TULIPWOOD ECONOMICS
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Final Destination

Transport and national productivity report

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Disclaimer

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At the heart of all modern economic activity is trade. People trade labour and ideas for cash, and cash for goods and services; firms trade technology, expertise, financial capacity, intermediate goods, administrative functions, and many other things with each other, with individuals, and with governments. All these transactions require communications and most require transportation of goods or people – to work, shopping, tourist sites, meeting locations. Thus, it is fair to say that transportation is central to economic activity.

Keneth A. Small et al in The Economics of Urban Transportation 2007

Table of contents

Abbreviations and terms

ABS	Australian Bureau of Statistics
ABS	Anti-lock Braking System
AGV	Automated Guided Vehicle
AMR	Autonomous Mobile Robot
ANZSIC	Australia and New Zealand Standard Industrial Classification
API	Application Programming Interface
ARTC	Australian Rail Track Corporation
ASN	Advance Ship Notice
AS/RS	Automated Storage & Retrieval System
ATAP	Australian Transport Assessment and Planning guidelines
ATO	Australian Taxation Office
ATO	Automatic Train Operation
ATSA	Australian Transport Satellite Account
AV	Autonomous Vehicle
BAU	Business as Usual
BIFT	Beveridge Interstate Freight Terminal
BLADE	Business Longitudinal Analysis Data Environment (dataset)
Bpkm	Billion passenger kilometres
BRT	Bus Rapid Transit
Btkm	Billion tonne kilometres
CBTC	Communications Based Train Control
CGE	Computable General Equilibrium (economic model)
CPI	Consumer Price Index
CRC	Cooperative Research Centre

DC	Distribution Centre
DWL	Deadweight Loss
EDI	Electronic Data Interchange
EGWWS	Electricity, Gas, Water, Waste Services
EMTR	Effective Marginal Tax Rate
EPC	Electronic Product Code
ERP	Enterprise Resource Planning
ETA	Estimated Time of Arrival
ETCS	European Train Control System
ETD	Estimated Time of Departure
FTE	Full-time Equivalent (employment)
GBE	Government Business Enterprise
GDP	Gross Domestic Product
GNI	Gross National Income
GNSS	Global Navigation Satellite Systems
GOC	Government Owned Corporation
GPS	Global Positioning System
GS1	Global standards body for barcodes
GSMA	Greater Sydney Metropolitan Area
GST	Goods and Services Tax
GVM	Gross Vehicle Mass
HPFV	High Productivity Freight Vehicle
HVNL	Heavy Vehicle National Law
ICT	Information Communications Technology
IEA	International Energy Agency

IMH	Inter-modal Hub
IoT	Internet of Things
ITF	International Transport Federation
JIT	Just-in-time (delivery)
KFR	Key Freight Route
MaaS	Mobility as a Service
MEB	Marginal Excess Burden
MHE	Material Handling Equipment
MNE	Multinational Enterprise
MRP	Material Requirements Planning
MSC	Marginal Social Cost
Mtkm	Million track kilometres
NACFE	North American Council for Freight Efficiency
NCP	National Competition Policy
NFSCS	National Freight and Supply Chain Strategy
OBU	Onboard Unit
OECD	Organisation for Economic Cooperation and Development
OMS	Order Management System
ONRSR	Office of the National Rail Safety Regulator
PBO	Parliamentary Budget Office
PIT	Personal Income Tax
PoD	Proof of Delivery
PP	Percentage Point
PPI	Producer Price Index
PPP	Public-Private Partnership

PT	Public Transport
QGEM	Qaive General Equilibrium Model
RBA	Reserve Bank of Australia
RCF	Reference Class Forecasting
RFID	Radio-Frequency Identification
RSNL	Rail Safety National Law
RTLS	Real-Time Location System
SAF	Sustainable Aviation Fuel
SEQ	South-East Queensland
SME	Small-Medium Enterprise (defined as turnover <$50m)
SOC	State Owned Corporation
SOGR	State of Good Repair
SRL	Suburban Rail Loop
SUV	Suburban Utility Vehicle
TAFE	Technical and Further Education
TMS	Transportation Management System
UOW	University of Wollongong
UPT	Urban Public Transport
VAGO	Victorian Auditor General’s Office
VRU	Vulnerable Road User
WIFT	Western Interstate Freight Terminal (Truganina)
WMS	Warehouse Management System

Part 1 Overview

In this first part of the report, we provide an overview of our study, including:

- A Key Points Box.
- An Executive Summary (Section 1).
- An overview of the evolution of Australia's Transport sector between 1970 and 2025 (Section 2).
- An analysis of the Transport sector's economic footprint (Section 3).
- A review and analysis of productivity trends in the sector (Section 4).

Key Points

The Australian transport sector is very large…

- The Australian Transport sector in the National Accounts generates 4½% of GDP and employs 726,000 workers, mostly in road transport. On broader measures that include 'in-house' transport services, such as delivery services within the Construction, Wholesale, Retail and Mining sectors, the transport sector accounts for up to 10% of GDP and employs 1.3 million workers.

- In 2024-25, the freight industry moved 253 billion tonne km by road (+82% since 2000-01) and 447 billion tonne kilometres (btkm) by rail (+225%).

- In 2024-25, the passenger network moved 280 billion passenger km by car (+18% since 2000-01) and 16 billion passenger kilometres (bpkm) by rail (+34%), while bus use had increased only modestly to 20 bpkm (+8%).

…but productivity performance has been weak for more than a decade

- For more than a decade, the sector has been trapped in a productivity paradox: despite record public investment in roads, rail lines, ports and public transport, productivity levels are barely above levels of a decade ago. From 2012-13 to 2024-25 annual growth in Transport sector labour productivity averaged a mere 0.4% while multifactor productivity actually fell by 0.4% per year on average.

- Traffic congestion on heavily used capital city routes, while largely unchanged since 2019 (as a result of the Covid-era (2020-2022) reduction in transport demand), adversely impacts both freight productivity and household welfare.

Structural, governance and regulatory weaknesses prevent sector-wide improvements

- Persistent structural and governance flaws prevent sustained sector-wide productivity growth and improved economic welfare for households:

    - Megaprojects dominate the $52 billion (in 2024-25) annual transport infrastructure pipeline, virtually guaranteeing the delivery of significant cost overruns and benefit shortfalls — a result of optimism bias, poor governance and loose fiscal policy — as well as crowding out smaller, higher-return projects.

    - Road use revenues, raised mainly via annual registration fees and fuel excise, although roughly matching total recurrent road expenditure, fail to sufficiently address road damage and congestion costs, adding deadweight costs to the economy. Meanwhile, declining fuel excise revenues with the rise of EVs steadily undermines the current system of cost recovery.

The 'size of the prize' is significant

- The economic dividends of restoring productivity growth in the transport sector are significant. **Increasing the sector's multifactor productivity to its 2012-13 level (which is**

13% higher than current productivity), would see GDP $14.6 billion higher in 2040 and be worth $86.2 billion (in NPV terms) over the period to 2039-40.

Four key levers to boost sector-wide productivity

- There are four key levers to address the productivity malaise:
  - **Public investment** needs to rebalance the national transport infrastructure pipeline toward smaller, staged, high-BCR upgrades — debottlenecking, shoulders and overtaking lanes, bridge strengthening, flood immunity, intermodal terminals and linkages, level crossing elimination, telematics and digital integration. The hurdle to approve megaprojects needs to be raised to offset optimism bias. Better public investment choices in transport infrastructure could potentially raise GDP by **$6.7 billion in net present value terms to 2039-40.**
  - **Road pricing reform** is needed to extract greater capacity and efficiency from the existing transport network and guide future investment. We need to:
    - continue to move to more cost-reflective and stable mass*distance user charges for heavy freight without inefficiently adding to overall system complexity,
    - introduce distance-based road user charging for EVs and rebalance fixed (i.e. registration) and variable (i.e. fuel excise) charges for all passenger vehicles to better reflect costs,
    - revisit estimating the costs of economically unjustified congestion and trial congestion pricing on a handful of very congested routes where there are potentially net benefits, and
    - apply more cost-reflective public transport fares to improve cost recovery and network frequency and quality.
  - Selective road congestion pricing, which would improve freight productivity and also benefit households, could potentially raise **GDP by $11.9 billion in net present value terms to 2039-40**. A broader suite of road pricing reforms would likely have an even larger positive impact on GDP.
  - **Improved regulatory flexibility and responsiveness** is required to support the uptake of larger, higher productivity heavy road freight vehicles. A more responsive and flexible regulatory environment that accelerated the uptake of new innovations and technologies and lowered costs could potentially **raise GDP by $11.5 billion in NPV terms to 2039-40**.
  - Finally, the productivity impact from the uptake of **heavy freight autonomous vehicles (AV)** could potentially **increase GDP by $78.3 billion in NPV terms** over the 2039-40 to 2069-70 period. However, much work needs to be done to establish the regulatory framework to enable the transition to heavy freight AVs.

1 Executive Summary

1.1 Introduction and background

1.1.1 Purpose of this analysis

The iMOVE Cooperative Research Centre has commissioned Tulipwood Economics to review the Australian Transport sector and provide recommendations for its improvement. We sought to identify the economic dimensions of the sector and to examine its productivity performance over time. Going further, we explored the factors that have affected the rate of productivity growth that has been achieved over different productivity cycles since the mid-1990s. From these factors we can see opportunities to return Transport sector productivity to its 2012-13 level through the implementation of judicious policy and regulatory changes.

Our report builds on recent Commonwealth, State, and international reviews, which refer to ongoing endeavours to:

- improve public infrastructure investment project selection and prioritisation,
- manage congestion and cost recovery through better road user charging systems,
- develop more flexible and responsive regulation to meet the challenge and opportunity of autonomous vehicles,
- build greater resilience against costly natural disasters, and
- prepare for a decarbonised industrial structure.

Our analysis endorses these aspirations.

1.1.2 Background

Australia's Transport sector is central to enabling productivity growth and rising living standards, shaping how people access jobs, education and health services, and their communities. The efficiency of the Transport sector determines how effectively goods flow from ports and distribution centres across cities, regions, and to export markets. Accounting for between 4–5 per cent of GDP in the National Accounts since the 1980s (and closer to 8–10 per cent on broader measures that account for 'in-house' industry transport), the sector underpins domestic supply chains, resources exports and everyday mobility.[1]

The Transport sector experienced strong productivity growth from the mid-1990s to the end of the 2000s — multifactor productivity (MFP) growth averaged 1.6 per cent per year between

[1] 'In-house' transport refers to transport services undertaken within an industry, such as Construction (moving building material) or Mining (moving iron ore to rail lines) or retail trade. See ABS Australian Transport Economic Account: An Experimental Transport Satellite Account, here: https://www.abs.gov.au/statistics/economy/national-accounts/australian-transport-economic-account-experimental-transport-satellite-account/latest-release

1994-95 and 2012-13 — as a result of a multitude of cost lowering innovations including the uptake of larger heavy road freight vehicles, ICT innovations in freight forwarding and warehousing that significantly reduced network coordination costs, economic reform of formerly publicly-owned rail freight networks, capital investment in key freight bottlenecks and intermodal hubs in our capital cities, and safety reforms.[2]

Technological progress and service innovations have continued for both freight and passenger transport since the 2012-13 productivity cycle peak with improved and lower cost EV batteries, driver assistance technology, end-to-end IoT freight tracking, advanced braking systems to reduce headway between passenger trains, advances in low carbon liquid fuels (LCLFs), a significant expansion of commercial passenger services (e.g. Uber, DiDi etc), distribution centre (DC) and container terminal automation, and a massive expansion in home grocery and parcel delivery services during and post-Covid-19.[3]

However, despite continued technological progress and service innovation, and rising annual public investment in real terms in the transport network since 2012-13, measured productivity growth has stalled. Whilst annual Transport sector labour productivity growth has increased in the intervening period (to 2024-25) by a mere 0.4 per cent per year, Transport sector multifactor productivity (MFP) has declined by 0.4 per cent per year on average between its peak in 2012-13 and 2024-25.[4] This indicates that the recent growth in labour productivity has been driven by capital deepening. We show in this study that this capital deepening has been expensive in the sense that it has yielded low returns to economic welfare.

Australia's Transport sector is not without its strengths and four in particular stand out.

- First, building the network to accommodate an eightfold expansion in Australia's domestic freight task since 1970 has been extraordinary. A key factor here has been the steep growth of bulk resources and commodities exports (largely transported by rail) through the mining boom period from the mid-2000's to the mid-2010s. Today, our major resources exports of iron ore, thermal and metallurgical coal, LNG, gold, beef and wheat are moved along highly efficient and internationally competitive export supply chains.[5]

- Second, meeting the growth in the urban freight task has been equally impressive. Australia's metropolitan road freight task increased sixfold over the five decades between 1974-75 and 2024-25, from 9.3 btkm to 56.7 btkm. Brisbane's growth (at

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[2] ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 1: Gross Value Added based Multifactor Productivity Indexes.

[3] In this report, we define the Covid-19 'era' as 2020-21, 2021-22 and, to a lesser extent, 2022-23. The Human Biosecurity Emergency Declaration under the Biosecurity Act (2015) lapsed on 11 April 2022, signalling the beginning of the end of the pandemic emergency response. On 20 October 2023, the Australian Government declared that COVID-19 was no longer a Communicable Disease Incident of National Significance. See here: https://www.pmc.gov.au/resources/covid-19-response-inquiry-summary-report-lessons-next-crisis/introduction?utm_source=chatgpt.com

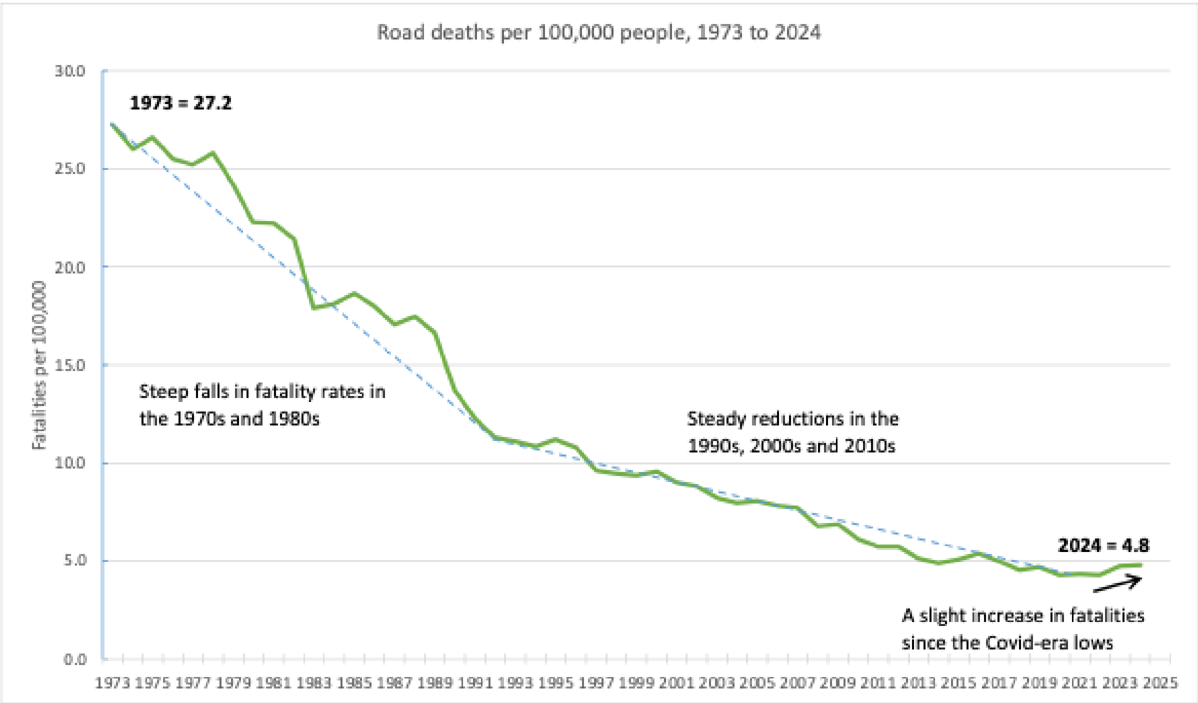
[4] ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 1: Gross Value Added based Multifactor Productivity Indexes.

[5] DFAT (2025). Accessed here: https://www.dfat.gov.au/sites/default/files/australias-goods-services-by-top-25-exports-2023-24.pdf

12.7 times) over the five-decade period, double the national growth rate, has been remarkable.

- Third, the improvement in Transport sector safety, especially with regards to roads, has been equally extraordinary. While fatalities have declined across all transport modes, the greatest improvement has been in road transport where fatalities declined from 27 per 100,000 people in 1972 to fewer than 5 per 100,000 people in 2024 (Figure 1-1).
    - And accounting for distance travelled, the road fatality rate per billion passenger kilometres travelled (bkmt) declined from a peak of 21.9 per bpkmt in 1978 to 3.23 per bpkmt in 2018 before rising again to be 3.71 per bpkmt in 2024.
- These impressive improvements in road safety have come without significant reductions in speed limits and, in some cases, increases in speed limits (e.g. from 60km/h to 70/80km/h and 100km/h to 110km/h) on some parts of some local and state roads, and national highways.

Figure 1-1 Road deaths since the early 1970s, per 100,000 population



Sources: BITRE Australian Infrastructure and Transport Statistics Yearbook 2025. Chapter 8: Transport Safety.

- Fourth, efforts to harmonise laws, regulations, licensing and codes across the Federation have, for the most part, improved freight sector efficiency and safety. For example, in the 2010s there was a move towards greater regulatory harmonisation and 'cooperative federalism'.[6]

- The Heavy Vehicle National Law (HVNL) was introduced in 2012 (and commenced 2014), which created the NHVR and a single set of regulations for heavy vehicles >4.5t in relation to fatigue, mass/dimension/loading, access permits, and Performance Based Standards (PBS).[7]

- The Rail Safety National Law (RSNL) introduced in 2012 (and rolled out over 2013–2017): established the Office of the National Rail Safety Regulator (ONRSR) and a risk-based national framework for rail accreditation and safety management to provide more consistent oversight and reporting in terms of accidents, serious faults, drug/alcohol use and fatigue.

1.2 What's not working

1.2.1 Poor long-term productivity growth

Productivity growth in the Transport sector bounced back following the Covid-19 shock, growing by 3.1 per cent in 2024-25, following a decade of poor performance. Taking a longer term perspective:

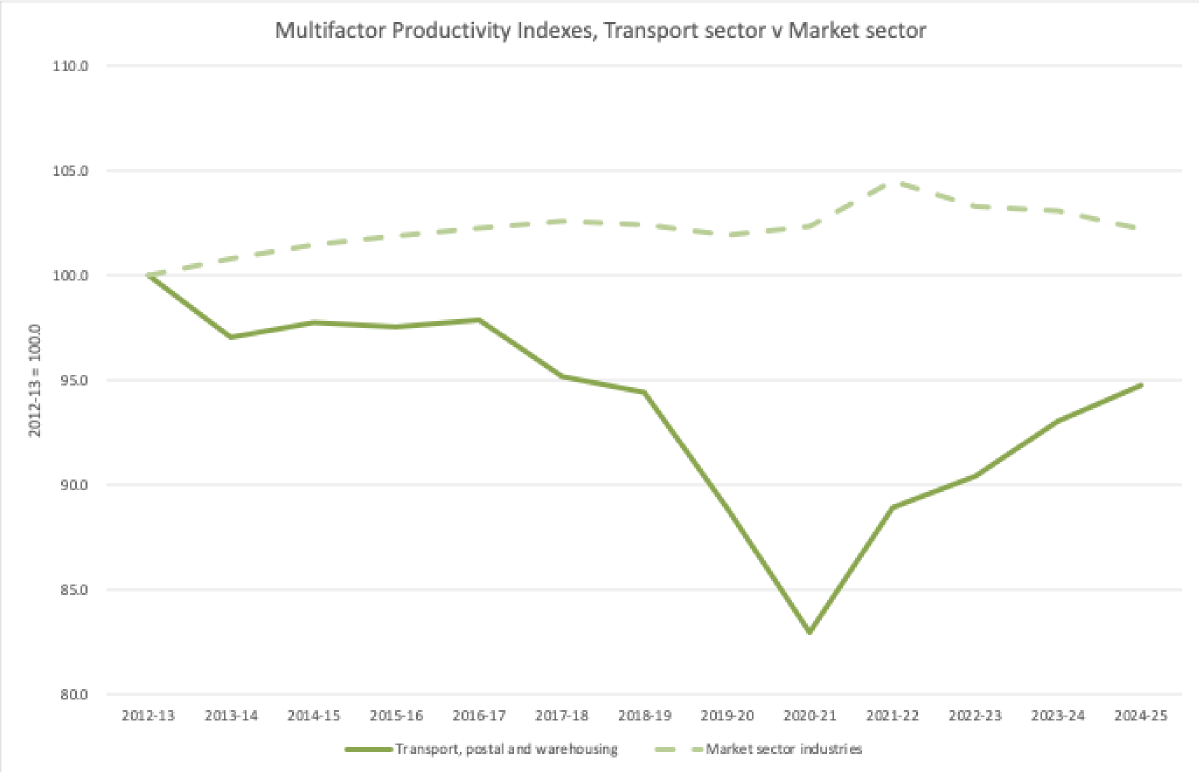
- Transport sector labour productivity (in terms of Gross Value Added per hour worked) grew by 2.9 per cent a year between 1993-94 and 2011-12 compared to a much lower 0.4 per cent per year growth rate between 2012-13 and 2024-25.[8]

- In the decade between 2012–13 to 2022–23, before a bounce-back in 2023-24 and 2024-25, the Transport sector recorded declines in labour productivity (-6.4 per cent), capital productivity (-14.4 per cent) and multifactor productivity (-9.5 per cent).[9]

- Figure 1-2 (below) shows the decline in Transport sector MFP compared to the increase in market sector productivity over the period 2012-13 to 2024-25. The collapse and subsequent bounce-back in Transport sector MFP levels was largely due to the Covid-era restrictions in 2020-21. That said, 'looking through' the Covid effect, the level of Transport sector MFP is well below that in the whole market sector when comparing 2024-25 to 2012-13.

[6] We should note that some harmonisation can be costly, such as a 'race to the top' or 'race to the bottom' rather than a considered move towards standards that improve on the average of the previously diverse standards across states and territories. Uniformity for the sake of uniformity is not a strong argument to change regulatory settings.
[7] PBS is run by the NHVR and lets operators use non-standard, higher-productivity combinations—like A-doubles, B-triples, Super B-doubles, quad-axle truck-and-dog—so long as the vehicle meets measured performance tests (stability, braking, swept path, road wear) instead of using a prescriptive length/axle rules style governance framework.
[8] ABS 5204.0 Australian System of National Accounts Table 15. Labour Productivity and Input, Hours worked and Gross Value Added (GVA) per hour worked - by Industry.
[9] ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Tables 6, 7 and 1.

Figure 1-2 Multifactor productivity, Transport v Market sector (2012-13 to 2024-25)



Source: ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 1.

1.2.2 Public investment and project selection has been poor

Australia's transport investment pipeline has become characterised by taxpayer-funded megaprojects that have delivered less value than promised and have suffered massive cost overruns. Several of these megaprojects did not pass, or barely passed, respectable BCAs even before the subsequent cost blowouts and scaling back of projected benefits. Two rail megaproject examples are:

- Cross River Rail in Brisbane was envisaged, costed and commenced in 2017. Whereas the initial project costing by Building Queensland was $5.4 billion[10], the most recent costing was close to $20 billion.[11] Projected benefits in terms of travel demand, even with near-zero PT fares, have been scaled back as a result of the reduction in CBD travel demand due to the post-Covid structural shift to more working and studying from home.

- The Melbourne to Brisbane Inland Rail was also originally envisaged, costed and commenced in the lates 2010s. Initial project costings were less than $5 billion, whereas the 2023 independent review re-estimated the total cost of the project at between $31 to $33 billion.[12] On the benefits side of the equation, given the efficiency

[10] See here: https://cabinet.qld.gov.au/documents/2017/Aug/CRRBusCase/Attachments/BusinessCase.pdf
[11] See here: https://statements.qld.gov.au/statements/103713
[12] See here: https://www.infrastructure.gov.au/department/media/publications/delivery-inland-rail-independent-review

of heavy vehicle freight on the north-south East Coast routes, the benefits of the project are questionable in terms of optimising the movement of imported goods at least cost.[13]

Poor capital investment decisions affect Transport sector productivity and household welfare in a number of ways.

i. Choosing projects that have low BCRs (either in prospect or retrospect) instead of projects with higher BCRs, delivers lower productivity gains, less travel time savings and lower reductions in other costs. Poor project selection can be an insidious process, as the Victorian Auditor General's Office has recently pointed out in relation to Victoria's "Big Build" — revising and re-scoping major infrastructure projects without revisiting business cases and revising cost-benefit analyses leads to the selection of lower value projects than otherwise (VAGO, 2025).

ii. Capital productivity is lower than otherwise. For example, the ABS has estimated a decline in capital productivity of 14.4 per cent in the decade from 2012-13 to 2022-23, indicating that poor investment choices, as well as the current regulatory framework, is negatively impacting the productive use of transport sector capital.

iii. All public expenditure is ultimately funded via taxation, which imposes costs on the Australian community.[14] Therefore excessive or low-value expenditure on public infrastructure imposes a consequent excessive cost on Australian taxpayers because more taxes need to be raised than otherwise to fund transport services.

iv. Government expenditure is also subject to fiscal and borrowing constraints, meaning that spending on one project can preclude or reduce spending on others. It is hard not to conclude that spending on large infrastructure projects has displaced spending on smaller projects with higher BCRs.

v. Project timing has also compounded the problem. Governments have often procured into overheated markets, pushing prices up at a time when labour and materials are already scarce (Branigan, 2016). This problem was evident during the mining boom in 2003-2011) and the Covid-19 era labour and material supply shock (Ergas and Branigan, 2012 and 2020). Further, layered codes and regulatory requirements have raised compliance costs and slowed delivery, and industrial-relations frictions and minimum 'best practice' standards on "Big Build" sites like Cross River Rail in Brisbane have created delays and budget pressure (Branigan, 2024).[15]

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[13] Suggestions to scale back the cost of the Melbourne-Brisbane Inland Rail project include expanding Parkes in Northern NSW into a north-south and east-west intermodal hub, and running lower cost heavy vehicle freight from Parkes into SEQ.

[14] Depending on the type of tax, the deadweight loss of raising $1 in tax revenue is generally estimated at between 20-30 cents. (Murphy, 2000).

[15] In February 2026, the Australian Workers Union and construction firms CPB and Acciona sign-off on a pay deal for the Suburban Rail Loop East project where the average tunnel worker will receive $300,000 per year in salary when overtime and allowances are factored in. The deal includes an additional five 4% pay increases over the life of the agreement. This agreement is likely to establishe a new higher benchmark for pay and conditions for construction workers on Australian megaprojects.

1.2.3 Economically inefficient road congestion imposes productivity and welfare costs

Road congestion remains a significant drag on both freight productivity and economic welfare with estimates placing the annual cost of economically unjustified congestion in 2024-25 at around $25 billion (BITRE 2008 and 2024). The problem of congestion is not easily solved and there are number of factors to consider.

- It is important to note that some congestion is economically justified. Eliminating all congestion via network expansion would be prohibitively costly and leave the vast bulk of the network underutilised most of the time.

- Congestion negatively affects both GDP and social welfare, but these measures of wellbeing are calculated separately and, crucially, the cost to social welfare is not counted in the measurement of the effect on GDP. The effect of congestion on GDP comes predominantly via a corresponding increase in freight costs (i.e. time and fuel costs), whereas the additional cost to social welfare relates to alternate uses that people would prefer to make of the time spent stuck in traffic.[16] This latter effect is not directly measured in GDP, but is nonetheless material in terms of household welfare.

- There is an important difference between economically unjustified congestion (i.e. congestion that could be avoided via better demand management) and unexpected congestion (e.g. traffic accidents that create blocked lanes). Economically unjustified congestion can be addressed via congestion pricing to 'clear' excess demand, more PT services, more high-capacity 'T2' lanes, lifting night-time freight curfews, or a combination of policy and network management tools.

1.2.4 There are notable vulnerabilities in the network

Australia is well-known as a land of "droughts and flooding rains" and our land transport network is, accordingly, vulnerable. Australia is the world's 6th largest country geographically with a relatively small population of 27 million. Although we are highly urbanised, our road and rail networks need to connect our capital cities and regional towns to each other, as well as our major inland export sources to ports and international markets. Despite increased investment, floods, bushfires and extreme weather still sever regional transport links like the heavily utilised Bruce Highway in Queensland. And in cities, legacy constraints such as level crossings, low rail bridge clearances and flood-prone underpasses create weak points that are vulnerable to network disruption.

Recent BITRE work indicates that Australia's transport networks are generally adaptable, but vulnerabilities cluster in specific places (BITRE, 2023).

- On roads, several Northern Territory routes (e.g., Arnhem Highway, Buchanan Highway, Central Arnhem Road, Lasseter Highway) and selected corridors in Western

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[16] The increase in freight costs also detracts from social welfare because it raises prices and, hence, lowers real incomes.

Australia and Queensland exhibit high/very-high vulnerability, with some intersections where up to 100 per cent of freight would be obstructed and detours are extremely costly.

- On rail, the East–West transcontinental line (WA/SA) and critical Queensland/New South Wales lines show high/very-high vulnerability; where no alternate rail path exists, shifting to road is impractical at scale and imposes large additional costs and community impacts.

- In late January 2013, heavy rain and flooding attributed to Cyclone Oswald caused shutdowns of coal exports and closure of parts of the coal-transport rail system in Central Queensland. Operators including rail haulage companies and coal-export terminals had to restrict operations or suspend them — some even invoked force-majeure for coal contracts owing to inability to deliver.

- On the positive side, the Pacific Highway and Hume Highway upgrades over many decades have significantly increased heavy vehicle freight resilience on the east coast freight routes. For example, much of the Ballina bypass section of the Pacific Highway is elevated and designed to operate during heavy flooding at a 1-in-20-year flood rating.[17]

    - The Bruce Highway in Queensland requires similar work to withstand the annual summer storm and cyclone season as well as the ever-growing road freight task. Work has begun (in 2025) with $9 billion in new funding jointly committed by the Commonwealth and Queensland governments to the Bruce Highway Upgrade Program in an 80-20 funding split.[18] It is reassuring that the Program has been conceived not as a megaproject but, rather, a series of smaller incremental upgrades to the most vulnerable parts of the Bruce Highway.[19]

1.3 Sector-wide decarbonisation by 2050 will be challenging

The difficulty for the Transport sector to meet the Net Zero policy objective by 2050 cannot be understated, although much depends on the definition and rules around the 'net' part of 'net zero' in terms of the sector's capacity to (for example) buy international carbon permits to offset remaining difficult to abate emissions.

There are four core problems facing the sector in terms of achieving Net Zero by 2050.

[17] See here: https://geomechanics.org.au/papers/design-and-construction-of-a-resilient-motorway-on-difficult-ground/
[18] Because the Bruce is a Federal Highway, the Commonwealth funds 80 per cent of the upgrade. See the Prime Minister's announcement here: https://www.pm.gov.au/media/7-2-billion-new-funding-australian-government-fix-bruce-highway
[19] Although announced as a megaproject for political reasons, the Bruce Highway upgrade is best viewed as a series of smaller incremental upgrades — project details are provided by the Queensland Department of Transport and Main Roads here: https://www.tmr.qld.gov.au/projects/programs/bruce-highway-upgrade-program

i. Average fleet turnover for passenger vehicles, light trucks and in-service freight vehicles is greater than 10 years — most carbon-based fuel vehicles purchased in the second half of this decade will be around well into next decade and potentially beyond that making it difficult for the Transport sector to achieve the necessary rate of fleet turnover by 2050 (ABS 2021, BITRE 2024, NHVR 2016). Under reasonable assumptions it would likely take three decades for EVs to reach more than 90 per cent of the total stock of passenger vehicles for example.[20]

ii. Moreover, the charging infrastructure required to service an electric vehicle fleet will take decades to roll out (BITRE 2024) and will be particularly slow outside the large cities as the grid supplying rural and regional Australia does not have sufficient capacity to bear the demand for high power loads. This 'chicken and egg' problem dampens the demand for EV sales.

iii. The electrical energy EVs use to charge their batteries is, currently, almost two-thirds supplied by carbon-based fuels; coal and gas.[21] For Net Zero to be achieved, both electricity generation mix and passenger and freight vehicle fleets need to be transformed.

iv. Lastly, the Net Zero policy objective is likely to remain politically contentious in Australia, slowing down or chilling the required investment in the sector to drive the energy transformation within the next 25 years.[22,23]

1.4 Size of the prize

The central paradox of the Australian transport system is that, despite large-scale public investment and decades of reform, productivity performance has stagnated, economically unjustified congestion has intensified in our major capital cities, and the extremities of the land transport network remain vulnerable to extreme weather events.

