- The **Western Suburbs Metro** (from Cudgegong Road to Second Sydney airport and eventually south to Campbelltown) and the **West Metro** (from the CBD to Parramatta and Westmead, and eventually to Second Sydney Airport) are currently in planning, with construction about to commence shortly. Parramatta will become an increasingly important location within Sydney for any High-Speed Rail, both as the second CBD and as an important interchange point with connections to middle and western Sydney, which are expected to house three quarters of Sydney's population in the future.
- **Australia's largest intermodal terminal** is currently under construction at Moorebank, near Liverpool. This will accommodate both container shuttle trains from Port Botany, and longer distance freight trains to and through Sydney, and is also conveniently located near major roads.

Brisbane

- Brisbane is currently building the $5.4 billion **Cross-River Rail project**, which will provide new stations in and around the CBD, and greatly increase capacity of the suburban rail network.
- Freight rail upgrades are also planned as part of the **Inland Rail Project**, which will provide a new standard gauge line to Brisbane from Toowoomba in the west.

Other cities

- The **Gold Coast** has completed stages 1 and 2 of its light rail network. Construction is due to start on stage 3 (Broadbeach to Burleigh Heads) and planning is underway for stages 4, 5 and 6 (extensions south to Coolangatta, and East-West links to Robina and Nerang).

- **Canberra** has completed stage 1 of its light rail network from Gunghalin to Civic, and is currently planning further stages to the Parliamentary Triangle and Woden, as well as longer term plans for links to the Airport, Belconnen and Tuggeranong.
- **Newcastle** has completed a short line from Newcastle Interchange to the Beach, and has undertaken some studies of possible extensions.
- The **Sunshine Coast** is planning an initial 20 km light rail / busway system from Maroochydore south to Caloundra, with longer-term plans for extensions further north and south.

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Figure 29: Examples of other rail projects in the East Coast corridor

Canberra's Light Rail [*lix*]

Sydney's Moorebank Terminal [*lx*]

Brisbane's Cross-River Rail [*lxi*]

TECHNICAL CONSIDERATIONS

Rail corridors are difficult to create given constraints from urban development and the need to minimise environmental and other impacts. Accordingly, such corridors should serve several purposes where this is feasible. However, there are differing technical requirements which need to be considered:

- High-speed passenger lines require large radius curves (up to 7 km for 350 km/hr operation) and electrification at 25 Kv AC for full high-speed potential, but can accommodate relatively steep gradients (up to 3%).
- Corridors for freight are generally designed for lower speed but much heavier trains, and so can utilise smaller radius curves but need shallower gradients (generally below 1.5%).
- Specialised higher-speed freight trains and fast commuter trains form an intermediate category, requiring relatively large radius curves but can potentially handle gradients up to the order of 3%.
- In addition, different signalling systems are used for high speed trains, and the greater speed of such trains generally means that track capacity is compromised when they are mixed with conventional, lower speed trains.
- If double-stack container trains are to be operated on freight trains, extra clearances are required. Generally double-stack container trains preclude the use of overhead catenary, although India has recently operated the world's first double stack container train on an electrified line, with a clearance of around 7.4m and specially designed pantographs for electric locomotives.

This is why in many studies it is assumed that high speed trains need to be segregated from other trains in completely separate corridors. Construction is often simpler when separate corridors are utilised as well. Unfortunately, the low train density and long distances in Australia makes the provision of completely segregated corridors for high speed rail expensive, and this has been a key factor in the failure of this technology to be accepted in Australia to date.

