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Integrating our Mega-Regions: Implications for Sydney-Newcastle High-Speed Rail.



March 2024

Executive Summary

- In the last few decades Australia has vacillated between aiming for high-speed rail and settling for the more modest concept of faster rail. So far however little has been achieved on the ground.
- The new Federal Government has recently committed to building high-speed rail between Melbourne and Brisbane, starting with the Sydney – Newcastle corridor, having apparently abandoned earlier efforts at faster rail.
- As is well-known, Sydney – Newcastle is the most difficult part of the whole East Coast Route. There is therefore a risk that, if implemented as a “stand-alone” HSR concept, it will be seen as too expensive and the benefits too far into the future, leading to cancellation of the project.
- However, an Integrated Network Design encompassing both HSR and faster rail can be more effectively staged, provide early benefits, and reduce the up-front risk. It will also provide the best long-term solution and allow significant upgrades to the rail networks ultimately serving three-quarters of Australia’s population.
- As with many rail projects, the “devil is in the detail”. It is therefore imperative that the High-Speed Rail Authority examine the integrated solution, including details of how the infrastructure is to be operated.
- In parallel with examining this project, the Government should also simultaneously examine the establishment of a National Passenger Rail Operator, changes to governance arrangements, and staging options on other corridors such as Sydney – Canberra. This will also allow projects to proceed on more than one corridor simultaneously.
- These can allow a much faster implementation of high-speed rail, and the generation of benefits for a much wider public

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Passengers about to board a Spanish High-Speed Train in Bilbao. Note the mix of regional and local trains on what is an integrated railway, which also now boasts 4,000 km of high-speed tracks. Image by Author.

1 An Integrated Solution



Cologne Station in Germany is typical of Europe , catering for high-speed , regional and commuter trains , as well as freight trains in the evenings. Image by Stefan Bemsman.

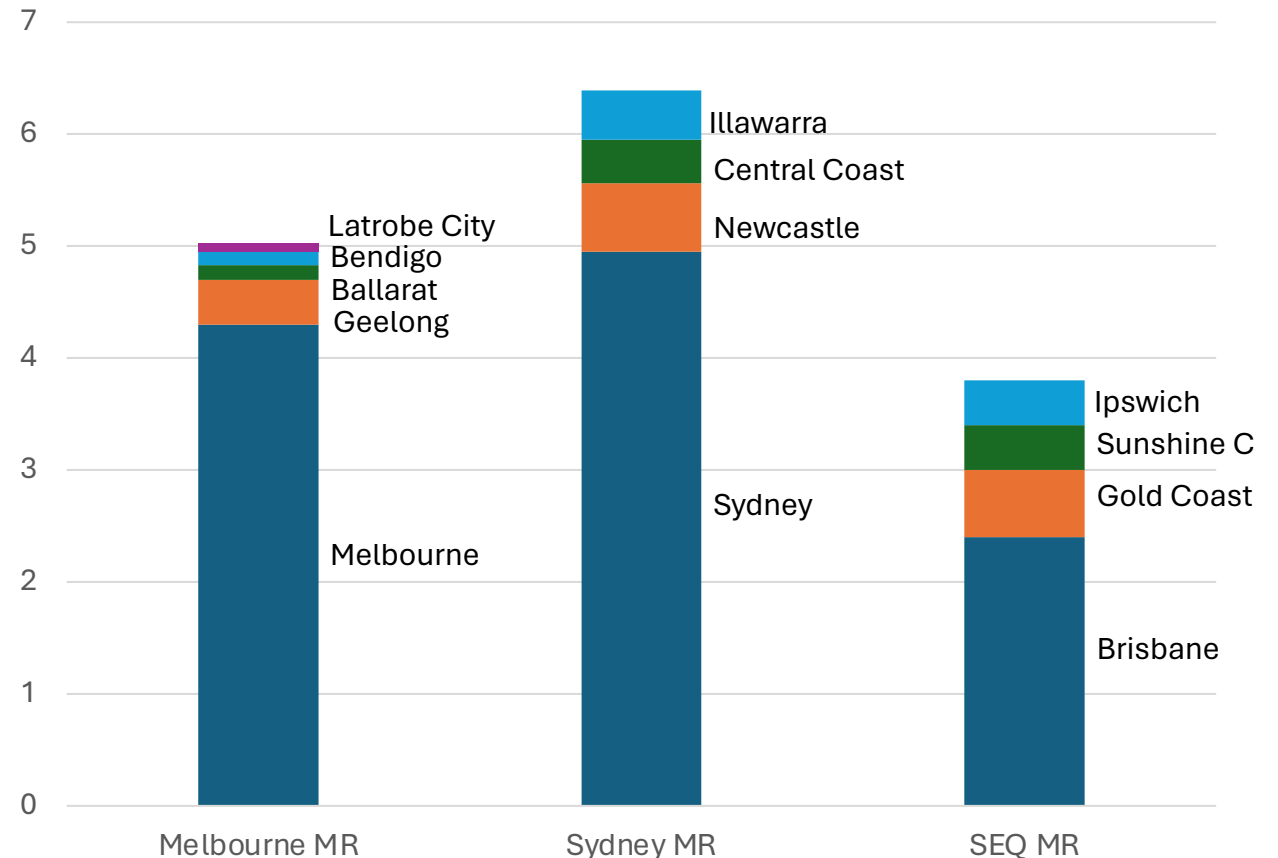
Australia's "mega regions"

Australia now has three "mega regions":

- The Sydney Mega Region, including Sydney, the Central Coast, Greater Newcastle, and the Illawarra.
 - The Melbourne Mega Region, including Melbourne, Geelong, Ballarat, Bendigo and Latrobe City.
 - The Brisbane Mega Region, including Brisbane, the Gold Coast, the Sunshine Coast and Ipswich.
- Between them, they had over 15 million people in 2022, 60% of Australia's total, and are dominating population growth
 - However, they are experiencing high housing costs, rising congestion and very high costs of infrastructure.

Source: <https://www.abs.gov.au/statistics/people/population/regional-population/latest-release>

2022 Population of our Three Mega-Cities (Million)



Fast Rail Links

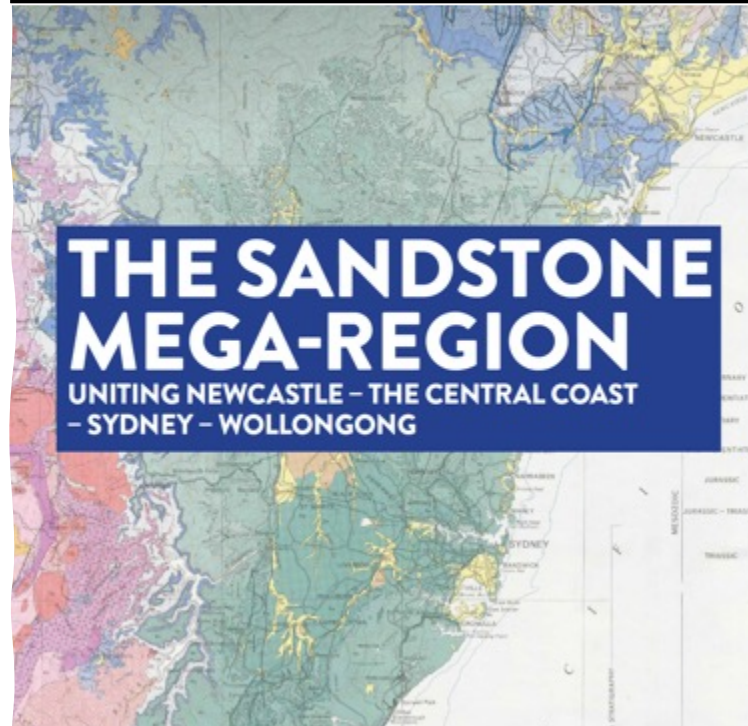
Fast Rail Links are crucial to improving connectivity and efficiency within each of these regions:

