



ENGINEERS
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Future of Rail Transport

A Transport Australia Society Discussion Paper

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FUTURE OF RAIL TRANSPORT

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1. Introduction

1.1 Purpose and objectives

An efficient land transport system that supports Australia's passenger and freight tasks is integral to our economic success and quality of life. Rail is a key contributor, but for many decades rail has become a secondary mode for most tasks, as roads received greater emphasis from governments in land transport planning, policy and funding.

This paper calls for increased use of rail in Australia's land transport system. It aims to enable policy makers, delivery agencies, investors, operators and the public to:

- Better understand the land transport situation and scenarios where rail can play a larger role;
- Develop strong visions for national land transport effectiveness and mobility goals; and
- Establish timelines for delivering major changes in our national mobility systems.

This paper presents an opportunity to review the current situation of Australia's rail system and consider its capabilities to provide more effective mobility and thus make a greater contribution to safe and sustainable economic growth. The approach aims to be agnostic of individual state needs or the merits of specific projects. Rather, it sets out to advocate for rail as the backbone of the national land transport system, supported by performance-based goals for mobility. The paper examines what our transport future could look like and explains what is needed to enable a significant shift to more rail journeys and rail share of our motorised transport.

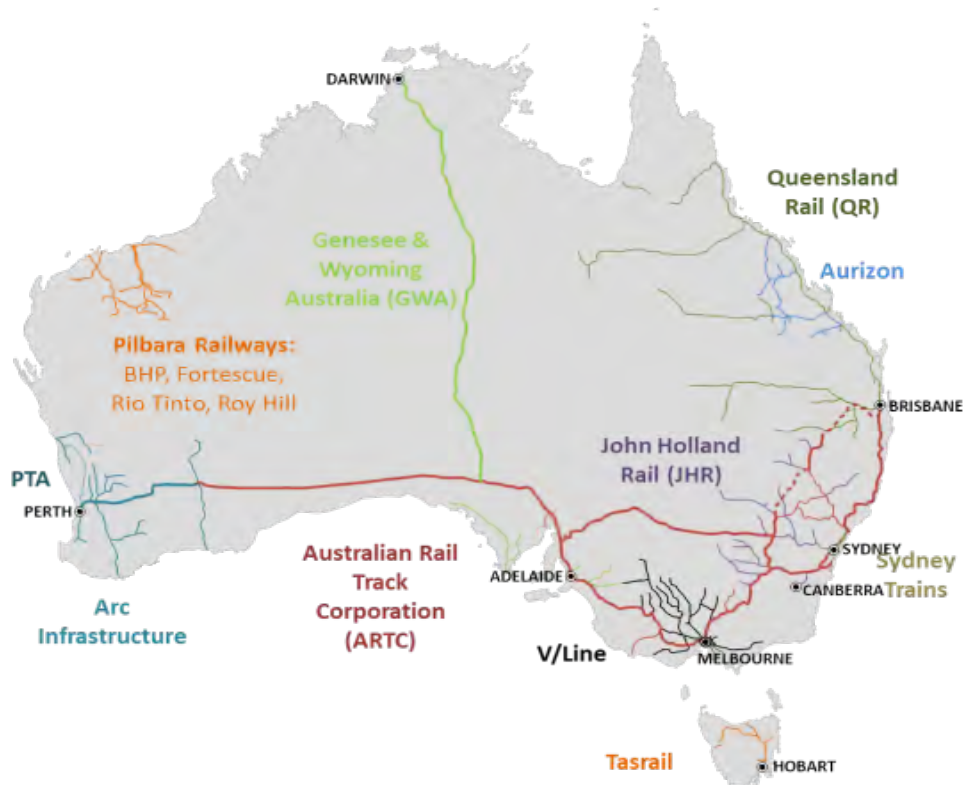
The discussion paper has been prepared by a working group of the Transport Australia Society (TAs). TAs is an Engineers Australia technical society and represents engineering and professionals working in transport infrastructure planning, design and operations in Australia. The recommended principles included are intended to inform discussion on the future of rail transport. The paper does not represent a formal policy position of Engineers Australia. This paper is structured to:

- Outline the current rail situation in Australia
- Look at how rail can help Australia achieve its mobility, economic and environmental goals
- Consider what's holding us back
- Set out what's needed for rail to succeed
- Recommend action and reform.

2. Current Situation in Australia

2.1 Australia's Rail System

Figure 1: Australian Rail Systems



Australia's rail system comprises:

- Five capital city heavy passenger rail networks.
- Five light rail networks in capital cities and regional cities.
- Seven Rail Infrastructure Management (RIM) companies managing freight networks, plus geographically separated Pilbara and Tasrail networks.
- 30 plus above-rail operators, including freight and passenger.
- Three track gauges covering approximately 32,900km of track.
- Fleet of over 2,100 locomotives, 5,000 passenger cars and 645 trams.
- High commitment to safety.