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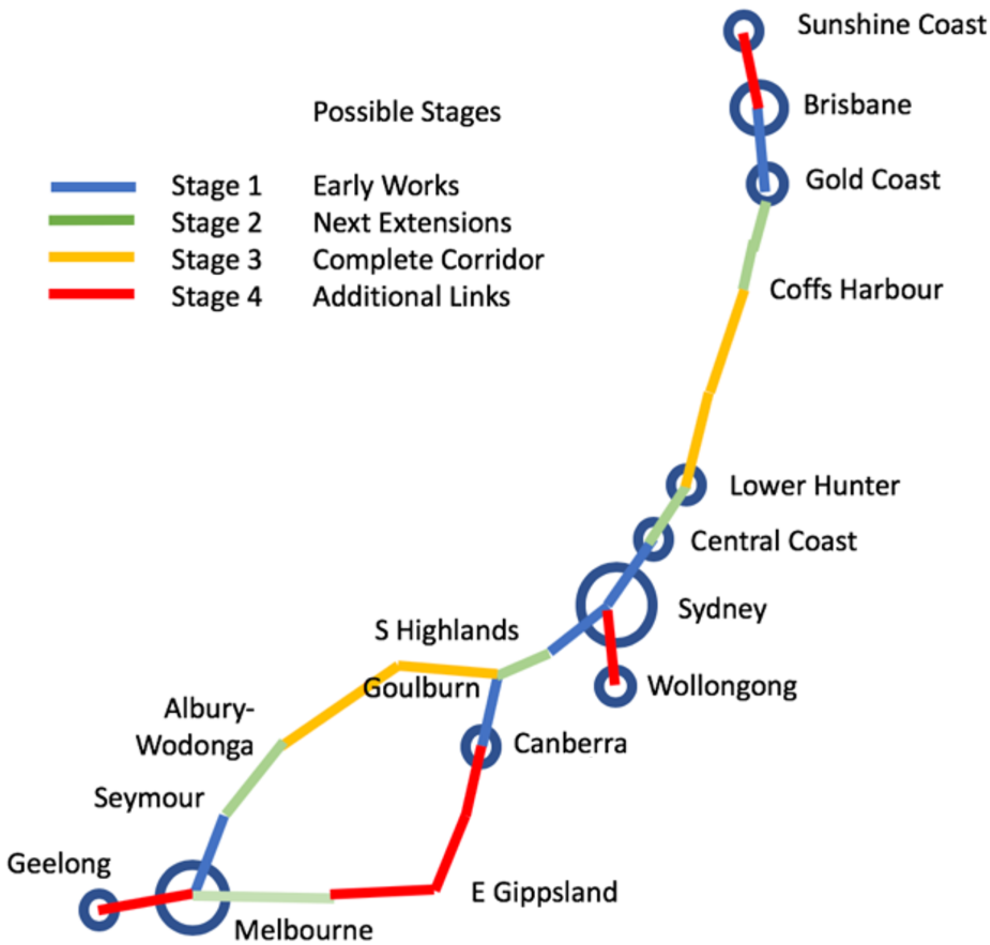
BUILDING THE NETWORK IN STAGES

It therefore requires some innovative thinking to develop a way to stage construction (and operation) of a high-speed rail system in Eastern Australia. The figure below shows one way to approach this.

In addition to the **"Core" Very High Speed Rail** route between Melbourne and Brisbane, a number of **higher-speed extensions** are suggested, including the links to Geelong, Sunshine Coast and Wollongong; and the link from Melbourne to Canberra via Gippsland. In addition, higher speed services can be provided to cities not on the corridor, such as Armidale, Dubbo or Griffith, by using tilt trains capable of running on both existing non-electrified tracks. Note that:

- "Very high speed" means operating at up to 330 km/hr when on suitable alignments
- "Higher-speed" means operating up to 250 km/hr on suitable alignments.
- "Fast" means operating at up to 180 km/hr on suitable alignments.
- "Current" means operating at up to 130 km/hr on suitable alignments.

Figure 30: Possible approach to staged construction of high speed rail



Details of the potential stages in the above scenario are outlined below:

Table 6: Examples of potential stages

Segment	Stage Indicative Timing	Stage 1: 2020-2030	Stage 2030-2040	Stage 3 2040-2050	Stage 4 2050-2060
North	Brisbane - Beaudesert		New HSR		
	Beaudesert – Gold Coast		HSR Link		
	Gold Coast – Northern NSW		New HSR		
	Northern NSW – Newcastle			New HSR	
	Newcastle – Central Coast		New HSR		
	Central Coast – Epping	New HSR			
Sydney	Epping - Glenfield		New HSR		
South	Glenfield – S Highlands	New HSR			
	S Highlands – Goulburn/Yass		New HSR		
	Goulburn/Yass - Canberra	New HSR			
	Goulburn/Yass - Wagga Wagga			New HSR	
	Wagga Wagga - Shepparton		New HSR		
	Shepparton – Seymour	Upgrade	HSR Conversion		
	Seymour – Broadmeadows	New HSR			
	Broadmeadows – Sth Cross		New HSR		
Other	Sunshine Coast - Beerburrum	Initial (N. Gauge)		HSR Conversion	
	Beerburrum - Brisbane			New HSR	
	Brisbane - Toowoomba	Inland Freight Rail			Upgrade
	Sydney – Wollongong			Upgrade	
	SW Sydney - Wollongong				New HSR
	Newcastle – North-West			Upgrade	
	Melbourne - Geelong	Initial (B. Gauge)			HSR Conversion
	Melbourne - Yallourn		Upgrade		HSR Conversion
	Yallourn - East Gippsland			Upgrade	HSR Conversion
	East Gippsland - Canberra				New HSR

Note: New HSR means a new section of track designed for high speed; Upgrade indicates a section which is subject to some upgrades; HSR Conversion means a section which is converted to high speed operation, either through gauge change, electrification, or other modifications.