The technological progress, investment, service innovation and policy reforms of earlier decades delivered improvements in productivity and safety whereas recent large public investments have not. However, with Australia's long-run population growth rate likely to

[20] Assuming for simplicity a 10-year holding rate for vehicles, and a rising EV share of new vehicle sales of 5 percentage points per year from the current level of just under 10%, it would take 32 years to achieve 90% EV penetration. New EV sales would reach 100% in Year-19 but there would still be a stock of carbon-based cars on the road for many years subsequently.

[21] In the NEM for example, carbon-based fuels (brown and black coal, and gas) accounted for 60% of generation fuels over the 12 months from December 2024 to December 2025. See here: https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/data-nem/data-dashboard-nem

[22] In November 2024, the Federal Opposition walked away from the formerly bipartisan commitment to Net Zero by 2050. The Federal Opposition maintains its support for the Paris Agreement to keep global temperatures below 2-3 degrees Celsius above pre-industrial (1850-1900) levels.

[23] The policy is likely to remain contentious because Australia cannot achieve the policy goal of keeping global temperature rises to less than 2-3 degrees Celsius by acting unilaterally. While there is broad global agreement on Net Zero, only five countries today and foreseeably in the future can arguably materially (i.e. to more than a small fraction of one degree Celsius) affect the amount of CO_2-e in the atmosphere — China (34.0% of global emissions in 2023), the United States (12.0%), India (7.6%), the European Union (6.4%) and Russia (5.3%). While the United States and the European Union have reduced emissions this century, the other three countries have dramatically increased their emissions.

remain at between 1.5-2.0 per cent per year, freight volumes further rising in line with population and real income growth, rising expectations around passenger mobility, and increasing frequency and/or severity of extreme weather events, the need for improvements in transport productivity and network resilience has never been greater.[24]

Multiple reviews have covered these issues.

- The Productivity Commission, in its 2017 report Shifting the Dial, recommended road pricing reform, stronger project appraisal, and better integration of land use and transport planning. And in its 2022 productivity inquiry, the Commission again highlighted that road use in Australia remains mispriced, with fuel excise, registration charges, and patchwork tolling sending poor signals that undermines both efficient use of the network and long-term funding.

- In a series of reports (2016, 2019, 2020), the Grattan Institute documented the rise of the "megaproject era", showing that large Australian road and rail projects consistently overrun budgets and underdeliver benefits ultimately pushing BCRs below the minimum 1.0x threshold. Grattan recommended shifting focus to smaller-scale, incremental upgrades, more transparent cost–benefit analysis, and congestion pricing as the single most effective reform package for Australia's cities.

The National Freight and Supply Chain Strategy 2025 Update identified several opportunities to lift productivity across the freight and logistics sector (DIRDC 2025).

- Emerging technologies such as robotics, automated and electric vehicles, drones, and automated warehousing facilities could transform efficiency and reduce costs.

- Increased modal integration and the development of connected, multi-modal freight precincts also offer significant benefits by improving the consolidation, storage and transfer of goods between road, rail, sea and air.

- Major projects—including the Moorebank Interstate Rail Terminal, Westport in Kwinana, the Beveridge Interstate Freight Terminal, and the Port Rail Shuttle Network in Melbourne—highlight how governments and industry can partner to deliver enabling infrastructure that supports higher productivity.

- The Strategy stresses the importance of a regulatory environment that is both fit-for-purpose and nationally consistent. Safety must remain paramount, but aligning laws and standards across jurisdictions can reduce costs and improve efficiency.[25] Key national reform agendas — such as the Heavy Vehicle National Law, Rail Safety National Law, the National Rail Action Plan's interoperability program, reviews of shipping legislation, and frameworks for automated vehicles — will be central to driving both wellbeing and productivity.

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[24] ABS Population Projections, Australia (2025). See here: https://www.abs.gov.au/statistics/people/population/population-projections-australia/latest-release

[25] Notwithstanding our point made earlier about the weakness of the 'harmonisation for the sake of harmonisation' argument.

In this report, we argue that achievement of the needed improvement in productivity will require a significant improvement in project selection and planning and a better-integrated, more efficiently priced transport system. This would lower costs for households and businesses, improve access to jobs, education and services, and strengthen resilience. Conversely, continuing poor project selection, congestion, weak intermodal links, and burdensome regulations will continue to impose costs and hold back living standards. International evidence suggests the payoff from lifting transport productivity is disproportionately large — with economy-wide welfare gains.

Our modelling indicates that restoring lost productivity via a suite of targeted reforms potentially carries large macroeconomic dividends.

- **A return to 2012-13 multifactor productivity levels, which were 13 per cent higher than in 2023-24, would add $75.8 billion in net present value terms over the modelling period 2026 to 2040**, with an average uplift of around 5,400 full-time equivalent jobs over the period.[26] The key policy enablers would be:
    - Directing transport infrastructure investment towards projects that achieve a **1.5x BCR hurdle could boost GDP by $6.7 billion to 2040**.
    - A well-designed congestion pricing regime, introduced on Australia's most congested roads, that reduces the incidence of avoidable congestion, could improve freight efficiency and, as a result, increase GDP by **$11.9 billion in net present value terms to 2040 and also provide additional household welfare benefits through passenger time savings.**
    - A more responsive and flexible regulatory environment that accelerates the uptake of new innovations and technologies and that adopts an economically feasible approach to decarbonisation could **improve sector performance by 1 per cent and would, accordingly, raise GDP by $11.5 billion in NPV terms to 2040**.
- Looking farther ahead to the 2040 – 2070 period we believe autonomous vehicles could significantly reduce freight costs and overall transport sector efficiency. Over this period, the improved productivity (and resulting decrease in the cost of road freight) would **increase GDP by $78.3b and employment across the economy by 40,100 FTEs with respect to the baseline, represent percentage increases of 1.2 per cent and 0.15 per cent respectively**.

1.5 Recommendations

To achieve these estimated productivity gains, we set out a number of in-principle recommendations below. We have focussed on what we see as the 'big issues' that, if

[26] CGE modelling for this project was undertaken before the release of the 2024-25 National Accounts, hence the 2023-24 year has been used.

addressed, could make a significant difference to national transport sector productivity and household welfare.

1.5.1 Higher public infrastructure investment hurdles

Regardless of whether progress is achieved in strengthening road network governance and better aligning cost recovery with road use and damage, it is vital that the process to decide public infrastructure investments be improved.

We propose that the current distortions affecting the decision-making process be moderated by an explicit commitment by the Commonwealth and state and territory governments (via Infrastructure Australia and the state bodies like Infrastructure NSW) to prioritise higher BCR projects — often the smaller, staged, high-return corridor upgrades (e.g. overtaking lanes, bridge strengthening, overpasses and safety works).

We propose the following new business case assessment rules:

- **For transport projects where the final outturn cost is likely to exceed 1 per cent of GDP for primarily federally funded projects (and 1 per cent of GSP for primarily State-funded projects), a minimum BCR of 1.5x at a 7 per cent discount rate and P90 costing for projects is required for a streamlined approval process to counter optimism bias and fiscal risk.**[27,28]
- At 2023-24 GDP (of $2.6 trillion) and equivalent GSP levels, the thresholds would be:
    - $26.0 billion for primarily federally-funded projects; and for the states and territories:
    - NSW $8.9 billion; VIC $5.8 billion; QLD $5.2 billion; WA $4.5 billion; SA $1.4 billion; all other states and territories the threshold would be arbitrarily set at $0.5 billion.
    - Projects like the Melbourne-Brisbane Inland Rail ($31-$33 billion) and Cross River Rail ($18-$20 billion) would be captured by this new threshold.
- **Infrastructure Australia should require project proponents to use Reference Class Forecasting methods in their Business Cases as a proven method to minimise optimism bias in transport planning.**[29]

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[27] Even for projects that exhibit strong welfare benefits (e.g. driven by travel time savings) create fiscal risks when there is not a direct pricing regime in place.
[28] In our view, a 7% discount rate should be used to evaluate publicly-funded infrastructure projects as it more accurately reflects market borrowing rates (i.e. the opportunity cost of public funds) and project risks (i.e. cost overruns and benefit shortfalls) than the lower government bond rates (e.g. 4 per cent). For an excellent discussion of why lower discount rates — that essentially reflect the State's coercive power or taxation — shouldn't be used see Harrison (2010).
[29] Reference Class Forecasting (RCF) is an established method for accounting for the systematic underestimation of cost and schedule overrun in projects. The underlying causes of this underestimation can include optimism bias (OB), strategic misrepresentation and economic incentives to see projects progress. RCF was first introduced in UK transport projects in the 2004 report Appraisal Guidance for Optimism Bias as the standard method to adjust estimates to account for biases in project cost estimates. (UK Government, 2025).

- **If a properly scoped megaproject BCR fails to achieve the 1.5x hurdle then these projects must undergo a more stringent review process.**
    - **A minimum 6-month public consultation period would be mandatory.**
    - **Full public disclosure of business cases would be mandatory (including cost and demand forecasts and other CBA calculations such that all analyses and findings can be independently replicated, tested and critiqued).**
        - **These megaproject business cases must be independently replicated, critiqued and evaluated by the Productivity Commission for Federally-funded projects, or the equivalent state body for largely state-funded projects.**

Essentially, this new 1.5x BCR hurdle should discourage the political announcement of very large megaprojects and instead focus on breaking up these large project investments into smaller, more digestible pieces that can be costed more reliably and delivered more efficiently with significantly lower risk of cost overruns and benefit shortfalls.

1.5.2 Road user charging reform

Road user charging (RUC) reform is widely recognised as essential to improving road network cost recovery, efficiency and performance (NTC 2024; DIRDC 2017; PC 2011, 2017; OECD 2026). The case for cost-reflective road pricing has been well established in the economics literature for decades: where access to road capacity is unpriced or mispriced, overuse and congestion are predictable outcomes. As Professor Clifford Winston observed more than thirty years ago:

"The only way to reduce congestion permanently is to set an explicit price for capacity." (Winston 1991, p.119).

But the introduction of cost reflective road user charges, in particular congestion charges, are politically unpopular and so an evolutionary pathway is needed to move from the current (mainly) registration/fuel tax regime.[30] The most obvious place to start is with heavy vehicle freight — which causes the most damage to road surfaces — because some progress with RUC reforms for freight has already been made. In December 2015, the Council of Australian Governments (COAG) agreed to accelerate Heavy Vehicle Road Reform (HVRR) and investigate the next steps to transition to independent price regulation of heavy vehicle charges.[31]

[30] Moving to an independent price regulator and then full economic regulation of the national road network could be potentially the most economically efficient, fairest and transparent way to set prices which adequately recover the costs of building, maintaining and operating Australia's road network. However, in our view this reform is likely to be an evolutionary process that occurs over a number of decades rather than a near term 'big bang' reform.
[31] The HVRR roadmap sets out the steps which form the Government's plan to turn the provision of heavy vehicle road infrastructure into an economic service where feasible. The roadmap is discussed in the Transport and Infrastructure Council's Heavy Vehicle Road Reform – What we are doing and why we are doing it paper, accessible at:

The system we presently use for setting the heavy vehicle user charge is not working well. While the National Transport Commission produces a recommended price in accordance with its stated principles, usually this recommendation is not accepted by governments and, instead, a price is agreed through political negotiation. (DIRDC, 2017).

A more sophisticated road pricing regime — one that reflects the total actual costs imposed by road users on other users — could both improve allocative efficiency and reduce (or defer) the need for expensive new capital works by managing demand more effectively.[32] However, any reform should be mindful of the trade-offs between efficiency and complexity. A perfect mass*distance*location pricing regime is, in our view, neither technically feasible at reasonable cost nor politically viable in Australia.

Reform should build on current NTC-led work and move toward cost-based road user charging based on a mass*distance framework.[33] The pricing regime should also account for the well-known problem of pricing large network infrastructure services — whereby charging marginal cost under-recovers required revenues but charging average cost leads to less-than-optimal network utilisation. The standard solution is to charge a two-part (or multi-part) tariff to ensure adequate cost recovery without impacting efficient road use.

- **Annual registration fees should reflect fixed network costs** — that is, the costs of 24/7 access to the whole network (e.g. road administration, signage, signalling and lighting, policing and other first responders). However, we acknowledge that it may be difficult to perfectly identify the fixed costs of providing the national road network.

- **The introduction of distance-based charges for EVs**, as EV uptake is likely to increase and, consequently, traditional fuel excise revenue declines. Given that fuel excise is, effectively, a distance-based road user charge, the scheme would not need to be extended to carbon-based vehicles. However, equivalence, in terms of per km charges, between the two charging regimes should be targeted to avoid cross subsidising costs between the two groups of road users.

- **Introduce congestion pricing on the five to ten most congested non-toll corridors as a 12-month trial**, with revenues hypothecated to site-specific upgrades and additional or alternative lanes/routes to garner and maintain public and political support. **These trials would not commence until after the BITRE reviewed its methodology for quantifying the costs of economically unjustified congestion at a corridor-by-corridor level (see immediately below)**.

1.5.2.1 Revisit the methodology to measure congestion costs

The BITRE (2007) method to estimate congestion costs is a useful scale indicator, but by its own description it is an aggregate, order-of-magnitude approach that is definition-sensitive,

[32] In economics, Downs' Law states that (absent congestion pricing) peak-hour congestion on urban expressways increases to meet the road's maximum capacity, regardless of initial capacity.
[33] The standard 'building block' model of identifying costs in the economic regulation of similar networks that exhibit monopoly characteristics (e.g. electricity) would be suitable. In our view, location-based pricing is unlikely to be politically viable in the Australian Federation.

valuation-heavy, and not suited to corridor-specific policy design. Given advances in traffic monitoring technology that have allowed the BITRE to better monitor rates of congestion and driver responses to it, **the original BITRE methodology should be reviewed and revised**.

There have been numerous 'parameters' that have likely changed since 2007, for example:

- while it is true that people largely do not travel merely for the sake of travelling, the in-vehicle 'disutility' from driving may have fallen significantly for many passenger vehicles and, to a lesser extent, freight vehicles;[34]

- changed work patterns that have affected peak congestion times and spread, and the amount of time spent in congestion per vehicle;[35]

- fleet technology and the availability of telematics that can inform how drivers will respond to congestion pricing on certain roads, better informing congestion cost estimates; and

- the parameters that drive the estimated costs of congestion have changed over time — values of time, reliability, speed–flow, and behavioural elasticities (in terms of how drivers would respond to the introduction of congestion charges).

We recommend that the BITRE be tasked to update its methodology to estimate economically unjustified congestion costs, and then re-estimate total economically unjustified congestion costs as well as route-specific costs using its revised methodology and contemporary data. In developing its revised methodology, the BITRE should consult widely, including with the Productivity Commission.

1.5.3 More flexible and responsive regulation

The next generation of high-productivity vehicles (HPVs) — such as longer A-doubles and autonomous-ready truck configurations — should be encouraged through regulatory reform, targeted infrastructure upgrades and trials. In the immediate term, the productivity of the current road freight vehicle fleet can be improved. For example:

- Distribution Centres and major grocery stores need to be able to cost-effectively open at night to accept deliveries in non-peak congestion periods. This will take trucks off the road during peak times of the day. A shift to after-hours freight delivery would be incentivised if freight vehicles were charged the full marginal social cost of their contribution to congestion. Moreover, Federal IR laws or state-based laws and local

[34] Driving has become a far more comfortable experience over the past 50 years. And in the past 20 years, since the BITRE developed its methodology for measuring the costs of economically unjustified congestion, further technology improvements have allowed drivers and passengers to be more productive — making hands free phone calls, listening to informative podcasts, or otherwise being entertained. This is not to say that, for example, being stuck in traffic with young children is enjoyable for anyone.

[35] It would be reasonable to assume that the cost of congestion is non-linear. That is, 60 vehicles stuck in congestion for one minute each would be far less costly than 1 vehicle stuck in congestion for sixty minutes.

government bylaws that discourage distribution centre or grocery stores being able to receive overnight deliveries should be reviewed.

- An alternative solution, which is a far blunter policy instrument, is to impose restrictions or curfews on delivery trucks to operate during peak times — essentially daylight hours. This would impact overall system efficiency and productivity and should be only considered as a last resort.

1.5.3.1 Preparing for automation

Automation represents the next frontier in transport productivity growth. Australia has been a global leader in mine-site automation, with Rio Tinto and BHP deploying large fleets of autonomous haul trucks in the Pilbara for example. Trials of automated shuttles have occurred in Sydney, the Gold Coast, and regional centres, while freight operators in the United States are already running autonomous trucks on selected routes.[36]

Policy must focus on preparing the regulatory and institutional frameworks to support automation for wider adoption. The National Transport Commission is developing an Automated Vehicle Safety Law, which will assign responsibility to "Automated Driving System Entities" and clarify liability in the event of crashes.

Done well, automation could deliver major safety, productivity, and environmental benefits — but it requires clear regulation, workforce transition planning, and strong public acceptance strategies.

- Governments should consider providing regulatory 'holidays' on designated corridors (an obvious candidate would be the Newell Highway in Western NSW) for trials of autonomous vehicles and A-triple road trains. For instance, with the appropriate safety protocols and warnings for motorists, AV trials could be permitted at nighttime when road use by passenger vehicles and Vulnerable Road Users (VRUs) is at its lowest.

- More generally, the current work of the NTC on the legal-regulatory framework for AVs such as in relation to liability, policing and so on needs to be strongly supported by governments (via resourcing) and industry (via consultation processes).

1.5.4 A pragmatic path to net zero

The guiding principles for Australia's transport decarbonisation objective must be adaptability and feasibility— ensuring that Australia's decarbonisation effort maximises domestic benefits while retaining the flexibility to align with global progress. A key economic principle is to meet the decarbonisation policy objective at least cost to the Australian community. Because there is no simple answer to this challenge, further analysis and research will be required to resolve

[36] See here for example: https://wgntv.com/business/press-releases/cision/20250908CG67252/international-begins-autonomous-fleet-trials-takes-the-next-step-in-self-driving-freight-transport/

the portfolio of solutions that will deliver the decarbonisation objective at lowest cost to the economy.

1.5.5 Greater network resilience

Network resilience relates to how the national transport network copes with extreme weather events like storm surges, bushfires and floods, and major traffic accidents. The costs of network vulnerability rise with population and economic growth because as the 'built environment' becomes larger not only does the cost of network damage and disruption increase but the opportunity cost of doing nothing increases as well. Therefore, as incomes rise, it is worth investing more to protect the built environment, such as the road and rail network that enables economic activity.

The BITRE's 2024 resilience review provided sensible recommendations to improve Australia's transport sector resilience. Their key recommendations were:

- Target investments at the most vulnerable critical road and rail Key Freight Routes (KFRs) identified by the TraNSIT/risk framework—prioritising upgrades that reduce isolation risk and cut detour costs during closures.

- Close data gaps by expanding the National Freight Data Hub (e.g., National Location Registry, service-level standards), and improve real-time disruption, asset condition, and capacity data; adopt interoperable standards and trusted data-sharing arrangements.

- Strengthen governance & coordination (e.g., clearer national guidance; better integration with emergency management; formalised industry–government collaboration) and embed post-completion evaluation of resilience outcomes.

- Prepare for emerging risks (heat, cyber, electricity dependency) by updating design/operational standards and contingency plans for prolonged closures. (BITRE, 2024)

We support these recommendations.

1.5.6 Better road network governance

Subjecting Australia's national highways, and state and local road networks to more robust and transparent governance arrangements, would enable state and federal authorities to improve infrastructure investment and road user charging (RUC) decisions.

- Road networks should be treated as economic entities and have a balance sheet and operating statement such that network revenues and expenditures can be estimated and compared. This governance framework — similar to the post-NCP economic regulation adopted for electricity transmission and distribution networks, water infrastructure, gas pipelines and below rail networks — would strengthen investment discipline and cost recovery via the recognition of nationally consistent fixed costs, road damage, congestion and decarbonisation charges, and provide much greater transparency.

- Independent price regulation for heavy freight vehicles would create a direct and automatic link between the charges that are imposed on heavy vehicles and the actual costs of road provision. This model would also provide the industry with greater transparency and certainty around the process for determining charges.

1.6 Conclusion

In mature technology and regulatory systems like Australia's, in our view the policy task needs to focus on both getting the most out of the existing transport network and on supporting technological innovation that could improve productivity, resilience and safety outcomes in the future. There is work to be done on both the supply side — with public infrastructure investment that provides the taxpayer with greater value, and on the demand side — with the continued evolution of heavy vehicle freight charges, reforms to passenger vehicle charges, PT fares that accurately reflect the net costs of provision, and gaining a deeper understanding of the costs of economically unjustified congestion before trialling congestion charges.

The task then, is not so much to do more or do less, but to do the right things, in the right order, at the right time, with the right price signals and fiscal and regulatory discipline. In relation to roads, we need to do two things — efficient pricing to effectively recover costs and regulate excess demand for road services, and efficient investment to minimise the costs of network provision. In relation to rail, it boils down to one thing — focussing investment on better intermodal integration and coordination to get the most out our heavy rail container freight network. And in pursuing decarbonisation, the goal should be to move in step with comparable international efforts, ensuring we reduce emissions without imposing costs that damage our competitiveness for no meaningful impact on global temperatures.

2 The evolution of Transport since 1970

2.1 Introduction

This chapter identifies ten major changes that have occurred in the Australian transport landscape in recent decades and explores the impact of five ongoing trends.

By 1970, the foundations of Australia's modern transport system were already in place. Mass car ownership had reshaped cities, extending the suburban footprint far beyond traditional local government boundaries and creating Australia's modern-day metropolises (Glaeser, 2011). In terms of the movement of goods, larger trucks were beginning to displace rail freight on interstate and intrastate corridors and coastal shipping's share began to decline. In terms of the movement of people, commercial aviation was becoming a mainstream option, especially for business and higher-income travellers. Thus, what followed over the next fifty years was not the invention of new transport modes, but the mostly gradual expansion, refinement, and integration of these existing transport systems.

That said, there have been two recent radical changes that can be described as revolutions rather than evolutions because of the speed of the change. Both occurred as a result of the Covid-era restrictions on the movement of people, but have been enabled by the significant investment in internet enabling technology such as submarine cables, satellites, and data centres that makes online shopping and high-definition low-latency video communication possible.

(i) Last mile delivery of goods directly to people's homes, instead of collection at grocery retailers, distribution centres, furniture and white goods stores, and post offices.

(ii) Working, studying and entertaining from home on the one hand, and service delivery (like medical services) directly to the home.

Today, in the mid-2020s, while the car — being significantly more comfortable and safer than in previous generations —remains the dominant form of passenger transport, PT services in our major cities have increased in quality (timeliness, reliability, interconnectivity), quantity, and range. And in freight, transport modes have become more specialised with rail taking the bulk of Australia's resources exports to port and roads taking the bulk of our merchandise imports from the port to intermodal hubs and distribution centres, while coastal shipping and air freight serve niche markets.

Box 2-1 What was travelling like in the 1970s?

> For most Australians, travelling by car in the 1970s could be a long, hot, uncomfortable, and often dangerous experience. If it rained heavily, roads were more likely to flood or even wash away and braking and steering systems were primitive, unable to prevent locking up and aquaplaning. Interstate travel was a more dangerous experience — the Pacific Highway connecting Brisbane and Sydney was predominantly single carriageway, winding and subject to flooding in northern NSW.

Seatbelts were not yet universally adopted (particularly in the back seats), airbags were unheard of, and there were no legally enforced limits on alcohol consumption. Australia recorded 3,798 road fatalities in 1970, compared with 1,266 deaths in 2023 despite the population being more double the level in 1970 (BITRE, 2024).

Drivers and their passengers might stop at a pub for a refreshing drink midway through a cross-city trip, a practice that reflected a very different social and regulatory environment in addition to how uncomfortable driving could be on hot days.

Breakdowns were a common sight: radiators overheated on summer days, batteries went flat, lower quality tyres were changed at the roadside while families looked for shade, and motorists could be seen towing each other's vehicles with ropes. The risk of burns or cuts inside a car on a hot summer's day were numerous – steering wheel, seatbelt buckles, broken vinyl upholstery to name a few. In traffic, exhaust fumes clung to the air and leaded petrol was the standard fuel source.

Public transport service quality was basic — buses pitched and yawed without modern electro-hydraulic suspension systems, plastic seating could be sticky and broken, passenger trains weren't air-conditioned but windows opened. There was often no lighting in tunnels.

Compared with today, journeys often took longer, were far more uncomfortable, breakdowns were frequent, and every trip carried a much higher chance that you might not make it to your destination or get back home compared to today.

This chapter sets out ten of the most significant changes that defined that transformation—from revolutions in safety to the rise of digital logistics, and automation—providing a chronological narrative of how transport in Australia evolved over the past half century. We then identify five current trends that are likely to shape the Australian Transport sector in the next five decades.

2.2 Ten big changes in Transport

The evolution of Australia's transport system since 1970 can be understood as a sequence of major shifts, each building on the last. Rather than ranking these changes by their ultimate impact — a task that would be both subjective and highly contested — we present them in roughly chronological order, tracing how successive developments reshaped the sector over five decades. From the breakthroughs in road safety during the 1970s and 1980s, to the mining-driven infrastructure investment boom of the 2000s, and the rise of automation and decarbonisation imperatives in more recent years, each change reflects the interplay of technology, Australia's industrial structure, population and economic growth, and political policy pressures.

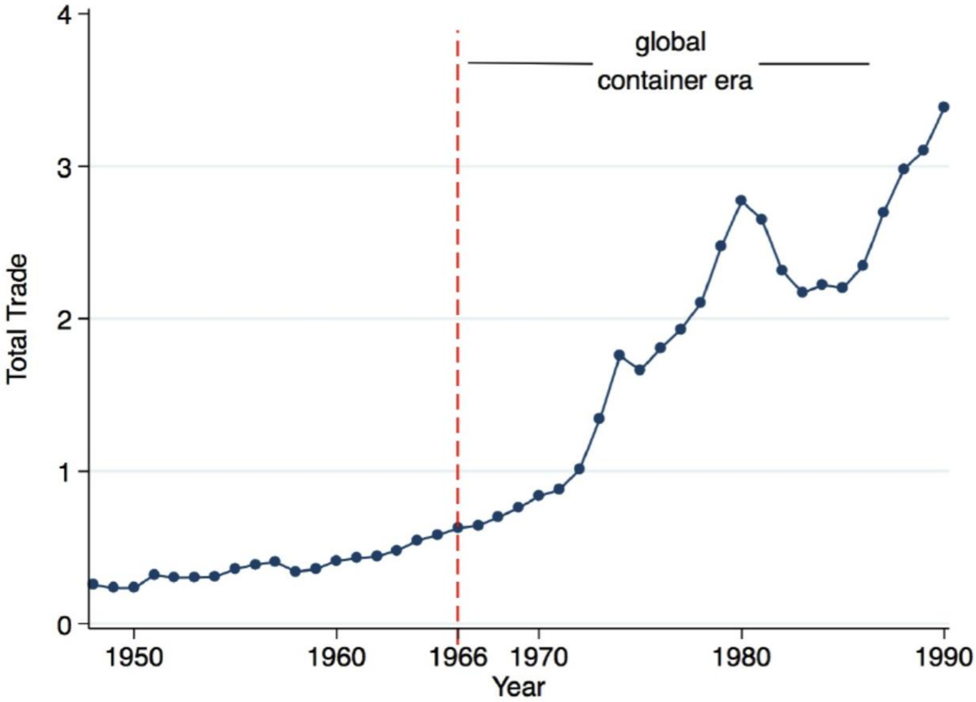
Over the past half-century, Australia's transport task has become more central to living standards with the transport task growing in per capita terms. The passenger and freight networks are more extensive, interconnected and safer than 50 years ago, but also far more complex, costly and politically contested, as community expectations — of a near-unrestricted "right to travel" and much higher service quality for both passengers and freight

— have grown faster than the system's capacity to deliver them efficiently and at reasonable cost.

2.2.1 Containerisation

The spread of containerisation from the mid-1960s and reaching peak uptake in the 1970s revolutionised freight movement worldwide, dramatically reducing port handling costs and expanding world trade (Figure 2-1). The adoption of standardised 20- and 40-foot containers enabled goods to move seamlessly between ships, trains, and trucks, reducing handling times, port turnaround costs, and the risks of damage or theft (Gómez-Ibáñez, 2003). Bernhofen et al (2016), estimates containerisation expanded world trade by 700 per cent in the two decades after its widespread adoption. For Australia, a trading nation with long sea routes to major markets, the efficiency gains from containerisation were especially important. It supported the integration of Australia into global supply chains and underpinned the rapid expansion of merchandise imports to support industrial specialisation (e.g. swapping our heavily subsidised PMV and TCF industries for lower cost imports) and population and economic growth (BITRE, 2022).

Figure 2-1 The growth in world trade, 1948 to 1990 (real)



Source: Bernhofen et al (2016).

2.2.2 Safety Improvements

The modern era of transport safety in Australia can be traced to landmark reforms in the 1970s. Victoria became the first jurisdiction in the world to mandate seatbelt use in 1970, with all other states and territories following soon after. This requirement is widely regarded as one of the most effective road safety measures ever introduced. Subsequent decades saw airbags, ABS disc brakes, power steering and electronic stability control become standard features, further reducing the lethality of crashes. Complementing these innovations, fuel standards were tightened: unleaded petrol was phased in from 1986, and diesel particulate requirements improved urban air quality while lowering risks from mechanical failure.

Table 2-1 (below) illustrates the improvement in transport safety over the past four decades.

- Road fatalities have fallen markedly both in absolute terms and as a proportion of our rising population. In 1983, road fatalities numbered 17.9 per 100,000 people and by 2023 were less than 5 people per 100,000.
- In terms of kilometres travelled, road deaths declined from 13.4 per billion kilometres travelled in 1977 to 4.7 deaths in 2023.
- Rail fatalities (excluding suspected suicides) are very low but have doubled in the decade to 2023 from 0.03 to 0.06 people per 100,000.
- Marine fatalities are almost zero per 100,000 people.
- Aviation fatalities are also less than 1 person per 100,000 and have fallen by almost two-thirds since the early 1980s. In per km travelled terms, fatalities declined from 0.2 deaths per billion passenger km in 1977 to 0.12 deaths in 2023. (BITRE, 2024).

Table 2-1 Fatality rate, by transport mode (per 100,000 population)

Calendar year	Road	Rail	Marine	Aviation
1983	17.9	0.43	n/a	0.35
1993	11.1	0.29	n/a	0.32
2003	8.2	0.17	0.22	0.22
2013	5.1	0.03	0.03	0.20
2023	4.7	0.06	0.01	0.13
2024	4.8	n/a	n/a	n/a

Source: BITRE Yearbook 2024. Note: For rail fatalities, the first three figures (1983, 1993 and 2003) include all recorded fatalities whereas the final two figures (2013 and 2023) exclude suspected suicides.

Does n/a = not available?

Behavioural regulation and enforcement also transformed safety outcomes. New South Wales introduced random breath testing in 1982, with other states quickly adopting the practice. The deterrent effect was magnified by lowering the legal blood alcohol concentration from 0.08 to 0.05 during the 1980s, a reform strongly supported by public health research (Homel, 1990). Road safety campaigns, particularly Victoria's Transport Accident Commission advertising from 1989 onwards, reinforced these measures by reshaping social norms around drink-driving. Graduated licensing systems, introduced from the late 1980s, imposed restrictions on younger drivers such as curfews and limits on vehicle engine power. These policies specifically targeted high-risk cohorts, driving down fatality rates among young motorists who had previously been disproportionately represented in crashes (Haworth et al., 1997).