2.2 Rail Market Share

Rail operates across several markets. These are:

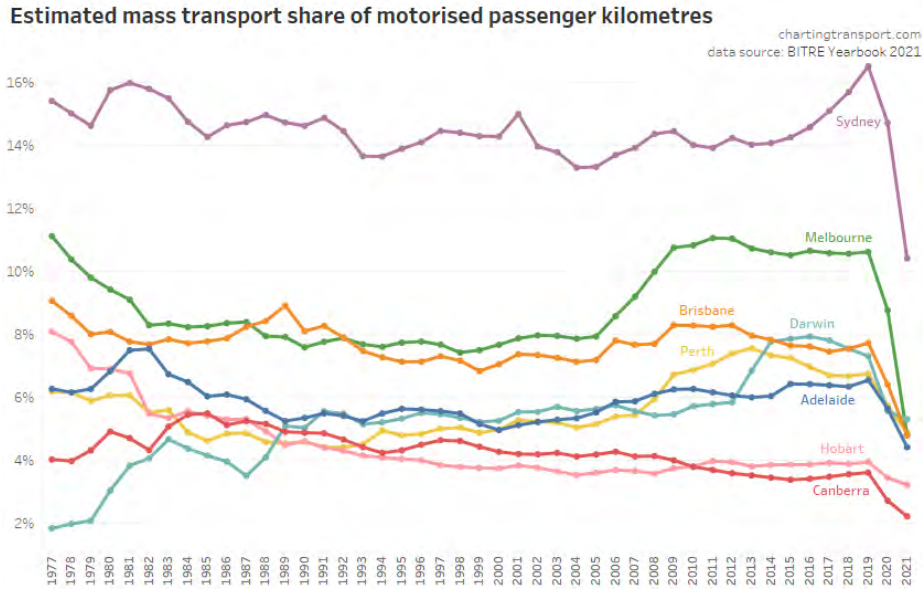
- Passenger – which can be split into urban and regional tasks.
- Freight – which can be split into three tasks – bulk (grains, minerals), non-bulk(containers) and heavy-haul (iron ore and coal).

In 2019, rail performed approximately 5.5 per cent (or 17 billion) of the total 316 billion passenger kilometres (pkm) that were travelled in Australia. Cars dominate the total transport task with 289 billion pkm.¹

¹ Infrastructure Statistics Yearbook – BITRE 2020

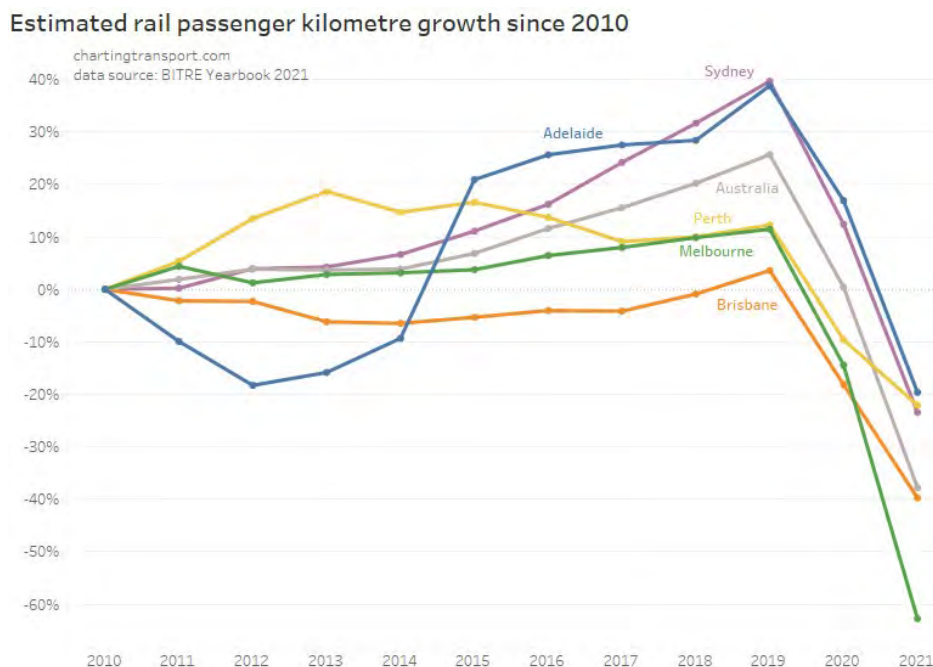
These total figures don't reflect the importance of rail, and other mass transport modes, to the economic life of Australia. Mass transport including rail, buses and ferries, performs a vital role in peak period travel to and from work. Across Australia's capital cities, rail does the heavy lifting for the urban public transport task; carrying 68 per cent of the mass transport passenger kilometres. However as shown in Figure 2, the market share has stayed relatively static. Longer journeys tend to occur on heavy rail with buses feeding the rail network and serving areas without rail.