- The Victorian Government has introduced “Vlocity” train services and upgraded regional rail links out of Melbourne to key regional cities
- The NSW Government has examined faster rail services out of Sydney to Gosford, Newcastle and Wollongong
- Queensland is upgrading its rail line between Brisbane and the Gold Coast, and is planning a fast rail link to the Sunshine Coast

Victoria's Vlocity trains at Southern Cross Station



City of Sydney's 2018 plan for Fast Rail



Brisbane-Gold Coast Line Upgrade under construction



High-Speed Rail

The Federal Government has established the High-Speed Rail Authority, and appointed a Board and CEO.

However previous work on “Faster Rail” links out of the capital cities has been paused for the last eighteen months.

It is now time for an Integrated, Bi-partisan, National Approach, utilising both faster and high-speed rail to:

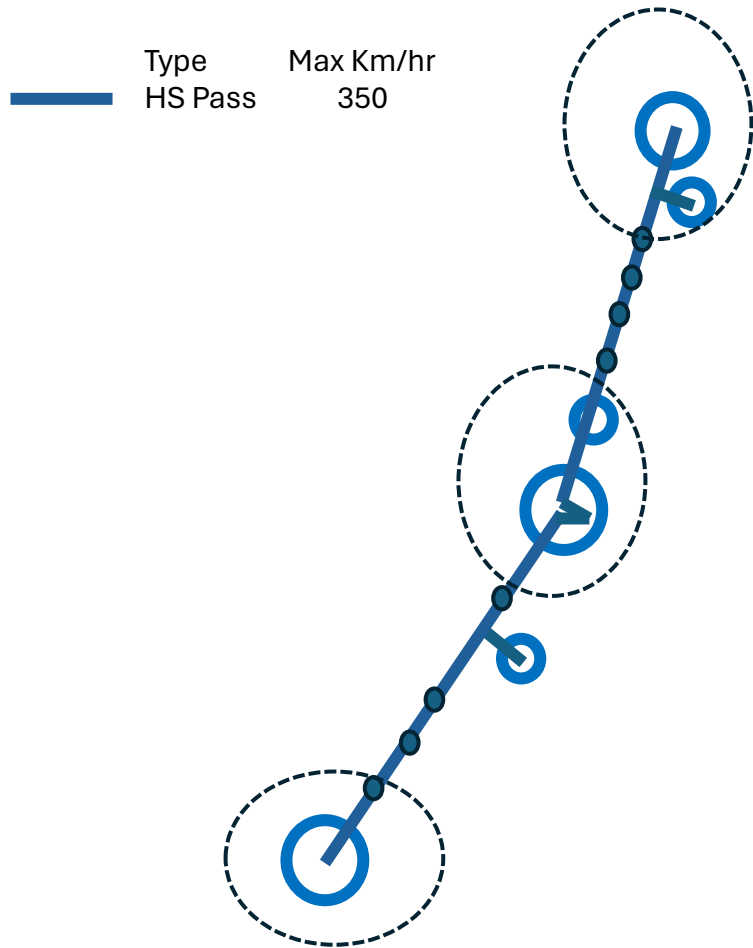
- Improve integration within each of our mega-regions
- Connect them together, providing fast access to key cities in the wider corridor, such as Shepparton, Albury, Wagga Wagga, Canberra, the Southern Highlands, Nowra, Coffs Harbour, Port Macquarie, Bathurst, Orange, Tamworth, Armidale and Toowoomba.
- Include Fast Freight as well as high-speed and fast passenger trains
- Facilitate extension to Adelaide.



An Integrated Approach

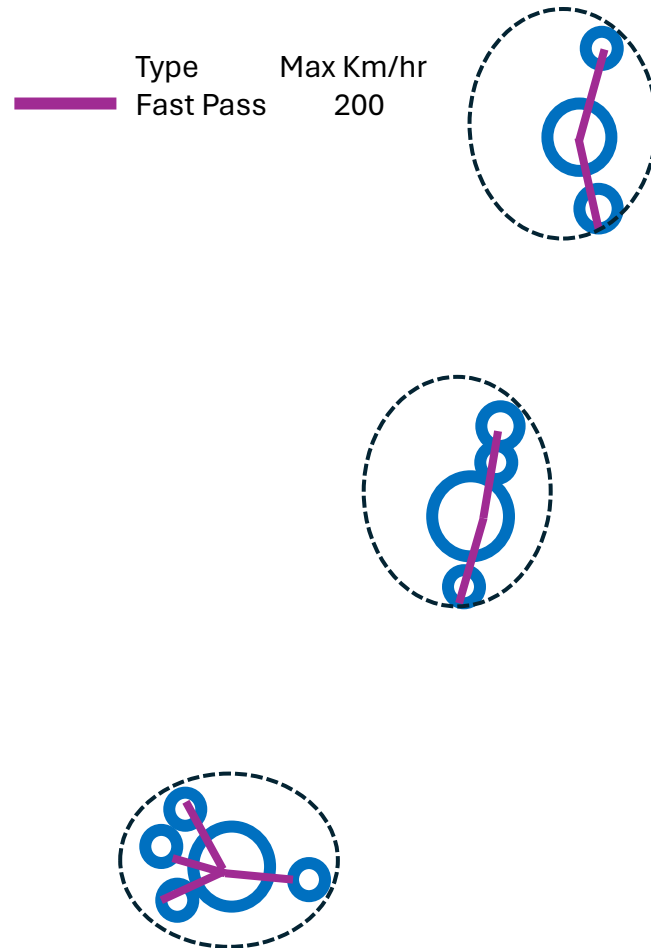
High Speed Rail

The 2013 report (1) envisaged a 350 km/hr stand-alone high-speed rail line connecting Melbourne, Sydney, Newcastle and Brisbane, with branches to Canberra and the Gold Coast