For heavy vehicles, national safety regulation has been a long-term project. Fatigue-related crashes drove reforms in the 1990s and 2000s, culminating in nationally consistent rules under the Heavy Vehicle National Law and fatigue management systems overseen by the National Heavy Vehicle Regulator (NHVR). These include strict limits on driving hours, mandatory rest breaks, and electronic work diaries to track compliance. At the same time, the proliferation of roadside enforcement—speed and red-light cameras, average speed limit testing, compliance monitoring, and weighbridge inspections—reduced the risks associated with high-mass vehicles sharing the road with passenger cars. These rules not only saved lives but also professionalised the road freight industry, embedding safety into its culture.

Parallel safety revolutions reshaped rail and aviation.

- In rail, fragmented state-based safety laws were harmonised through the establishment of the Office of the National Rail Safety Regulator (ONRSR) in 2012, which introduced consistent national standards and eliminated duplication across jurisdictions (Productivity Commission, 2020).
- The aviation sector, driven by alignment with International Civil Aviation Organization (ICAO) standards, embraced advanced air traffic control systems and stricter maintenance regimes. These reforms all but eliminated fatal commercial aviation accidents in Australia from the 2000s onwards (BITRE, 2017).

The cumulative result is that, across all modes, Australians today enjoy a vastly safer transport system than their counterparts of half a century ago—a transformation that is among the most remarkable successes of post-1970s transport policy.

2.2.3 Just-in-time delivery

The ICT revolution in the 1980s and 1990s facilitated the rise of just-in-time logistics technologies, which became standard practice across most Australian industries by the 2000s. The adoption of barcoding, electronic data interchange (EDI), and later GPS tracking gave firms unprecedented visibility over inventories and supply chain flows (Gómez-Ibáñez, 2003). These tools laid the foundation for just-in-time logistics systems, which allowed firms to minimise warehouse holdings and reduce costs. By the 2000s, real-time analytics, AI-driven routing, and warehouse automation had further enhanced the efficiency of freight networks. For Australian producers in mining, agriculture, and retail, these advances enabled smoother integration into global supply chains, lifting competitiveness and service standards (BITRE, 2022).

In particular:

- Firms moved from linear barcodes to RFID tags/readers and mobile scanners to speed, bulk-read and error-proof identification, giving real-time inventory visibility and documented throughput in warehousing and distribution.

- Truck fleets adopted GPS/telematics units and IoT sensors to track vehicles and loads continuously, tightening ETA windows and enabling dynamic dispatch and exception management.

- The adoption of industry-wide standards let forwarders, carriers and shippers exchange purchase orders, advance ship notices and invoices machine-to-machine, while modern freight forwarding software allowed for far more efficient freight optimisation, slotting and routing.

- In recent years, the industry has seen elevated investment in real-time visibility platforms, telematics, and WMS–TMS integration, reflecting a shift from static planning to continuous, data-driven control — essential to minimising buffer stocks (i.e. inventories), shortening cycle times and cutting working capital in JIT networks.

These modern systems have minimised inventory holding costs and allowed businesses to rely on globally integrated supply chains. However, the very efficiency of just-in-time delivery associated with lower inventories created vulnerabilities.

- The COVID-19 pandemic and the 2022 flooding in northern NSW of the Pacific Highway and East–West rail line showed how disruptions to ports, shipping schedules or freight corridors could bring parts of the economy to a standstill (BITRE, 2024).

As a result, supply chain resilience has become a major policy concern in Australia in recent years, highlighting the double-edged nature of globalisation in transport.

2.2.4 High-productivity road freight vehicles

The adoption of articulated trucks improved the efficiency of road freight in Australia and overseas. The introduction of B-doubles in the late 1980s, and later Performance-Based Standards (PBS) freight vehicle frameworks, enabled much higher payloads per trip (BITRE, 2022). As a result, and given Australia's vast distances and dispersed population, road freight became the dominant mode for most domestic tasks, including containerised freight flows. The consequence of the structural shift to larger trucks was a long-run increase in road freight productivity through the 1980s and 1990s. Another consequence was the structural mode shift from rail to road freight, particularly in general freight tasks, reflecting both the flexibility of high-productivity vehicles, the end-to-end nature of the general freight task, and the high transactions costs associated with intermodal transhipment, and the relative decline of Australia's rail freight competitiveness outside bulk commodities (BITRE, 2024).

- Total domestic road freight has grown more than nine-fold over the last five decades, from around 27 billion tonne kilometres in 1970-71 to 249 billion tonne kilometres in 2023-24.[37]

- Over that period the average productivity of road freight vehicles; that is, the freight carried per registered freight vehicle, including light commercial vehicles (LCVs) has more than tripled.

- Productivity growth of heavy freight vehicles; that is, rigid and articulated trucks has been even more pronounced; increasing almost six-fold since 1971. Articulated trucks alone have contributed over 90 per cent of the increase in total road freight vehicle productivity. The principal factors contributing to increased heavy vehicle productivity include:

    - the introduction of and expanded network access for larger heavy vehicle combinations, particularly B-double articulated trucks;

    - progressive increases in regulated heavy vehicle mass and dimension limits, allowing strong growth in long-distance freight; and

    - cumulative long-term investment in major road infrastructure, particularly the realignment and duplication of parts of the inter-capital national highway network. (BITRE, 2024).

[37] A tonne kilometre is one tonne of freight moved one kilometre.

Figure 2-2 A 27 metre B-Double prime mover and road-train

Source: https://www.roadtrains.com.au/news/27-meter-b-doubles-to-get-green-light/

2.2.5 National Competition Policy

One of the most transformative shifts in Australia’s transport sector came in the years following the release of the Hilmer Report in 1993 and the implementation of the National Competition Policy (NCP) from the mid-1990s. The Hilmer reforms extended competition and access rules to previously monopolistic infrastructure and services — ports, rail lines and ‘above-rail’ operators were now subject to new economic regulation. These reforms enabled ports and rail corridors that were uneconomic to duplicate to be declared as essential infrastructure, requiring access regimes that allowed multiple operators to compete on the network. Wharf and stevedoring reform also broke entrenched practices that had reduced efficiency, significantly lifting productivity on the waterfront.

In road freight, NCP spurred reforms in road network cost recovery and regulation. One key innovation was aligning heavy vehicle registration and licensing charges with engineering-based estimates of road damage — particularly the well-known “fourth power rule” that pavement wear increases exponentially with axle weight.

- As BITRE (2016, p.3) explains: “The current charging system is based on the principle that heavy vehicles should collectively cover the allocated costs of the infrastructure that they consume, with charges broadly linked to the degree of road wear they impose.” This was a significant departure from flat fee systems and helped move road charging closer to an efficient cost-recovery model, even if progress toward fully cost-reflective pricing remains incomplete.

The National Competition Policy also inspired governance and investment decision-making reforms to embed greater rigour and transparency — although the extent to which these two goals have been achieved is a matter of conjecture.

- The establishment of Infrastructure Australia in 2008 provided, for the first time, a national independent advisory body to assess, prioritise and monitor major infrastructure projects. State governments soon followed with their own agencies, such as Infrastructure NSW, Infrastructure Victoria and Building Queensland, to ensure long-term planning and consistency.

- As Infrastructure Australia (2019, p. 18) notes: "Robust, transparent evaluation of infrastructure proposals is critical to ensuring that scarce public funds are directed to projects that deliver the greatest community benefit."

The NCP era also coincided with major reforms in aviation. Australia dismantled its "two-airline policy" in the early 1990s, opening the domestic airline market to full competition. This unleashed fare reductions, intense rivalry, and the eventual rise of low-cost carriers such as Virgin Blue and Jetstar, which expanded access to air travel and reshaped tourism and regional connectivity (Forsyth, 2003). The regulation of major airports also evolved, with economic oversight of slot allocations, aeronautical charges and parking fees to prevent monopoly abuse.

Aviation reform has not been without its setbacks. In the end, Australia's small population has meant that having two major domestic carriers (as opposed to three or four) is the right industrial structure for the industry — especially after the post-Covid collapse in interstate business travel. Regional airline viability has also been problematic, with Rex Airlines recently requiring a government bailout and the possibility of nationalisation remains on the table if a commercial buyer cannot be found.[38]

In relation to sea freight, the industry is largely de-regulated and operating on a fully commercial basis in line with other transport modes although a form of license-based cabotage remains.[39]

Finally, public–private partnerships (PPPs) became increasingly common for toll roads, airports and freight terminals, bringing private capital and expertise into infrastructure delivery. This new financing model required more disciplined project appraisal and coordination across levels of government — although cost overruns and benefit shortfalls were still common. Moreover, toll roads have brought their own problems, complicating public investment in toll-free road networks and impacting overall system efficiency through

[38] See here: https://minister.infrastructure.gov.au/c-king/media-release/australian-government-supporting-air-ts-bid-acquire-rex

[39] Cabotage is a rule or set of rules governing international 'flagged' transport services on domestic routes. Generally, cabotage rules require international operators to adhere to Australian rules and regulations in relation to safety, employment conditions and so on. See here: https://www.legislation.gov.au/C2012A00055/latest/text

pricing regimes designed to maximise toll road cost recovery rather than overall network efficiency.

The combination of Hilmer-inspired reforms — economic regulation on monopoly infrastructure, more cost-reflective pricing regimes, and stronger governance institutions marked a decisive shift *toward* a more efficient, transparent and strategically aligned transport system in Australia. The Productivity Commission (2005) concluded that NCP "had delivered substantial benefits to the Australian community which, overall, have greatly outweighed the costs" by increasing efficiency across infrastructure and service delivery.

However, Australia's transport system has by no means reached its final destination in terms of economic regulation.

- Rail regulation has been problematic with incentives for cost-shifting between above-rail and below-rail operators apparent.

- PT cost recovery is too low to guarantee and expanded high-quality system in the future without increasing cross-subsidisation from the Australian taxpayer.

- Before very recent reforms in relation to the establishment of the National Freight Data Hub, public reporting of transport system performance had been poor, suffered from coordination and commercial issues, and the consequent lack of data and visibility has been a major impediment to system reform and evolution.[40, 41] However, this problem is widely recognised and work continues in this area.

2.2.6 Rising infrastructure investment but rising costs

From the 1970s, state governments oversaw massive investments in road and rail expansion, especially in the major cities (e.g. South-East Freeway between Brisbane and the Gold Coast built between 1970 and 1985).

The resources boom of the early 2000s drove enormous investment to expand Australia's rail and port export supply chains. Meanwhile, digital technologies revolutionised logistics—barcoding, GPS and real-time analytics reshaped freight and retail. Since 2010, public transport and active modes have returned to prominence to tackle congestion and environmental sustainability.

Figure 2-3 (below) illustrates the ramp-up in transport network investment through the mining investment boom period (2002-03 to 2011-12) and again from the mid-2010s.

- Transport infrastructure engineering construction work tripled in real terms during the mining investment boom period, from $16 billion in 2002-03 to $48 billion in 2011-12.

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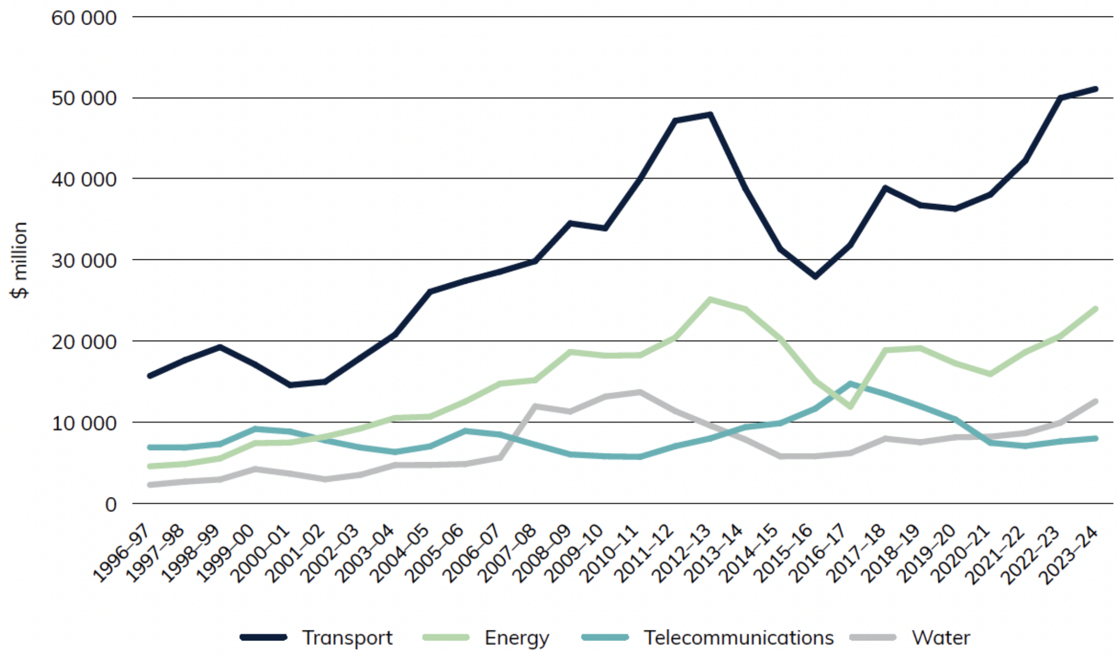
[40] See here: https://datahub.freightaustralia.gov.au/
[41] See iMOVE submission here: https://imoveaustralia.com/news-articles/freight-and-logistics/national-freight-data-hub/

- In 2023-24, transport infrastructure engineering construction work reached a new all-time high of $51 billion, accounting for just over one-half of the total infrastructure construction work done in Australia.
    - Most of the $51 billion investment was allocated to roads and bridges ($33 billion), followed by railways ($16 billion) and harbours ($1.5 billion).

Figure 2-3 Annual capital investment by industry sector since 1996-97, real $2023



Source: ABS Engineering Construction Activity Australia 2023, in BITRE (2024, p.40).

One of the most significant challenges facing Australia's transport sector since the 1970s has been the sustained escalation of infrastructure construction costs. Data from the Bureau of Infrastructure, Transport and Regional Economics (BITRE) and the ABS show that transport infrastructure costs have risen faster than general inflation, reflecting both global and domestic pressures (BITRE, 2022).

Cost drivers include higher labour and material expenses, increasingly stringent safety and environmental requirements, and the complexities of delivering projects in congested urban areas (Branigan, 2016). The result has been that governments today must spend significantly more in real terms to deliver equivalent levels of infrastructure compared with earlier decades, placing pressure on budgets and making project prioritisation increasingly contentious.

Figure 2-4 (below) illustrates the strong rise in infrastructure construction costs in Australia, especially from the mid-2010s.

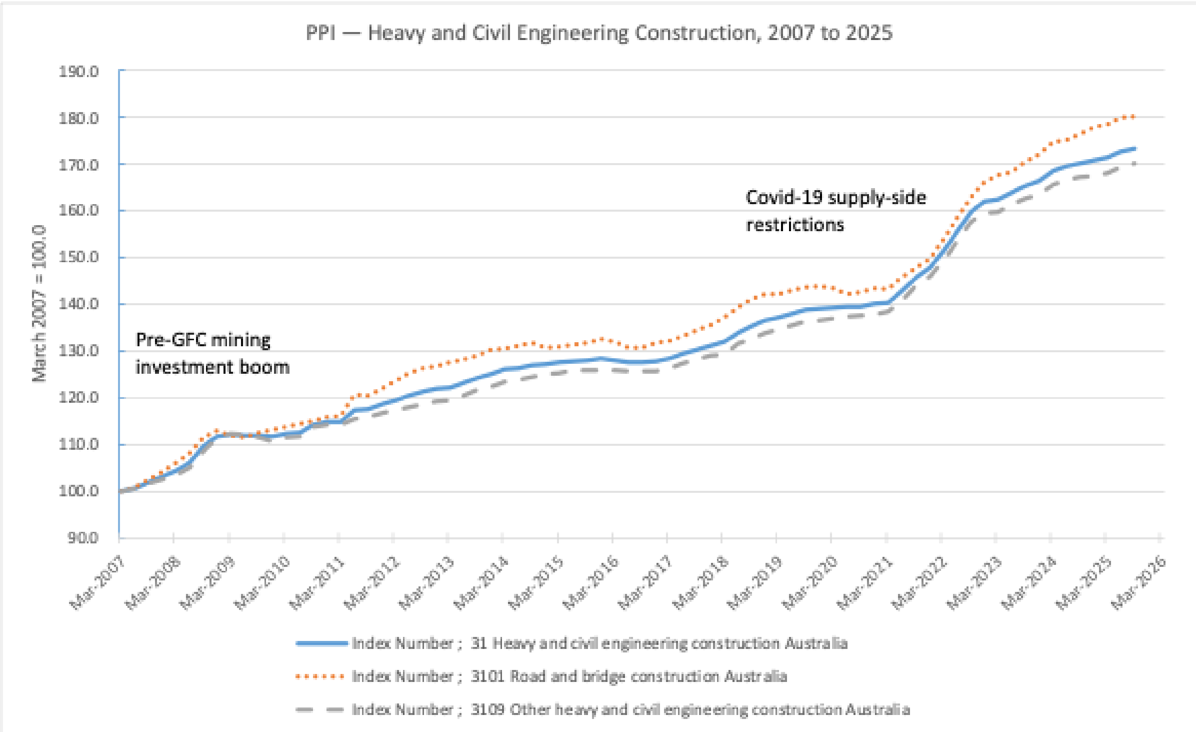
- There was a sharp rise in costs in Phase 1 of the mining investment boom before the GFC temporarily flattened cost escalation (Box 2-2).

- Costs then rose steadily in the first half of the 2010s before rising more strongly in the second half of the decade.

- Costs then accelerated sharply during the Covid-19 years as a result of severe supply restrictions on both the materials and labour side.

- In the post-Covid era, construction costs continue to rise strongly, driven by strong growth in public investment, low unemployment and surging population growth (itself driven by a post-Covid catch-up in population growth of more than 500,000 per year in the 2022 and 2023 calendar years.[42]

Figure 2-4 Cost escalation in Heavy and civil engineering construction, 2007 to 2025



Source: 6427.0 Producer Price Indexes, Australia. Table 17. Output of the Construction industries, subdivision and class index numbers.

Overlaying this long-term trend was the mining investment boom from 2003 to 2012, which reshaped both Australia's economy and its transport sector (Box 2-2). The effects of the mining investment boom on infrastructure construction costs are still being felt — for example Infrastructure Australia's (2024, p.7) latest Market Capacity Report cautions: "Labour shortages, rising costs and stagnating productivity are compounding challenges in delivering major transport infrastructure projects, highlighting the need for ongoing reform to ensure efficiency gains are not lost."

[42] Australia's population growth was 546,490 in 2022 and 636,375 in 2023. See here: https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/mar-2025

Box 2-2 Impact of the mining investment boom on the transport sector and construction costs

In the decade of the mining boom, more than $100 billion in private capital was poured into expanding the nation's export capacity, particularly for iron ore, coal, and later liquefied natural gas (LNG). This surge of private investment generated strong demand for skilled labour, materials, and construction services, which in turn drove up the costs of public infrastructure projects as governments competed for the same inputs. Economists have described this as a classic "crowding out" effect, where private sector demand inflates prices across the broader construction market (Connolly & Orsmond, 2011).

The mining boom triggered large-scale transport investments in resource-rich regions. In the Pilbara, mining companies financed highly efficient, vertically integrated railways dedicated to iron ore exports, complemented by expanded port facilities at Dampier and Port Hedland. In the Bowen Basin of Queensland, new coal rail lines and port expansions supported surging thermal and metallurgical coal exports, while the Hunter Valley network was progressively upgraded to meet global demand. By the late 2000s, coal seam gas development in Queensland added a further layer of infrastructure requirements, with new pipelines and port capacity. Even agricultural exports such as grain benefitted indirectly from these supply chain upgrades, though they also had to compete with bulk commodity flows for rail and port access.

While these investments created world-class bulk commodity supply chains, the boom highlighted the risks of resource-driven inflation for public infrastructure delivery. Governments found themselves facing higher costs for urban transport projects at the same time as resource companies were driving construction activity in remote regions. The legacy has been enduring: Australian transport infrastructure is now among the most expensive in the world on a per-kilometre basis, particularly for urban rail (Infrastructure Australia, 2019). Risk management, stringent safety standards, and increasingly complex governance processes all add to the bill. The mining boom thus underscores a uniquely Australian dimension to global transport trends—where the resource sector's dominance magnifies both the opportunities and costs of building and maintaining the nation's transport system.

2.2.7 Goods to people revolution

One of the most profound changes to transport's role in the economy has been the rise of home delivery. Where once consumers travelled to stores to purchase goods, today goods are increasingly brought directly to people's homes. The growth of e-commerce from the late 2000s, spearheaded by companies like Amazon globally and large supermarket chains domestically, has fundamentally changed the role of transport in the purchase of goods and, to a lesser extent, services provided in the home (like nursing care). Logistics providers now routinely deliver everything from groceries to clothing apparel to pharmaceuticals to electronics within 24 hours, reshaping urban freight patterns. This shift has reoriented distribution networks around parcel delivery rather than bulk shipments to retail outlets, with implications for both road congestion and the measurement of freight activity in official statistics.

The COVID-19 pandemic accelerated these changes dramatically. With lockdowns confining consumers to their homes, online shopping volumes surged, forcing rapid scaling of parcel delivery networks and last-mile logistics. Grocery retailers vertically integrated their supply chains, investing directly in distribution centres, vehicle fleets, and data platforms to control costs and meet surging demand. The result was a redefinition of the boundary between retail and transport sectors: logistics is now inseparable from the core business model of many retailers, supermarkets, and even technology companies. For policymakers and analysts, this has made it more difficult to delineate the scope of the transport sector, as transport services are increasingly embedded within broader commercial ecosystems.[43]

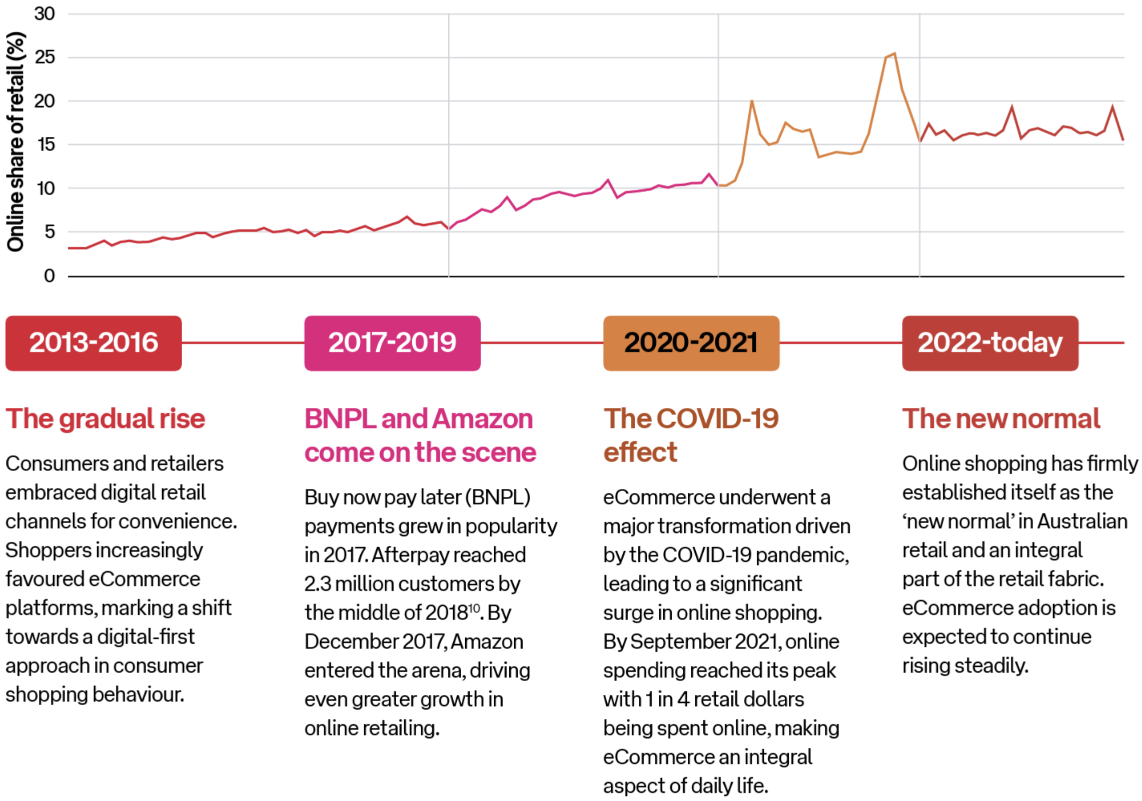
For example:

- For home grocery delivery, households pay around $10 per delivery to secure a 1-2 hour delivery window. Rates are significantly lower for wider delivery windows. Major retailers offer a flat fee monthly subscription of around $20 per month (with a minimum delivery order of, say, $50). The household savings are considerable and clearly exceed the charges households are willing to pay for the service — saving a trip to the grocery store that might normally take 30-60 minutes could be worth $100-$200 per month based on the median hourly wage rate.[44,45]

- Home parcel delivery has exploded since Covid-19, with delivery costs in urban centres generally around $10-$15, although higher in regional and remote Australia.[46] In 2023, eight in ten households made an online purchase and spent a total of $66.3 billion. Online retail's share of total retail expenditure continues to rise and is now 16.8 per cent (Figure 2-5). (Australia Post 2024).

[43] See the discussion on the Transport sector's footprint in Section 3.
[44] Estimates are based on an average of the two leading grocery retailers.
[45] ABS Employee Earnings and Hours, Australia 2023. Accessed here: https://www.abs.gov.au/statistics/labour/earnings-and-working-conditions/employee-earnings-and-hours-australia/latest-release
[46] However, the use of parcel locker networks where households travel a short distance to pick up their parcels, can keep delivery costs down — especially in regional and remote Australia where last mile costs can be prohibitively expensive.

Figure 2-5 Online share of total retail expenditure



Source: Australia Post (2024).

2.2.8 Traffic congestion

Traffic congestion has become one of the defining challenges of urban transport policy in Australia's capital cities. Rapid population growth, suburban expansion, and rising car ownership have combined to stretch the capacity of road networks in major cities such as Sydney, Melbourne, Brisbane, and Perth despite the building of hundreds of kilometres of new motorway and freeway lanes since 2000. By the early 1990s, commuting times were beginning to lengthen significantly, with Infrastructure Australia estimating that avoidable congestion cost the economy around $12.8 billion in 2010, a figure projected to rise to over $30 billion by 2030 without intervention (Infrastructure Australia, 2019). We discuss how congestion costs are estimated in Section 6.

These rising costs are not only measured in terms of lost productivity — that directly translate into GDP - they also impact households in many ways that are not necessarily measured in GDP.

- Vehicle passengers and PT commuters lose time, which is valuable and could have been utilised to undertake more work, study, exercise, leisure or household chores.
- Traffic congestion can affect mental health and household tranquillity.

- Households that elect to avoid traffic congestion by staying at home miss out on potentially valuable economic, health and social activities.

Policy responses to traffic congestion have been diverse and increasingly sophisticated, in Australia and overseas. Sydney and Melbourne pioneered extensive toll road networks, such as Sydney's M2 and M7 motorways and Melbourne's CityLink, which sought to provide faster, more reliable travel at a user-pays price. However, tolling has generated political debate, particularly where toll revenue objectives discourage expansion of parallel public transport or free road alternatives. At the same time, new mass transit investments—such as Sydney Metro, Melbourne Metro, and Brisbane's Cross River Rail—have aimed to provide high-capacity alternatives to car travel, reflecting a growing recognition that urban congestion cannot be solved by roadbuilding alone. Bus rapid transit systems, including Brisbane's pioneering Busways from the 2000s, have further expanded the toolkit for managing demand.

Governments have also experimented with other demand-management measures. Dedicated public transport lanes on arterial corridors, such as Sydney's T-ways, and high-occupancy vehicle (HOV) "T2" lanes for private vehicles carrying multiple passengers, have been trialled to encourage multiple car occupancy. Cycling lanes and pedestrian upgrades have expanded steadily since the 2000s, aligning with broader efforts to promote "active transport" as a healthy, low-cost alternative to private car use that could suit some workers and students. These initiatives signal that a cultural shift is required as the community comes to understand that congestion cannot simply be engineered away but, rather, as a system-wide challenge requiring better economic regulation and pricing on the one hand and better integrated planning across modes and land use in the other.

Despite these efforts, congestion pressures remain persistent and, in some cases, worsening. Travel-time delays have increased by more than 20 per cent since the 1990s across major cities, and congestion now ranks among the top infrastructure concerns identified by Australians in surveys (BITRE, 2020). The policy challenge has therefore evolved into balancing investment between roads and public transport, coordinating with land-use planning to reduce car dependence, and managing the competing incentives and interests of toll road operators, governments, and commuters. The future trajectory of congestion management will likely rest on a mix of new infrastructure, pricing reform, and behavioural change, rather than reliance on any single "silver bullet" solution. Importantly, some congestion at peak times can be optimal, in that the costs of its removal would exceed its benefits: moreover, to prevent all congestion requires a transport network that would never be fully utilised.

Picture 2-1 Congestion on the Brisbane-Gold Coast M1

Source: 'Gold Coast traffic: M1 in 25km of gridlock', Gold Coast Bulletin 13 July 2018.

2.2.9 Working and studying and entertaining from home, and service delivery in the home

The rise of digital connectivity since the 1990s has profoundly reshaped travel behaviour in Australia. Broadband internet, smartphones, and cloud-based collaboration tools have enabled many activities once tied to physical locations — such as work, education, and entertainment — to migrate online. At the same time, while average house sizes have not increased in the past two decades, the number of people per household has fallen providing more space per person to work, study, entertain or exercise.[47]

Research by the Productivity Commission (2021), Hensher (2022) and CSIRO (2024) suggests that about half of all service-sector jobs could be performed remotely for at least part of the week, with millions of workers now engaging in hybrid or work-from-home (WFH) arrangements. This trend accelerated dramatically during the COVID-19 pandemic, which demonstrated both the feasibility, welfare benefits (in terms of commute time and cost savings) and productivity performance of large-scale remote work. As a result, transport demand has structurally (i.e. permanently) shifted: fewer commuters are travelling daily, and peak-hour volumes in major cities have moderated compared with pre-pandemic forecasts.

Education has followed a similar trajectory. Universities now live stream or provide recorded lectures, allowing students to view content asynchronously (i.e. time shifting), while online tutorials and learning management systems reduce the need for physical attendance on campus. This has created a more flexible learning environment but also significantly cut back

[47] ABS (2024). See here: https://www.abs.gov.au/articles/characteristics-new-residential-dwellings-15-year-summary

on daily transport demand, especially in student-heavy urban precincts. Families and households, meanwhile, increasingly consume cultural and sporting content from home, with major events broadcast in high-definition and now 4KHD resolution, reducing the traditional incentive to travel to cinemas, clubs, or stadiums.[48] These shifts reflect a broader social reorganisation: communities are increasingly convened online, whether through video calls, streaming platforms, or social media, rather than through the traditional institutions of church, local clubs, or physical community hubs (ABS, 2022).

Medical and health services are also migrating steadily into the home, reshaping how Australians access care and how service systems are configured. The rapid expansion of telehealth — accelerated during the COVID-19 pandemic and now embedded as a mainstream mode of care — has normalised virtual consultations for everything from routine GP appointments to mental-health sessions and allied-health assessments. A growing ecosystem of innovative digital-health firms now offers on-demand services such as online GP consultations, electronic prescriptions, pathology referrals, medication management platforms and even remote monitoring for chronic conditions. This shift reduces the need for patients to travel, particularly in regional areas, and enables more continuous, preventative care delivered through digital interfaces.

At the same time, households are increasingly consuming health and wellness services via online platforms that replicate functions once tied to physical locations. Exercise programs — yoga, pilates, high-intensity circuits, physiotherapy-led strength therapies — are now routinely streamed into living rooms, supported by subscription platforms, wearable devices and virtual coaching. For many households, the home has effectively become a hybrid clinical and fitness environment, supported by apps, remote specialists and integrated digital tools. Together, these developments signal a broader trend in which health, wellbeing and primary care are progressively shifting away from fixed sites such as clinics and gyms and into flexible, technology-enabled home settings.