Figure 2: Mass transport share of passenger travel km



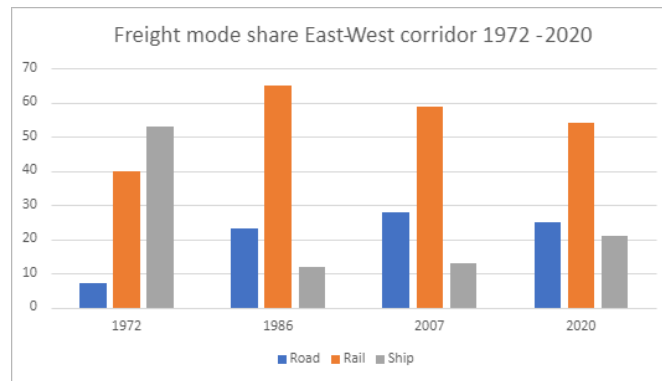
Urban rail has experienced dynamic performance over the last 10 years. Figure 3 shows Sydney passenger rail has grown by over 30 per cent since 2010. This acceleration reflects significant investment in service frequencies and new infrastructure.

Figure 3: Rail passenger growth since 2010



In terms of non-bulk freight on rail such as intermodal containers, market share on the main interstate corridors has differed over time depending on the levels of competition, regulatory settings and quality of infrastructure.

Figure 4: Freight mode share East - West²



In Figure 4, the East-West (Sydney / Melbourne - Perth) corridor has seen some mode shift away from rail, reflecting gains made by coastal shipping from relaxed regulatory settings and improved road productivity from sealing the Stuart and Eyre Highways.

Figure 5: Freight mode share North - South³

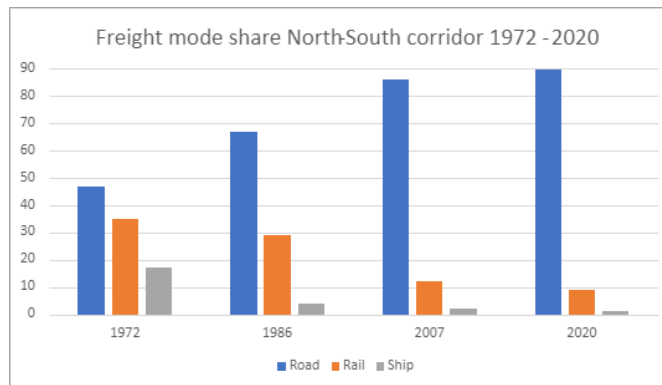
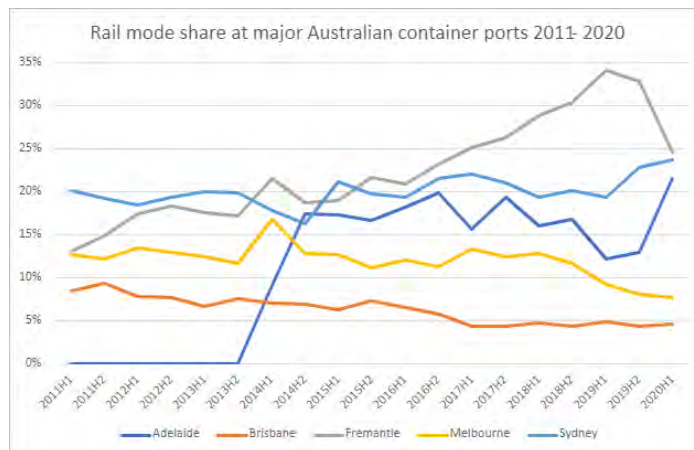


Figure 5 shows how the North-South (Melbourne-Sydney-Brisbane) corridor has experienced significant mode shift from rail to road as the adjacent road corridors on the national highway network (particularly the Hume, Newell and Pacific highways) were improved. At the same time freight rail access through urban environments was squeezed by growth in capital city passenger rail patronage.

² 'Who moves what where: Freight and passenger transport in Australia' National Transport Commission August 2016, accessed 11 March 2022 <https://www.ntc.gov.au/sites/default/files/assets/files/Whomoveswhatwherereport.pdf> and 'Freight flows in Australian Transport Corridors: Occasional Paper 98' Bureau of transport economics accessed 11 March 2022 https://www.bitre.gov.au/sites/default/files/op_098.pdf

³ *ibid*

Figure 6: Australian Ports and Rail Transfers⁴



Rail has an important role in alleviating transport congestion on urban transport networks through the port rail container shuttles. The different levels of integration between rail and international shipping at the five major ports is illustrated by rail’s mode share of container movements in Figure 6.

Fremantle has achieved significant growth over the last 10 years following active policy moves for more freight on rail. Brisbane has stagnated to below 5 per cent mode share on rail; while Sydney has experienced modest growth from improved network coordination and infrastructure improvements to better separate passenger and freight trains, balanced against improved road access to Port Botany.