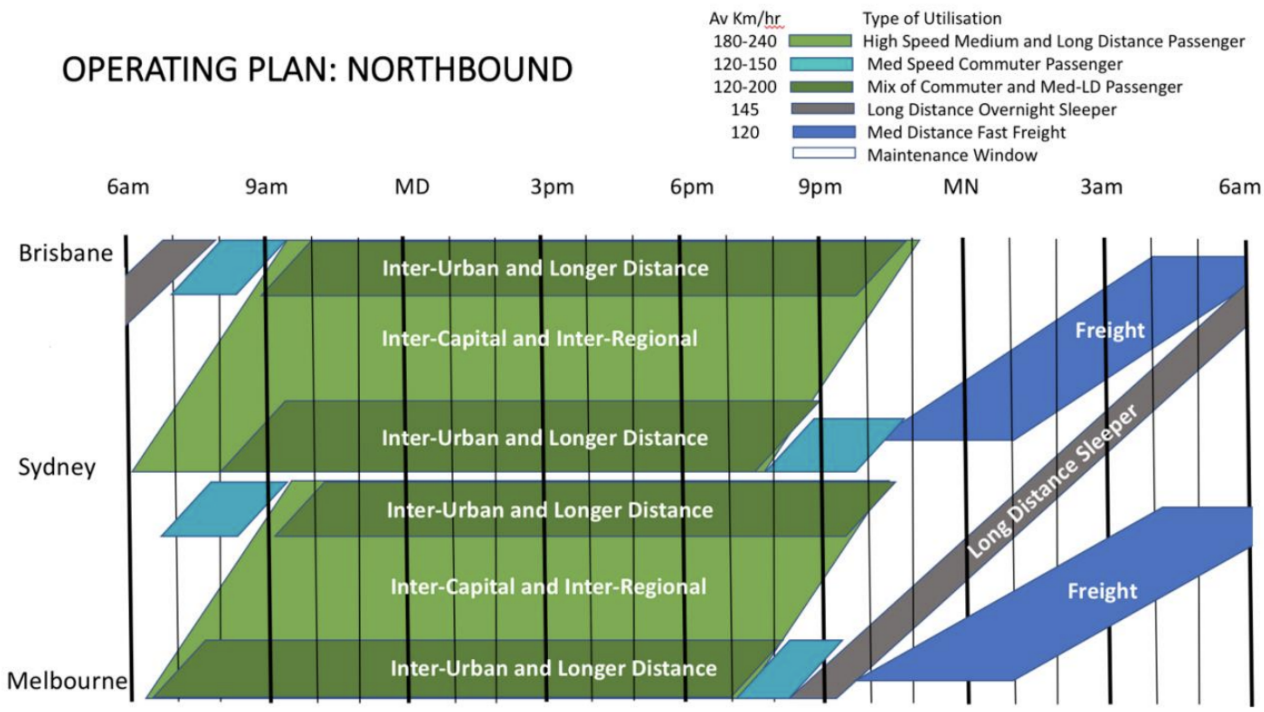
BUILDING UP OPERATIONS IN STAGES

High speed services would be built up in parallel with the infrastructure:

- **Fast commuter services** would be provided first, linking the major cities to nearby regional cities. These could initially utilise existing electric or diesel inter-urban or inter-regional trains. These could later be replaced by higher-speed intercity trains capable of up to 180 km/hr.
- **Higher speed inter-regional and inter-capital city services** would be introduced on longer routes, as soon as the first stages of the network were completed. These would be operated by rollingstock with both electric and diesel propulsion, as well as tilting capability, similar to the Talgo Dual, which is capable of 250 km/hr on electrified lines and 180 km/hr elsewhere. These would allow substantially faster running on new high-speed sections, as well as travel time savings of the order of 15% on existing track, enabling significant time savings compared to current inter-city trains.
- **Very high speed trains** capable of up to 330 km/hr would be introduced once overall sections were completed, starting with the Sydney–Canberra route. These trains would be “conventional” and electrically powered, not requiring diesel propulsion. They may or may not have tilting capability, depending on the specific route, since they would be operating mostly or exclusively on high speed alignments.
- **Fast overnight sleeper services,** probably using locomotive-hauled trains, can also be added. These could utilise existing tracks where required as well as high speed segments, and could use hybrid electric / diesel locomotives capable of up to 160 km/hr. These trains would operate largely outside the operating times of the high speed and very high speed inter-capital and inter regional trains.
- **Fast overnight freight services** would operate at times when passenger services were generally not operating, between specialised intermodal terminals on the outskirts of Brisbane (Acacia Ridge / Bromelton), Sydney North (near Ourimbah), Sydney South (Moorebank area), and Melbourne (northern and north-western suburbs).