In 2024-25:

- 22.5% of people used telehealth services, down from a peak of 30.8% in 2021-22;
- 18.5% of people had a telehealth consultation with a GP; and
- 4.0% of people had a telehealth consultation with a medical specialist.[49]

The consequences for transport planning are far-reaching. Lower commuter and leisure travel volumes have eased pressure on peak-hour demand, flattening the curve of daily usage. This in turn reduces the scale of required investment in costly new infrastructure designed solely to cater for peak loads and defers by many years the timing of capacity increase required to service ‘average’ or ‘unavoidable’ transport demand. State and federal infrastructure agencies have acknowledged that digital substitution has altered demand forecasts,

[48] Stadium builds and attendance in Australia is shrinking. See here: https://www.abc.net.au/news/2020-02-11/stadiums-too-big-for-some-australian-sports/11951632
[49] ABS (2025). See here: https://www.abs.gov.au/statistics/health/health-services/patient-experiences/latest-release#experience-of-telehealth-services

challenging long-held assumptions that passenger kilometres would rise inexorably alongside population growth (Infrastructure Australia, 2021). For governments, this creates both opportunities—lower capital expenditure needs—and challenges, particularly in justifying major expansions of road or rail systems that may never again operate as intensively as previously envisaged.

Public transport networks have been especially affected. With peak patronage suppressed, many services now operate below capacity, prompting governments to heavily subsidise fares in an effort to boost utilisation. Initiatives such as fare caps in New South Wales and Victoria, or reduced off-peak ticket prices, are designed to spread demand more evenly and entice commuters back to the system. Queensland's 50-cent fares are the boldest effort to attract patronage lost during the Covid-19 era. However, the underlying shift remains: digital connectivity has permanently rebalanced the relationship between mobility and daily life. The era of near-universal commuting and compulsory physical attendance has given way to a more flexible system in which demand is mediated by the availability and quality of digital alternatives.

2.2.10 The rise of the Megaproject

Over the past two decades, Australia has entered what might be described as a new "mega-project era" in transport infrastructure. Where the post-war decades were dominated by incremental extensions to roads, railways and ports, governments today are committing to projects of a scale once considered exceptional. As the Grattan Institute's The Rise of Megaprojects: Counting the Costs (2020) makes clear, projects valued at more than $5 billion are no longer rare, and the scale of ambition has grown faster than the institutional capacity to deliver. The consequences are predictable: projects consistently run late and over budget, with Grattan's analysis showing that since 2001, transport projects valued above $20 million have overshot initial cost estimates by an average of 21 per cent. Seven of the largest projects alone account for more than a third of all cost overruns in the period.

International evidence suggests these outcomes are not accidental but systemic. Bent Flyvbjerg, one of the world's leading scholars on megaprojects, has described what he calls the "iron law" of megaprojects: they are almost always over budget, over time, and underdeliver on promised benefits. In Megaprojects and Risk: An Anatomy of Ambition and subsequent work, Flyvbjerg shows that promoters systematically underestimate costs and exaggerate benefits, while political pressures and the prestige attached to building "nation-shaping" infrastructure create what he calls "technological sublimation" — a bias towards scale and novelty. Once governments lock into a megaproject, path dependency makes reversal politically impossible, even when costs balloon.

Australia's experience aligns closely with these patterns. The Melbourne–Brisbane Inland Rail, originally proposed as a transformative national freight corridor, is now estimated to cost between $31 and $33 billion, more than triple early projections. Melbourne's proposed Suburban Rail Loop, now costed by some experts at $125 billion, is a project with great risk and weak benefits relative to costs. Brisbane's Cross River Rail, once envisaged as a $5 billion project, is now approaching $20 billion. These blowouts are not isolated miscalculations but symptoms of the structural risks that Flyvbjerg identified: optimism bias, political lock-in, and the sheer difficulty of delivering complex infrastructure in densely settled environments.

The macroeconomic context has compounded these risks. During the mining investment boom of 2003–2012, Australia saw more than $100 billion in private capital poured into iron ore, coal, and LNG projects. This surge not only transformed bulk export supply chains — building world-class heavy haul railways in the Pilbara and expanding ports at Newcastle, Gladstone, and Port Hedland — but also pushed up the costs of labour, materials, and equipment nationwide. Public sector megaprojects competing for the same inputs faced crowding-out and cost escalation. In effect, the appetite for bigger public projects coincided with a period when construction was most expensive, helping to entrench cost overruns as a structural feature of the pipeline.

Taken together, the rise of the megaproject reflects ambition and increases risk (Flyvbjerg, 2009). On the one hand, large-scale projects promise to reshape cities, expand capacity, and deliver long-term productivity gains. On the other, the concentration of resources into a handful of billion-dollar projects "constipates" the infrastructure pipeline, as the Grattan Institute warns, diverting attention from smaller projects or maintenance that might yield higher returns with lower risk. As Flyvbjerg argues, reform requires discipline in the early stages: more rigorous forecasting, the use of "reference class" comparisons with past projects, and transparent reporting to parliament and the public. Without such reforms, Australia's megaproject era risks illustrating the iron law — grand ambition overshadowed by even grander overruns.

2.3 Looking ahead – five trends

The Covid-19 shock marked a structural break for the Transport sector: remote work and digital delivery turned a slow drift into a step-change, leaving CBD commuting and peak-hour public transport loads well below their 2019 highs and forcing governments to rethink fares, service patterns and long-run investment.

From this new baseline, the next 50 years (2020–2070) will be shaped by five intertwined forces: **how and where we work and study** (hybrid demand and dispersed trip patterns); **automation and data** (from high-productivity vehicles to autonomous freight and real-time network management); **demography and urban form** (a larger, older population and polycentric cities); **energy and emissions** (electrification, alternative fuels and grid adequacy); and **pricing and governance** (shifting from blunt fees and megaprojects to cost-reflective user charges, staged upgrades and resilience by design). None of these trends is certain in timing or scale—but taken together they imply a transport system that must deliver more reliability and access with fewer emissions, tighter fiscal space and greater climate risk. Our task in the chapters that follow is to trace how policy, technology and markets can turn those pressures into productivity gains rather than rising costs.

2.3.1 Continuation of trend to home-centred life

The legacy of Covid-19 on how we go about working, studying and entertaining is likely to be permanent for those households and employers where it makes sense. This is because travel is, ultimately, a cost that households seek to minimise. This is not to say that the roads will be empty — households will demand more deliveries to the home and, consequently, freight is likely to take up a larger share of suburban transport demand.

Hybrid work and study and entertainment patterns will keep peak CBD commuting structurally lower than before Covid-19, while e-commerce, telehealth and on-demand services will increase shorter, local, off-peak trips and increasingly push freight into suburban micro-fulfilment and last-mile networks. Home care services, like nursing services for the elderly, will also increase as our population ages.

Overall, this means:

- Peak congestion will be lower but shoulders (i.e. either side of peaks) and interpeak periods and weekends will be busier.
- An increased demand for reliability and frequency and services where people actually are (outer suburbs, cross-town links), not just radial corridors.
- More flexible, digitally managed capacity—demand-responsive buses, all-door boarding, dynamic lanes—and pricing that reflects time and place, rather than blunt charges that assume a five-day morning and afternoon peak.
- Land use and telecoms policy now matter as much as rails and roads: planning for 15-minute neighbourhoods, permitting small suburban logistics sites, and ensuring high-quality home connectivity will all shape transport demand in the future.

2.3.2 Very large trucks, Automated trucks

The freight sector has long pursued scale efficiencies, and Australia has become a global leader in the operation of very large, high productivity road freight vehicles. From the introduction of B-doubles in the 1980s, to triple road trains in the Northern Territory, and now High Productivity Freight Vehicles (HPFVs) operating on designated freight corridors, each iteration has allowed more freight to be carried with fewer drivers.

The Productivity Commission and BITRE note that the freight task has grown more than eightfold since 1970, with road freight now moving nearly 300 billion tonne-kilometres annually. Larger trucks have played a key role in accommodating this growth. Yet they bring challenges:

- Road networks must be engineered to withstand higher axle loads, urban safety risks rise where trucks mix with cars and cyclists, and last-mile delivery remains difficult in constrained urban environments.[50] The policy challenge is to balance efficiency with safety, sustainability, and infrastructure wear-and-tear.

Automation represents the newest frontier in transport, with Australia already hosting some of the world's earliest large-scale deployments. Mining giants such as Rio Tinto and BHP

[50] HPVs can stay within regulated axle load limits by adding more axles.

operate fleets of autonomous haul trucks in the Pilbara, where closed environments and predictable routes make automation highly viable. Similar technologies are being applied in automated port terminals and AI-driven traffic management systems, while smaller autonomous shuttle trials have been conducted in Sydney Olympic Park, the Gold Coast, and regional centres.

- Internationally, the pace is faster: in the United States, firms such as Aurora and Kodiak are operating driverless freight lanes on interstate corridors like Dallas–Houston and Houston–Oklahoma City. These examples suggest that automation is most likely to emerge first at scale on high-volume, well-defined freight routes, rather than across the entire road network.

Australia has begun laying the regulatory foundations for wider adoption. The National Transport Commission (NTC), working with Austroads and state governments, has issued national Guidelines for Trials of Automated Vehicles (most recently updated in 2023) to ensure consistency in how pilots are assessed and monitored. Beyond trials, the Commonwealth is developing an Automated Vehicle Safety Law, which will establish the responsibilities of “Automated Driving System Entities” — the companies accountable for the design, maintenance, and safety of autonomous systems. This reform is critical, as existing laws assume a human driver is in control, leaving liability and insurance unresolved. Until such a framework is legislated and adopted nationally, autonomous vehicles will remain confined to pilots and controlled environments.

The promise of automation is substantial. Advocates highlight productivity gains in freight — easing driver shortages, reducing fatigue-related accidents, and cutting costs. Safety could also improve if autonomous systems remove human error, which contributes to most crashes. When combined with electrification, automation may deliver a “double dividend” of lower emissions and higher efficiency, while enabling new models of shared and on-demand mobility. Yet risks remain significant: questions of liability and insurance are unresolved, public acceptance is uncertain, and the employment impacts for professional drivers could be profound.

As with containerisation in the 1970s, automation and AI may fundamentally reshape transport over the coming decades. The most likely trajectory is gradual: expanding in controlled settings such as mines and ports, cautious rollout on freight corridors (perhaps even dedicated lanes for autonomous trucks), and incremental reform of legal frameworks. While Australia is not at the global frontier, it is positioning itself by harmonising national regulation and drawing on international experience. If these foundations prove robust, automation could become one of the most transformative changes in transport since the post-war era.

One caveat is that the increased uptake of higher productivity vehicles available under Performance Based Standards (PBS), such as B-triples and AB-triples, is likely to have a lesser impact on national heavy vehicle productivity than the introduction of the B-Double because the type of freight that can take advantage of these larger vehicles represents less than 20 per cent of total road freight (BITRE, 2011).

There are also regulatory barriers to increasing heavy vehicle road freight productivity. The BITRE (2011) argued that:

- In the absence of further heavy vehicle productivity enhancing regulatory reform, fleet-wide heavy vehicle average loads are likely to increase by less than 5 per cent between 2010 and 2030, which contrasts sharply with the 40 per cent growth in average loads over the past two decades (BITRE 2011, p.v).

2.3.3 Continued population growth and mega-cities

Demography is the ultimate driver of transport demand, and Australia's population outlook points to sustained pressure on urban infrastructure. Current projections suggest that by 2060 the national population will reach around 40 million, with the bulk of growth concentrated in Sydney, Melbourne, Brisbane, and Perth. These metropolitan regions already carry some of the world's highest congestion costs — estimated by BITRE at more than $20 billion annually — and are the focal points of housing affordability debates, rising urban density, and transport bottlenecks.

Population growth directly shapes the transport task in two ways. First, it magnifies peak-hour demand for roads and public transport, forcing governments to expand capacity through megaprojects such as Sydney Metro, Melbourne Metro, and Brisbane's busways. Second, it fuels the expansion of suburban fringe communities, where car dependence and long commutes dominate. Over the past two decades, planning strategies have increasingly sought to "build ahead" of demand, investing in rail extensions, bus rapid transit, and integrated land-use policies to encourage density along corridors. Yet the infrastructure pipeline has consistently struggled to keep pace, leaving many outer suburbs underserved and reinforcing reliance on the private car.

At the same time, the link between population growth, immigration, and housing costs has become politically charged. Australia experienced a post-COVID migration surge, with net overseas migration adding more than 500,000 people in both 2022 and 2023. This rapid rebound coincided with a housing shortage and sharp rises in rents and prices, fuelling community concerns that high immigration is exacerbating affordability pressures and worsening congestion. Some commentators now argue that future population growth may slow in the decades ahead, both as immigration settings respond to political pressures and as fertility continues to decline. If growth from 2025 to 2050 proves slower than in the first quarter of the century, long-term demand on transport networks could be less than current high-end projections suggest.

For policymakers, the challenge is therefore twofold. On one hand, planning for density, integrating land use and transport, and managing the balance between public and private modes remain central to making cities liveable as they grow. On the other hand, demographic uncertainty — particularly around immigration and its effects on housing and infrastructure — complicates long-term forecasting. Whether Australia's transport future is defined by rapid growth requiring constant expansion or by a period of slower growth enabling consolidation will depend as much on population policy choices as on engineering and investment.

2.3.4 Finding a workable and sensible decarbonisation pathway

Decarbonisation as a policy objective is perhaps the most profound challenge facing Australia's transport sector because almost all passenger and freight transport currently use carbon-based fuels either directly (i.e. petrol, diesel, aviation gasoline) or indirectly sourcing electrical and battery power from the National Electricity Market network that is still largely supplied by carbon-based fuels, coal and gas. In addition to the technical challenge, there is no clear consensus on the 'Net Zero by 2050' decarbonisation policy objective itself or the best pathway for Australia.

While the beginnings of the decarbonisation transition are already underway: sales of electric vehicles have been rising, supported by state incentives and expanding charging infrastructure, and there are some trials of LCLFs (SAF and biogenic diesel) targeting heavy freight and aviation. Yet with the average passenger and freight vehicle age over 11 years, fleet turnover is slow.

- Almost 1.3 million vehicles were registered in 2023-24 out of a stock of almost 22 million vehicles, representing a less than 6 per cent turnover (BITRE 2024).[51]

The transition to net zero is not only about the national passenger and freight vehicle fleet but also about commuter behaviour and transport networks: shifting more commuters to public and active transport, reducing the carbon intensity of freight, and embedding climate criteria in every infrastructure project assessment will be necessary to achieve a meaningful reduction in Transport sector carbon emissions.

There are two main carbon emissions classifications systems — one based on the ANZSIC industry classification system and the other, more relevant one, based on the UNFCC classification system where energy consumption is directly allocated to industrial use sectors. Under the UNFCC classification system, the Transport sector accounted for 21.3 per cent of Australia's emissions in 2023.

Vehicle electrification has become the centrepiece of Australia's Transport sector decarbonisation strategy. Battery costs, which fell by more than 80 per cent between 2010 and 2020, have made passenger EVs and light trucks electric vehicles increasingly competitive, while improvements in battery density have addressed earlier limitations on range (IEA, 2021). However, for large heavy freight vehicles the imposition of batteries has a significant negative impact on vehicle payload capacity and therefore on operating economics.

Governments have begun to co-invest in charging infrastructure: the Australian Renewable Energy Agency (ARENA) and state governments have supported the rollout of fast-charging corridors along key highways, ensuring intercity travel is feasible for EVs. But the actual number of charging stations remains small. At the same time, vehicle efficiency standards—long lagging international peers—are now being strengthened, aligning domestic regulation more closely with the European Union and United States. These measures are designed to accelerate the transition from internal combustion engines to electric drivetrains.

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[51] The average age of the freight fleet is older, at between 10-20 years.

2.3.5 Policy reform and further economic regulation of transport networks

Looking ahead, Australia is likely to enter a period of more deliberate and systemic transport-policy reform, reflecting pressures identified in the National Freight and Supply Chain Strategy (2019) and reiterated by Infrastructure Australia and the Productivity Commission in recent reviews.

A central shift will involve replacing blunt, legacy revenue instruments — notably fuel excise and uniform registration charges — with pricing frameworks more closely aligned to the marginal social cost of use (see Section 11.2). Congestion charging, already standard practice in leading global cities, will need to be explored more seriously as urban networks approach capacity constraints. Distance-based charging for light vehicles is also emerging as a policy inevitability as the fuel-excise base erodes with electric-vehicle uptake. For heavy vehicles, the Strategy and successive Productivity Commission inquiries highlight growing recognition that mass–distance–location charging provides a more economically rational foundation for cost recovery and incentivises the efficient use of high-value freight corridors.

A second anticipated trend is a renewed interest in economic regulation of the transport network itself. Although Australia has developed strong institutional frameworks for regulating electricity, water and telecommunications, roads remain largely unpriced and outside independent regulatory scrutiny. As user-charging reforms mature, governments may move toward applying independent price regulation to parts of the National Land Transport Network — particularly the national highway system — to improve transparency around cost recovery, maintenance obligations and service standards. The idea of treating major road corridors more like regulated utilities has been canvassed by both Infrastructure Australia and the Productivity Commission, which argue that clearer governance and pricing signals would lead to more efficient investment and reduced political distortion in funding allocations.

A third direction for reform is stronger scrutiny of publicly funded infrastructure projects. The cost escalations and benefit–cost volatility seen across megaprojects over the past decade have already prompted Infrastructure Australia to strengthen its assessment framework and push for earlier-stage options analysis, more transparent modelling and staged investment pathways. Future project appraisal is likely to place greater weight on climate resilience, lifecycle operational costs and whole-of-network performance — themes reinforced in both the National Freight and Supply Chain Strategy and state-level freight plans. In an environment of tighter fiscal constraints, governments are likely to prefer incremental upgrades and targeted bottleneck relief over very large greenfield expansions unless supported by robust, independently verified demand analysis.

Finally, transport policy is likely to become more integrated and data-driven. The Strategy emphasises the need for nationally consistent regulation, better freight data visibility, and improved coordination between land-use planning and transport investment — all of which point to a future where digital tools shape network operations in real time, and policy settings are designed to optimise overall system performance rather than individual modes. Integration of road pricing with public transport fares, expanded network management technologies, and more uniform safety and access frameworks across jurisdictions are all plausible developments. The overarching trajectory is towards a transport system that is more economically coherent, technologically enabled and governed with greater transparency — aligning user charges, investment decisions and regulatory oversight to deliver a more resilient and efficient national network.

Table 2-2 Distinction between Price and Economic Regulation

Function	Price regulator	Economic regulator
Sets heavy vehicle charges based on agreed principles and methodology	Yes	Yes
Audits input data to ensure it is within scope of charge setting methodology	Yes	Yes
Defines efficient, prudent or otherwise recoverable expenditure	No	Yes
Ensures on efficient, prudent or otherwise recoverable expenditures flow through to user charges	No	Yes
Develops and sets agreed service levels	No	Yes
Monitors delivery of agreed service levels, including any CSOs	No	Yes
Conducts ex-post evaluation of investments	No	Yes

Source: Land Transport Market Reform Independent price regulation of heavy vehicle charges (DIRD, 2017).

3 Transport sector footprint

3.1 Introduction

Australia's transport sector is the backbone of the economy, moving people and goods within our densely populated cities and across vast distances between our cities and regions. Accounting for 4-5 per cent of GDP in the National Accounts and up to 10 per cent on broader definitions, Australia's network of roads, rail lines, ports and intermodal hubs support the people and freight movements that collectively underpin the efficient functioning of businesses, government services, communities, and households.

- In GDP terms, Australia's Transport sector today is five times the size it was in the mid-1970s, outperforming growth in the Australian economy by 18 per cent. The roads subsector has expanded the fastest—about sixfold—while rail, at around threefold, has declined relative to national output.[52]

- The sector's share of GDP rose from below 4 per cent in the 1970s to just under 5 per cent at the height of the mining investment boom in 2007-08, dipped below 4 per cent during the Covid-19 era in 2020-21, and is at its long-run average of 4.4 per cent in 2023–24.[53]

- In 2023-24, the sector accounted for 44 per cent (or 1,759 PJ) of total Australian energy consumption (of 4,036 PJ). Transport's energy consumption exceeds that of the Household and Commercial sectors combined (at 792.0 PJ) by a factor of more than two.[54]

- In dollar terms, in 2022-23 the Transport sector 'consumed' (i.e. purchased) Petroleum and coal product manufacturing ($2.4 billion), Electricity generation ($479 million), and Electricity transmission, distribution, on selling and electricity market operation ($596 million).

- Beyond energy consumption, the sector's economic footprint is extensive, consuming billions annually in Transport support services and storage ($17.7 billion in 2022-23), Road transport ($11.7 billion), Professional, scientific and technical services ($10.7 billion), Employment, travel agency and other administrative services ($9.1 billion), Construction and Construction services ($7.7 billion), and Automotive repair and maintenance ($5.1 billion).[55]

- In 2022-23, the transport sector produced $259.3 billion in output, using $122.9 billion in resources, creating $110.1 billion in value to the Australian economy (Figure 3-1).[56]

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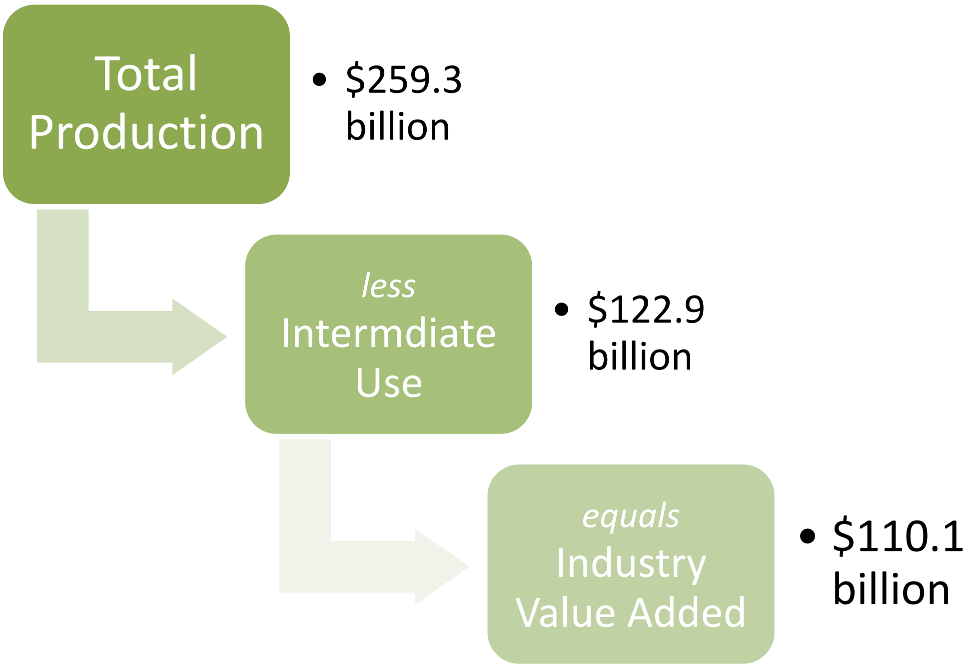
[52] ABS 5204.0 Australian System of National Accounts. Table 5. Gross Value Added (GVA) by Industry.
[53] Ibid.
[54] Department of Climate Change, Energy, the Environment and Water, Australian Energy Statistics, Table A, August 2025.
[55] ABS 5209.0.55.001 Australian National Accounts: Input-Output Tables, 2022-23.
[56] Ibid.

Figure 3-1 Transport sector resources supply and use, 2022-23



Source: ABS 5209.0.55.001 Australian National Accounts: Input-Output Tables, 2022-23.

- The performance of the transport network has an disproportionate impact on national productivity. Coşar et al (2024) finds that "the calibrated change in transportation productivity had a sizable impact on aggregate welfare, magnified by a factor of 2.3 compared to its sectoral share in GDP".

- The design and performance of the transport network directly affects how easily workers can access jobs, how efficiently businesses can reach households, and how reliably supply chains operate. Inefficiencies — whether from congestion, delays due to natural disasters, or poor intermodal connectivity — impose broad costs across the economy, reducing efficiency and ultimately limiting growth in living standards. By contrast, an efficient, well-integrated transport network lowers business and household costs, accelerates the flow of both people and goods across the economy and, as a result, increases access to economic opportunity.

This means that transport is more than just an enabling service — it is a critical driver of economic performance. Investment in transport infrastructure and better system management multiplies productivity gains across all industries, from agriculture and manufacturing to services and digital trade. By ensuring Australia's cities and regions are well connected internally and to the world, a high-performing transport system strengthens resilience, supports innovation, and sustains long-term economic prosperity.

3.2 The Transport task

In this section we have classified the total transport task by network user (i.e. passenger and freight) rather than by mode. In other sections of the report, it is more useful to focus on transport mode.

3.2.1 The Passenger Task

Passenger transport in Australia has been dominated by the private car for more than half a century (Figure 3-2). In 1971, there were 2.5 million passenger vehicles registered; by 2024, that number had increased to more than 15.7 million. Over the same period, vehicle-kilometres travelled by cars nearly tripled, outpacing population growth and entrenching car dependence. Suburban expansion in cities such as Sydney, Melbourne, Brisbane and Perth reinforced this reliance, while public transport patronage stagnated through the 1970s and 1980s before reviving in the late 1990s and 2000s (BITRE 2024).

Australia's passenger transport task is vast in both scale and complexity. Its growth has been driven by population and income growth on the one hand, and the design of Australia's cities on the other.

- In January 2024, the national vehicle fleet numbered 21.7 million registered motor vehicles, compared with just 4.8 million in 1971.

- The road network extends to approximately 463,000 kilometres of paved roads, on which Australians travelled an estimated 260 billion vehicle-kilometres in 2023–24 — nearly triple the 92 billion kilometres recorded in 1971. (BITRE 2024).

Within the passenger fleet, vehicle composition has shifted dramatically. Family sedans dominated in the 1970s and 1980s, but by 2023–24, SUVs accounted for 56 per cent of new sales, compared with 30 per cent just a decade earlier. Smaller, lighter cars and utility trucks ('utes') are also more popular than the family sedan. The average vehicle age has crept upwards to 11.2 years, slowing turnover and delaying the adoption of new technologies like EVs (BITRE 2024). That said, this decade EVs are beginning to emerge: in 2015 there were fewer than 2,000 registered electric vehicles nationwide; by 2024 there were almost 168,000 battery and fuel-cell EVs, though they still represent only about one per cent of the passenger fleet.

3.2.1.1 Impact of Covid-19

Work-from-home arrangements and digital substitution are also reshaping the passenger task. Where daily CBD commutes once defined a large part of total passenger demand, peak travel has flattened since the COVID-19 pandemic, leading to permanent shifts in public transport ridership despite government attempts to reverse the trend with heavily discounted PT fares.

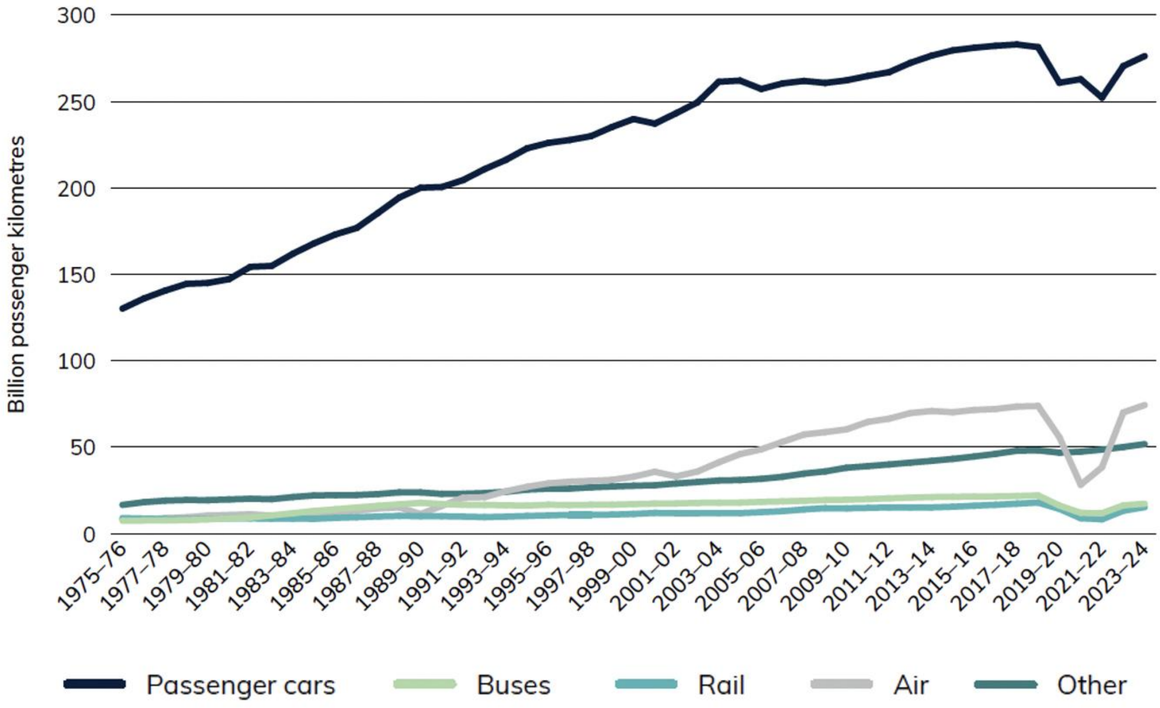
According to the BITRE, the percentage reductions in passenger transport demand, in particularly PT ridership, since the pre-Covid peak have been significant.

- Private vehicles declined from 281.4 bpkm in 2018-19 to 276.2 bpkm in 2023-24 or by 1.8 per cent;

- Buses declined from 22 bpkm to 17.2 bpkm or by 21.8 per cent; and

- Rail declined from 17.9 bpkm to 15.2 bpkm or by 15.1 per cent (BITRE 2024 Yearbook).

Figure 3-2 Australian domestic passenger task, by transport mode



Source: BITRE Australian Infrastructure and Transport Statistics Yearbook 2024, January 2025.

3.2.2 The Freight Task

In 1971, Australia's domestic freight task was estimated at 106 billion tonne-kilometres. By 2020 it had surpassed 870 billion tonne-kilometres, more than an eightfold increase.

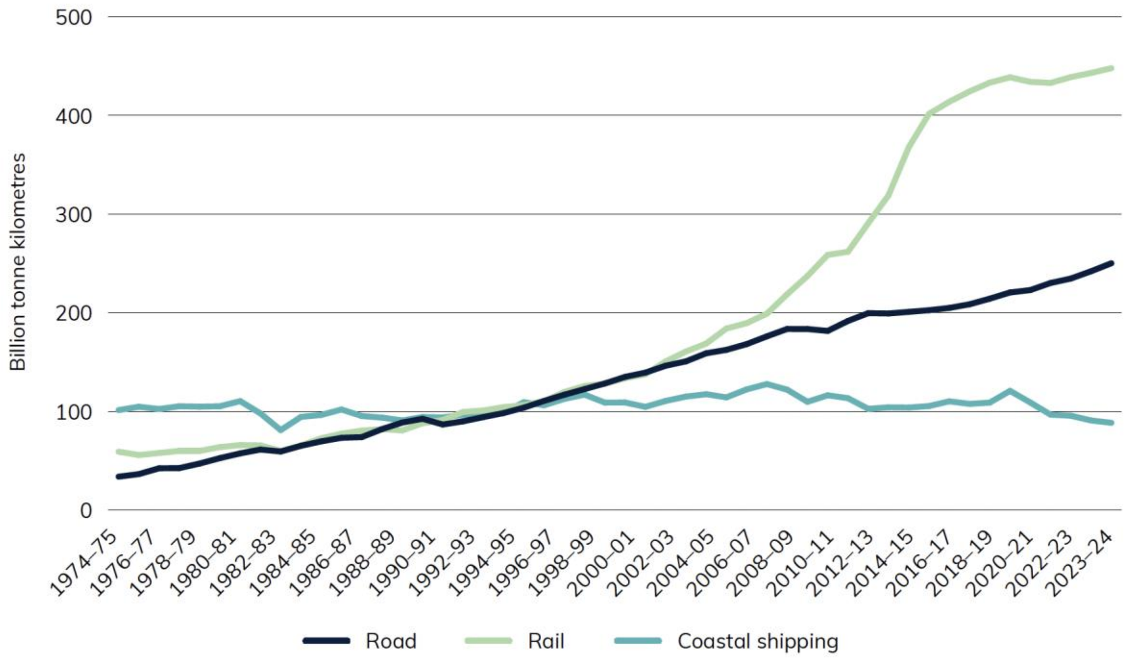
- Rail freight has led the surge, with bulk resources and commodity exports more than doubling through the mining boom period from 150 btkm in 2003-04 to almost 400 btkm in 2011-12. Rail freight now accounts for more than 50 per cent of the total freight task.