2.3 Economics and Growth

Australia is the 14th largest economy by Gross Domestic Product (GDP) in the OECD. Exports of mining and agriculture commodities underpin our GDP and balance of payments. Rail’s chief freight task has long been moving bulk export commodities of grain, coal and iron ore. In 2020/21, iron ore and coal achieved record prices and haulage was approximately 1.5 billion tonnes. Much of this was on dedicated mine-to-port rail corridors or on open access networks linking mine and port operations. While rail’s mining tasks are growing, in many states, grain-only branchlines are in decline or have closed.

Rail remains underutilised in carrying non-bulk general freight such as manufactured industrial and food products; however, their production, collection and distribution are crucial to Australia’s economic and social success. Australia’s sparse population density is a challenge for network connectivity. This is compounded by inherited differences in standards between jurisdictions. Policy settings and ownership structures have led to further imbalances in road and rail utilisation. The high costs of rail access, low barriers to road network access and a permissive regulatory environment have helped high performance freight vehicles (HPFVs) achieve mode share gains on routes where higher productivity rail solutions would be superior from economic, environmental and social perspectives. Intermodal transfers between road and rail are critical to an effective land transport system but require significant improvements to be more effective. In recent years, there has also been a renaissance in coastal shipping, which although slower, offers lower transport costs and increasingly direct deliveries to smaller ports.

Australia’s population is growing at around 1.5 per cent per annum. The recent exceptions of 2020/21 aside, each year over 300,000 more people call Australia home with many arriving from overseas. Our transport networks struggle to keep pace with societal expectations due to expanding suburbs and the rise of urban congestion. At the heart of this are long term policies supporting "the great Australian dream" with land use prioritised around single dwellings and private cars. The results are cities with low urban density and inefficient mobility systems.

⁴ "Who moves what where: Freight and passenger transport in Australia" National Transport Commission August 2016, accessed 11 March 2022 <https://www.ntc.gov.au/sites/default/files/assets/files/Whomoveswhatwherereport.pdf> and "Freight flows in Australian Transport Corridors: Occasional Paper 98" Bureau of transport economics accessed 11 March 2022 https://www.bitre.gov.au/sites/default/files/op_098.pdf

In 2016, Infrastructure Australia recognised the need for Australia's largest cities and inter-urban centres to deliver 'turn up and go' services for multi modal journeys.⁵ It noted the need for investment in services between inner and outer suburbs to accommodate population growth and expectations for improved services. The COVID-19 pandemic has had dramatic impacts on passenger transport. The rapid and substantial shift to working from home, combined with heightened climate awareness, indicate the potential to affect longer term trends. Reports are arising of people looking to travel less often and with different expectations. Faster or more frequently may not always be best. Anecdotally, conversations now occur on the potential for better designed overnight rail passenger services as an alternative to early business flights and hotel stays.

⁵ Australian Infrastructure Plan, 2016: Australian Infrastructure <https://www.infrastructureaustralia.gov.au/publications/australian-infrastructure-plan-2016>

3. Why invest in Rail? Productive, safe and clean mobility.

For two centuries, railways have proven to be a highly efficient system of land transport for carrying heavy loads and large numbers of passengers. Rail networks continue to support regional and urban growth and development.

Railways have survived competing innovations including coastal shipping that carries freight from port to port, the car and truck with their greater flexibility, aircraft's superior speed and more recently, digital technology which can make some journeys redundant. Throughout, railways have remained relevant and able to thrive where rail can use its inherent technical advantages to best effect.

Trains perform best on segregated corridors where they function as the high-capacity spine of integrated, multi-modal networks. Rail's 'steel wheels on steel rails' provides the greatest efficiency of any land transport mode, hauling more for each unit of energy, with less friction than 'rubber tyres on asphalt roads' and providing the structural integrity to deliver superior tractive effort and haulage benefits. Rail is also an inherently safe transport mode, particularly where segregated corridors reduce the probability of collisions at the road/rail interface.

Significant technology advances since the 1970s have enabled railways to achieve gains in capacity, efficiency, and reliability from improved utilisation of corridors, fleets, and stations. The introduction of AC traction power has helped deliver higher-speed trains and heavy haul locomotives as well as providing better fine motor controls for low-speed maneuvers. Digital train control systems have significantly improved corridor capacity, service levels and operational safety.

Efficient land use has become critical. The nostalgic view of Australia as "...a sunburnt country. A land of sweeping plains⁶..." is only partly relevant today. Our modern, global cities and highly productive regions all contribute to our situation. Transport effectiveness may remain a quintessential human need, but our opportunities and constraints differ. Railway corridor-land required for freight or passenger journeys can be potentially far less demanding⁷ compared with the equivalent capacity delivered by other modes. Railways can move more people and goods, using less space and resources than other forms of motorised land transport.

Current strategies in Australia focus on creating accessible stations and freight terminals which allow for multi-modal transport and attract people and businesses through convenience, efficiency, and ease of use. These goals differ from the late 20th century when urban railways were seen as the mode of last choice. Now, the intrinsic efficiency of railways links people to their mobility goals and functions as a catalyst for economic and societal growth.