The figure below indicates how the core route between Brisbane and Melbourne could be operated, providing a mix of different types of passenger, as well as freight services. This would utilise the opportunity to segregate services by time of day where possible.

Figure 31: Utilisation of future high speed rail corridor



Typical rollingstock which could be utilised for an Australian East Coast Route are shown below. Note that these are examples only, and not intended to endorse any particular manufacturer.

Table 7: Examples of potential high speed trains

Type of Service	Fast Commuter	High Speed Inter-Regional	Very High-Speed Inter-Capital	Overnight Sleeper	Fast Freight
Manufacturer	Siemens	Talgo	Bombardier	Alstom	Stadler
Model	Desiro HC	Dual 250	ETR 400	Prima	Eurodual
Max Speed					
Electrified	160 km/hr	250 km/hr	360 km/hr	200 km/hr	150 km/hr
Non-Electrified	-	180 km/hr	-	-	150 km/hr
Tilting	No	Yes	No	No	No
Train Weight (Tare)	400	360	500	500	2200*
Train Weight (loaded)	450	400	550	550	4400*
Axle Load (tonnes)	15	19	17	21	21
Power (MW)-Electric	8	4.8	9.8	6.4	21**
Power (MW)-Diesel	-	2.4	-	2.0	8.4**
Seats/Capacity	840	300	485	300	
Length (metres)	210	186	200	270	1600*

(*) Assumes 45 Dual ModaLohr wagons (capacity 90 trailers).
(**) Weight includes three locomotives per train.

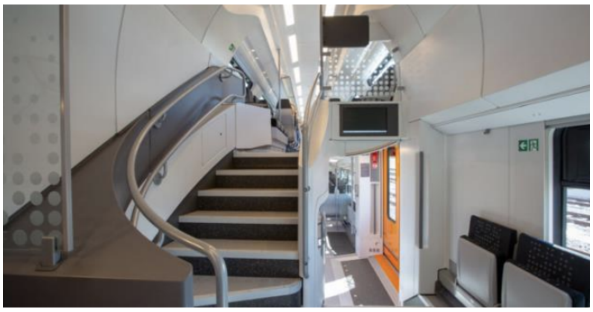
Figure 32: Examples of existing and potential higher speed rail rollingstock

NSW new inter-city train

NSW new regional and inter-state train

Queensland rail tilt train for inter-city service

Bombardier Vlocity for Melbourne-Albury

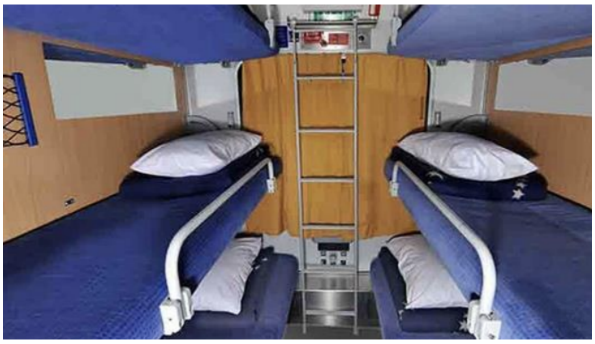


Interior of Siemens Desiro inter-urban commuter train

Stadler inter-urban commuter train

Talgo 250 Dual

Bombardier ETR 400 lxii



Sleeper train in Italy [*lxiii*]

CargoBeamer Piggy-Back Train in Europe [*lxiv*]

Note: These are examples only and not meant to endorse any particular manufacturer.

HIGH SPEED RAIL AT MID CENTURY

The figure below shows how the network infrastructure might ultimately be configured.