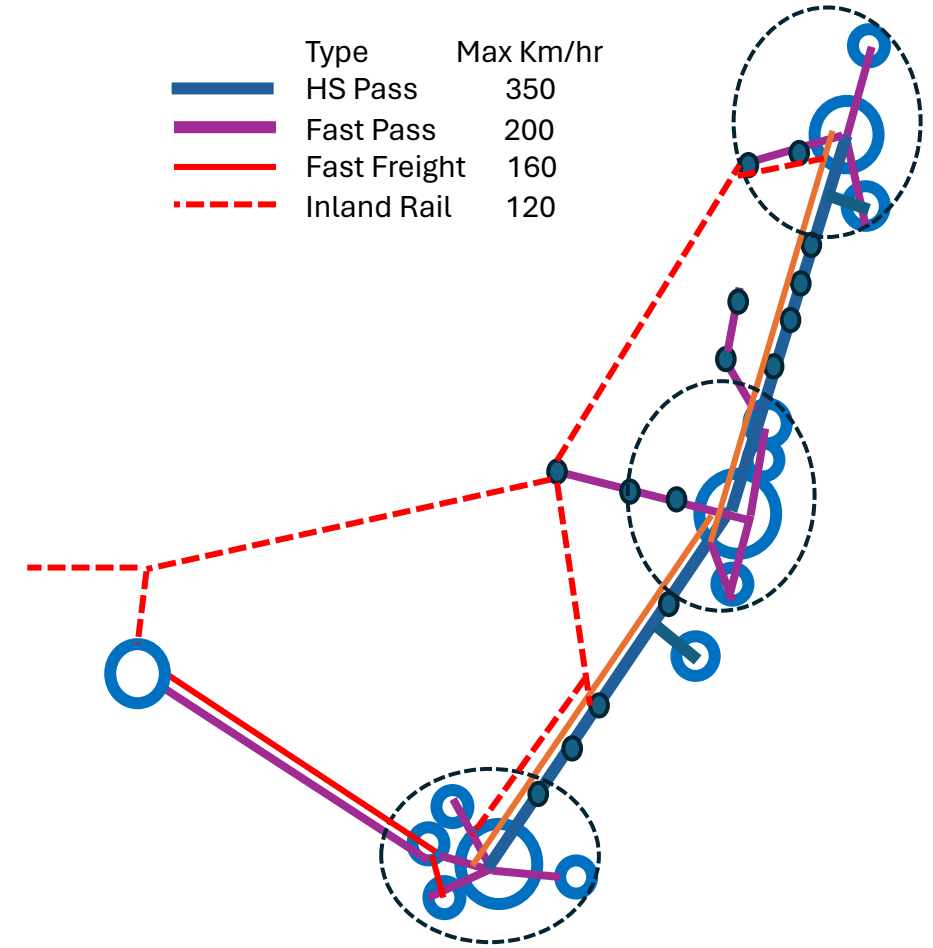
Faster Rail

Victoria, NSW and Qld are building or planning upgraded rail links out of their capital cities to nearby regional cities

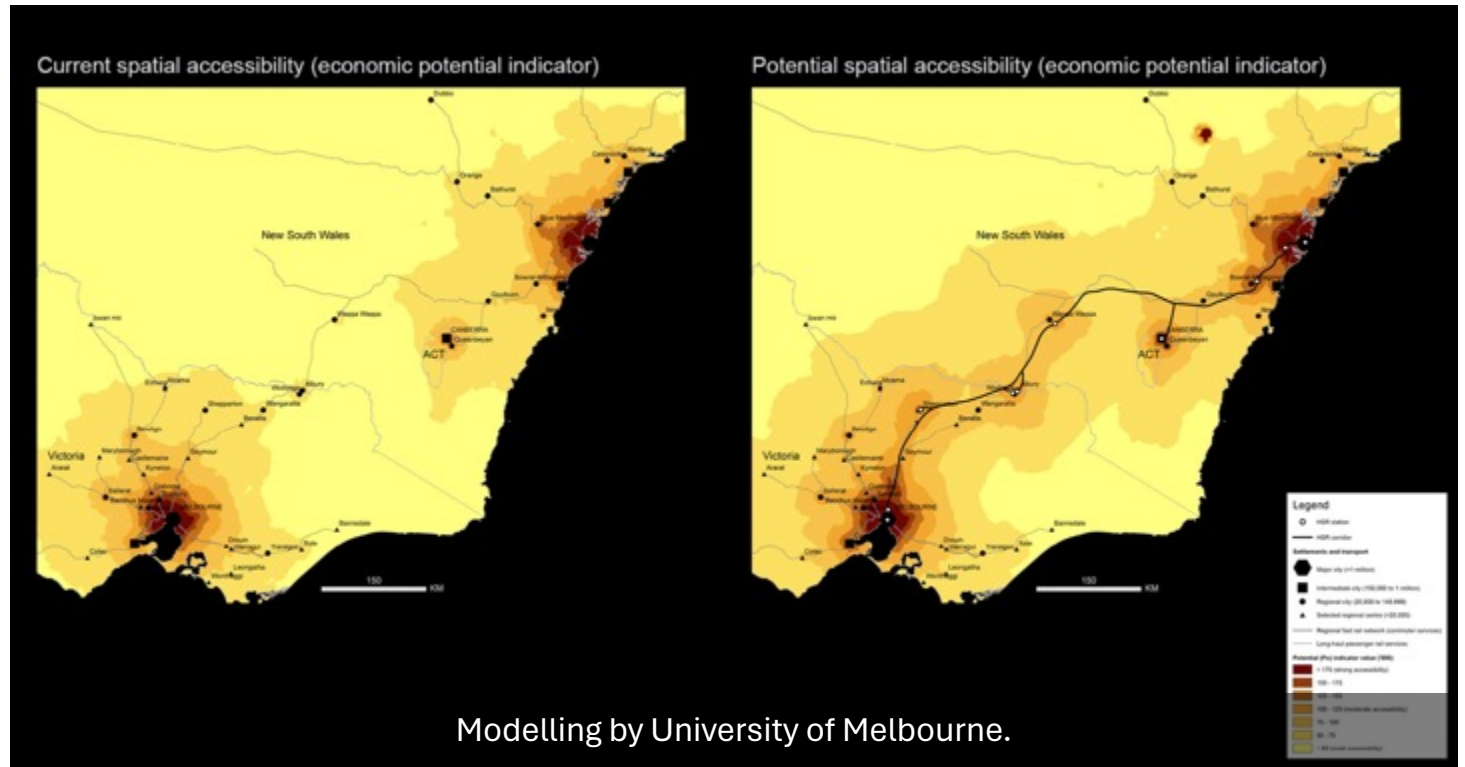


Integrated Approach

Fastrack Australia propose integrating high-speed and faster rail, freight and passengers, and extension to Adelaide.



Impact on Accessibility


















The map shows the impact which high-speed rail would have on accessibility for the wider corridor, reducing once and for all the “Tyranny of Distance” which has led to the over-dominance of our capital cities.