Climate change is a global challenge that requires urgent focus to reduce emissions. Railways are proven to lower carbon emissions for transport systems and offer extensive opportunities for further improvement through innovation and technology. However, the most recent Australian Government transport related policy on climate change is largely focused on the electrification of cars, light commercial and heavy vehicles. Rail's potential to move more people and freight to decouple the current link between transport and emissions is yet to be properly tapped. Australia's passenger and freight systems need to be more efficient and safer with lower environmental impact if our quality of life is to be maintained. Investment in rail and supporting systems is vital to realising this ambition.

⁶ My Country, Dorothea MacKellar, 1908

4. What is holding us back?

4.1 Complexity of factors

Since the 19th century, Australia's rail systems have seen disjointed technical strategies, best illustrated by differing track gauges which still hinder formation of genuinely integrated networks that can span states and regions. Transport effectiveness is a complex interaction of demand, accessibility, journey times, congestion, land use and competition with alternative modes, which all affect mobility decisions. Our urban growth is creating a need to preserve or create transport corridors, electrify systems, and reduce emissions. Intermodal compatibility and interoperability are required for efficiency and in urban freight, adaptability, and alternative technologies, can play key roles in future effectiveness and productivity.

Australia's world class engineering capabilities (spanning civil, electrical, ICT, and mechanical disciplines) and rapid adoption of modern technologies is transforming the rail network. Current rail investments are delivering great gains in mobility, access and placemaking. However, there are still things holding rail back, such as:

- Limited interoperability & varying standards.
- Inadequate 'last mile' solutions.
- Insufficient and piecemeal policies for developing sovereign rail innovation and industries.
- Transport system and land use planning that is not specific and coordinated enough to establish optimised multi-modal corridors.

4.2 Current Situation

4.2.1 Interoperability & Varying Standards

Existing long distance rail infrastructure on the east coast has limited interoperability, with some routes and infrastructure unable to accept the full range of locomotives and rolling stock. Lack of interoperability also hinders options for regional passenger and freight services. Three different gauges are engineered barriers for full access to a national network:

- Narrow 1067 mm (Qld/SA/WA/Tas).
- Standard 1435 mm (NSW, Vic (part) & interstate network).
- Broad 1600 mm (Vic & SA).

There are also significant barriers to national interoperability through variable track capacities and standards, structure clearances, signalling & safeworking systems, communications protocols & operating practices. All of these are legacies from state-focused rail networks. Upgrading and standardising all of Australia's rail infrastructure is not feasible or necessary but needs to be continued on key corridors and routes. However, a National Concepts of Rail Operations (NCRO) can improve line haul integration between rail and other modes. Linking regions via key interchanges is also needed to allow multi-modal "hubs and spokes" for improved transport system productivity.

4.3 Track Standards

- **Speed:** In New South Wales, Queensland and Victoria maximum design speeds are specified up to 160km/h although track design/track geometry rarely supports this, despite the ability of some passenger rolling stock to operate at higher speeds. Our definitions of track speeds make us inconsistent with the International Union of Railways (UIC) definition of High Speed Rail (HSR) which operates at speeds of 250km/h or higher. This language is potentially confusing and ultimately affects our ability to adopt international best practices and the delivery of efficient rail transport solutions where needed.

- **Total Axle loadings (TAL):** Our rail networks have a wide range of minimum axle loading capacities depending on track quality and purpose. They range from 15.75TAL (Qld), 16TAL (WA) 19TAL (NSW), 20TAL (Vic), 21TAL (Direct Interstate Rail Network - DIRN) and up to 32.5TAL on heavy haul networks for bulk commodities. Queensland coal lines are 22TAL and ARTC is future proofing Inland Rail for 30TAL. Such variety in technical capabilities constrains the ability of rail transport to offer more integrated end to end services on key corridors, freight supply chains and other areas of strategic need.
- **Horizontal Alignment:** A legacy of Australia's rail networks (as with all legacy networks) are the early trade-offs made between horizontal alignment elements (tight curves) and train speeds to save on construction costs. Over time, road systems have sought engineering solutions to ease curves and increase speeds. However, parts of the interstate network have curves as low as 400m radius, which slow journey times for trains between Australia's largest cities and require skilled driving to brake and accelerate through each short radius curve. It wastes fuel and increases wear and tear on trains and tracks which increases operating and maintenance costs. Track realignment and curve easing can address this, along with innovative rolling stock allowing higher speeds on curved track such as tilt train technology (introduced from the 1990s in Queensland).
- **Vertical Alignment:** Typical maximum grades around Australia are 3 per cent for electrified networks and 2 per cent for non-electrified. An absence of a cohesive approach to the dynamic interaction between horizontal and vertical alignments constrains the ability for trains to operate efficiently from end-to-end across local and national networks.
- **Clearances:** Double-stacking containers is becoming an accepted practice to maximise the efficiency of freight trains. This is currently only possible on the Parkes-Perth and Adelaide-Perth corridor. Significant works on the new Inland Rail route are being undertaken to allow double-stacked trains between Melbourne and Brisbane. A significant challenge is to determine the level to which the network can be future proofed to meet current trends in the global shipping markets such as the dominant market share of 40' containers compared to traditional 20' containers, or 'high cube' containers which are now 350mm higher than previous containers. This is particularly important on the East Coast network where legacy tunnels and narrow track centres constrain efficient train operations to become 'bottlenecks' across the national rail network.