Figure 33: Potential long-term network infrastructure

Note that:

- Some relatively lightly used lines (Canberra-Gippsland; Beerwah-Sunshine Coast) could be single track, and that some connecting lines (e.g. Hunter Valley, Riverina) would not need to be electrified, but served by dual (electric and diesel) rollingstock.
- Not all lines would be designed for 350 km/hr speeds.
- Some lines would remain with current infrastructure (e.g. the Blue Mountains line and the lines to New England, and potentially the Geelong and East Gippsland lines

It is worth considering what the capacity of such a system could be by that point (see below).

Table 8: Notional southbound service pattern – Brisbane to Melbourne core network

Service Type	From	To	Via	A/D/T (*)	No/Hr	Hours	Extra Peak	Trains/ Day	/Hr am Peak	/Hr Day	/Hr Night
Inter-Capital	Brisbane	Sydney	Cantral	A	1	13	1	14	1	1	0
Inter-Capital	Brisbane	Melbourne	Parramatta	T	1	10	0	10	0	1	0
Inter-Capital	Sydney	Canberra	Central	D	1	14	2	16	1	1	0
Inter-Capital	Sydney	Melbourne	Central	D	1	13	2	15	1	1	0
Inter-Capital	Canberra	Melbourne			1	13	0	13	1	1	0
Inter-City	Newcastle	Canberra	Parramatta	T	1	13	0	13	1	1	0
Inter-City	Newcastle	Wollongong	Parramatta	T	1	13	0	13	1	1	0
Inter-City	Wagga	Melbourne			1	13	0	13	1	1	0
Inter-City	Shepparton	Melbourne			1	12	2	14	1	1	0
Inter-Regional	Coffs H	Sydney	Central	A	0.5	12	0	6	0	0.5	0
Inter-Regional	Armidale	Sydney	Central	A	0.5	12	0	6	0	0.5	0
Inter-Regional	Brisbane	Sydney	Central	A	1	12	0	12	0	1	0
Inter-Regional	Sydney	Wagga	Central	D	1	12	0	12	1	1	0
Inter-Regional	Canberra	Melbourne			0.5	12	0	6	0.5	1	0
Commuter	Brisbane	NNSW			1	14	0	14	1	1	0
Commuter	Brisbane	Gold Coast			2	15	2	32	2	2	0
Commuter	C Coast	Wollongong	Parramatta	T	2	15	0	30	2	2	0
Commuter	C Coast	Sydney	Central	A	2	15	2	32	3	2	0
Shuttle	Epping	SSydney	Parramatta	T	4	16	14	78	8	4	0
Commuter	Sydney	S Highlands	Central	D	1	16	4	20	1	1	0
Commuter	S Highlands	Canberra			0	14	2	2	1	0	0
Commuter	Goulburn	Canberra			1	14	2	16	2	1	0
Commuter	Seymour	Melbourne			1	14	6	20	3	0	0
Sleeper	Brisbane	Melbourne	Parramatta	T				2	0	0	1
Sleeper	Brisbane	Canberra	Parramatta	T				1	0	0	0.5
Fast Freight	Brisbane	Sydney						7	0	0	2.5
Fast Freight	Sydney	Melbourne						9	0	0	3

(*) - A = Arriive at Central; D = Depart Centtra; T = Southbound service through Parramatta

A notional service pattern was developed for the core network between Brisbane and Melbourne, including links to Canberra and Wollongong (see Table above).

This pattern is estimated to have the capacity to accommodate over 120 million passengers, and 20 million tonnes of freight p.a. (Table 6). This compares to an estimate of 83 million passengers and no freight by 2065, as reported in the 2013 High Speed Rail Study

Table 9: Estimated capacity of the core Melbourne-Brisbane network

SERVICE TYPE	Trains/ WeekDay both ways)	Capacity /Train	Load Factor (1)	Av Load / Train	Thousand passengers or tonnes /	Million Pass / Tonne pa
INTER-CAPITAL	136	450	75%	338	45.9	13.8
INTER-CITY	106	370	120%	444	47.1	14.1
INTER-REGIONAL	84	300	150%	450	37.8	11.3
COMMUTER	480	1000	60%	600	288.0	86.4
SLEEPER	6	400	75%	300	1.8	0.5
TOTAL PASSENGER	812				420.6	126.2
FAST FREIGHT*	32	2700	80%	2160	69.1	20.7

Note: (1) Inter-city and inter-regional trains experience turnover of seats as they cater for trips between cities/towns en route.
Note: (2) Assumes 8 fast freights per evening at 15 minute intervals southbound Sydney-Melbourne and Brisbane-Sydney, and similar number northbound. Each train capable of hauling 90 trailers or equivalent container/palletised freight, with 85% slot utilisation.