Maximizing Benefits

An Integrated Network Strategy will produce much greater benefits:

- Benefits both longer and shorter distance passengers, as well as freight movement
- Significantly increases regionalisation, not only to nearby cities but to the wider corridor
- Enables shifts from cars, trucks and air to the more energy efficient rail mode
- **Allows easier staging of infrastructure and services, bringing forward the benefits.**

Benefits	Stand-Alone HSR	Fast Rail Only	Integrated National Network
Long Distance Passengers			
Commuter Passengers			
Freight Efficiency			
Decentralisation			 
Regional Development			
Emissions Reduction			 

Example: the Sydney Mega Region

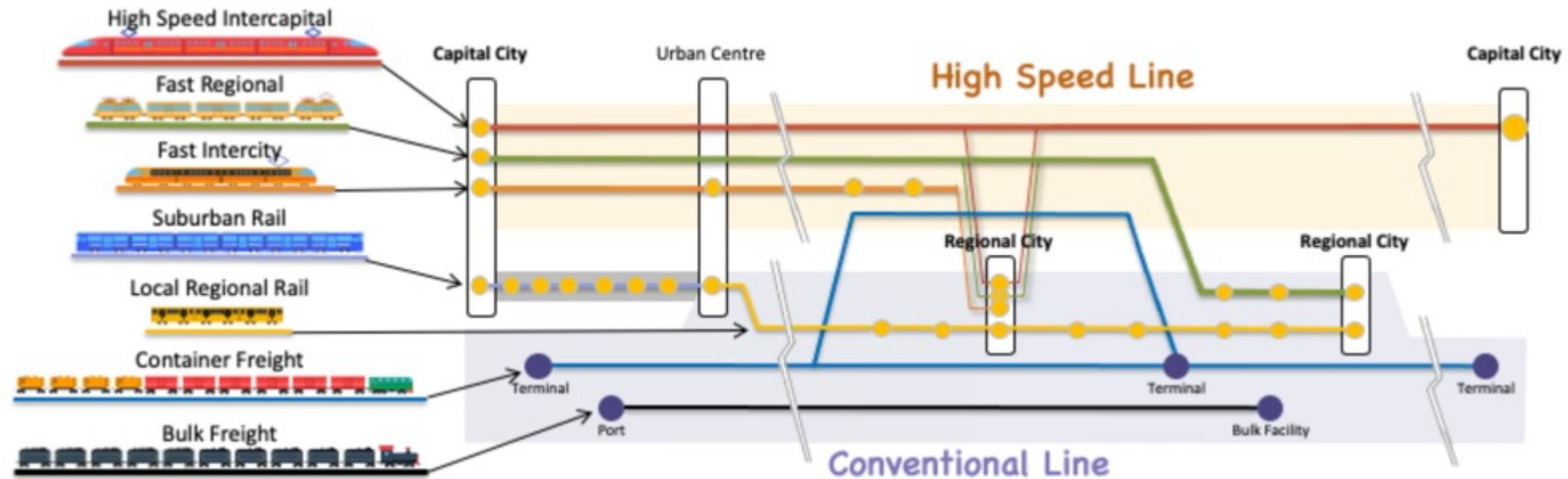
- The Committee for Sydney proposed a fast rail network linking Newcastle, Gosford, Sydney and Wollongong, but with a highly schematic concept devoid of concrete detail (left).
- The actual existing rail links in the Sydney Mega Region service the historic CBD's. However, they have poor alignments due to topographical constraints. They cannot support fast, let alone high-speed services (right).
- Conversely any realistic high-speed alignment will need to be routed away from the main CBD's, but linked to them and to other centres via existing heavy rail and metro lines.
- This requires careful design of stations and rail services, and an understanding of the range of rollingstock and service characteristics required for different purposes.



Integrated Network Design

This will enable

- High-Speed Trains for Long-Distance and Inter-capital Services
- Fast freight trains to utilise parts of the high-speed network at night when passenger traffic is low
- Fast Interurban, Regional and Commuter trains to join and utilise the high-speed line at appropriate junctions, producing travel time savings for commuters and regional passengers from existing catchments
- Well-designed interchanges at other points for passengers using high-speed and fast services to switch to metro or suburban services or to Park and Ride to access a wide variety of locations.
- Bulk Freight, local regional passenger trains, and fast regional trains together with single and double-stack container trains to continue to use the existing conventional lines.



Implications for Infrastructure

High-Speed Lines

- High-speed lines should be designed for speeds up to 320 km/hour, but some sections (e.g. in tunnels, approaches to major cities or areas with particular topography) might be designed for lower top speeds, in the region of 180-250 km/hr.
- Fast freight trains with limited axle loads (up to 22 tonnes) would also be permitted at speeds up to 160 km/hour, mainly at night, on suitable sections of the high-speed network.
- Sleeper trains could also operate at night at similar speeds to the fast freight trains on the high-speed network, as well as on the conventional network.
- The infrastructure should generally be powered at 25 KVAC, except where high-speed lines are also accommodating fast regional or commuter trains which are running on 1500 VDC, or where traffic volumes are low and hybrid hydrogen powered trains will operate in the future.
- All trains accredited to operate on high-speed lines would meet common safety standards set by the HSRA.
- Clearances would not need to accommodate heavy and slow double-stack container trains, but should be higher than the current NSW structure gauge to enable fast piggy-back and high-speed double deck passenger trains in future.

Conventional Lines

- As at present, conventional lines will have a variety of loading gauges, axle loads, power supply systems and signaling. For example, the Inland Rail is being built to allow double-stack container trains, heavy mineral lines such as in the Hunter Valley allow axle loads up to 30 tonnes, while some rural branch lines have axle loads of only 19 tonnes.
- Many conventional lines in Victoria and Queensland will continue to use broad or narrow gauge as at present, and these would not be suitable for high-speed trains. However, some lines, for example the Brisbane – NSW Inland Rail line and some lines in Victoria should be replaced in due course by standard gauge tracks, enabling further integration over time.



Implications for Rollingstock, Operation and Governance

A variety of **New Rollingstock** will be needed to utilise the improved infrastructure provided under an integrated National HSR Network, including:

- Modern sleeper trains for overnight inter-capital long distance services
- Fast hybrid-powered tilt trains for fast regional services on both electrified and non-electrified lines
- Dual Voltage HSR trains for services on fully electrified HS lines
- Dual voltage Fast and InterCity Commuter trains able to use both HS and conventional lines
- New types of Fast Freight Trains able to minimise terminal times and travel at up to 160 km/hour on sections of high-speed lines.

A new **National Passenger Rail Operator** is proposed to begin a revolution of long-distance passenger rail services, starting with trains which can utilise existing lines as well as sections of new HS lines as they are completed.

Some changes to **Governance Arrangements** will also be needed to facilitate appropriate access arrangements and to use access charging regimes designed to stimulate and support HS rail services in particular.



2 The Sydney – Newcastle Corridor

- The line between Sydney and Newcastle (otherwise known as the “Short North”) carries substantial intercity commuter traffic, as well as some long-distance passenger and freight traffic and some slower suburban traffic. It includes the notorious “Cowan Bank” with 2.5% gradients and 80 km/hour maximum speed limits.
- The busiest period is 7:00am and 8:00am, when 12 trains arrive at Hornsby from the North.
 - 4 of these are Intercity Trains from Newcastle , which continue to Central via Strathfield
 - 4 are Intercity trains from Gosford or Wyong in the Central Coast, which proceed via the North-Shore Line and Chatswood
 - 4 are suburban trains from Berowra, which also proceed to Sydney via the North-Shore Line
- Adding more trains to the current route via the Cowan Bank in peak periods is virtually impossible. Freight services therefore have a curfew, arriving only after the peak period. Any significant increase in intercity, long-distance passenger, freight or suburban traffic on the Short North line is therefore difficult to timetable during peak periods.
- However, the construction of a High-Speed line between Sydney and Newcastle could easily double current capacity, as will be explained in the following. This will be needed to cater for anticipated population growth in the Central Coast and Newcastle, a shift from road to rail especially with faster trains, and increased rail freight (intermodal and port shuttles).
- Achieving this requires maximizing the use of both the existing and the new line. This is easier to accomplish if some of the current intercity trains from Newcastle and the Central Coast can also use the high-speed line, bypassing the Cowan Bank and Hornsby, and also congestion between Epping and Central Station by running to a new High-Speed station at Rosehill.
- This requires junction stations at Hawkesbury River and at Tuggerah to enable Intercity Trains (which are high-capacity) to join the high-speed line. This will not only address capacity issues but will also provide greater travel time savings for commuters from the Greater Newcastle and Central Coast regions.