Railways perform very well in relatively narrow corridors and have long asset lives. Outdated infrastructure on legacy rail networks are difficult to improve. Legacy corridors usually require “surgical” approaches to re-engineering through deviations, curve or grade easings, ‘daylighting’ of tunnels and bypasses. When change is needed, many things are affected over wide areas. This can be complex, difficult and expensive. Greater national vision is needed to select and commit to options which maximise long term opportunities for corridor interoperability.

4.4 Signalling, communications and safeworking

Australian rail infrastructure managers are introducing next generation signalling & safe working systems. A range of differing standards are being deployed:

- European Train Control System (ETCS) – TfNSW & QR Citytrain.
- Communications Based Train Control (CBTC) – Sydney Metro, Metro Tunnel (Melbourne) & TransPerth.
- Electronic Block Authority (EBA) - ARTC DIRN.
- Computer-based Train Order Working – NSW regional network (ARTC & UGL).
- Electronic Train Order Working (V/Line).
- Direct Train Control (QR regional branchlines).

New systems will work alongside existing signalling and safe working systems, however, managing interfaces at network boundaries will be critical; or we risk a new 'digital break of gauge'. Interoperability challenges arise with a potential need to fit multiple sets of equipment to locomotives and railcar fleets crossing network boundaries. The lack of digital uniformity also affects train crewing.

Train radio systems and protocols are improving. Standard protocols are being applied to interstate line-haul routes under ARTC. However, lack of consistency remains (especially with Train Orders & 'warm transfers' of trains across network interfaces), despite the progressive movement from analogue to digital communications. A National Concept of Rail Operations can help avoid operational and safety challenges which require train crews to be trained and accredited in multiple systems.

4.5 Operational practices

Under the Rail Safety National Law (RSNL) each operator is obliged to determine the risks and mitigations needed to be safe, So Far As Is Reasonably Practicable (SFAIRP). To help achieve some degree of harmony, the Rail Industry Safety Standards Board (RISSB) was established by government and the rail industry to develop standards, share experiences and practices. The underlying challenge to interoperability is the unique risk profile of each operator. Australia has only a 'best endeavours' approach to adopting standards, technologies or practices to interface between operators and jurisdictions.

4.6 Adequate 'Last Mile' solutions

Railways work best when they can carry large numbers of people and freight. To compete with the flexibility of the motor vehicles in dispersed cities and regions, we need additional scalable 'last mile' solutions which offer greater convenience, ease of use and comfort. Where good last mile connectivity exists, such as effective local bus or tram interchanges for passengers and rapid intermodal transfers for freight, rail systems are attractive and effective. A significant, yet relatively easy improvement would be greater integration of local bus interchanges. Such initiatives are now included in new or upgraded system solutions, however, there is great disparity in the quality and performance of the last mile across the nation.

5. Future factors for success – a five pillar strategy

Good policy and engineering begins with imagination and is underpinned by sound principles. There is much to do to evolve land-based transport networks into a rail-centred network for faster, more reliable journeys. A coordinated national strategy is needed to:

- Align road & rail corridors in the same environmental envelope, such as along the Hume highway between Sydney to Melbourne;
- Improve track standards to straighten, flatten and electrify the rail system; and
- Develop a hub and spoke style network to deliver a truly integrated, intermodal land transport network.

Greater focus is needed on human centred systems and values. For example, people may travel less, but seek to travel more sustainably when they do. We need to consider how to:

- Develop strategies for new rail services which can compete with aviation on interstate business and leisure trips; and
- Bring people together using fewer resources.

A set of National strategic transport objectives is recommended to help transform the transport mix. The five strategic pillars proposed below are design to support effective transport and mobility:

Future Railway Strategy				
Mobility Scenarios and Goals	Integrated land use and Mobility Planning	National Concept of Operations	Sustainability - Low Carbon Future	Internationally Competitive Industry

5.1 Mobility scenarios and goals

Good global practice demonstrates benefits from looking at transport as an integral part of city, state and national activity. An overarching strategy for how our cities, freight and national mobility services operate is essential. Ambitious goals for transport effectiveness defined by specific measurements will lead to better mobility, social, environmental, and economic outcomes

Measures of effectiveness should be split by freight and passenger market segments. Metrics would include goals for distances covered in time, levels of safety, resource consumption and access. These could be tailored into national standards to help create policy settings for equitable allocation of resources and funding.