- Road freight has grown steadily, expanding fivefold in the four decades since 1974-75, consistent with population and income growth.

- Coastal shipping has essentially remained steady in absolute terms at around 100 btkm since 1974-75. This decade, there is some evidence of a trend decline since 2019-20, but demand is likely to have been impacted by Covid-19. (Figure 3-3).

The mining investment boom of the 2000s and 2010s was a significant turning point in the use of freight rail transport. Heavy-haul railways in the Pilbara, the expansion of the Hunter Valley coal network, and port upgrades at Newcastle, Gladstone and Port Hedland has created some of the world's most efficient supply chains. Bulk exports of iron ore, coking and thermal coal and later LNG drove much of the growth, while agricultural exports such as grain also benefitted from infrastructure upgrades.

Figure 3-3 Australia's domestic freight task by mode of transport, 1974-75 to 2023-24



Source: BITRE Yearbook 2024.

3.2.2.1 Looking ahead

In 2023-24, 785 billion tonne kilometres (btkm) of goods moved by rail, road, coastal shipping and air, as follows.

- 448 btkm by rail (57% of the total freight task);
- 249 btkm by road (32%);
- 88 btkm by coastal shipping (11%); and
- 0.2 btkm by air (i.e. a negligible amount), (Figure 3-4).

The freight task continues to grow and has been forecast by the Australian Government to increase by 35 per cent between 2018 and 2040 to be more than one trillion tonne kilometres.[57]

- The bulk commodity export rail freight task is expected to grow in line with global economic growth with India potentially replacing China as a key driver of increasing demand. Both India and China continue to invest in carbon-based sources of energy production and in steelmaking, driving demand for thermal coal and LNG on the one hand, and coking coal and iron ore on the other. China continues to buy large volumes

[57] National Freight and Supply Chain Strategy (2019). Accessed here: https://www.freightaustralia.gov.au/sites/default/files/documents/national-freight-and-supply-chain-strategy.pdf

of iron ore from Australia, accounting for 85 per cent of total Australian iron ore exports in 2023-24.[58] LNG exports to South Korea, Japan are continuing to ramp up.

- Domestically, the relative competitive advantage of the Melbourne to Brisbane Inland Rail vis-à-vis the potential for lower cost larger autonomous heavy freight vehicles will largely determine rail freight's share on the north-south east coast route. Currently, road freight accounts for more than 90 per cent of the north-south east cost route: although rail has a 10-15 per cent cost advantage per tonne over long distances, it is slower, less reliable and requires more intermodal transfers to deliver goods to their final destination.

- Road freight is expected to grow in line with population and income growth. As noted above, the relative success of larger autonomous heavy road freight vehicles will determine road freight's inter capital city share. The growth in online shopping will drive increasing demand for home delivery and the size of the small light commercial vehicle fleet.

- Coastal shipping will continue to decline as a proportion of the total freight task and may continue its post-Covid decline in absolute terms.

- There have been innovations in air freight in recent years with, for example, fresh produce (e.g. beef and leafy vegetables) exports out of Wellcamp Airport in Toowoomba direct into Asia. However, these developments, while value creating, are not expected to materially lift total freight volumes.[59]

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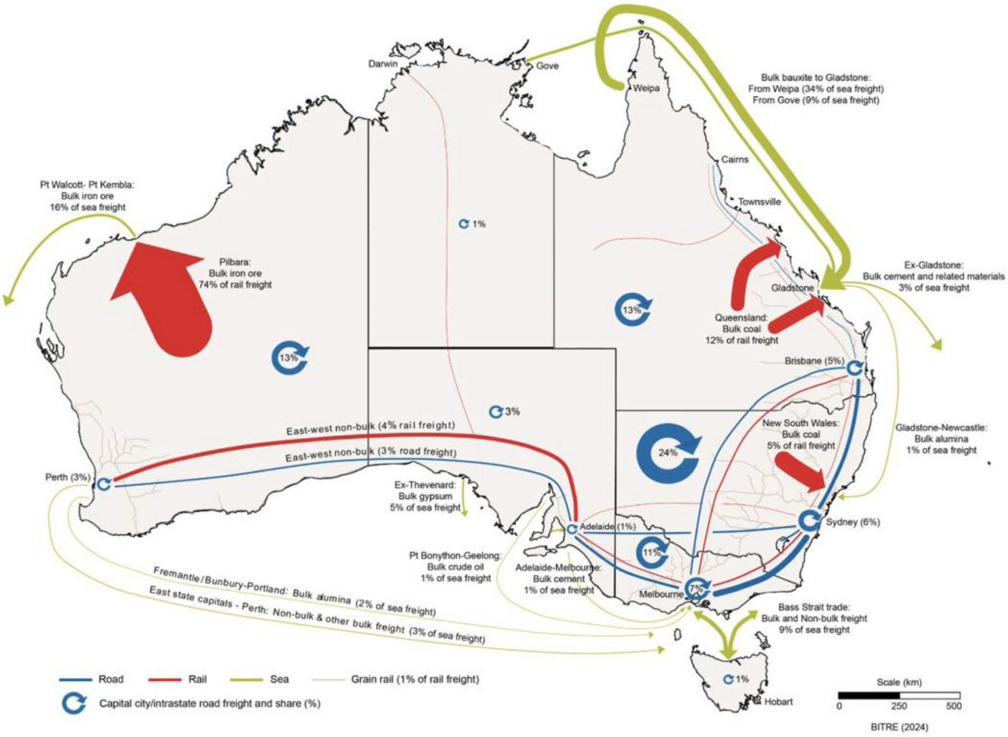
[58] Currently, India is largely self-sufficient in iron ore production, but requires thermal coal imports for electricity production. In 2024-25, India purchased only $371 million out of $116.4 billion in Australian iron ore exports. India's imports of thermal coal are currently half that of China's. India may become a net importer of iron ore if steelmaking demand rises faster than its ability to build new iron ore mine capacity. (Department of Industry, Science and Resources, September 2025).

[59] See here: https://statements.qld.gov.au/statements/92767

Figure 3-4 Australian freight flows map



Source: BITRE Yearbook 2024.

3.3 Measuring transport's economic contribution

3.3.1 Transport services is a derived demand

The demand for transport services is derived from another demand — for goods or people to be delivered from one place to another. Improvements in transport services can be expected to have important positive economic effects, which are valued by businesses and households. Some of these effects translate directly into GDP, some indirectly and some are not captured but are nonetheless important.

For example, improvements in the transport network produce a number of benefits.

- People save time. For instance, driving to and from work takes less time, which provides an economic benefit to the commuter in terms of more leisure time or time spent studying, working or performing household tasks.
- Freight is delivered more quickly and/or more reliably.
- Freight is delivered at a lower cost.
- Reducing the per-kilometre cost of freight can widen the market for the production and distribution of goods. This leads to greater competition and lower cost mark-ups on goods and services relative to when freight costs are higher.

- A factory can draw supplies from a wider area with potential gains in the terms of the cost and/or quality of input materials.

3.3.2 Measuring economic activity

There is no single approach to measuring economic activity. For example, GDP is reported in the National Accounts in three different ways — based on estimates of total production, income and expenditure. A separate concept of economic welfare is used to measure the benefits and costs of a particular government policy or infrastructure project, usually in a cost-benefit analysis (CBA) framework.

In the Australian System of National Accounts, the production measure of GDP identifies the size of the Transport sector, which was 4.4 per cent of GDP in 2023-24. This production measure estimates the total returns to labour (i.e. wages paid) and capital (i.e. profits) plus taxes paid (i.e. personal and company income tax and GST etc) less subsidies received by the sector. While this defines the economic contribution of the Transport sector to the Australian economy, its measurement is limited to organisations whose main business is the provision of transport services. It ignores the 'inhouse' transport services that are provided by companies whose primary business is in another sector. It is also silent on the potential change in household (i.e. individual) welfare as a result of changes in economic activity within the sector.

Economic welfare, as used in the CBAs that generally support business cases, is a much broader and household-centred concept. It asks: are people better off once all monetisable costs and benefits of a proposed infrastructure project (or policy reform) are counted? Technically, economic welfare is measured as the sum of the consumer and producer surplus. The producer surplus is an easier concept to understand and can be proxied by the returns to capital (i.e. profits), which is essentially the difference between revenues and costs. The concept of consumer surplus tries to identify the gain to an individual's wellbeing after subtracting the cost of obtaining the good or service that supports wellbeing. If I was willing to pay $10 to avoid 5 minutes of traffic and the toll on the road was $4, then the welfare gain is the difference between benefits and costs, that is $6.

- For example, a new arterial road that saves commuters 5 minutes a day will be credited in a CBA with the sum of time saved × value of time (often proxied by the average wage rate), even though no extra "output" was produced. That benefit never appears in GDP because nothing new was produced — drivers and passengers undertook the same trip with fewer resources. Infrastructure Australia's appraisal guide and ATAP make this distinction explicit: CBAs seek to measure the total change in social surplus (i.e. consumer plus producer surplus), not just market production.

Ultimately, economic welfare gains should translate into GDP as, for example, travel time savings are converted into increased hours worked or more spending on leisure activities and so on (Table 3-1).

Table 3-1 Transport infrastructure project, economic measurement

Measure	GDP	Welfare
Capital investment	Yes – in the E measure of GDP	Yes – as a cost in the CBA
Overheads	No – to avoid double counting	Yes – as a cost
Labour costs	Yes	Yes – as a cost
Travel time savings	Not directly	Yes directly – as a benefit
Avoided traffic accidents, congestion and pollution	Not directly	Yes directly – as a benefit

Source: Tulipwood Economics.

3.3.3 Transport's economic contribution

The transport, postal and warehousing sector accounted for 4.4 per cent of GDP in 2023-24 (or $115.4 billion in industry gross value added). In terms of mode share, road transport dominates accounting for 29.6 per cent of total industry GVA, with the rail share 13.9 per cent and air and space transport 12.3 per cent. Services to the sector accounted for 44.2 per cent of sector GVA in 2013-24.[60]

The ABS has estimated the sector's broader footprint in the Australian Transport Satellite Account, which includes 'in-house' transport GVA in addition to 'for-hire' transport GVA. In-house transport services are classified as transport services provided within an industry other than Transport — for instance in Mining, Construction, Wholesale and Retail trade.[61] Using this definition, the sector's share of GDP is roughly double the traditional measure, peaking at the end of the mining boom in 2011-12 at 10.8 per cent of GDP before declining to be 8.5 per cent of GDP in 2018-19.[62]

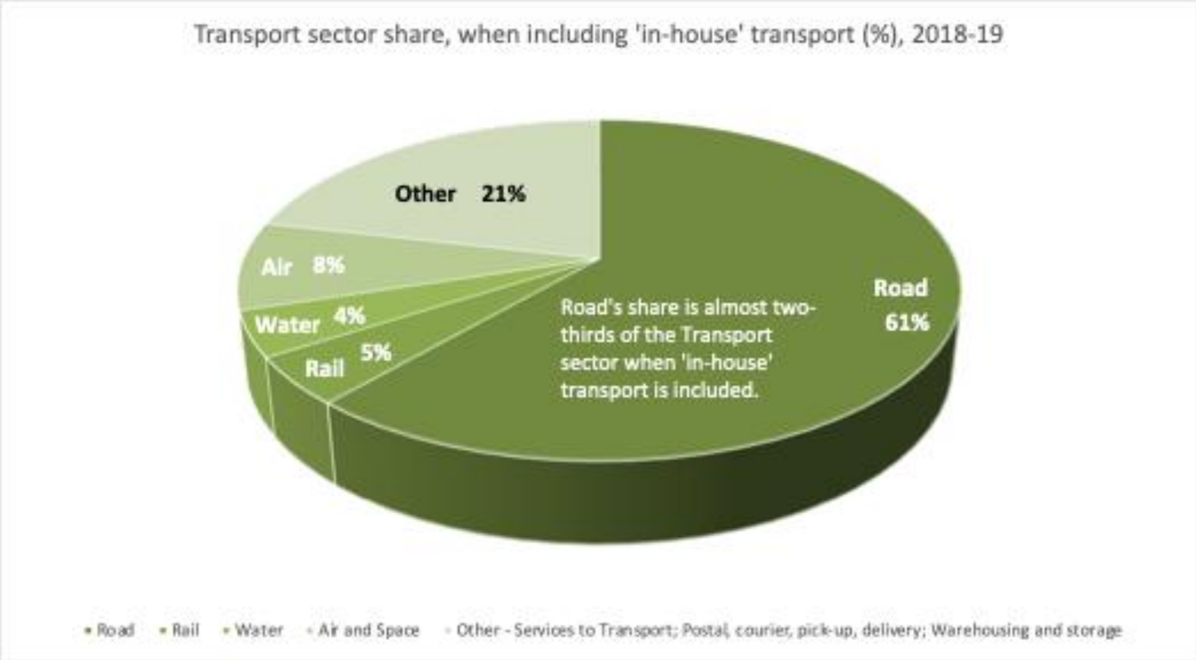
In 2018-19, when 'in-house' transport services are included:

- Road's share of the Transport sector is 61%; Rail's share (5%), Water (4%), and Air and Space transport (8%).

[60] ABS 5204.0 Australian System of National Accounts, Table 5. Gross Value Added (GVA) by Industry. https://www.abs.gov.au/statistics/economy/national-accounts/australian-system-national-accounts/latest-release#data-downloads
[61] For example, a vertically integrated mining firm transports its iron ore to port or a construction firm transports its building material to the building site.
[62] We have ignored two further years in the experimental series 2019-20 and 2020-21 as they have been affected by the Covid-induced lockdowns and other restrictions on the sector.

- The grouping of Services to Transport (like design and engineering services); Postal, courier, pick-up, delivery; and Warehousing and storage services is 21%.

Figure 3-5 Transport sector shares when including 'in-house' transport



Source: ABS 5720.0 Australian Transport Economic Account: An Experimental Transport Satellite Account. Table 2 Total Transport Output by Mode, basic prices.

The sector's size has been relatively stable since the mid-1970s, ranging between 4-5 per cent of GDP since 1977-78 apart from 2020-21 (3.8%), which was impacted by the Covid-induced lockdown rules that drastically reduced non-freight transport demand. Over the same period, road's share of output has steadily increased while rail's share has steadily declined. Prior to the Covid period, which saw a significant switch from in-person meetings to video conferencing, air transport's share of sector output had doubled from 10-11 per cent in the mid 1970s to 22-23 per cent in the late 2010s. In the post-Covid era, air transport's share has declined to 12.3 per cent in 2023-24, a share not seen since the late 1980s.

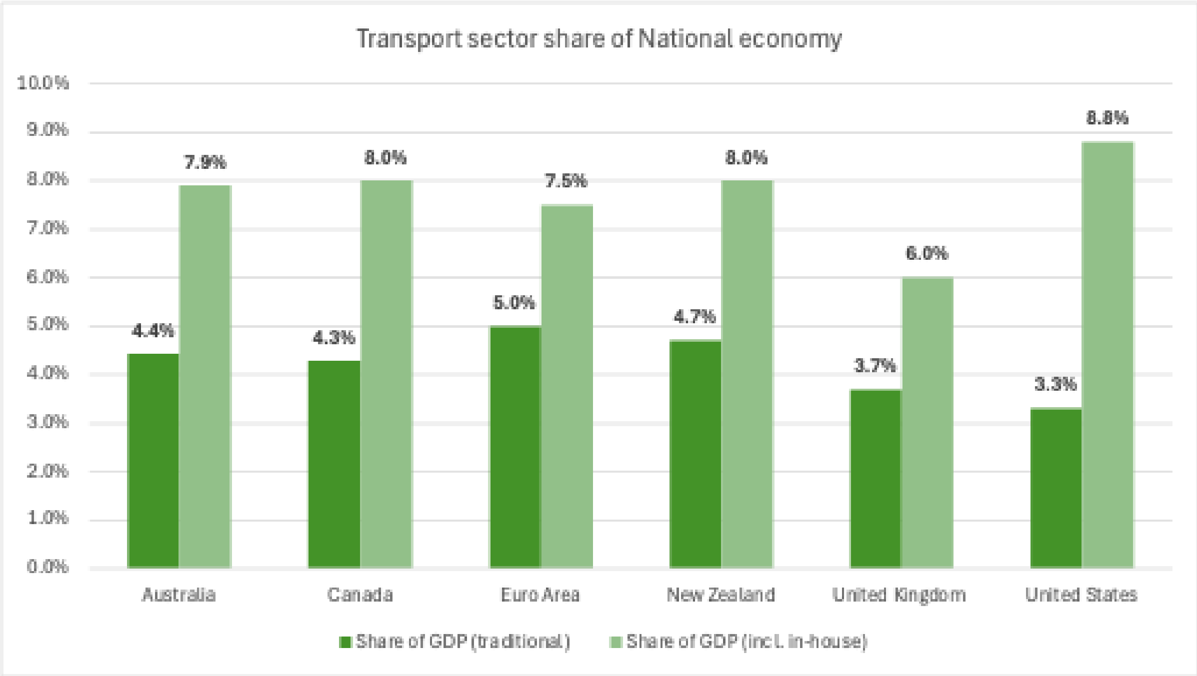
Figure 3-6 Transport sector v Market sector industry GVA, 1994-95 to 2023-24

Source: ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 8: Gross Value Added, Chain Volume Indexes.

An emerging trend across all advanced economies is the reclassification of transport's role within national accounts. Increasingly, measured value-added in transport is shifting away from traditional modes such as road, rail, sea, and air, and toward warehousing, logistics, and postal services. This reflects the structural transformation of economies towards e-commerce and just-in-time logistics. Australia is not unique in this shift, but its dispersed geography and fast adoption of digital logistics tools mean that the warehousing and postal subsector is becoming a larger part of measured transport GDP than in many European peers.

Taken together, international comparisons highlight two key points. First, Australia's transport share of GDP is structurally higher than that of the United States or the United Kingdom because of geography and density, not necessarily inefficiency. Second, however, Australia underperforms relative to best practice in areas such as project selection, congestion management, and urban passenger transport integration. As OECD (2019) and ITF (2021) both emphasise, moving closer to the productivity frontier will require pricing reform, better project prioritisation, and deeper integration across modes (Figure 3-7).

Figure 3-7 Transport's share of GDP, selected OECD countries



Source: OECD Transport sector database.

4 Productivity trends

4.1 What is productivity?

Productivity is defined as how much output can be produced with a given set of inputs. Productivity increases when more output is produced with the same quantity of inputs or when the same amount of output is produced with less inputs. In layman's terms, productivity growth happens when we work harder or smarter or both.

There are two widely used productivity measures.

- Labour productivity is defined as output per worker or per hour worked. Factors that can affect labour productivity include workers' skills, technological change, management practices and changes in capital inputs such that the capital-labour ratio rises.

- Multifactor productivity (MFP) is defined as output per unit of combined inputs. Combined inputs typically include labour and capital, but can be expanded to include energy, materials and services. Changes in MFP reflect changes in output that cannot be explained by changes in the quantity of inputs.[63]

Two other useful concepts in productivity analysis relate to the use of capital — capital deepening and capital productivity.

- Capital deepening refers to an increase over time in the capital to labour ratio (or K/L). Increased capital deepening is generally beneficial to economic growth since, on average, each unit of labour has more capital to work with to produce output and, therefore, is an indicator of an economy's ability to increase labour productivity.[64]

- Capital productivity is defined as a ratio of output to capital input; that is, output per unit of capital invested. Changes in this ratio can reflect technological changes, and changes in other inputs (such as labour). Capital productivity can be measured as the ratio of value-added produced to the capital stock.

Output can be increased by increasing labour productivity or increasing the total number of hours worked.[65] The two key formulas are:

Output = Labour productivity * hours worked

Labour productivity = Capital deepening + MFP

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[63] See RBA Productivity Explainer here: https://www.rba.gov.au/education/resources/explainers/productivity.html

[64] See ABS Interpreting ABS productivity statistics here: https://www.abs.gov.au/articles/interpreting-abs-productivity-statistics

[65] In the Australian Treasury's '3P's' framework — Productivity, Population, Participation — Labour productivity is 'Productivity' and hours worked is either 'population' or 'participation'; that is, either the total labour force increases or each worker on average increases their hours worked.

4.2 What drives productivity growth in transport?

4.2.1 Bigger trucks

Measured truck productivity rose faster than the freight task from the 1970's through to the mid-2000s. For articulated trucks, average loads more than doubled (from about 9.7 to over 20 tonnes per vehicle-km) and average distance travelled per vehicle increased by about 90 per cent between 1971 and 2007. Together, these changes delivered roughly a three-fold lift in articulated truck productivity. Across the whole heavy-vehicle fleet (rigids plus articulated ≥4.5 t), average vehicle productivity rose nearly six-fold over the same period, with articulated trucks driving about 95 per cent of the gain. Fuel consumption per tonne-kilometre also improved substantially, falling by around half between 1971 and 2007 (BITRE 2008).

Policy and engineering changes underpinned these gains. Larger combinations progressively entered the fleet, supported by tri-axle trailers in the 1970s, widespread adoption of six-axle articulated trucks, the early 1980s trials of B-doubles and their network rollout from the early 1990s, and expanded road-train access in the 1990s outside their traditional dusty remote Australia heartlands. In parallel, there were six major revisions to mass and dimension limits since 1971, lifting allowable masses under General Mass Limits by 15–28 per cent (and more under Higher Mass Limits), with rigid-truck limits also rising. BITRE's decomposition suggests around 80 per cent of the increase in fleet-wide average loads came from the shift toward larger combinations, with the balance due to higher mass and dimension limits (BITRE 2008).

4.2.2 Increased coordination and cost efficiency

A second wave of productivity came from operational and technological improvements. Duplication and realignment of highways cut running times; deregulation and harmonisation reduced administrative frictions; and firms adopted telematics, GPS-based fleet management, and computer-assisted routing to lift loads and reduce empty running. BITRE notes the strong link between larger, more capable vehicles and lower unit freight costs—one reason articulated trucks increased their share of total road tonne-kilometres from around 55 per cent in 1971 to nearly 80 per cent by 2007 (BITRE 2008; BITRE 2012).

Since the mid-2000s, the Performance-Based Standards (PBS) scheme has provided a structured path to further gains by approving innovative "high-productivity" vehicles that meet safety and infrastructure performance criteria. National reviews emphasise that PBS can deliver sizable productivity and safety benefits, but uptake depends on consistent access (especially on local government roads) and streamlined approvals. Recent NHVR and Austroads assessments show rapid PBS fleet growth and significant potential crash-rate reductions and productivity improvements compared with conventional fleets (NHVR 2021; Austroads 2020). Together, these studies reinforce PBS as the main channel for "next-step" productivity, provided access and governance keep pace.

4.2.3 Looking ahead

Looking forward, BITRE cautions that the “easy” gains from mass and dimension changes and larger combinations may already have been harvested. Without further regulatory and access reform, fleet-wide average load growth is likely to slow. Additional productivity will hinge on deeper PBS access (including metropolitan freight corridors), targeted increases in mass limits where pavements and bridges allow, and better first- and last-mile connections. Digital optimisation tools (such as platooning, advanced driver-assist systems, and richer telematics) and road-freight pricing reforms that align charges with wear and congestion will be crucial to unlocking the next tranche of gains (BITRE 2012; Productivity Commission 2017).

For corridor planning and appraisal, Australia increasingly relies on CSIRO’s TraNSIT model to quantify the supply-chain cost impacts of road upgrades and access to higher-productivity vehicles. This approach helps ensure investment is targeted to where truck productivity, reliability, and safety benefits are greatest (Higgins et al. 2016).

Governments can influence productivity through regulation, economic settings and standards, but many freight and supply chain operations lie beyond their direct remit. Commercial realities also play a role: operators must balance the push for efficiency against customers demand faster and more reliable deliveries.[66] This plays out in context of increasing digitalisation but little financial capacity among the operators to invest.

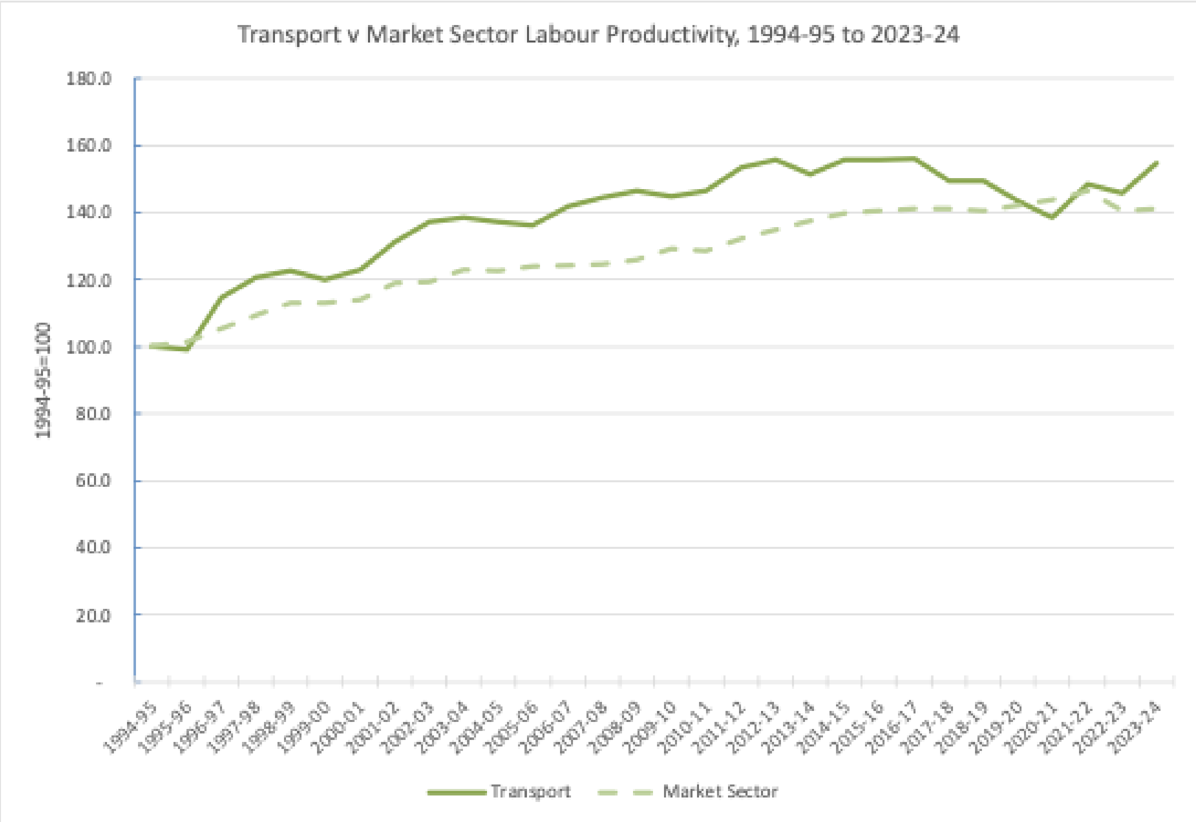
In addition, the sector faces increasing disruption from extreme weather events. Severe floods, fires and storms have left key road and rail links inoperable for extended periods, especially in regional and remote areas. In 2022, for example, flooding closed the East–West rail line for more than three weeks. Flooding regularly closes the Bruce Highway in Central and North Queensland. These disruptions reduce productivity by leaving labour and equipment idle and forcing a shift to more expensive alternative transport. Future rebuilding of critical transport networks will need to incorporate long-term resilience and productivity improvements.

4.3 Long-term productivity trends

From the mid-1990s until the mid-2010s labour productivity growth in the transport sector was relatively strong compared to total market sector productivity growth.[67] By 2014-15, labour productivity in the transport sector was almost 60 per cent higher than its level in 1994-95 whereas the total market sector labour productivity was just 40 per cent higher (Figure 4-1).

[66] Industry consultation indicates that gross margins in the transport industry average around 5 per cent, and can be as low as 2 per cent.
[67] Total market sector includes the Transport sector. Removing the Transport sector from the Market sector would increase Transport’s relative performance.

Figure 4-1 Transport v Market Sector labour productivity, 1994-95 to 2023-24



Source: ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 6 – Labour Productivity Indexes (quality adjusted hours worked basis).

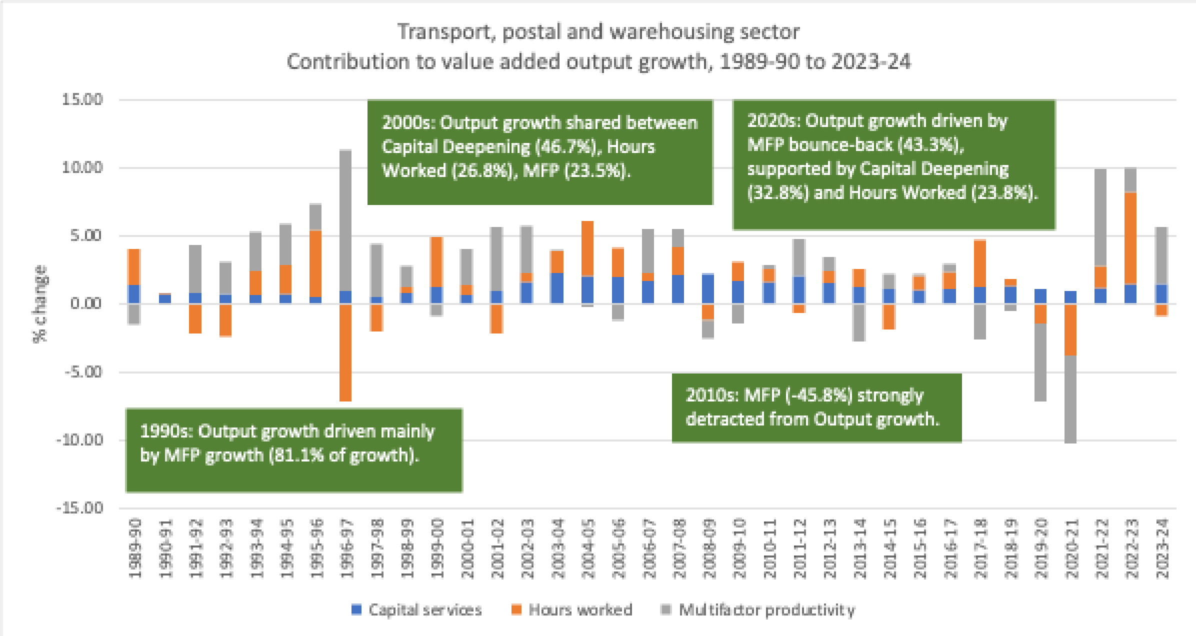
Since the mid-2010s, transport sector labour productivity growth slowed such that, by 2018-19 — the year prior to the Covid-19 impact — total productivity growth measured since the mid-1990s had reverted to the market sector level.

- The real cost per tonne kilometre in road and rail transport fell by 31 per cent and 58 per cent respectively in the 20 years leading up to 1998, and then *increased* by 5 per cent and 8 per cent respectively in the next 20 years to 2018.[68]
- The strong productivity growth in the 1990s reflected a relatively higher rate of technological progress and the widespread adoption of containerisation, larger articulated trucks and just-in-time delivery practices.
- This decade, productivity performance has been mixed, collapsing and then bouncing back, and largely driven by Covid and post-Covid era factors.

The impact of productivity on output can be seen by disaggregating the contributions to growth into capital services growth (i.e. capital deepening), hours worked and MFP (Figure 4-2).

[68] BITRE (2024).

Figure 4-2 Contributions to Transport sector growth, 1989-90 to 2023-24



Source: 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 25: Industry Growth Accounting Analysis: Annual points contribution to growth.

4.3.1 Productivity growth cycles

Measuring productivity growth across 'productivity growth cycles' — that is, from peak-to-peak — means that measured average growth is not distorted by temporary booms or slumps in capacity utilisation. The ABS identifies the years in which multifactor productivity (MFP) sits furthest above its long-run trend, and treats those years as cycle peaks; the average growth reported for a cycle is then measured between successive peaks. The aim is to minimise cyclical noise and better reflect underlying productivity growth rather than short-run swings in hours worked, capital use or demand.