The actual service pattern would of course depend on the demand evident for the services. For example:

- For inter-capital city services, this will depend on population growth in Sydney, Melbourne and Brisbane, as well as the attractiveness of high speed rail compared to flying and driving. This in turn will depend on a range of factors, including travel times, fares, comfort levels and the accessibility of high speed rail stations.
- For inter-regional services, the demand will depend on the growth of regional cities, as well as the role of high-speed rail in connecting people with other regional cities and the capital cities.
- For freight, the demand will depend on the competitiveness of higher speed rail with trucks, and the effectiveness of innovations in freight handling currently emerging in Europe. However as discussed in a separate technical report, an East Coast high speed route, plus the existing interstate route and the Inland rail currently under construction, would be able to accommodate 50% of the estimated north-south freight task in the Eastern Corridor by mid century.

TRAVEL TIME SAVINGS

In addition to increasing the capacity of surface transport in the East Coast Corridor, high speed rail will very significantly reduce travel times compared to current rail, bus and car options. This will not happen overnight, but progressively in stages as new sections of high speed alignments are built and as new, faster rollingstock is introduced. For example, the graphs below show how estimated rail travel times will be reduced in stages for:

- Sydney to Canberra
- Sydney to Melbourne
- Sydney to Newcastle

Figure 34: Estimated travel times: Sydney Central-Canberra (left) and Sydney Central-Melbourne (right)

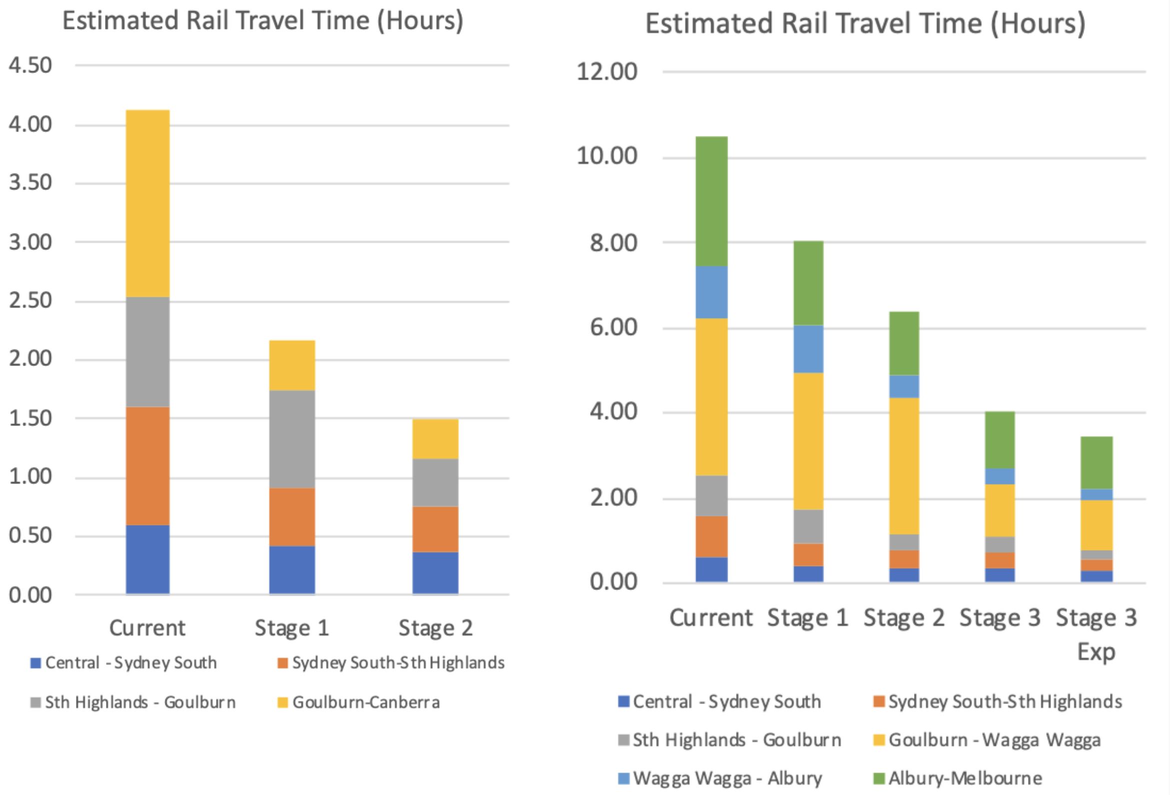
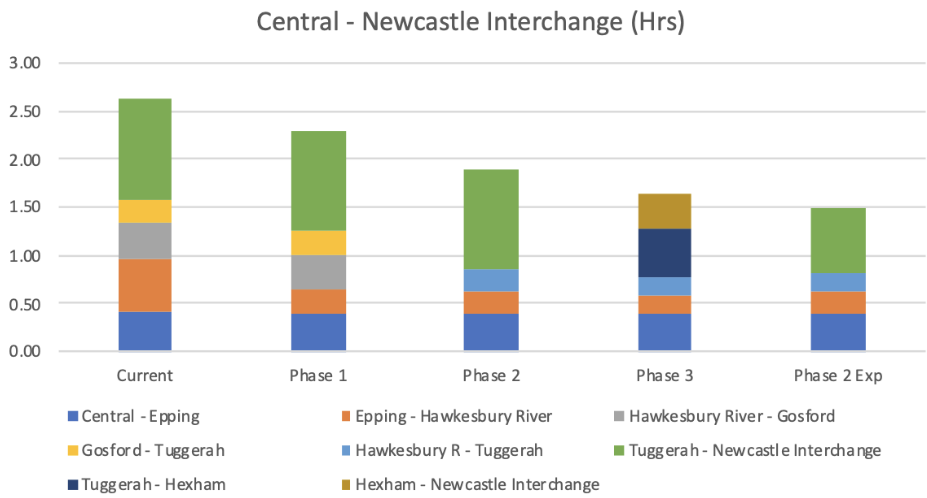