A nationally co-ordinated, transport plan based on scenario modelling is needed to establish the investment and policy settings required to deliver a meaningful shift and growth in the mode share and to evaluate future transport system designs for:

- Urban mass transit systems at nominal levels of 20 per cent, 30 per cent and 50 per cent of all motorized trips;
- Non-bulk interstate and interregional freight at nominal levels of 20 per cent, 30 per cent and 50 per cent of all motorized trips; and
- Heavy and dangerous goods haulage mode shift from road to rail.

Such a plan needs to identify the available and foreseeable technology options together with land use, transport policy and market pricing structures which can underpin the choices and outcomes over more extended time frames of 30-50 years – with an eye on a 100-year horizon.

National journey standards for distances able to be covered in one hour, two hours or three hours are needed to help provide planning goals for land use and transport in urban and regional systems. Some jurisdictions are already using such measures, but a national system which aligns the goals for transport effectiveness would improve investment planning scenarios.

5.2 Integrated land use and mobility planning

The mobility goals set in a national transport plan could be linked with state-based implementation pathways that explicitly links transport system and land use planning. This is required to deliver the required interchanges, corridors and densification of land use.

The integration between large-scale railways and small-scale transport lends itself to hub and spoke networks. Rail, Road and Airport integration needs to be enhanced to densify travel catchments for major cities and regional centres whilst offering smooth interchanges with greater amenity and travelling convenience.

Integrated road and rail corridors will deliver straighter, faster journeys, and accommodate other infrastructure such as communication systems, pipelines and energy transmission networks. Efficiency could be gained by extending the scope of protected rail corridors for future regional evolution or urban development. The backbones for intelligent intermodal and autonomous transport, links to critical energy infrastructure, vehicle battery charging along with customer and emergency services information could be combined to deliver national productivity improvements.

For passengers, densification of population areas is needed with effective interchanges such as at stations which:

- Deliver frequent feeder bus and tram services to extend rail's catchment area beyond walking distance which will optimise journeys and minimise 'interchange penalties'.
- Provide safe and convenient access to active transport infrastructure to improve walking and cycling opportunities.
- Provide attractive levels of comfort, accessibility and convenience, not just functionality in both vehicles and infrastructure.

For freight and the logistics value chains, the task of converting contestable freight traffic to rail again needs land use planning and transport system planning to be closely coordinated to provide:

- More 'Last Mile' connections, with sidings or short spurs off mainlines for direct rail access to major freight generators such as factories, processing plants, distribution centres and wholesale markets.
- Intermodal logistics parks / inland ports where major traffic generators are co-located with rail terminals to integrate linehaul rail with 'last mile' trucking.
- Standards of reliability and service performance for end-to-end freight journey costs and timings which are competitive with road and shipping alternatives.

5.3 National Concept of Rail Operations (NCRO)

A national plan to accelerate rail harmonization for interoperability and integration is critical to gaining the most from the current wave of infrastructure investment and guiding future investment.

To achieve this, a national concept of rail operations (NCRO) is recommended to enable an over-arching strategic policy which guides the operation of rail networks across Australia. An NCRO will help governments, regulators, the rail industry and communities by providing the policy depth needed to meet and harmonise mobility, social, economic and environmental goals. An NCRO needs to:

- Work towards rail industry interoperability across the whole of Australia.
- Enable rail transport to become sufficiently effective for households and businesses to select rail as a mode of choice and access the low carbon economy.
- Shape investment in rail infrastructure to meet mode share targets and customer needs for safety, reliability, punctuality and levels of service.
- Enable confidence in rail operators to invest in new locomotives and rolling stock and to train their future workforce.

- Define the factors required for successful green or brownfields rail corridors and protect these corridors through planning from encroachment or alternative appropriation.
- Be legally binding and enabled with supporting authority and leadership structures.

The NCRO would provide the national set of standards for the rail systems that Australia needs. Building on the current national standards, first adopted 25 years ago at the Australian Transport Council's 1997 Rail Summit, Australia could adopt the 'conventional' rail standards set by the International Union of Railways (UIC, generally applicable for speeds up to 200km/h. Future improvements could articulate toward dedicated HSR infrastructure and rolling stock for trains operating at speeds above 250km/h. Alternatively, Australia could establish its own standards, however this would be regressive, in much the same way that the original situation of differing colonial and state-based standards has led to the current situation.

The European interoperability vision, released in 2002 supports the "Technical Specifications for Interoperability" standard for technical designs, encompass all aspects of rail operation from infrastructure to rolling stock. Successful interoperability requires:

- Legally bound and agreed rules for operations between two destinations.
- Consistent railway infrastructure and rolling stock standards.
- Consistent operating practices and procedures.

5.4 Stability in a low carbon future

Railways offer immense potential to lower the carbon footprint of transport. Transport decarbonization goals need to expand to embrace rail within a land transport system that lowers carbon emissions and attracts users by improved ease of use, comfort, convenience and cost.

The concept of the railway, as the backbone of the transport system corridors, could enable greater electrification and the use of green energy. Green hydrogen-powered locomotives could be part of the solution for net zero line-haul freight services.