Table 4-1 (below) identifies five productivity growth cycles since the mid-1990s in the Transport, postal and warehousing sector.

- The highest rate of MFP growth was in the 1996-97 to 2002-03 period where annual MFP growth was 2.56 per cent, contributing 69 per cent of total output growth during the period. This period was the 'golden age' of productivity growth in the Transport sector.

- Output growth in the 2002-03 to 2007-08 period (the pre-GFC mining investment boom Phase 1) relied much more on contributions from increased hours worked (44.7%) and capital deepening (41.8%) than on MFP growth (13.5%).

- In the post-GFC Phase 2 of the mining investment boom from 2007-08 to 2012-13, output growth in the sector relied overwhelmingly on capital deepening, which contributed 76.6 per cent of the total output growth.

- In the post mining boom period from 2012-13 to 2018-19, MFP growth went backwards and output growth relied on a roughly equal combination of capital deepening (54.5%) and increased hours worked (45.5%).

- In the most recent Covid era period from 2018-19 to 2023-24, capital deepening (66.7%) contributed significantly more than increased hours worked (24.6%) and MFP growth (9.3%) to total output growth.

- Returns on the transport capital stock have declined from a peak of 10.4 per cent in 2006-07 to 7.9 per cent in 2023-24 while avoidable congestion on capital-city corridors — especially freight routes — continues to impose large economic costs.[69]

Table 4-1 Contributions to average annual growth in the Transport, postal and warehousing sector, by productivity growth cycle

Productivity growth cycle	Capital services (A)	Hours worked (B)	MFP (C)	Output growth (A+B+C)
1996-97 to 2002-03	0.95	0.21	2.56	3.72
2002-03 to 2007-08	1.98	2.12	0.64	4.74
2007-08 to 2012-13	1.80	0.27	0.28	2.35
2012-13 to 2018-19	1.15	0.96	-0.69	1.42
2018-19 to 2023-24	1.22	0.45	0.17	1.83

Source: ABS 5260.0.55.002 Estimates of Industry Multifactor Productivity, Australia. Table 26: Productivity Growth Cycles – Transport, postal and warehousing industry.

4.4 Recent productivity developments

This decade the main factor driving changes in Transport sector productivity has been Covid-19. The first Covid-19 cases in Australia were recorded in 2020 — that is, in the 2019-20 financial year. In response, Federal and State governments to varying extents instituted industry shutdowns that impacted transport demand.

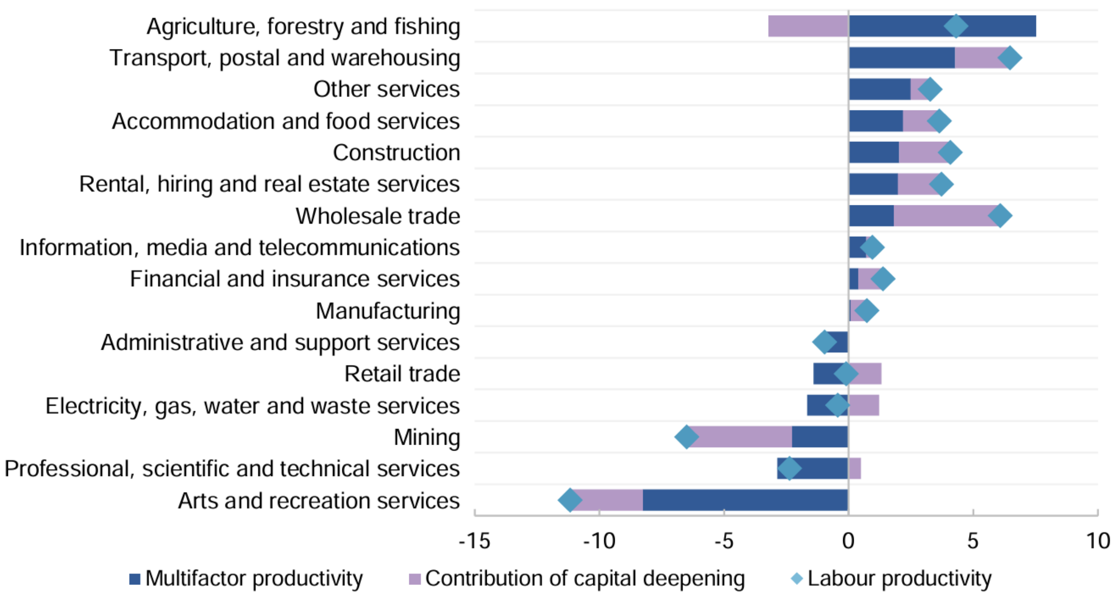
- Output growth collapsed in 2019-20 (-6.1%) and 2020-21 (-9.3%).

- Growth rebounded strongly (off a lower base) as the economy returned to normal operation in 2022-23 and 2023-24.

[69] Measured as Gross Operating Surplus divided by the Net Capital Stock in the Transport sector using the ABS System of National Accounts.

- Figure 4-3 (below) shows the contributions of MFP growth and capital deepening to labour productivity growth by industry in 2023-24. In the market sector, labour productivity growth was highest in the transport, postal and warehousing sector (at 6%) with positive contributions from both MFP growth (4%) and capital deepening (2%).

Figure 4-3 Productivity growth by industry, 2022-23 to 2023-24 (percentage change)



Source: Productivity Commission, Annual Productivity Bulletin 2025.

4.5 International comparison

Australia's transport sector is broadly comparable in relative scale to those of other advanced economies, but with important differences shaped by geography, population density, and institutional arrangements. Across OECD countries, transport typically accounts for between 3 and 5 per cent of GDP, reflecting its role as an essential intermediate input into almost every other sector of the economy. Australia sits in the middle of this range, with transport contributing around 4.4 per cent of GDP, a figure very close to Canada (4.3 per cent) and New Zealand (4.7 per cent), and slightly higher than the United Kingdom (3.7 per cent) and the United States (3.3 per cent). By contrast, the Euro Area average is closer to 5 per cent, reflecting both higher population densities and relatively less efficient logistics performance across parts of Eastern and Southern Europe (OECD, 2019; ITF, 2021).

In Figure 4-4 (below), Andrews et al (2022) plot the unweighted-average productivity of firms in the Services sector (including Transportation) relative to the global technological frontier of high productivity firms, the Australian frontier, and Australian laggards, to understand how Australian firm's compare relative to the technological frontier.

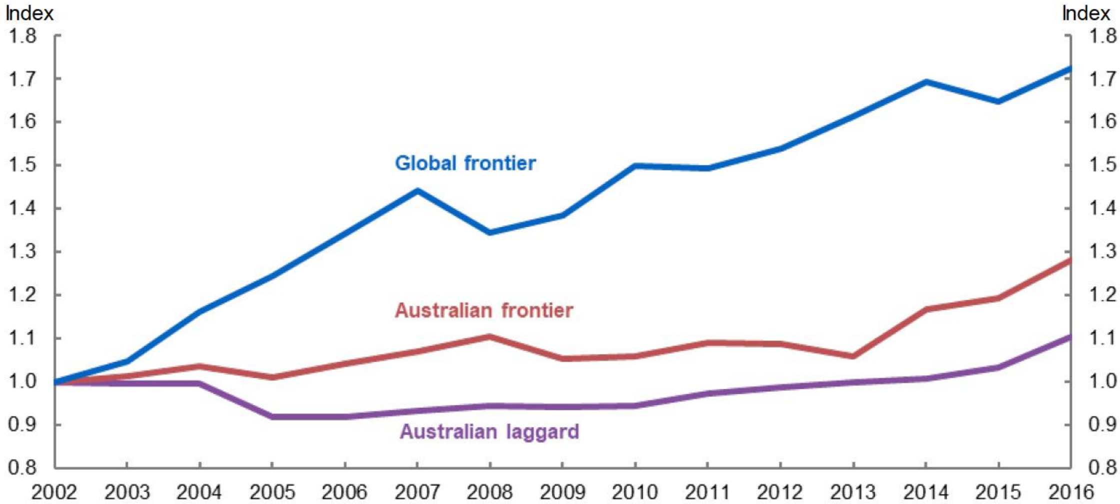
- Andrews et al (2022) sourced labour productivity data for the global productivity frontier from the OECD-Orbis database. These data are sourced from annual balance sheet and income statements using a variety of underlying sources such as credit rating agencies, national banks and financial information providers.

- Labour productivity at the global frontier in each industry is taken to be the (unweighted) average labour productivity of the most productive 5 per cent of firms in that industry for a given year. Andrews et al (2022) identify the top 5 per of firms using a fixed number of firms across years.
- The Australian frontier is defined in the same way using BLADE data.

The figure illustrates a growing gap between the productivity of the average global frontier firm and the average Australian firm over the period 2002 to 2016.

- While the productivity of those firms in the global frontier is 60 per cent higher in 2016 compared to 2002, Australian frontier firms' productivity is only 25 per cent higher, and other 'laggard' firms only 15 per cent higher.[70]
- Andrews et al (2022) note that it "is worth reiterating here that the firms that make up the Australian and global frontier are allowed to change, so we are showing the average productivity of firms in each of these groups over time, rather than tracking the productivity growth of any given firms."
- This is a stark result, repeated across all industry sectors when compared to the global frontier. In other words, Australia's poor productivity performance relative to the global technological frontier is not just isolated to the Transport sector.

Figure 4-4 Australian services sector productivity versus the global frontier



Notes: See Figure 1. Services sector defined as NACE industry codes 45-82, excluding 64-66.

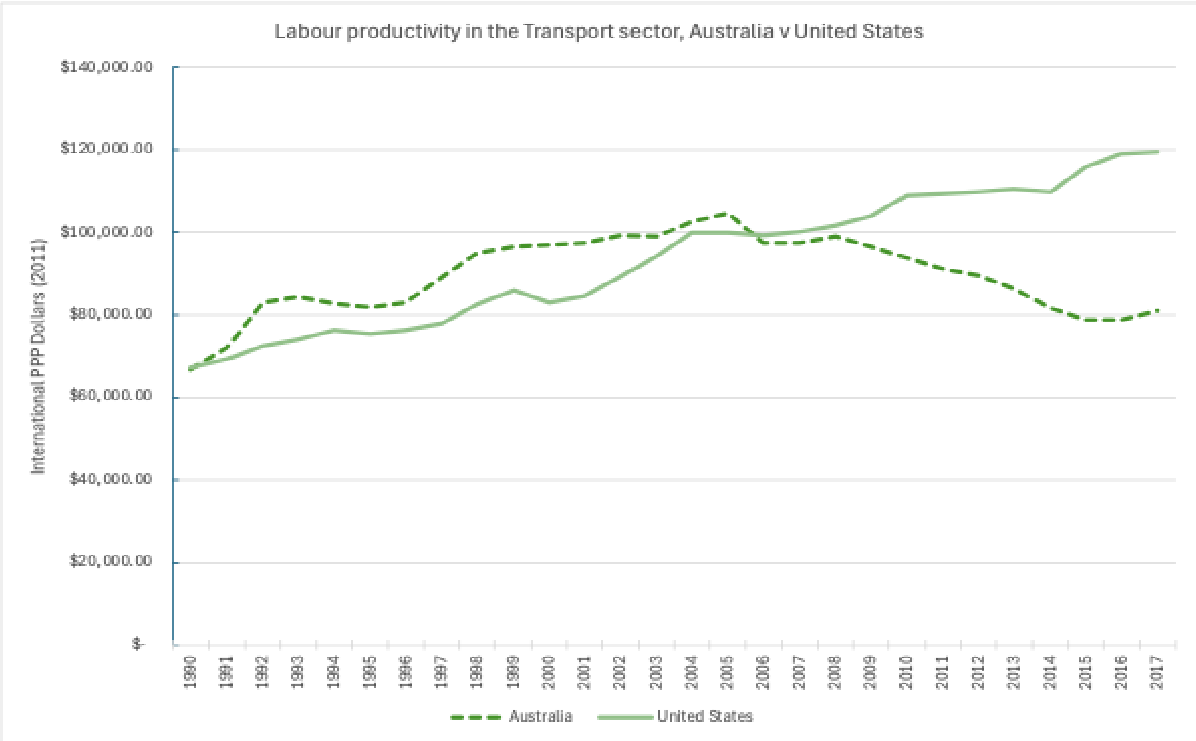
[70] Year-to-year declines in these indices do not necessarily indicate technological regression. They can also be affected by demand induced decreases in capacity utilisation and churn in the constituent firms in each group. As such, it is best to focus on the overall relative trends.

Source: Andrews et al (2022). Note: Transportation services are including in the Services sector, under the NACE industry classification system (NACE sections 49 to 53).

Population density is one of the most significant structural drivers of these outcomes. Australia's density of just 3.5 people per square kilometre is among the lowest in the OECD, matched only by Canada (4.5) and New Zealand (19.9). In such sparsely populated countries, transport networks must stretch across vast distances to connect dispersed populations and industries, raising unit costs and requiring higher investment shares of GDP. By contrast, densely populated economies such as the United Kingdom (286 people/km²) and the Euro Area (127) can achieve more efficient utilisation of infrastructure, explaining why their transport sectors account for a smaller share of GDP relative to economic output. The United States, at 37 people/km², is less dense than Europe but has a larger, more integrated domestic market that enables economies of scale in freight and logistics.

In terms of productivity, the United States remains the global frontier. Studies by the International Transport Forum (2021) show that US freight rail, in particular, operates with the highest labour productivity in the world, supported by vertically integrated private railroads that compete across parallel corridors. Australia's rail freight sector, while efficient in bulk exports such as coal and iron ore, lacks the same productivity in general freight, where road continues to dominate. Similarly, in road freight, the United States has adopted larger truck configurations only recently, whereas Australia has been a global pioneer in high-productivity vehicles such as B-doubles and road trains. This has given Australia an edge in long-distance freight efficiency, but not enough to offset structural disadvantages of scale and distance (Figure 4-5).

Figure 4-5 Transport sector labour productivity, Australia v United States



Source: World Bank ASPD Database.

Industry-level production account data for the United States (Eldridge et al., 2020) shows that over the past seven decades, multifactor productivity (MFP) growth in the freight transportation (non-air, including warehousing) has outpaced aggregate productivity growth in the private economy.

- In 2016, MFP in freight transportation was 59 per cent higher than its 1947 level, compared to a 32 per cent increase in the rest of the private economy; during the same period, despite the large increase in domestic shipments and in contrast to other service sectors, the share of freight transportation in hours worked experienced a secular decline from 5 per cent in 1947 to 3.6 per cent in 2016, and its value added share declined from 6.0 per cent to 2.6 per cent (Coşar et al, 2024).

Passenger transport comparisons are also instructive. European countries, with dense populations and compact cities, rely far more heavily on public and active transport, supported by long-standing investment in metro, regional rail, and cycling infrastructure. The United States and Australia, by contrast, are heavily car-dependent, with urban form and investment patterns reinforcing high private vehicle mode shares. The United Kingdom sits somewhat in between, with higher public transport reliance than Australia but without the integrated metropolitan rail systems of continental Europe.

Table 4-2 Comparison on Transport sector share and population density, selected OECD countries

Country/Region	Share of GDP (Transport)	Population Density (people/km²)	Freight Productivity	Passenger Mode Share
Australia	4.4%	3.5	Strong in bulk rail exports and high-productivity trucks	Highly car-dependent; limited metro systems; rising PT investment since 2000s (but heavily subsidised)
United States	3.3%	37.0	Global frontier in freight rail productivity (private operators, economies of scale)	Predominantly car-based; limited PT outside major cities
Canada	4.3%	4.5	Efficient export corridors; similar challenges to Australia	Car-dependent, PT limited outside major metros
New Zealand	4.7%	20.0	Smaller scale but efficient inter-island logistics	Car reliance high; PT concentrated in Auckland/Wellington
United Kingdom	3.7%	286.0	Smaller landmass enables efficient freight, but ageing rail capacity a challenge	Higher PT use than Australia; dense metro and intercity rail
Euro Area (average)	~5%	127.0	Freight less efficient in some Eastern/Southern states; strong in Western Europe	Extensive PT networks, metro systems, and cycling/active culture in some countries

Source: Tulipwood Economics analysis.

Part 2 Pinch points and problems

In Part 2 of this report, we identify the main pinch points and problems restraining Australia's Transport sector. These problems affect both freight productivity and household welfare. We divide the issues as follows:

- Transport sector investment (Section 5)
- Road congestion (Section 6)
- Rail freight challenges (Section 7)
- Passenger transport (Section 8)
- Decarbonisation (Section 9)

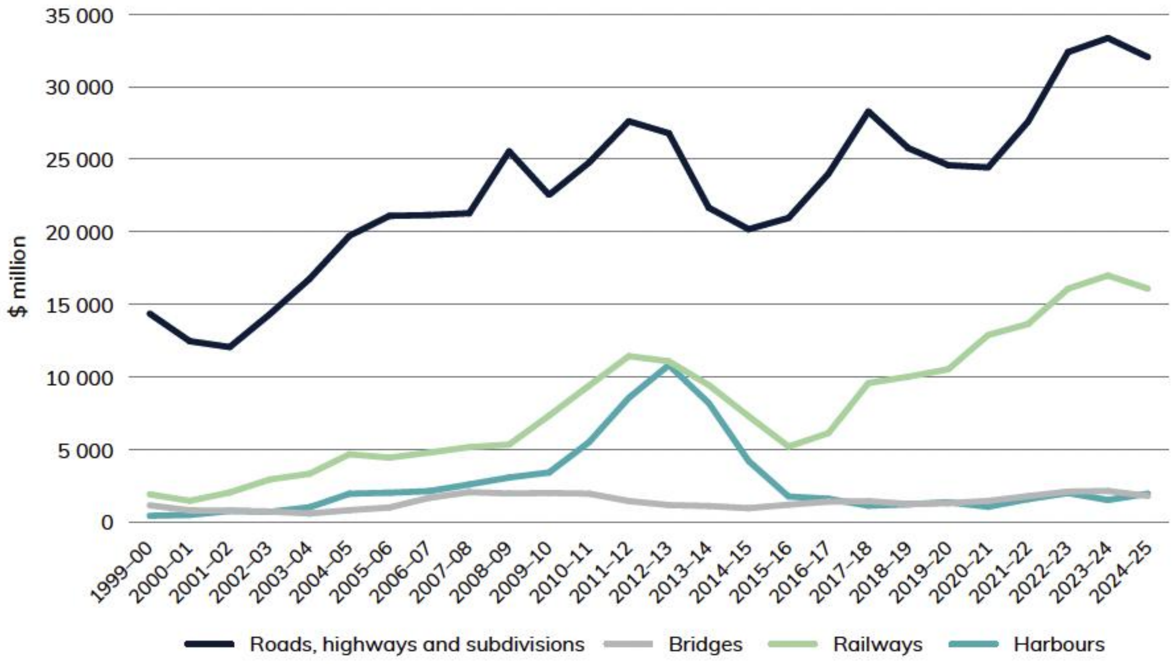
5 Transport sector investment

5.1 Introduction

In 2024-25, the value of Transport sector infrastructure construction work done exceeded $50 billion in real terms, or just under 2 per cent of GDP, for the third consecutive year. Over this period, the Transport sector accounted for just over one-half of total infrastructure engineering construction work done.[71] Accordingly, the stock of annual transport infrastructure investment and the return on that investment matters in terms of Australia's overall productivity performance and economic growth.

More than half of the total value of infrastructure engineering construction work done each year is allocated to Australia's road network. Annual road investment has risen from a post mining boom low of $20 billion in 2014-15 to $32 billion in 2024-25, or by 60 per cent in real terms in a decade. Since the mid-2010's, growth in annual rail investment has kept pace with road investment, tripling from $5 billion in 2015-16 to be more than $15 billion in 2024-25. Bridges and harbours generally represent only a small share of annual transport sector investment (Figure 5-1).

Figure 5-1 Transport construction activity ($2024-25)



Source: ABS (2025), *Engineering Construction Activity, Australia*

Source: BITRE Yearbook (2025).

[71] Over the three-year period 2022-23, 2023-24 and 2024-25, Transport sector engineering and construction work done amounted to $158.3 billion out of a total of $298.9 billion (in 2024-25 dollars adjusted by the CPI).

5.2 The problem with megaprojects

Megaprojects are large-scale infrastructure investments, typically defined as projects with total capital costs exceeding $5 billion. In Australia, transport megaprojects — particularly major urban and freight rail, and large motorway projects requiring tunnelling — have increasingly become the dominant form of public infrastructure investment (Terrill, 2020). Yet the defining characteristic of megaprojects is not simply their scale, but their chronic difficulty in being delivered as planned. As the world's leading infrastructure academic Professor Bent Flyvbjerg (2009) has observed, megaprojects are often "over time, over budget, over and over again." Their size and complexity make them inherently challenging to conceptualise, design and manage, particularly in accurately forecasting costs, benefits and risk. As a result, questions of scope control, cost escalation and benefit realisation are not peripheral concerns, but central structural features of the megaproject model itself.

The problem with megaprojects is well known (Flyvbjerg 2009, Branigan 2016, IA 2019, Terrill 2020, Lockwood and Mrdak 2022, Victorian PBO 2024). For example, Infrastructure Australia, in its reviews of major infrastructure project business cases has been generally critical of project proponents' identification of costs, benefit streams and discount rates applied such that the true benefit-cost ratio of proposed projects is often significantly lower than stated on the business case.[72] More recently, Deloitte Access Economics in its December 2025 Investment Monitor noted:

> *Across 13 publicly funded projects valued at $10 billion or more, the latest cost estimates have blown out by approximately $130 billion, equivalent to more than the entire value of residential construction work done across Australia in the past year. (DAE, December 2025).*

A review of several IA Business Case reviews indicate that larger projects tend to suffer from these flaws in estimated benefits and costs more than the smaller or incremental transport infrastructure projects (IA 2019, Terrill 2020).

- A succession of multi-billion-dollar Federal and State funded transport network megaprojects since 2010 has arguably diluted value for money by locking in optimism bias, cost escalation and benefit shortfalls, while crowding out smaller, staged, often high-BCR proposals that are more likely to deliver earlier and more certain returns.

- In practice, generally the biggest BCR 'undershoots' occur when projects are announced early without the required detail and/or are rushed through during economic upswings. As a result, designs can be effectively lock-in via political announcement before utility (e.g. EGWWS infrastructure) and land use risks are resolved, and when limited tier-one project bidder competition results in high bid costs.

[72] See, for example, IA reviews of Inland Rail, Cross River Rail, and sections of the Suburban Rail Loop. Accessed here: https://www.infrastructureaustralia.gov.au/project-evaluations/past-evaluations

- Moreover, pro-cyclical timing has compounded the problem. Governments have often procured megaprojects in overheated markets, pushing prices up at a time when labour and materials are scarce.

- Cost escalation seems to be routine on major schemes (e.g., WestConnex, Inland Rail, Cross River Rail, Suburban Rail Loop, North-East Link), with large gaps between business case cost estimates and actual out-turn costs (see Table 5-1).

- IR pressures on large works, especially in Victoria and Queensland, have contributed to schedule slippage and higher delivered costs.

Table 5-1 Transport megaproject forecast costs and benefits over time

Megaproject	Initial cost estimate ($b)	Latest cost estimate ($b)	Initial published BCR	Adjusted BCR
Inland Rail	9.9	32.0 to 34.0	1.1	0.3
Cross River Rail	3.5	20.0	1.4	0.3
Suburban Rail Loop	50.0	120.0 to 130.0	1.1	0.4
North-East link	6.0	26.1	1.4	0.3
Westconnex	10.0	21.0	1.7	0.8
Sydney Metro - West	13.0	27.0-29.0	1.0	0.5
Sydney Metro – City and SW	12.0	23.0	1.5	0.8
Adelaide T2D	5.5	16.0	0.7	0.2
Perth METRONET	4.0	12.4	2.6	0.8
West Gate Tunnel	5.5	10.0	1.3	0.7

Notes: To the extent possible, initial cost estimates (column 2) reflect a similar scope to the latest available cost estimate. For example, Inland Rail was initially costed at $4.4 billion in 2010, but the later $9.9 billion estimate is more reflective of the current scope of the project. Updated BCRs do not account for benefit shortfalls, such as the impact of working-from-home on Cross River Rail patronage. Note: Costs include both capital and ongoing operating costs in order to properly equate the BCR calculation with ongoing benefit estimates. Sources: Grattan Institute (2020), Deloitte Access Economics Investment Monitor (December 2025, publicly available version), Infrastructure Australia, Victorian Parliamentary Budget Office, NSW Audit Office, Queensland Government Ministerial Statements and various other reports.

5.3 What's been done about it?

5.3.1 Establishment of independent but powerless infrastructure advisory bodies

Fiscal pressures, cost blowouts and interstate coordination problems led to the creation of Infrastructure Australia (IA) in 2008 and various copycat state bodies such as Infrastructure NSW (est. 2011) and Infrastructure Victoria (est. 2015). Building Queensland (est. 2015) was absorbed back into the Queensland Treasury Department in 2021.

- IA's mandate — to publish a national Infrastructure Priority List, assess business cases against a common framework, and advise on project sequencing — has brought greater visibility to the Australia's infrastructure pipeline. That visibility has reduced some of the stop–start volatility that plagued the market, encouraged earlier options analysis and staging, and normalised the publication of independent assessments (including benefits in a BCR framework, risks and delivery readiness), especially at the State level.

- Over time, IA's assessment framework has also lifted capability: agencies now speak a more consistent "Business Case" and "CBA language," disclose underlying assumptions more clearly, and face more scrutiny on scope, costs, discount rates used and risk.

- A second, related shift has been the establishment of state infrastructure advisory bodies (e.g., Infrastructure NSW, Infrastructure Victoria). These entities publish state strategies and pipelines, run gateway reviews, and increasingly release business-case summaries and post-completion findings.

The combined effect of these governance reforms has been to professionalise and systemise project selection and review, improve market signalling, and give cabinet processes better material to review before committing to very large capital investments.

That said, greater pipeline transparency has not solved the problem of poor project selection, especially in relation to megaprojects. Political imperatives still drive some megaproject announcements ahead of robust analysis, business cases are sometimes rushed or unpublished, and optimism bias manifested in costs overruns and benefits shortfalls persists. As a result, numerous over-sized, under-scoped megaprojects have proceeded despite low and/or questionable benefit–cost ratios.

5.4 Further governance reform is needed

5.4.1 More transparency and coordination in required

The Lockwood-Mrdak Review (2022) found IA's remit had blurred as states built their own "I-bodies", multiple Commonwealth entities crowded the field, and IA's product suite wasn't tightly wired to Cabinet/Budget decision-making. That produced duplication (parallel assessments), variable appraisal standards across jurisdictions, weak feedback on whether past projects delivered promised benefits, and a Board/governance model that left IA influential on paper but patchy in practice. The definition of "national significance" (dominated by a dollar threshold) didn't always pick the right set of projects, and IA's advice often arrived out of sync with fiscal timetables—limiting its impact.

Lockwood-Mrdak recommended a narrower mandate, clearer accountability, and closer coupling to the Federal Budget deliberations. The review recommended:

- amending the Infrastructure Australia Act to set IA's core role as national investment planning and project prioritisation across economic and social infrastructure;
- issuing a five-year Charter of Infrastructure Investment Objectives to anchor what "good investments" look like;
- reshaping IA's outputs to directly inform each Budget, including annual statements of priorities and performance;
- shifting IA's assessment work toward accrediting capable state processes via an accreditation process (with IA doing full assessments only where needed);
- strengthening post-completion evaluation to build a national learning loop;
- clarifying "national significance" beyond a dollar cap; and
- upgrading governance (inquiry powers; a Productivity Commission-style leadership; stronger links with central agencies) so advice is independent and more likely to be acted upon.

The Lockwood-Mrdak recommendations are sensible and recognise the weaknesses in the current IA remit and processes.

5.4.2 Fiscal policy coordination is also important

One of the most significant challenges facing Australia's transport sector since the 1970s has been the sustained escalation of infrastructure construction costs. Data from the Bureau of Infrastructure, Transport and Regional Economics (BITRE) and the ABS show that transport infrastructure costs have risen faster than general inflation, reflecting both global and domestic pressures (BITRE, 2022).

Cost drivers include higher labour and material expenses, increasingly stringent safety and environmental requirements, and the complexities of delivering projects in congested urban areas (Branigan, 2016). The result has been that governments today must spend significantly more in real terms to deliver equivalent levels of infrastructure compared with earlier decades, placing pressure on budgets and making project prioritisation increasingly contentious.

This is not to say that these rising costs have been entirely predictable or preventable or acceptable.

- The Covid-19 supply shock that led to materials and labour shortages was not predictable ex-ante.

- The mining boom related rise in the cost of materials and professional services was not preventable (see Box 5-1).

- The more stringent regulations related to safety have been, arguably, acceptable.

Figure 5-2 (below) illustrates the strong rise in infrastructure construction costs in Australia, especially from the mid-2010s.

- There was a sharp rise in costs in Phase 1 of the mining investment boom before the GFC temporarily flattened cost escalation (Box 5-1).

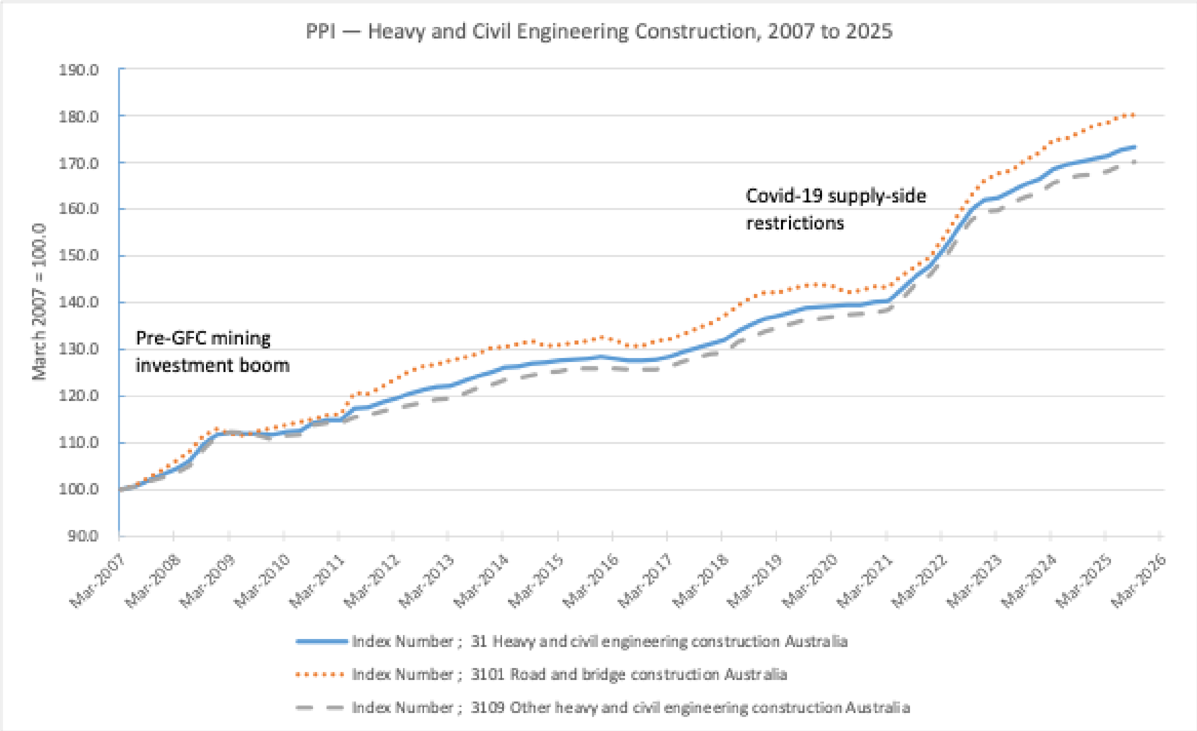
- Costs then rose steadily in the first half of the 2010s before rising more strongly in the second half of the decade.

- Costs then accelerated sharply during the Covid-19 years as a result of severe supply restrictions of both materials and labour.