NSW new Intercity Trains due to enter service soon.



Freight Train on the Cowan Bank.

Stand-alone High-Speed Options

- The 2013 HSR study proposed a stand-alone HSR line from Sydney (Central) to Brisbane (Roma Street) and the Gold Coast, for HS passenger trains only.
- In the Sydney – Newcastle part of the corridor, stops were proposed at
 - Central Station
 - Hornsby Station
 - Ourimbah
 - Newcastle HSR (west of the city) (park and Ride Station only)
- Existing NSW Intercity and Regional trains would not be able to operate on the line as it was 25 KVAC only. Thus, all passengers other than park and ride passengers would need to change from conventional inter-city or regional trains at either Ourimbah or Hornsby. Ourimbah HS station was 2km from the existing rail corridor, so the connection would have been problematic.
- This would have limited travel time savings for most existing rail passengers from the Central Coast and many from the Newcastle area. For example, passengers from Gosford or Woy Woy would have had to travel north to Ourimbah (taking a minimum of 15 -25 minutes even if the low-speed line was deviated to interchange with the HS station), before travelling south.
- Longer distance passengers from Brisbane, the North Coast, the Hunter Valley or beyond would also have to have interchanged at Ourimbah, since the Newcastle HSR station is well off the existing rail corridor,
- As a consequence, it is likely that patronage on the HS line would be limited for many years until it was extended all the way to Brisbane and the Gold Coast.



Fast Rail Options

Since the 2013 study, Transport for NSW spent some time examining fast rail options in the Sydney – Newcastle corridor. It is believed that these options, while not finalized, were considering:

- Continuation of a “stand-alone” HSR unable to integrate with the existing railway for either passenger or freight trains.
- Moving the main Sydney HSR station to either Olympic Park or Parramatta, given the then likelihood of Metro West Proceeding.
- Relocating the Sydney North HSR station from Hornsby to Epping, which is a more strategic location following completion of the NW Metro.
- Establishing a HSR station at Gosford, which may have had to be underground, below the existing station. If so, this would be extremely expensive and disruptive to build.
- Crossing the Hawkesbury by either a tunnel or by a bridge, with the alignment not finalized.
- A long tunnel from Epping (underground HSR station) to the Hawkesbury River, with further tunnels to Gosford and north of Gosford to the Orimbah area.
- Somewhat slower top speeds than 350 km/hr in the tunnels.
- Potential for sharing the HSR corridor north of Ourimbah with the proposed Freight Bypass Line, which would link with the existing line in the vicinity of Hexham.

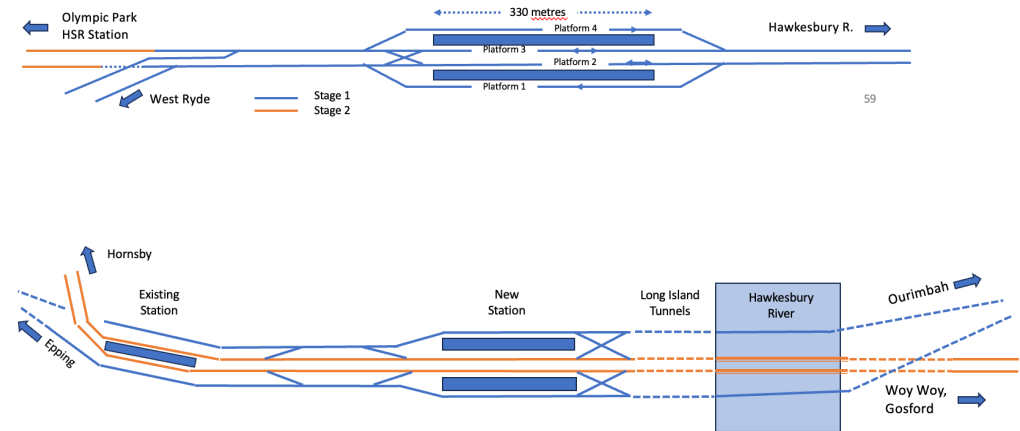
Most recently the confirmation of Metro West and a potential metro station at Rosehill opens up the possibilities of a Sydney HSR station to be co-located at Rosehill, with the metro on an East-West alignment and the HSR station on a North-South alignment.



Gosford Station currently accommodates all Intercity, long-distance and local passenger trains as well as freight on the Short North. It has a highly constrained site.

Integrated Options

- FastrackAustralia have proposed a modified alignment and station location and operating plan for the Sydney – Newcastle Corridor. The proposal was outlined in the “High Speed Rail Through Sydney” report.
- Since then, discussion of a metro station at Rosehill suggests a modification, with the HS line running from Epping to Glenfield via Rosehill and Liverpool rather than via Olympic Park and Bankstown.
- The Fastrack proposal between the HSR Sydney Station and Newcastle is for an integrated system, with the HS line accommodating eventually:
 - High-Speed inter-capital trains to Brisbane
 - High-Speed and Fast Regional Trains to the Gold Coast, Coffs Harbour, the Hunter Valley and New England
 - Fast Intercity Trains to Gosford, Newcastle Interchange and to Newcastle HS Station
 - Fast Commuter Trains to Epping
- In addition, fast freight trains would be able to use at least the tunnel between Hawkesbury River and Epping, joining the North Sydney Freight line north of West Ryde.
- The “Route Through Sydney” report examined potential operations and timetabling issues and included indicative designs for Epping and Hawkesbury River stations.
- High-Speed stations would also be included at Ourimbah/Tuggerah, and in the vicinity of Hexham, where long-distance regional trains from the Hunter and the North-West could join the high-speed line from the conventional line.
- In addition to the Fast Intercity Trains utilizing part of the HS line, conventional Intercity trains would also operate to Sydney via the existing route through Gosford, Woy Woy, Hawkesbury River, the Cowan Bank, Hornsby and Chatswood to Central (continuing to the Western Line over the Blue Mountains).



Proposed Staging

The proposed Integrated option would enable the Sydney – Newcastle HS line to be built (and operated) in consecutive stages. Four stages are suggested, enabling early commencement of accelerated services and a steady build up in patronage, frequencies, average speeds and travel time savings as additional stages are completed.