Figure 35: Estimated travel times: Sydney-Newcastle



More details on these issues are covered in the technical appendices on:

- Technical Appendix on Alternative Routes and Alignments, which covers such issues as estimated travel times and station locations.
- Technical Appendix on Population Management, which covers issues such as population growth in capital cities and regional cities under current trends and decentralisation options.
- Technical Appendix on High Speed Rail and Freight, which covers estimates of current and future freight demand, new intermodal services, and capacity issues on the high speed rail, the existing intercity rail line, and on the Inland Rail between Melbourne and Brisbane.

6 STARTING NOW

As noted earlier, there has been considerable investigation of High Speed Rail in the East Coast. The 2013 Study forms an excellent basis to start, as it considered route alignments, markets, costs, station locations and designs in considerable detail. Some of these details need to be modified to incorporate various developments since the report was written, both locally and internationally. But much of the 2013 report can be utilised.

In addition, studies are now underway in all States on potential fast regional rail corridors. These will identify opportunities and constraints. If we want to maximise the benefits from these projects, we need to identify early on how they can be built into a longer-term system. This requires:

- Using appropriate national standards, which will ensure any infrastructure is fit for the longer term, as well as the shorter term.
- Identifying optimal routes, alignments and station locations. This needs to consider developments since the 2013 HSR report.

The issue of standards is not complicated for other modes. For example, we all drive on the same side of the road in Australia, and our aircraft all use standard equipment and procedures at different airports. Railways however, are different, because they were originally developed under different State jurisdictions. Everyone is familiar with the "break of gauge" problem in this country which has bedevilled the attempts to develop a national railway system. But there are many other, more subtle differences between State systems as well, including loading gauges, axle loads, signalling and power supply systems, platform heights and the like. Furthermore, train loads depend on axle loads and gradients, train speeds on curvatures. If we are to develop a more integrated high-speed railway covering three States and the ACT, we need common standards in all of these areas as far as possible, as was discovered in designing the Inland Rail project from Melbourne to Brisbane.

Fortunately, it is possible to design new railways so as to be both backwards- and forwards-compatible. For example, tracks can be relatively easily converted from broad gauge to standard gauge in the future, provided this is designed in at the outset. It is more difficult, but still possible, to do this so that narrow gauge lines (like part of the Brisbane-Sunshine Coast route) could be converted to standard gauge at a later date if this was found beneficial. Suggested standards for developing the East Coast HSR system are given below:

Table 10: Suggested standards for an East Coast high speed rail network

Area	Suggested Standard	Notes
Track Gauge	Standard Gauge	Routes built initially as narrow or broad gauge should be built to be gauge convertible
Loading Gauge,	NSW standard but with additional height	To accommodate semi-trailers on low-loader wagons for high-speed freight services
Platform heights	NSW Standard	Routes built initially as narrow or broad gauge should be built to be convertible
Power Supply	25 KvAC	On new sections of track, except in low speed areas
Design Speeds	330 km/hr	Where cost effective in open areas
	250 km/hr	In long tunnels, built up areas
	130 - 160 km/hr	On existing alignments shared with other traffic
Gradients	< 3%	High-powered electric locomotives will be able to handle freight on gradients up to 3% while maintaining >80km/hr
Axle Loads	18 tonnes @ 330 km/hr	For High Speed passenger trains
	20 Tonnes @ 160 km/hr	For Special High-Speed Freight trains

7 CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

High speed rail has so far eluded Australia. Critics have claimed Australia doesn't have the population to support it, or that high speed rail is too costly, or that the technology is not mature.