- In the post-Covid era, construction costs continue to rise strongly, driven by strong growth in public investment, low unemployment and surging population growth (itself driven by a post-Covid catch-up in population growth of more than 500,000 per year in the 2022 and 2023 calendar years (Figure 5-2).[73]

[73] Australia's population growth was 546,490 in 2022 and 636,375 in 2023. See here: https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/mar-2025

Figure 5-2 Cost escalation in Heavy and civil engineering construction, 2007 to 2025



Source: 6427.0 Producer Price Indexes, Australia. Table 17. Output of the Construction industries, subdivision and class index numbers.

Overlaying this long-term trend was the mining investment boom from 2003 to 2012, which reshaped both Australia's economy and its transport sector (Box 5-1). The effects of the mining investment boom on infrastructure construction costs are still being felt — for example Infrastructure Australia's (2024, p.7) latest Market Capacity Report cautions: "Labour shortages, rising costs and stagnating productivity are compounding challenges in delivering major transport infrastructure projects, highlighting the need for ongoing reform to ensure efficiency gains are not lost."

Box 5-1 Impact of the mining investment boom on the transport sector and construction costs

In the decade of the mining boom, more than $100 billion in private capital was poured into expanding the nation's export capacity, particularly for iron ore, coal, and later liquefied natural gas (LNG). This surge of private investment generated strong demand for skilled labour, materials, and construction services, which in turn drove up the costs of public infrastructure projects as governments competed for the same inputs. Economists have described this as a classic "crowding out" effect, where private sector demand inflates prices across the broader construction market (Connolly & Orsmond, 2011).

The mining boom triggered large-scale transport investments in resource-rich regions. In the Pilbara, mining companies financed highly efficient, vertically integrated railways dedicated to iron ore exports, complemented by expanded port facilities at Dampier and Port Hedland. In the Bowen Basin of Queensland, new coal rail lines and port expansions supported surging thermal and metallurgical coal exports, while the Hunter Valley network was progressively upgraded to meet global demand. By the late 2000s, coal seam gas development in Queensland added a further layer of infrastructure requirements, with new pipelines and port capacity. Even agricultural exports such as grain benefitted indirectly from these supply chain upgrades, though they also had to compete with bulk commodity flows for rail and port access.

While these investments created world-class bulk commodity supply chains, the boom highlighted the risks of resource-driven inflation for public infrastructure delivery. Governments found themselves facing higher costs for urban transport projects at the same time as resource companies were driving construction activity in remote regions. The legacy has been enduring: Australian transport infrastructure is now among the most expensive in the world on a per-kilometre basis, particularly for urban rail (Infrastructure Australia, 2019). Risk management, stringent safety standards, and increasingly complex governance processes all add to the bill. The mining boom thus underscores a uniquely Australian dimension to global transport trends—where the resource sector's dominance magnifies both the opportunities and costs of building and maintaining the nation's transport system.

In many ways, the problem is a 'good problem to have', but it can be better managed to minimise negative consequences. From a macroeconomic perspective, when private investment is strong, governments should try to minimise public investment so as not to compete for scarce materials and labour resources, which drive up costs.

5.4.3 Fewer megaprojects would likely increase ROI

Australia's transport infrastructure project pipeline has been increasingly skewed towards multi-billion-dollar, multi-year megaprojects (Terrill 2020), (Figure 5-3). There is now ample evidence that very large transport infrastructure projects generally suffer from optimism bias — consistently overestimating benefits and underestimating costs (Flyvbjerg 2009 and 2014, Terrill 2020). Yet despite the increased transparency and rigour brought to bear by Infrastructure Australia and State agencies like Infrastructure NSW, these projects continue to dominate Australia's infrastructure pipeline.

- The Melbourne to Brisbane Inland Rail, Cross River Rail and Suburban Rail Loop projects illustrate how early estimates of project scope, costs, risks and timing are ultimately dwarfed by reality, while promised benefits remain uncertain and deeply problematic in the post-Covid era for urban PT projects. While the timing of a global pandemic cannot be predicted, the increased capacity of ICT networks to host video conferencing could. Hence, while Covid accelerated the structural adjustment to WFH, it was nonetheless predictable because the technology made it possible and made travel to work an avoidable cost for many.

- Poor project selection and weak prioritisation frameworks mean resources are drawn into politically attractive but low-return investments, crowding out smaller, projects that offer higher rates of economic and social value return.

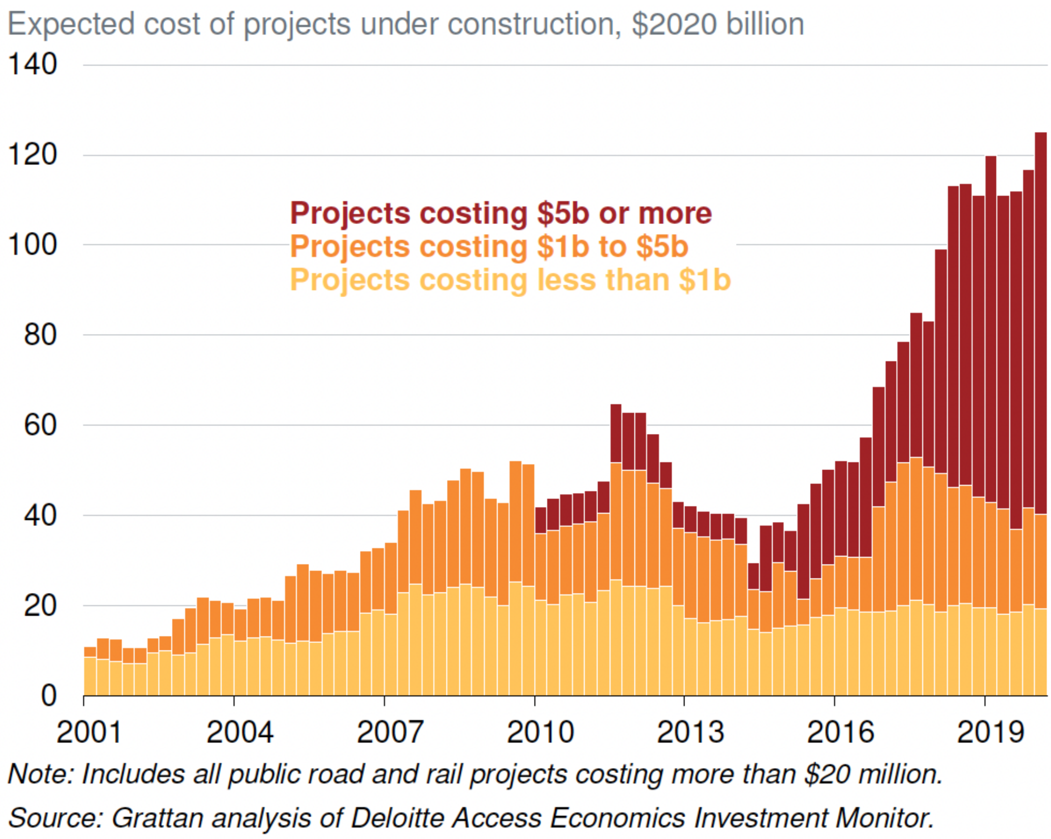
- Many megaprojects are cancelled or significantly recalibrated in subsequent years.

The most recent estimate for the Cross River Rail project in Brisbane is $19.2 billion, and the final outturn figure may be well into the $20 billion range. At the same time, due to the structural shift to working from home in the post-Covid era, the current estimates of benefit now fall well short of the original claims.

Independent analysis by the Victorian Parliamentary Budget Office estimates that building and operating Melbourne's SRL East + North segments may cost $216.7 billion over 50 years. The PBO calculates a benefit–cost ratio (BCR) for this project in the range of 0.6 to 0.7 (meaning every $1 of cost yields about $0.6 to $0.7 in benefits) under a 7 per cent discount rate, based on the government's benefit estimates. Infrastructure Australia, in its Stage 3 evaluation, noted "low confidence" in the cost estimates and benefit assumptions underlying the SRL East plan.

Grattan's analysis in 2020 found larger projects overrun more often and by proportionately more (with multibillion-dollar projects averaging around 30 per cent overruns), a pattern compounded by capacity constraints in construction markets (Figure 5-3).

Figure 5-3 Projects under construction, by size



Source: Grattan Institute (2020).

5.5 Conclusion

The megaproject problem will not go away by itself, and public policy needs to provide more guidance and guardrails around publicly-funded infrastructure investment to protect taxpayers and ensure value for money. There are several practical approaches to addressing the persistently weak returns associated with large public infrastructure investments.

First, independent infrastructure advisory bodies must be strengthened — not merely as evaluators, but as genuine gatekeepers. Where business cases are weak, overly optimistic or highly sensitive to small changes in assumptions, these bodies should have the authority and institutional backing to transparently recommend deferral, scope reduction, staging or redesign. In many cases, breaking large megaprojects into smaller, sequentially delivered components would reduce risk exposure, promote tier-2 competition, improve cost discipline and allow lessons to be incorporated before full-scale commitment.

Second, governments must take a more disciplined approach to capital allocation across the economic cycle. Infrastructure investment does not occur in isolation; it competes for labour, materials and specialist capability with private construction and other public projects. Large clusters of megaprojects can generate industry-wide cost inflation, eroding value for money across the entire investment pipeline. The responsibility for managing this risk lies primarily with the public sector, which has greater flexibility to sequence projects over time. Where capacity constraints are binding, governments should defer or re-stage projects rather than exacerbate construction cost pressures that ultimately diminish net economic returns.

Third, megaproject governance should incorporate stronger mechanisms for accountability and learning. Forecasts of costs and benefits should be systematically benchmarked against international experience and adjusted for optimism bias. Reference Case Forecasting should be introduced by Infrastructure Australia. Post-completion reviews should be mandatory, publicly released and used to refine future appraisal methods. Without feedback loops, the same forecasting errors are repeated — a pattern well documented in the megaproject literature.

Finally, policymakers should reconsider the implicit bias toward scale. Large projects often promise transformational change, but smaller, incremental upgrades may generate higher benefit–cost ratios, lower delivery risk and greater adaptability. In many cases, network optimisation, demand management and targeted bottleneck removal can deliver substantial gains without the financial and governance risks inherent in multi-billion-dollar undertakings.

Megaprojects will remain an important feature of modern infrastructure policy. However, if they are to deliver sustained economic value rather than repeated disappointment, stronger institutional discipline, better sequencing, and a greater willingness to stage, defer or redesign must become standard practice rather than exception. The objective should not be to avoid ambition, but to ensure that ambition is matched by economic realism and delivery capability.

6 Road congestion and user charges

6.1 Introduction

This chapter focusses on the problem of road congestion and road user charges (RUCs) more broadly. Congestion affects both freight and passenger transport in our major cities and its costs are reflected in lower than otherwise freight productivity (and, hence, GDP) as well as diminished household social welfare (for example, in terms of lost time). The design of RUCs affects the fiscal capacity of governments to maintain and expand the road network as well as affecting the demand for network use and, as a result, the amount of congestion.

6.2 The scale of the problem

Urban road congestion is a visible and costly drag on freight productivity and the living standards of Australian households (BITRE 2007, 2008, 2014, 2024). Congestion is primarily an issue relevant to our large capital cities and there is no silver bullet policy solution (CRWG, 2006). Notwithstanding the Covid-19 era (2020-2022), which experienced large reductions in road demand and consequently reduced congestion, the measured aggregate costs of congestion have been increasing in line with population and economic growth (BITRE 2024). This is despite continued annual investment and expansion in Australia's capital city road network, including toll roads.

The BITRE (2007, 2008) measures the costs of congestion both in terms of reduced passenger and freight travel times, and increased fuel and vehicle emissions. Time cost calculations are based on average wage rates. Updates to the cost estimates are based on updating these parameters — like wage rates and fuel consumption.

- Based on the BITRE (2007) methodology, current estimates of the avoidable costs of road congestion — for freight and passenger vehicles — are around $25 billion in 2025, growing to $30 billion by 2030 (see Box 6-1).[74]

- At peak congested times on key freight routes, freight delivery is slower and less reliable, adding to delivery and warehousing costs. These costs are reflected in lower GDP because the economic return to the freight sector is lower. Based on the BITRE methodology and recent capital city traffic flow estimates, we estimate that only about 30 per cent of congestion costs directly affect GDP via reduced freight productivity (see Appendix B).

- In terms of the other 70 per cent of congestion costs, vehicle passengers take longer to complete trips, foregoing time that could be utilised to spend working, studying, undertaking household chores or relaxing with family and friends. These costs are not

[74] The BITRE define the concept of 'avoidable' congestion. In this report, we prefer to use the term 'economically unjustified' congestion. Both terms refer to when the marginal social cost of a trip exceeds its marginal benefit (see section 6.2.2).

directly or immediately reflected in GDP but nonetheless clearly affect the utility or what economists refer to as social welfare of households.

It's important to also note that an economically efficient network would always tolerate some congestion, as eliminating all congestion via network expansion (with no additional demand pricing signal) would be prohibitively costly. For example, doubling Australia's capital city road network capacity to accommodate peak congestion might eliminate most of the estimated $25 billion in economically unjustified congestion costs but could potentially add more than $100 billion in infrastructure network expansion costs.[75] The new expanded network would require a vastly increased annual maintenance budget and the network would be grossly underutilised for most of the day and night.

Box 6-1 Congestion cost estimates

- An early national estimate put the cost of avoidable congestion (see discussion at Appendix B) at $9.4 billion in 2005, projected to reach $20.4 billion by 2020. Time losses (for both passenger and freight) dominate these estimates — around 70–80 per cent of measured congestion costs — so even small speed and reliability gains have outsized economic value (BITRE, 2008).
- Infrastructure Australia (IA) – estimates road congestion and public-transport crowding cost $19.0 billion in 2016, rising to $39.8 billion by 2031 if road investment doesn't keep pace (IA, 2019).
- BITRE Information Sheet 74 – estimates 'avoidable' congestion costs of $16.5 billion in 2015 (in 2010 dollars) across the eight capitals, with a 2030 range of $27.7–$37.3 billion depending on assumptions (BITRE, 2016).
- Australian Automobile Association (AAA) – cites IA/BITRE and reports a national figure exceeding $23 billion in 2018–19, with a 2030 projection of $30.6–$41.2 billion.
- TfNSW's technical guide puts Sydney's congestion cost at $7.7 billion in 2019, forecast to $12.3 billion by 2029 (≈ 17 c/km rising to 22 c/km), (TfNSW, 2019).

Source: BITRE (various years), AAA (2020), TfNSW (2020).

6.2.1 Recent congestion trends

BITRE's recent freight-vehicle telematics reports show that, excess delay and (especially) travel-time uncertainty on key urban corridors continue to impose large, economy-wide time costs on shippers and households.

- Sydney M4 Western Motorway (Glenbrook–Strathfield): 2023 saw a pronounced increase in excess travel time relative to 2022.

[75] We have not made a considered estimate of the costs of doubling Australia's capital city road network. Rather, this estimate should be considered illustrative of the point that the costs to eliminate all congestion would almost certainly exceed the likely benefits.

- Sydney M5 Motorway (Hume Motorway–M1): inbound median times were ~15% above best-case (METR 1.150) with elevated uncertainty on some sections.

- Melbourne Monash Freeway (M1 East, City–M420): flagged for a pronounced increase in 2023 (after earlier pandemic-era easing).

- Brisbane M1 (Gateway corridor, Bruce Hwy–Pacific Mwy): the city's heavily weighted north–south spine remains a critical, congestion-affected freight route.

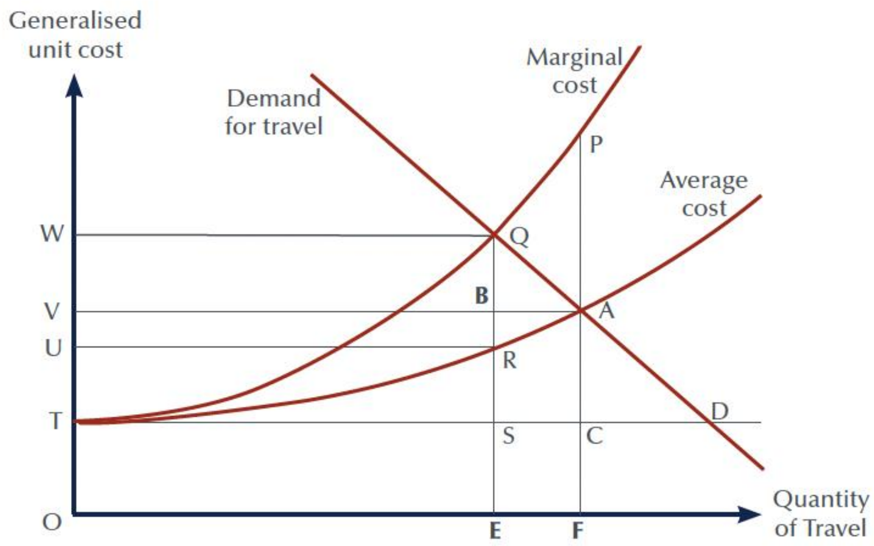
- Perth Kwinana Freeway (Route 2): a key freight freeway where city-level uncertainty rose in 2023, indicating reliability pressure on principal links.

6.2.2 What is the optimal amount of road use?

Figure 6-1 (below) illustrates the basic theory of congestion costs. In the figure, the initial amount of travel is at Point F (on the x-axis) and the cost of travel at Point V (on the y-axis). This is where demand and supply intersect. However, the average cost curve (which represents supply) does not account for all of the costs of road use. Rather, the marginal social cost (MSC) curve represents the total cost of road use. Hence, the network should ideally find its equilibrium at Point Q rather than Point A. At this point, drivers only enter the network if they are willing to pay their full private plus social costs (i.e. their own costs plus their impact on other driver's travel times). At Point Q the deadweight loss (DWL) from congestion, represented by the area inside points AQP is eliminated. The drivers travelling between points E and F on the Quantity axis no longer enter the network because the total costs of their travel exceed their privately captured benefits. The area AQP represents what the BITRE defines as the cost of avoidable congestion; that is, the avoided costs if drivers entering the network paid their full marginal social cost.

- This analysis poses the question: how would the drivers between points E and F respond to a congestion charge? In this illustration, those drivers simply don't take the trip. However, for freight vehicles, it is likely that they will continue to enter the network and the congestion charge is absorbed — in part by the freight business as lower profits and in part by households as higher prices. For passenger vehicles, these marginal drivers might elect to take an alternative route (aka "rat running" through toll-free adjacent suburbs), take a PT alternative if available, car pool to share the cost of the congestion charge, or delay their trip to a time when the congestion charge didn't apply (say, before a 6am-9am congestion charge window). Alternatively, drivers may determine that the trip is simply not worth taking — they might decide to work from home, take a telehealth appointment from home, order some good or service from home, or not visit family or friends.

Figure 6-1 Optimal congestion pricing model



Source: BITRE (2008).

6.2.3 RUC reform options must go broader than congestion charges

In principle, we should try to price entry into the road transport network at the marginal social cost (MSC) of its provision. However, this is not practical because the MSC would be different across thousands of different road corridors. In essence mass*distance*location pricing is technically difficult, too complex for road users and too costly to implement.

Instead, a more generalised and staged approach towards an optimal RUC pricing framework is needed to garner political and public understanding and support. This would be broader than simply adding congestion charges to the existing pricing regimes for passenger and light trucks and heavy freight vehicles. Essentially, we should:

- In terms of heavy vehicles, continue with the process of further reform to heavy vehicle charging in consultation with the freight industry, working towards more precise mass*distance-based pricing. However, as we have noted, there is a trade-off between targeting ‘perfectly efficient pricing’ and minimising complexity. There are technical and cost barriers to measuring mass on each and every trip a heavy vehicle undertakes. Moreover, setting different charges for different locations to account for differences in road quality (and, hence, road damage) would be problematic technically and politically. Although a ‘postage-stamp’ pricing model is not perfectly efficient as there would be inevitably some cross-subsidisation to support the least-utilised extremities of the national road network, it is easier to understand and administratively cheaper to operate. Moreover, payments can be thought of as providing an option to access a national network at any time in the future, which has value in and of itself.
- The NTCs current work moving towards more predictable RUCs with less annual variation should be supported. In this regard, a building block model of costs, such as that used in economic regulation (e.g. of electricity networks) would smooth out

annual fluctuations and spread the costs of large infrastructure investments across several years or decades. This would better align the allocation of costs to those freight operators in the future who will benefit from the new ‘lumpy’ infrastructure investments.

- Commission the BITRE (or an independent expert supported by the BITRE) to revisit the BITREs congestion cost modelling methodology. As part of this, we recommend undertaking stated preference surveys on Australia’s most heavily congested roads to better understand possible (passenger and freight) driver responses to congestion charges.[76]
  - The costs of economically unjustified congestion as well as the likely behavioural responses to congestion charging need to be better understood before we proceed to congestion trials.

- Introduce distance-based pricing for EVs because EVs don’t pay fuel tax (which is effectively a distance-based charge for road use that carbon-based passenger vehicles pay).

- As part of an overall switch to distance-based pricing (as the rate of EV use rises), set registration charges for passenger vehicles (sedans, SUVs, Utes) at a rate that more closely reflects the, (in our view potentially), very low per vehicle fixed costs of network availability.[77] This change in revenue collection would help garner political support for a greater emphasis on distance-based road user charges.

- There should be transparent hypothecation of road-based revenues back into the transport system, which would improve public trust in the transition to more optimal road user charges that should improve efficiency, equity, and fiscal sustainability.[78]

[76] Stated preference surveys seek to understand consumer behaviour, their willingness to pay (WTP) for certain outcomes they value, and how they would respond (in this case) to a range of congestion charges to achieved certain reductions in travel time.

[77] This study has not attempted to estimate the per vehicle fixed costs of providing access to the road network 24/7. By way of illustrative example, if it cost (say) $4 billion annually in fixed costs (streetlights, traffic lights, signage, public safety) to keep the road network available to users 24/7 then the fixed charge to the 22 million registered vehicle owners would be $182 per year. The $4 billion figure is entirely illustrative — whether or not passenger vehicle registration charges are currently too high depends on the definition of ‘fixed costs’, which we have not explored in this paper.

[78] It’s true that economists generally disapprove of hypothecation—ideally, funds should go to where they generate the highest net return, and that need not be on the activity that generates the funds. This ideal system requires a ‘benevolent dictator’ as decision maker. However, Public Choice notes that a Leviathan would use congestion charging to generate funds that it could spend on, say, better salaries for chairs of parliamentary committees. The maximum congestion revenues would be the goal of the Leviathan, and that may well occur when the cost of congestion is some multiple of its optimal level (from the point of view of society-as-a-whole). Hypothecation disrupts the Leviathan’s scheme. The efficiency-seeking economist, citing the Public Choice literature, could approve of hypothecation in some cases on a ‘second best’ basis, namely, that otherwise too little public spending may be directed to goods and services that do not generate much by way of political kudos: hypothecation puts a lower limit on that spending (presumably, at a level closer to the optimal level).

7 Rail freight challenges

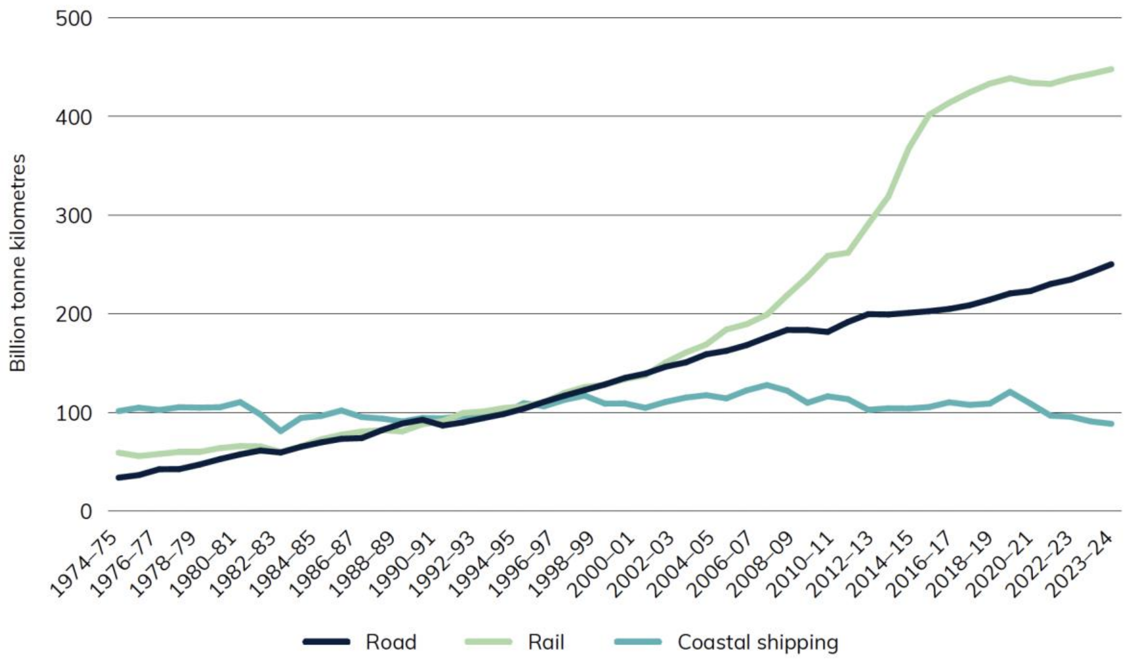
7.1 Introduction

The extraordinary growth in rail freight has been export focussed and driven almost entirely by the 2003-2012 mining boom where rail freight more than doubled (Figure 7-1).

In terms of imported container freight, despite rail freight's per tonne kilometre cost advantages in moving large volumes efficiently over long distances, it has struggled to capture market share on key interstate corridors such as the north-south Melbourne–Sydney–Brisbane corridor where 90 per cent of container and general freight is moved by truck. In fact, it is estimated that around 4,000 trucks per day travel the Sydney-Melbourne route.[79]

This lopsidedness in mode share stems from a mix of infrastructure gaps, first/last mile cost advantages favouring heavy vehicles, intermodal inefficiency, fragmented regulation, and policy settings and pricing that, arguably, tilt the playing field toward road freight. Addressing these issues will be critical in order to maximise total transport system efficiency and deal with future challenges such as the net zero decarbonisation target.

Figure 7-1 Australia's domestic freight task by mode of transport, 1974-75 to 2023-24



Source: BITRE Yearbook 2024.

[79] See here: https://www.nationalintermodal.com.au/about/#strategic-priorities

7.2 Rail freight strengths

In 1971, Australia's domestic freight task was estimated at 106 billion tonne-kilometres. By 2020 it had surpassed 870 billion tonne-kilometres, more than an eightfold increase.

Rail freight has led the expansion in Australia's domestic freight task, with bulk resources and commodity exports more than doubling through the mining boom period from 150 btkm in 2003-04 to almost 400 btkm in 2011-12. Rail freight now accounts for more than 50 per cent of the total freight task. The mining investment boom of the 2000s and 2010s was a significant turning point in the use of freight rail transport. Heavy-haul railways in the Pilbara, the expansion of the Hunter Valley coal network, and port upgrades at Newcastle, Gladstone and Port Hedland has created some of the world's most efficient supply chains.

Australia's commodity exports (iron ore (21% of total goods and services exports), thermal and metallurgical coal (14%), LNG (10%), gold (5%), beef (2%) and wheat (1.5%)) enjoy no significant economic protection and are, therefore, exposed to vigorous international competitive forces (PC 2024).[80] As a result, the supply chains along which these products move have evolved to be highly efficient.[81]

Some of these supply chains are fully vertically integrated and privately owned and operated (e.g. iron ore supply chains in the Pilbara). Others are subject to economic regulation to prevent network owner's setting inefficient monopoly prices (e.g. coal rail networks in the Bowen Basin and Hunter Valley). Despite problems with gaming and cost-shifting, the economic regulation of the coal rail networks has been largely effective compared to the counterfactual of full public ownership and bureaucratic operation.

7.3 Challenges

Rail freight in Australia faces several challenges, not the least of which is modal competition from road freight, which has improved in efficiency and reliability over time thanks to technological innovation.[82]

It is arguable that road transport is favoured over freight rail despite rail's cost advantages over 'goldilocks' distances of around 1,000km. For example, some argue that economic assessment frameworks are biased against rail because current cost–benefit analyses undervalue rail's external benefits, such as lower emissions, reduced road maintenance costs, and improved resilience. At the same time, road project assessments fail to properly account for the full external costs of road freight, including congestion and safety. This bias, arguably, leads to systematic underinvestment in rail projects relative to their true social value.

Putting that issue to one side, rail infrastructure reliability, intermodal connectivity and resilience remain weak points relative to road. Rail networks can be more vulnerable to natural disasters, delays, and operational interruptions because of far more limited

[80] See the Productivity Commission's annual publication Trade and Assistance Review.
[81] DFAT (2025). Accessed here: https://www.dfat.gov.au/sites/default/files/australias-goods-services-by-top-25-exports-2023-24.pdf
[82] See discussion at Section 2.

alternative routes, with recovery times in terms of maintenance often slower than for road freight. Inland Rail promises to improve trunk capacity between Melbourne and Brisbane, but without complementary investment in connecting intermodal terminals and resilience upgrades, it will not deliver the full modal shift expected. And as the 2023 Independent Review starkly highlighted, the full cost of the upgrades required to make the Melbourne-Brisbane Inland Rail effective is far higher than early estimates.[83]

Additionally, fragmented governance and inconsistent operating standards across states hamper seamless freight flows. Different rules, signalling systems, and access regimes make it costly and inefficient to run services across multiple networks. Operators often cite the need for mandatory national standards, enforced at the national level, to support productivity and safety.

Freight trains face pathing disadvantages on shared networks dominated by passenger services. This often results in slow and unpredictable transit times that erode rail's competitiveness against road. More automated scheduling, digital train control systems, and stronger coordination across networks are needed to give freight timely and reliable paths while at the same time guaranteeing passenger slots.

Freight transfer efficiency is another critical weakness in Australia's freight rail network. Moving goods through Australia's largest cities remains a slow and costly process, with last-mile connections between ports, rail, and road networks underdeveloped.

Finally, data transparency is limited, undermining planning and private investment. Freight operators, governments, and regulators lack consistent, public, and comparable datasets on performance, demand, and costs. Without better data, network-wide planning remains reactive rather than strategic.

[83] Accessed here: https://www.infrastructure.gov.au/department/media/publications/delivery-inland-rail-independent-review

8 Passenger transport

8.1 Overview

Private passenger vehicles remain the dominant form of motorised passenger transport in Australia. Only the private car and for-hire passenger vehicles (e.g. rideshare services or taxis) can take people door-to-door from point A to point B, or at the very least to the nearest parking space to point B.

- In 2023-24, almost two-thirds (63.2%) of all motorised passenger travel (by passenger km travelled) was taken by passenger car, followed by air travel (17.1%), Other – mainly for-hire passenger vehicles (11.5%), Buses (4.5%), and Rail – including heavy rail and light rail (3.6%). (BITRE 2025).

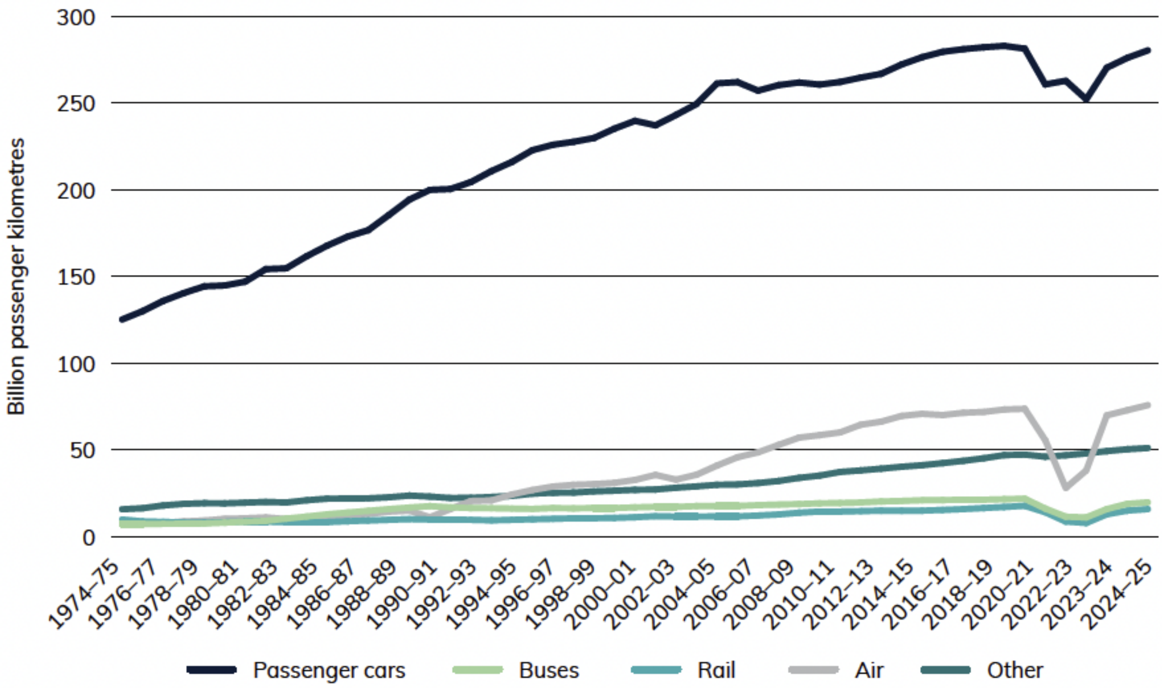
Figure 8-1 (below) illustrates the domestic passenger task between 1974-75 and 2024-25. Several trends are prominent.