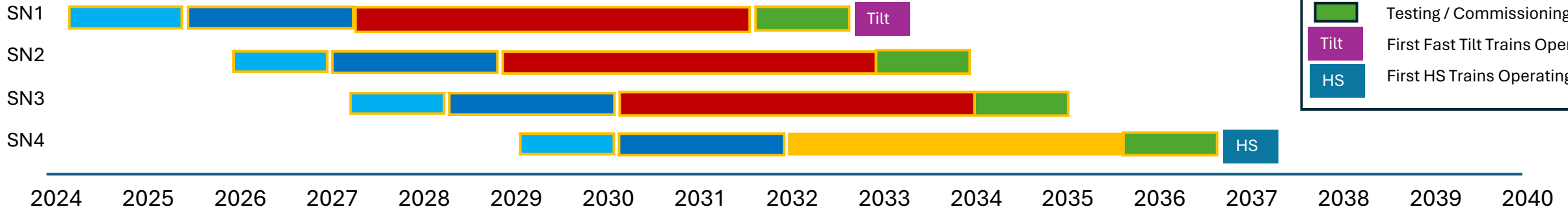
Stage	Section	New HS Stations	Major Infrastructure	Further Details (a)	Travel time Savings (b)	Travel Times (Newcastle – Sydney) (b)
SN1	W Ryde to Hawkesbury River (via Epping HSR)	Epping Hawkesbury R	Tunnel from W Ryde to Hawkesbury River	1500V DC initially to accommodate new Intercity and regional trains*	Approx 15 min for all commuter and long-distance services north;	2 hours Newcastle IC– Central
SN2	Hawkesbury R - Tuggerah	Central Coast (near Tuggerah)	Hawksbury River Bridge; Tunnel to Tuggerah	Could be 1500V DC initially	45 min travel time saving for all Newcastle and long-distance services	1 hour 30 min Newcastle IC - Central
SN3	Epping - Rosehill	Rosehill	Epping – Rosehill (tunnel + bridge)	25 KV AC.	60 min travel time saving for Newcastle West and Long-Distance Services; 30 min savings for Central Coast services	1 hour 15 min Newcastle IC - Rosehill
SN4	Tuggerah - Hexham	Hunter/ Newcastle West (near Hexham)	High-Speed and Parallel Freight Bypass Route	25 KV AC	75 min travel time savings for Newcastle West and Long-Distance Services;	1 hour Newcastle West - Rosehill

(a) Assumes that the recently acquired Intercity and Regional Trains cannot be easily converted to 25 KVAC; if this is not the case, then the line would be built to 25 KVAC from the outset

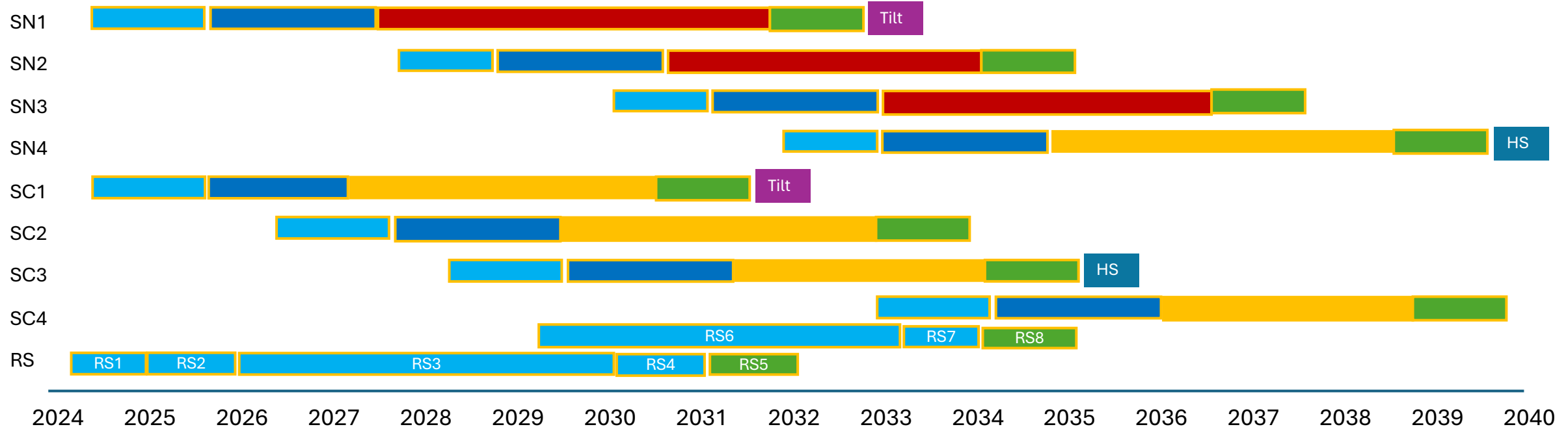
(b) Note that these are conservative estimates and include stops at Central Coast and Epping HS Stations. Express services (eg Intervapital trains from Brisbane m) might take 50 minutes from Newcastle West to Rosehill.

Staging construction

The Sydney – Newcastle corridor could potentially be built in as little as 12-13 years subject to funding, if multiple stages were built concurrently. This would require up to a dozen TBM's to be being operated simultaneously



Alternatively, it could be built over a longer time period, allowing more time to evaluate options, construction experience and operations. This would enable simultaneous progress on other corridors – e.g. Sydney – Canberra, within the same funding envelope. This would accelerate the phasing in of infrastructure, rollingstock, and services.



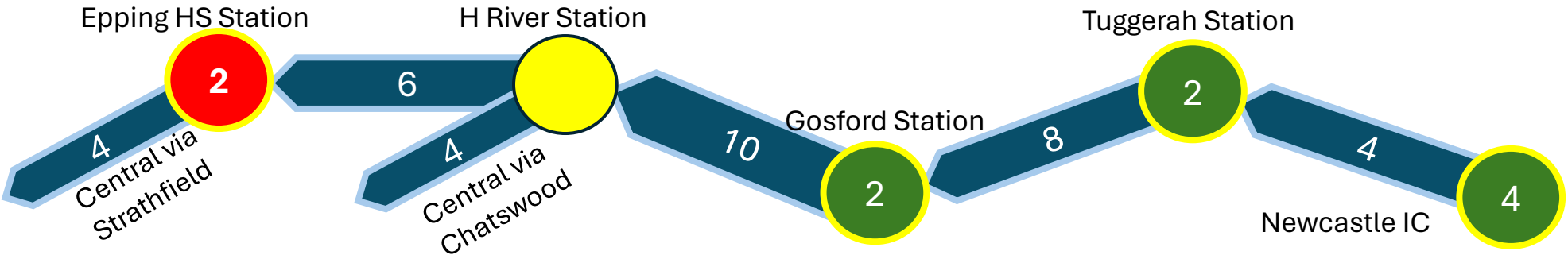
SN1: Epping – Hawks R; SN2: Hawks R – Tuggerah; SN3: Epping – Roesehill; SN4: Tuggerah – Hexham; SC1: Canberra – Goulb/Yass; SC2: Macarthur – Mittagong; SC3: Mittagong – Goulburn; SC4: Macarthur - Rosehill