5.5 Internationally competitive industry

Australia is already investing heavily in rail infrastructure, with procurement of systems and technologies from abroad already a challenge.

State-based local content strategies have succeeded in retaining meaningful advanced manufacturing capabilities in production and maintenance. This needs to be more nationally coordinated and consistent. Our current and future demand for investment in rail infrastructure is an opportunity for local development of competitive products and services and a skills base in advanced manufacturing disciplines.

Australia needs a rail industry policy which can attract or create internationally competitive transport manufacturing and technology firms in the global railway supply chain. Even with good products and services, the opportunity to compete internationally will need greater access to markets through collaborative instruments such as free trade agreements.

Australia needs to develop centres of excellence for the advanced manufacturing of products and services in a high-cost environment. Our history and experience of rapid adoption and application is an opportunity to develop an incubator for rail services where we can:

- Create export-oriented businesses.
- Demonstrate technology leadership and sovereign capability.
- Access global markets.
- Offer Trade and Investment incentives.

Australia has a strong history of leadership and innovation. We have achieved export success in many engineering disciplines and have attracted significant global investment and ownership in our heavy engineering construction sector. However, through macroeconomic reform of the rail sector and fragmentation of the rail industry over the last 40 years, Australia has reduced the capacity of our industrial base in rail systems and technology.

Our engineering is focused on local application of internationally proven systems and local manufacturing is largely constrained to fabrication and assembly of internationally designed equipment. Except for high volume heavy haul of coal and iron ore, Australia has not found a category of excellence and leadership in rail systems and operational design to take to the global marketplace that is sustainable in the long term.

The new scale and timeframes of Australia's rail investment profile means our industry deserves a better coordinated focus to leverage this opportunity and to develop commercially competitive engineering and technology ventures.

5.6 A National Rail Testing Facility (NRTF)

Development of a national rail test facility (NRTF) is recommended, like those in the US and UK. This facility would undertake static and dynamic testing to investigate, research and evaluate concepts, components and integration of systems to evaluate performance, develop nationally consistent type approvals and reduce the time-to-market cycle in an Australian environment. If the NRTF is linked with TAFE and university partners, it would also help address the growing needs for skills development, maintenance and retention in the rail workforce and reduce the shortfall in engineers, scientists and other skilled workers needed to deliver the infrastructure pipeline⁸.

⁸ Infrastructure Australia (2021) Infrastructure Market Capacity report

6. Future of Rail: Recommendations

A coordinated, national approach to operational concepts and the adoption of standards for interoperability are imperative to achieving high performance outcomes. An intelligent strategy for industry development is needed to capitalise on current investments in rail. We need to create a national base of advanced rail manufacturing which can innovate and compete in the global rail supply chain. This will enable the development of skills and economic growth through engineering exports and technology transfer. Work is needed in the areas of standards, operational procedures and technologies through support for the National Rail Action Plan.

The current delivery of projects and future pipeline, represents the highest levels of investment in rail in generations. This is bearing fruit in areas such as Sydney's passenger rail task. However, rail is more generally standing still in terms of passenger and freight mode share.

Rail can be the spine of a more effective transport system. It is more efficient in its use of land, time and energy resources than any other mode land based transport. Great use of rail can deliver better reliability, greater capacity, a much lower carbon footprint and enhanced safety and wellbeing. Our national economic, social and environmental outcomes can be enhanced if we shift to rail as the backbone of an integrated land transport system for all Australians.

The five recommendations below aim to help railways become the transport mode of choice for high-capacity passenger and freight tasks underpinning a more effective transport system that Australia needs. Action on these recommendations should be coordinated across governments, in consultation with industry, by the National Cabinet's Infrastructure and Transport Minister Meetings forum.

- **Recommendation 1:** Develop a land-based transport strategy, positioning rail as the high-capacity spine of the national network with clear goals for mode-shares and minimum service standards (speed, reliability, safety, air-pollution and carbon emissions) for market segments, corridors and regions.
- **Recommendation 2:** State and territory governments should develop land use and transport system plans that identify necessary rail corridors, hubs, spokes and densification zones. These plans should be developed in concert with the land transport strategy and in consultation with infrastructure owners and providers and adjoining jurisdictions to ensure national cohesion.
- **Recommendation 3:** Work already underway on the National Rail Action Plan is accelerated and evolved to develop a National Rail Concept of Operations encompassing uniform operating and technical standards.
- **Recommendation 4:** An industry and innovation policy for rail and the broader transport industry is developed to create centres of excellence for advanced manufacturing of rail and transport industry products and services, feeding into national and international infrastructure supply chains.
- **Recommendation 5:** The Australian Government, in conjunction with the rail industry, create a National Rail Test Facility. This would investigate, research and test concepts, systems and components to enhance Australia's engineering and manufacturing capacity, affirm performance and type approvals to reduce time-to-market cycles. The Facility should be linked with TAFE and Universities to augment training and skills provision.



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