But we are now well behind the rest of the advanced world in adopting the technology, which is readily available. Our population is growing and is past the threshold for high speed rail. And we are spending hundreds of billions of dollars in any event to deal with congestion in our major cities.

High speed rail has the potential to reduce rail travel times dramatically, for example:

- from over 10 hours between Sydney and Melbourne to under three and a half hours,
- from over 4 hours from Sydney to Canberra to under an hour and a half,
- from over two and half hours from Newcastle to Sydney under an hour and a half.

With an East Coast high-speed rail corridor, everyone in the corridor from Geelong to the Sunshine Coast will be within two hours of a major capital.

It is a project of national significance, directly benefitting two in three Australians, and with the potential to benefit three in four Australians when connecting services to nearby cities and towns are considered. It can help us address issues of congestion, housing affordability, regional access to jobs and services, and climate change.

It can be built in stages to fit into an overall plan, if designed properly and if we use the most appropriate technologies for the Australian environment. This can start with fast regional links from the major capitals to nearby centres, studies of which are already underway. It can build into a system with the capacity for at least 120 million passengers and 20 million tons of fast freight annually. However, unless it is planned as an integrated system, the opportunity for a full high speed corridor will be lost.

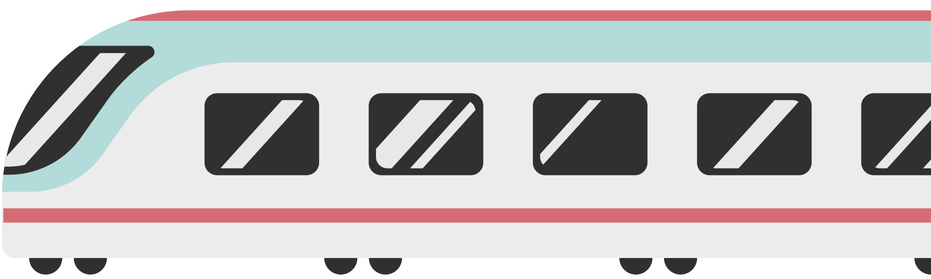
The alternative is to continue with our past strategies of relying purely on the automobile, aircraft and truck, and undertaking piecemeal projects which fail to achieve their full potential. We have already wasted decades. Interest rates are at all-time lows, and delays in proceeding will increase costs and reduce the opportunities for value capture around stations. **The time to embrace high speed rail is now.**

RECOMMENDATIONS

The Federal Government, and the Governments of Victoria, NSW, Queensland and the ACT should establish a **Joint High-Speed Rail Task Force**, supported by appropriate national and international experts to:

1. Review the potential long-term, strategic benefits from an East Coast High Speed Rail Corridor between the Sunshine Coast and Geelong, including the potential for telecommuting and high speed rail to enable better population growth management in the East Coast corridor.
2. Examine international developments in High Speed Rail in the last decade and identify the most appropriate technologies and options for the staged introduction of high speed rail in Australia.
3. Undertake an outreach program with the Australian public in the corridor, as well as with key organisations, to inform them of their findings, and to obtain feedback on their responses.
4. Review the alignments and station locations identified in the 2013 High Speed Rail Report between Brisbane and Melbourne, and current plans for fast regional rail links, to identify how the two can be integrated, where cost efficiencies can be achieved, and how construction and operation can be staged.
5. Develop key national technical standards for high speed rail to ensure all relevant new rail projects in the East Coast Corridor can be harmonised at minimum cost, and to enable increased speeds and capacities for both passenger and freight movement in the corridor. This includes track and loading gauges (including potential for gauge conversion at appropriate times), power supplies, signalling systems, alignment parameters (speed, gradients, tunnel clearances etc), station locations and designs and rollingstock compatibility issues.
6. Identify early projects which can be undertaken over the next five to ten years which will form the beginning of the high-speed corridor.

The **Task Force should report within nine months** to the relevant parliaments and to the public and interested parties on their findings.



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g.glazebrook@fastrackaustralia.net

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