Staging of Service Enhancements

- 2 Trains starting /hour
- 2 Trains terminating /hour

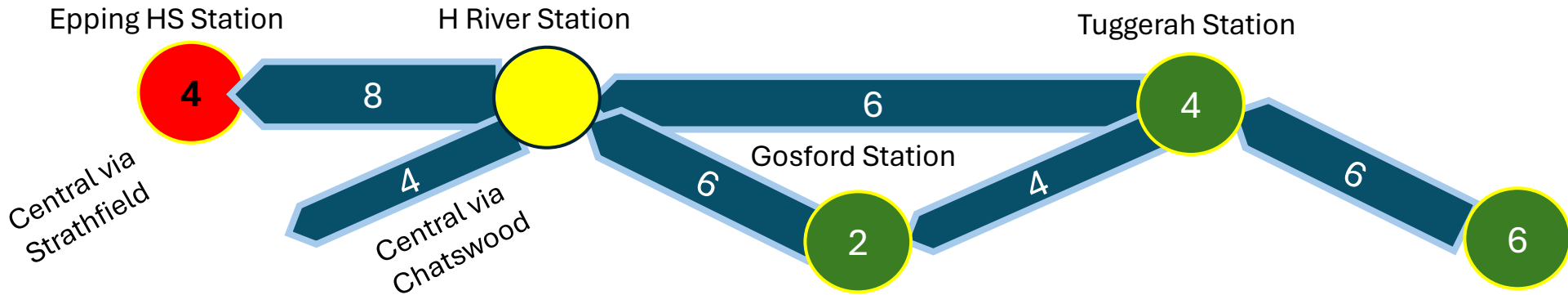
Southbound trains in morning peak hour (Commuter services only shown)

Stage N1



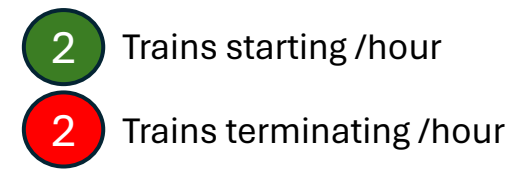
After Stage N1 is complete, a 25% increase in capacity can be accommodated, with 2 trains added, terminating in the centre roads of Epping Underground Station. Train volumes to Central would be held constant. 60% of commuter trains from Newcastle and the Central Coast would travel via the long tunnel, saving at least 15 minutes travel time compared with current services.

Stage N2

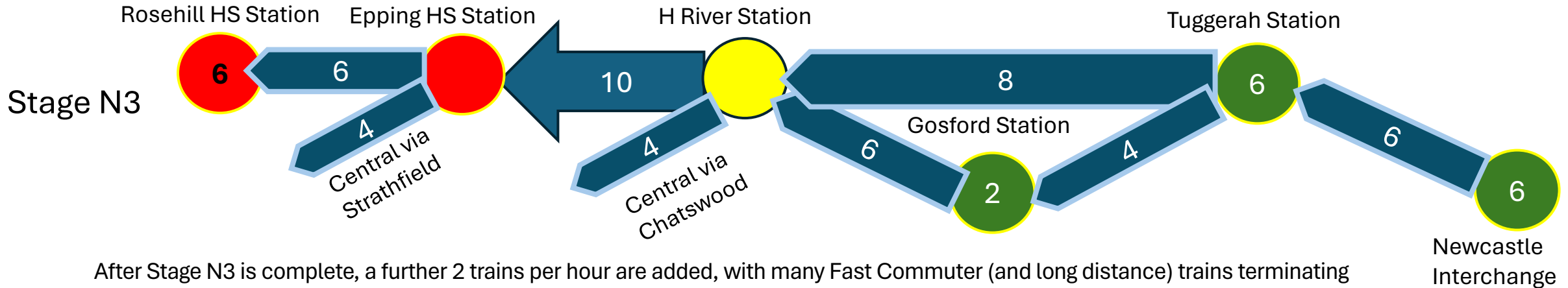


After Stage N2 is complete, a further 2 trains can be added, with 4 trains per hour terminating at Epping HS station. Train volumes to Central would be held constant. 66% of commuter trains from Newcastle and the Central Coast would travel via the long tunnel, saving 15-35 minutes travel time depending on their starting point.

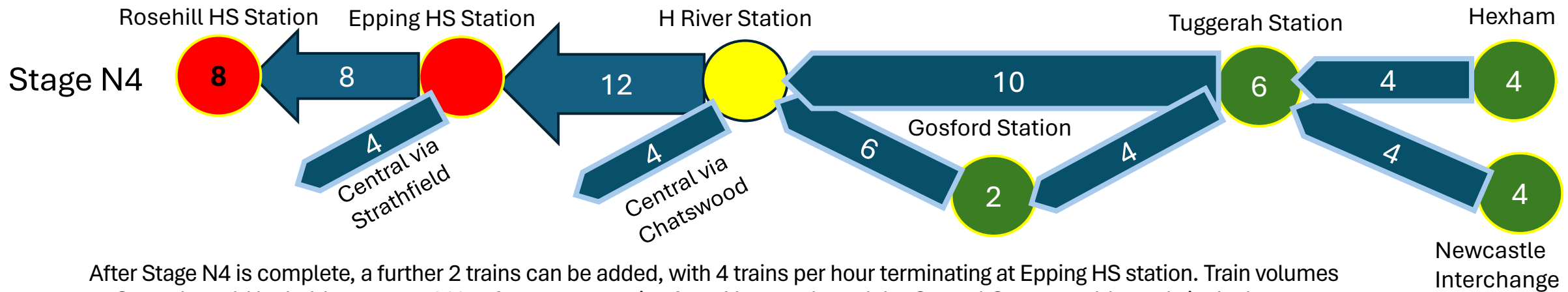
Staging of Service Enhancements (cont.):



Southbound trains in morning peak hour (Commuter services only shown)



After Stage N3 is complete, a further 2 trains per hour are added, with many Fast Commuter (and long distance) trains terminating at Rosehill HSR Station. Train volumes to Central could be held constant. Major additional travel time savings would accrue to passengers for destinations such as Parramatta, Olympic Park, Five Dock, Pyrmont and the northern CBD. The centre roads at Epping HS station would be used to terminate Fast Suburban Trains from Glenfield via Rosehill.



After Stage N4 is complete, a further 2 trains can be added, with 4 trains per hour terminating at Epping HS station. Train volumes to Central would be held constant. 66% of commuter trains from Newcastle and the Central Coast would travel via the long tunnel, with significant travel time savings depending on their starting point.

Staging of Capacity Enhancements

As shown below, there are approximately 63 southbound passenger trains per day currently in the existing corridor. The addition of the HS line integrated with the existing line would allow this to be tripled, with a ten-fold increase in long distance trains, a 150% increase in the number of intercity trains, and a tripling of local services. Freight traffic increases could also be handled, as discussed next.

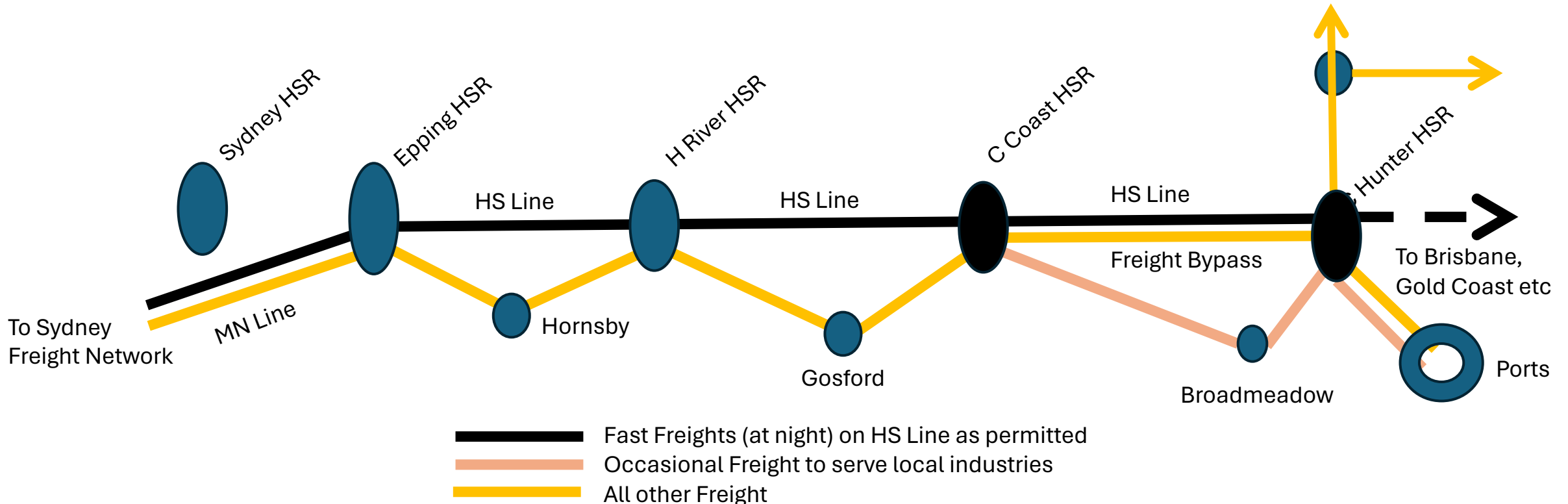
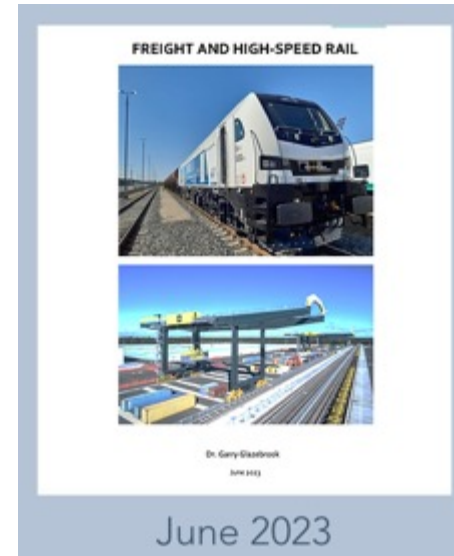
TYPE	FROM	TO	VIA	CURRENT	N1	N2	N3	N4	LATER
Inter-capital	Brisbane	Sydney (Central)	Strathfield	1	2	2			
Inter-Regional	Gold Coast / Lismore	Sydney (Central)	Strathfield	1	2	2			
Regional	Coffs Harbour	Sydney (Central)	Strathfield	1	2	2			
Regional	Upper Hunter / NW	Sydney (Central)	Strathfield	1	2	4			
Sleeper	Brisbane	Sydney (HS Station)	Epping HS Station				1	1	2
Sleeper	Gold Coast	Sydney (HS Station)	Epping HS Station						1
Intercapital XP	Brisbane	Sydney (HS Station)	Epping HS Station				2	4	12
Fast Regional	Gold Coast	Sydney (HS Station)	Epping HS Station						6
Fast Regional	Mid-North Coast	Sydney (HS Station)	Epping HS Station				4	4	6
Fast Regional	Upper Hunter / NW	Sydney (HS Station)	Epping HS Station				8	8	12
TOTAL LONG DIST				4	8	10	15	17	39
Intercity	Newcastle Interchange	Sydney (Central)	Strathfield	36	18	18	18	18	18
Intercity	Wyang/Central	Sydney (Central)	Strathfield	7	18	18	18	18	18
Intercity	Wyang / Gosford	Sydney (Central)	Chatswood	6	8	8	8	8	8
Fast Intercity	Hunter HS Station	Sydney (HS Station)	HS Line					14	24
Fast Intercity	Newcastle IC Station	Sydney (HS Station)	Tuggerah HS Station		24	24	24	24	24
Fast Intercity	Tuggerah / Gosford	Sydney (HS Station)	H River HS Station				24	32	32
TOTAL INTERCITY				49	68	68	92	114	124
Suburban	Newcastle Interchange	Tuggerah / Wyong	Existing Line	3	10	20	30	30	30
Suurban	Wyang/Tuggerah	Gosford	Existing Line	7	10	10			
TOTAL SUBURBAN				10	20	30	30	30	30
TOTAL PASSENGER				63	96	108	137	161	193

Sydney – Newcastle: Freight Services

Fastrack’s report on “Freight and High-Speed Rail” examined the potential for a major shift from road freight to rail freight in the Sydney – Melbourne corridor, utilizing the latest developments in terminals, rollingstock and high-speed rail infrastructure

While coal traffic to Newcastle is anticipated to decline over coming decades, intermodal, fast freight and industrial traffic could increase, especially if Newcastle develops as a significant container port and if high-speed freight trains are successful.

The diagram below shows potential freight services on completion of the Sydney – Newcastle HSR route and the Newcastle Freight Bypass.



Conclusions

- **60% of Australia's population live in three "Mega Regions", based on Sydney, Melbourne, and Brisbane.**
- **Fast rail links from the three capitals to their surrounding cities are now seen as crucial in improving the economic performance of these regions.**
- **There is also now a revival of interest in an East Coast High Speed Rail (HSR) linking Melbourne, Sydney and Brisbane.**
- **Fast Rail and High-Speed Rail can and should be integrated. This will improve internal connectivity within each mega region, as well as linking them with cities in towns in the wider corridor, and with Adelaide.**
- **Such an approach will maximize the economic, social and environmental benefits of investment in HSR, by upgrading freight as well as passenger movement, improving long-distance travel as well as commuting, and by shifting transport to the most energy efficient and carbon neutral mode.**
- **This will require an Integrated Network and a National Perspective, rather than disparate State-based approaches which have dogged the rail industry in Australia for the last 170 years.**
- **The Federal Government has indicated its first priority for HSR is the Sydney – Newcastle corridor. This provides a case study of how best to design HSR to maximise benefits both in the short and longer term by careful integration and staging of construction and operations.**
- **Suggestions of how this might best be achieved are therefore provided, including consideration of the route, alignment, station locations, rollingstock and operating regimes. Similar analyses are needed for other key sections of the HSR corridor, including the best route through Sydney, as well as into Melbourne and Brisbane.**

- Amtrak fleet replacement:
<https://www.youtube.com/watch?v=hLRgDLuhth8>