- There was a sustained increase in passenger car vehicle kilometres travelled in the 25 years from the mid-1970s to the turn of the century, after which the pace of growth slowed in the first two decades of the 21st century, and then declined during the Covid-19 era.
    - The slowdown in passenger car growth in the 2000s coincided with a marked increase in air travel, suggesting a switch from long-distance car travel between Australia's east coast capital cities (e.g. Brisbane-Sydney, Sydney-Melbourne) to air travel. In addition to the significant time savings derived from air travel, increased competition in domestic aviation beginning in the 1990s brought down the monetary cost of domestic air travel significantly (BITRE, 2016).[84]
    - The slowdown in passenger car growth was also a marked by a rise in 'Other' travel, especially from around 2010, which relates mainly to light commercial vehicles like ride share, taxis and small private hire buses and limousines.
- The Covid-19 era changed everything, with passenger transport demand declining by just under one-fifth (19.0%) at its low in 2021-22 compared to the pre-Covid level in 2018-19.
- Overall, comparing the mid-1970s to the mid-2020s, while still the dominant form of motorised passenger transport, the passenger car has given ground to interstate air travel and ride sharing while bus and rail transport have remained a relatively constant share of total motorised transport demand.

[84] BITRE Information Sheet 85, 2016. Accessed here: https://www.bitre.gov.au/sites/default/files/is_085.pdf

- While bus patronage increased as networks expanded in the 1980s and 1990s, bus passenger km in 2024-25 is still 9½ per cent below pre-Covid levels.
- Similarly, rail passenger km travelled in 2024-25 remains more than 10 per cent below pre-Covid levels. (Figure 8-1).

Figure 8-1 Australian domestic passenger task, by mode of transport



Source: BITRE (2025).

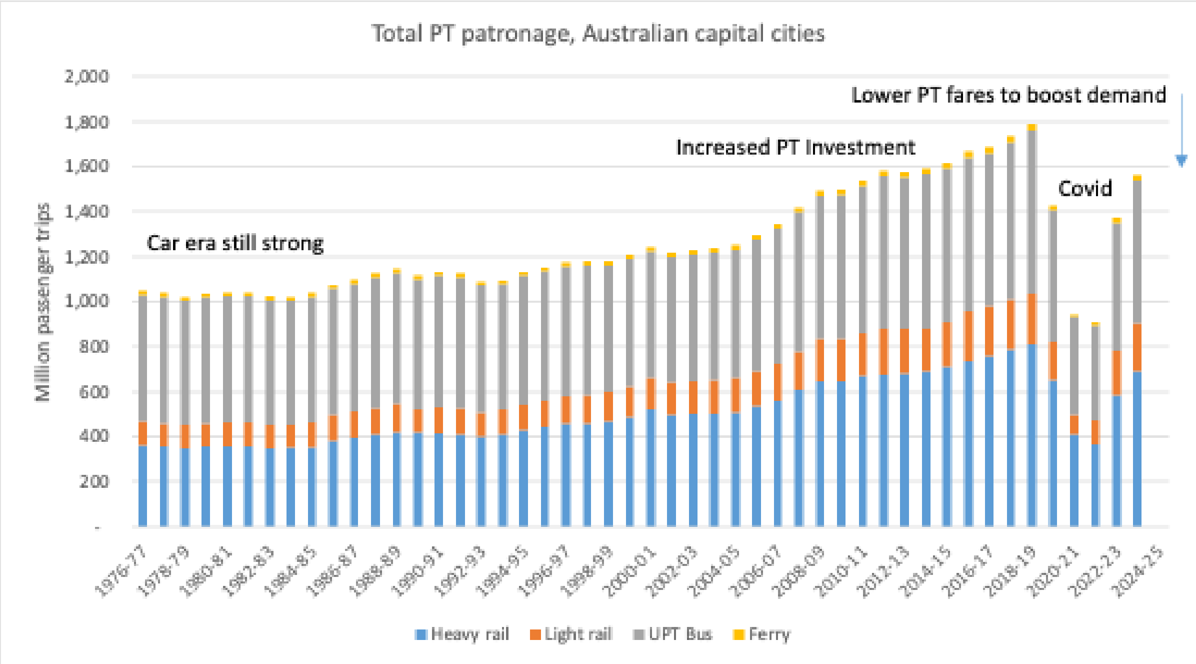
8.2 Public transport

Public Transport (PT) services include buses, heavy and light rail, and ferries. Public Transport patronage increased by almost 80 per cent in the four decades from the mid-1970s to 2018-19. The Covid-19 era restrictions on travel as well as a lingering concern about 'catching Covid on PT' led to a dramatic collapse in transport demand from 2019-20 to 2022-23 (BITRE 2024). PT demand has yet to reach its pre-Covid era level of just under 1.8 billion passenger trips per year (Figure 8-2).

- The shift to working from home (WfH) for those workers who can, and which accelerated during Covid, has had a significant and permanent effect on PT demand, especially for suburb-to-CBD routes (iMOVE, 2022).
- State governments have been encouraging a return to CBD work, especially for public sector employees. The Queensland Government has taken the most radical step, introducing 50 cent fares for all PT trips— well below the average cost of around $20 per trip to encourage higher patronage (TransLink, 2024). This has had some effect on encouraging greater commuter PT use, but it has largely increased PT demand on

weekends for non-work activities, like enjoyable CityCat ferry routes. If fares remain heavily discounted (see discussion below), PT demand could continue to rise relative to car travel following the post-Covid structural adjustment (Figure 8-2).

Figure 8-2 Total PT patronage, Australian capital cities 1976-77 to 2022-23



Source: BITRE (2024).

8.2.1 PT quality has improved

In the last two decades, the quality of PT services has increased markedly across several dimensions.

- Urban heavy rail passenger services in Sydney and Melbourne are high frequency at peak times (i.e. turn up and go) arriving every 15 mins or less.

- Many inner-city bus services operate at high frequency (e.g. every 10 minutes) during the work week.

- Rail and bus services are generally airconditioned and provide disability access. However, while there has been some progress, States are generally falling well behind their obligations under national accessibility law.

- Many bus and rail services now run overnight on weekends at 30-minute intervals between midnight and 6am. This has been a significant safety improvement, especially for young women.

In terms of improved accessibility:

- In Victoria, for example, the 2022–23 state budget allocated $157.8 million toward upgrading train stations, bus stops, and tram stops to improve accessibility, aiming to rectify historic deficiencies.

- And under the Accessible Public Transport Action Plan, the state has mandated that level crossing removal projects incorporate wheelchair ramps and that the PTV app be redesigned with full accessibility features including support for blind and low-vision users.

- In New South Wales, the Transport Access Program (TAP) has so far delivered over 520 station upgrades and helped push accessibility coverage to more than 73 percent of suburban, intercity, Metro and regional stations.

These accessibility upgrades are visible at many Melbourne and Sydney stations that were once only reachable by stairs now feature lifts and ramps for step-free boarding.

- For example, East Pakenham station — opened in 2024 as part of the level crossing removal project — offers step-free access and modern amenities as a premium station on the Pakenham line.

- Likewise, Montmorency station in Melbourne was rebuilt in 2023 with full accessibility, including pedestrian ramps, sheltered waiting areas, and accessible signage.

8.2.2 Low-cost recovery and funding pressures

One of the most persistent problems for the public operation of passenger rail and bus services is farebox revenues falling far short of operating costs. Public bus and rail services in Australia's capital city networks generally operate with fares set far below the full budgetary cost of providing services. For example, NSW and Victoria set rates of cost recovery between 20-30 per cent of the average cost of supplying a trip. (see Table 8-1).

That said, standard economics maintains that the ideal price to support continued investment, innovation and quality public transport services is to charge less than full cost recovery to account for the benefits (or avoided costs) of less, traffic congestion and vehicle emissions when commuters use PT instead of passenger cars. The taxpayer is effectively making up the difference between revenues and costs to avoid the unpriced social costs of car use.

A second and classic problem with large infrastructure networks where the upfront or fixed cost of provision is high, but the incremental cost of use is low, is how to charge and recoup the upfront expenditure. Charging average cost will result in underuse of the network, because charging below average cost will increase use and revenues. But charging only marginal cost will result in underfunding of the network because revenues will not be sufficient to fund the fixed costs of network provision. The standard answer in economics is to charge a two-part or multipart tariff. The first component of the tariff covers the fixed costs of network access (e.g. 24/7 access to the road network), and the second component covers the incremental or marginal cost of use. In very abstract terms, the taxpayer subsidy can be thought of as covering the fixed cost of provision and the fare charged can be thought of as covering marginal costs. Nonetheless, because farebox revenue is so low and, in any case, not hypothecated to PT investment, borrowings are almost always required to fund new network expansion.

Table 8-1 Farebox cost recovery in NSW, VIC and QLD

State / Network	Approx. Farebox Recovery (%)	Notes & Source
NSW (Sydney Trains + multi-mode PT)	20-25% opex 0% capex	IPART finds fare revenue recovers ~22% of actual costs in 2015-16, ~25% when inefficient costs removed (ipart.nsw.gov.au)
Victoria (Melbourne rail + metro)	20-30% opex 0% capex	Australian summary tables list ~30% recovery for Melbourne transport systems (Transport Victoria).
Queensland (SE Queensland, trains + buses + ferries)	<5% opex 0% capex	After introduction of $0.50 flat fares, fare revenue recovers ~5% of costs per L.E.K. report (L.E.K. Consulting)

Source: IPART (2024), Transport Victoria, LEK Consulting (2024).

In Queensland, the 50-cent fare policy, now considered permanent with bipartisan political support, has driven the rate of recovery of operating costs down to around 2.5 per cent, well below the economically efficient price of PT services. Recent patronage gains have been largely driven by non-work travel, such as weekend ferry services use, and the subsidy from the Queensland taxpayer to the Department of Transport now exceeds $2 billion per year (Box 8-1).

Box 8-1 Queensland's 50 cent fares

In February 2025, Queensland's 6-month 50 cent fare trial became 'permanent' with widespread political and community support. The near-zero fare model is expected to continue until at least the next State Election in late 2028 and potentially beyond that until the 2032 Olympic Games if both major parties commit to the policy in the 2028 election campaign.

Queensland's Treasury transfers a vast amount of taxpayer money – more than $2 billion per year – to the Transport and Main Road Department to subsidise the 178 million passenger trips, mostly benefiting regular users. This amount could reach and then exceed $3 billion per year once the Cross River Rail extension comes online (TransLink 2024).

In 2023-24, the average public transport running cost was $19.21 per trip, but farebox revenue averaged just over $6.00. In other words, before 50 cent fares the taxpayer subsidy represented two-thirds of the operating cost of providing public transport services. Including capital costs, the Queensland taxpayer's effective subsidy was more than 75 per cent. Now, with 50 cent fares, the subsidy is around 97.5 per cent and will approach 100 per cent with cost escalation and network expansion.

The first and potentially most serious problem with near-zero PT fares is that, given the Queensland Government's other significant public spending commitments, including in hospital care and preparing for the Olympic Games, future governments will be reluctant to increase the cost of the subsidy to fund network expansion and maintenance to ensure a high-quality service.

Standard economics maintains that the ideal price to support continued investment, innovation and quality public transport services is to charge full cost recovery less the avoided costs of traffic accidents, traffic congestion and vehicle emissions. This price promotes economic efficiency, as follows. Productive efficiency because service delivery is not subsidised hence there's an incentive to provide the services at lowest possible cost; allocative efficiency because the subsidy is minimised to the unpriced marginal social costs; and dynamic efficiency because higher PT revenues promote service innovation and investment in the network.

Even in the dense and often congested urban road network of SEQ, the ideal PT price should be significantly greater than 2.5% of full cost recovery. The Queensland policy is well outside global benchmarks for cost recovery. Table 8-2 (below) is from NineSquared (a prominent transport sector consultancy firm) and reports fare costs in terms of minutes worked to buy a single ticket by city. Brisbane (at 1.2 minutes worked) is about half the cost of the next lowest city Beijing (2.3 minutes) and a fraction of Sydney (7.9 minutes).

The reduction in public transport fares is ultimately capitalised into land prices of homes in areas where there are abundant transport options – i.e. the inner city. The distributional impacts of virtually zero fares are, therefore, likely to be regressive, boosting the wealth of inner-city residents.

Finally, the 50 cent price point is below the cost of providing the tap on-tap off infrastructure and supporting technology such as the TransLink app, credit card facilities and fare evasion monitoring infrastructure.

8.2.2.1 Pricing reform is needed

Recent work undertaken in the Australian context indicates that rates of cost recovery should be mode-specific and aim to recoup at least 30 per cent of operating costs (CIE and Jacobs 2020, IPART 2024, PC 2021). With further reform of road user charges (see Sections 6 and **Error! Reference source not found.**) farebox revenues could target higher rates of cost recovery, which will provide the revenues to further invest in high quality and high frequency PT services.

It's important pricing is set by mode because of the vastly different capital and operating cost structures between heavy rail, light rail, buses and ferries.

- Required capital investment for passenger heavy rail is very high while for buses is very low. Pricing should reflect the higher costs of heavy rail to ensure efficient investment between modes.
- Therefore, heavy rail expansion should be a last option, after increasing the footprint and frequency of buses and then light rail.

Table 8-2 Fare costs in minutes of time worked, by city 2025

City	Single ticket (Minutes)	Rank	Weekly Product	Weekly Cost	Rank
Brisbane	1.2	1	No	12.0	1
Beijing (Bus)	2.3	2	No	22.7	2
Hobart	3.3	3	No	32.7	3
Delhi (Bus)	5.2	4	No	51.6	5
Wellington	5.3	5	No	52.6	6
Taipei	6.3	6	5 Day Pass *	63.2	7
Los Angeles	6.4	7	Weekly Cap*	63.6	8
Singapore	6.5	8	No	64.7	9
Jakarta (BRT)	6.7	9	5 Day Pass*	67.4	10
Beijing (Metro)	6.8	10	No	68.2	11
Auckland	7.1	11	Weekly	71.5	12
Darwin	7.2	12	No	48.1	4
Perth	7.6	13	No	75.8	13
Sydney (Bus)	7.9	14	No	79.4	14
Canberra	8.0	15	7 Day Pass*	79.8	15
London (Bus)	8.6	16	7 Day Pass	86.0	18
Chicago (Bus)	9.0	17	No	80.0	16
Vancouver	9.1	18	No	90.8	20
Tokyo	9.2	19	No	91.8	21
Seoul	9.3	20	7 Day Pass	92.7	22

Source: Fares Benchmarking 2025, NineSquared.

8.2.3 Institutional fragmentation and coordination issues

In the Australian Federation, passenger rail responsibility is split across multiple levels of government—state authorities, local councils, and sometimes federal agencies (particularly when federal funding is involved). This fragmentation leads to mismatches in planning, funding, fare integration, and operational priorities. Some states have adopted long-term rail plans, but implementation can stall due to short electoral cycles, shifting political priorities, or funding uncertainty.

9 Decarbonisation

9.1 The current commitment

The pressure on the Transport sector to decarbonise has been driven by the (until recently) bipartisan political commitment to a Net Zero by 2050 emissions reduction target. The Net Zero target remains Federal (and State) Government policy with the next Federal Election due in the first half of 2028. Both major political parties support the current Paris Agreement to keep global warming to no more than 2.0 degrees centigrade above pre-industrial levels.

Economic theory would suggest that Australia seek to find the least cost way to adapt to global warming given its own actions won't materially impact global temperatures. And, in terms of achieving the Net Zero by 2050 policy objective, Australia should try to find the least cost pathway to reducing emissions in order the maximise the welfare (i.e. living standards) of the Australian people.

9.2 The scale of the task

The Transport sector consumes a very large amount of energy and makes a significant contribution to national carbon emissions. Total decarbonisation as a policy objective is undoubtedly the most profound challenge facing Australia's transport sector because almost all passenger and freight transport currently use carbon-based fuels either directly (i.e. petrol, diesel, aviation gasoline) or indirectly sourcing electrical and battery power from the National Electricity Market network that is still largely supplied by carbon-based fuels coal and gas.[85] Consequently its transition to the net zero paradigm will require a fundamental transformation. In addition to the technical challenge, there is no clear consensus on the 'Net Zero by 2050' decarbonisation policy objective itself, what it means in practice (e.g. scope for purchasing internation carbon abatement permits), or the optimal pathway towards the goal for Australia.

While the beginnings of the decarbonisation transition are already underway: sales of electric vehicles more than doubled in 2023, and heavy freight and aviation sectors are trialling LCLF's. Yet with annual refreshment of the passenger car fleet occurring at only 6 per cent per year it will be many years before a material level of decarbonisation is achieved.

The transition to net zero is not only about the national passenger and freight vehicle fleet but also about commuter behaviour and transport networks: shifting more commuters to public and active transport, reducing the carbon intensity of freight, and embedding climate criteria in every infrastructure project assessment will be necessary to achieve a meaningful reduction in Transport sector carbon emissions.

There are two main carbon emissions classifications systems.

[85] 2025 fuel mix in the NEM was roughly two-thirds carbon-based fuels and one-third renewables, as follows: Black coal (45%), Brown coal (15%), Gas (3%), Wind (19%), Solar (12%), Hydro (5%).

- Based on the ANZSIC industry classification system, the Transport, Postal and Warehousing sector accounted for 7.5 per cent of national greenhouse gas emissions in 2023, with Road Transport responsible for 46.3 per cent of that total.

- Under the UNFCC classification system where energy consumption is directly allocated to industrial use sectors, the Transport sector accounted for 21.3 per cent of Australia's emissions in 2023 (Table 9-1).

The second (and more onerous) definition is more relevant to Australia's international commitments and Net Zero goals. Under the UNFCC classification system, Transport sector emissions currently account for more than one-fifth of the total.

- Transport sector emissions reached a peak in the pre-Covid-19 year 2018-19 of 99.8 $MtCO_2$-e.

- Transport sector emissions then declined significantly during the Covid-19 years (2019-20, 2020-21, 2021-22) before returning to be 96.6 MtCO2-e in 2022-23.

Table 9-1 Transport sector emissions, by classification system, 2022-23

Sector / subsector	ANZSIC industry classification $MtCO_2$-e	UNFCC classification $MtCO_2$-e
Transport sector emissions	34.0	96.6
of which…		
Road transport	*15.7*	*80.8*
Aviation	*9.0*	*9.0*
Rail transport	*3.6*	*3.6*
Water transport	*3.6*	*NR*
Total CO_2-e emissions	453.4	453.4
Transport / Total (%)	7.5%	21.3%

Source: Australia's National Greenhouse Accounts. Accessed here: https://www.greenhouseaccounts.climatechange.gov.au/ . Notes: NR = Not Reported.

9.2.1 EVs are the pathway to net zero

Vehicle electrification has become the centrepiece of Australia's Transport sector decarbonisation strategy. Battery costs, which fell by more than 80 per cent between 2010 and 2020, have made passenger EVs and light trucks electric vehicles increasingly competitive, while improvements in battery energy density have addressed earlier limitations on range (IEA, 2021). However, for large heavy freight vehicles the imposition of batteries has a significant negative impact on vehicle payload capacity and therefore on operating economics. Moreover, there is still a reluctance to purchase EVs without more ubiquitous charging infrastructure to support longer trips.

- Governments have begun to co-invest in charging infrastructure: the Australian Renewable Energy Agency (ARENA) and state governments have supported the rollout of fast-charging corridors along key highways, supporting feasible intercity travel for EVs. But the actual number of charging stations remains small. At the same time, vehicle efficiency standards—long lagging international peers—are now being strengthened, aligning domestic regulation more closely with the European Union and United States.

Alternative fuels also feature prominently in policy and industry responses. Hydrogen is being trialled for long-haul freight and heavy vehicles, particularly where battery technology remains constrained by weight and range limitations. Biofuels, already used in aviation through international carbon offsetting schemes, are being tested at scale in domestic aviation.

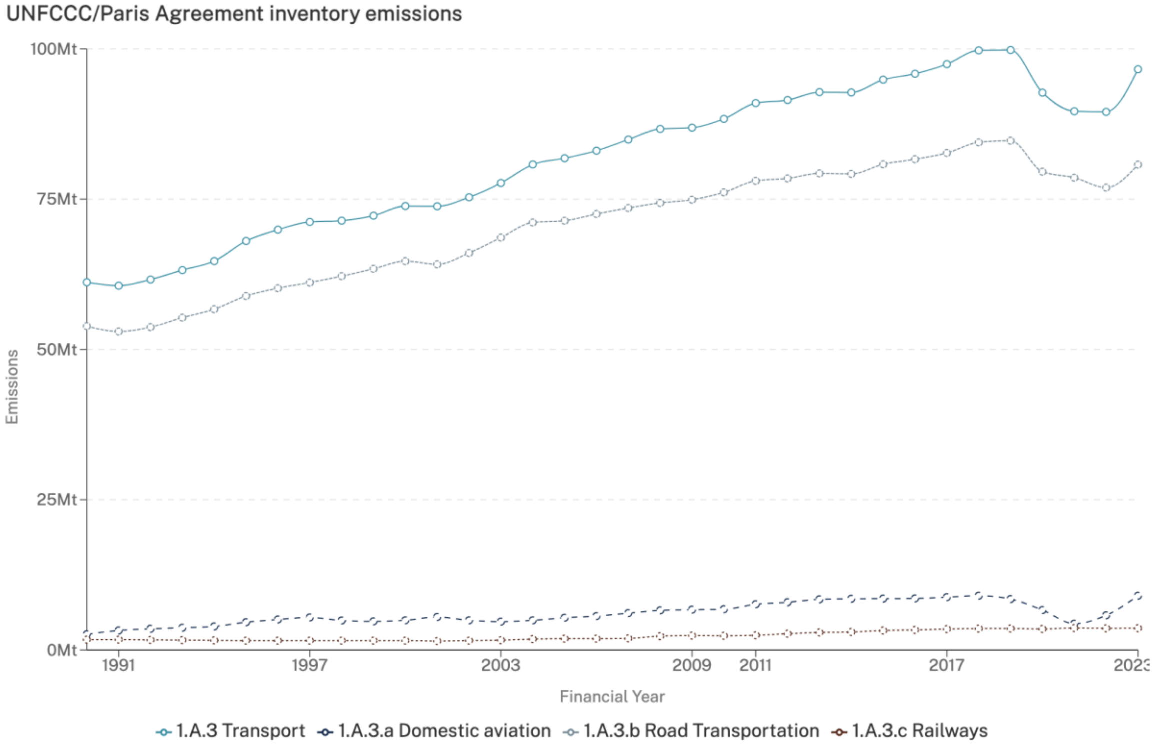
These technologies offer partial solutions to the unique challenges of decarbonising freight in a country where road transport dominates supply chains and distances are vast. Infrastructure agencies have flagged freight decarbonisation as a "hard-to-abate" sector requiring innovation, public–private collaboration, and long-term investment (Infrastructure Australia, 2019).

9.3 Is Net Zero possible?

It is debatable whether achieving Net Zero carbon emissions by 2050 is physically possible, let alone economically feasible. Figure 9-1 (below) illustrates the scale of the task in the Transport sector under the UNFCC classification system. The sector will need to eliminate almost all of its 100 million tonnes CO2-e annual emissions.

This steep decarbonisation pathway may exclude a transition to LCLF's as an intermediate step because of the urgency to build the new electricity grid and motorised vehicle fleet and the long lead times and high cost to produce LCLFs.

Figure 9-1 Screenshot of Australia's National Greenhouse Gas Accounts, 2023 emissions by ANZSIC sector



Source: Australia's National Greenhouse Gas Accounts: National Inventory by Economic Sector. Accessed here: https://www.greenhouseaccounts.climatechange.gov.au/

Part 3 Transport reform priorities

In Part 3 of this report, we set out key Transport sector reform principles. In this part, we have divided the discussion into three sections.

- Public infrastructure investment (Section 11).
- Road reform priorities (Section 12).
- Rail reform priorities (section 13).

10 Public infrastructure investment reform

10.1 Stronger governance around megaproject proposals

To support higher economic and social returns to public investment in transport infrastructure, we propose a new business case assessment hurdle for very large projects (‘megaprojects’):

- **For transport projects where the final outturn cost is likely to exceed 1% of GDP for primarily federally funded projects (and 1% of GSP for primarily State-funded projects), a minimum BCR of 1.5x at a 7% discount rate and P90 costing for projects is required for a streamlined approval process to counter optimism bias and fiscal risk.**[86]
    - At 2023-24 GDP (of $2.6 trillion) and GSP levels, the thresholds would be:
        - $26.0 billion for primarily federally-funded projects; and for the states and territories:
        - NSW $8.9 billion; VIC $5.8 billion; QLD $5.2 billion; WA $4.5 billion; SA $1.4 billion; all other states and territories the threshold would be arbitrarily set at $0.5 billion.
        - Projects like the Melbourne-Brisbane Inland Rail ($31-$33 billion) and Cross River Rail ($18-$20 billion) would be captured by this new threshold.
- **If a properly scoped BCR fails to achieve the 1.5x hurdle (but meets the 1.0x threshold) then these megaprojects projects must undergo a more stringent review process.**
    - **A minimum 6-month public consultation period would be mandatory.**
    - **Full public disclosure of business cases would be mandatory (including CBAs such that all analysis and findings can be replicated and critiqued).**
    - **Business cases must be independently reviewed by the Productivity Commission or a person suitably qualified to lead the review. A report must be published.**

[86] Even for projects that exhibit strong welfare benefits (e.g. driven by travel time savings) create fiscal risks when there is not a direct pricing regime in place.

11 Road reform

11.1 Introduction

In this section we build on Part 2 of this report and set out the main road reform principles and priorities across road based freight and passenger transport.[87]

The 'road challenge' is to fund, maintain and augment a vast — 1 million lane km[88] — network of Federal, State and local public roads such that road network use maximises the twin objectives of freight productivity and household social welfare at least cost.

11.1.1 Current road funding

Australia's road-related revenues and expenditures remain broadly in balance.[89] In 2022–23, total road-related revenue amounted to $39.4 billion, while total road expenditure was $38.6 billion (BITRE, 2024).

The Commonwealth and the states each play important roles, though with different revenue bases and responsibilities.

- The Commonwealth Government's largest single revenue source is fuel excise, which raised nearly $12 billion in 2022–23. Yet the yield from excise is declining steadily as fuel efficiency improves and electric vehicles, which do not pay fuel tax, enter the fleet.
- States, by contrast, raise more from registration fees ($9.5 billion) and stamp duties on vehicle sales ($4.2 billion), while New South Wales and Victoria also rely heavily on tolling revenue from private concessions. In New South Wales, almost one-third of all road-related revenue comes from tolls, compared to roughly one-quarter in Victoria and less than 10 per cent in Queensland. In other states, toll roads and tolling revenue remains negligible or zero.

On the expenditure side, states carry the primary responsibility for road investment and maintenance, reflecting their constitutional ownership of most road assets.

- The Commonwealth contributes mainly through tied grants, generally on an 80–20 funding split for national highways and priority projects, as with the Bruce Highway upgrade in Queensland.
- In 2022–23, the states spent $23.7 billion on roads compared with the Commonwealth's $8.7 billion, while local governments, responsible for vast but low-volume road networks, spent $6.3 billion (Table 11-1).

[87] In the next section we address rail reform priorities in the same manner.
[88] BITRE (2025).
[89] See discussion at section 6.2.

- Local governments, however, collect very little road-related revenue directly, apart from parking meters and traffic fines. This vertical fiscal imbalance reinforces dependence on intergovernmental transfers, limiting the capacity of councils to manage congestion, and fund upgrades or new projects without State or Commonwealth support.

Table 11-1 Road related revenue and expenditure by jurisdiction, 2022-23

2022-23 ($m)	Federal	State	Local	Tolls, GST, FBT, LCT	Total
Road related revenue	12,420.1	14,684.4	0.0	12,325.7	39,430.2
Road related expenditure	8,662.2	23,695.1	6,282.1	n/a	38,639.3

Source: BITRE (2024), Australian Infrastructure and Transport Statistics Yearbook. Table 3.

11.2 Road pricing principles

The fact that, in total, annual road-related revenues meet annual road expenditure is not sufficient to conclude that road pricing — via registration charges, fuel taxes and tolls — are at the optimal level to manage the allocation of scarce road space (or slots) for (and between) passenger and freight vehicles, especially at peak congestion times.

As a matter of economic theory, the optimal benchmark for transport pricing is to charge each user (whether a passenger or freight vehicle) their marginal social cost (MSC) of their trip.

- Marginal social cost includes not just private vehicle costs (e.g. fuel and maintenance) that households and businesses already pay, but also the fixed costs of road provision (e.g. traffic lights), the marginal wear on road pavements, the incremental congestion imposed on other users, the increased risk of accidents, environmental externalities such as emissions, and localised amenity impacts such as noise. In theory, charging MSC at each road location and time of day ensures an efficient allocation of scarce road space, maximising social welfare.

- That said, for networks with large fixed sunk costs and, therefore, a decreasing long-run average cost curve, setting P = MC would under-recover the costs of network provision. Moreover, setting P = AC leaves underutilised capacity. The usual recommendation in these cases is for a multipart tariff, with fixed and variable components. The fixed part is for the option of using the road whenever you want to use it: to give you this option requires the provider of the road to keep it useable—and roads deteriorate even when not being used. (See Box 11-1).

In practice, however, a perfect MSC system — that would require thousands of telematics sensors costing billions of dollars — is administratively and politically infeasible. A viable framework must balance efficiency with revenue adequacy, equity, transparency, simplicity, and technical feasibility. A system that reflects total social marginal costs but is incomprehensible or unenforceable or doesn't raise adequate revenue to fund the road network will not survive. There are also equity considerations and transitional arrangements to consider.

Box 11-1 Marginal v average cost pricing

Average cost (AC) pricing is easy to understand. If it costs $1 million to build and operate a road and there are 1 million road trips taken, the road's owner could charge $1 for each trip to recoup the costs of providing the service. However, if costs vary across the time of day or by vehicle weight or depend on the number of vehicles using the road, then average cost pricing will fall short as an effective pricing tool. In essence, while AC pricing raises sufficient revenues, it distorts behaviour in a way that is economically suboptimal.

Marginal social cost (MSC) pricing provides better consumption signals. In the context of roads, marginal social cost pricing means charging users the incremental social costs of their trips — including, in addition to fuel and car maintenance, road damage, congestion delays imposed on others, accident risk, and emissions. This form of pricing aligns private decisions with social costs, reducing deadweight loss and maximising overall welfare. If the cost of the nth car entering a roadway raises costs by more than average, then AC pricing won't fully recover the costs of the nth trip.

Winston (1991, 2013) showed that the efficiency losses from under-pricing congestion are among the largest in the transport sector, often exceeding the costs of raising revenue through general taxation. Gómez-Ibáñez (2004) similarly warned that when users are charged average rather than marginal costs, investment and regulatory systems are systematically distorted, leading to overbuilt but underutilised infrastructure. The OECD (2019) has also argued that congestion pricing is the "gold standard" for managing peak demand, as it directly targets the marginal external cost of delay.

"Economists usually argue that the access charges should be set at the incremental or marginal cost, for a reasonably efficient infrastructure firm, of accommodating additional demand. Access charges set at incremental costs will ensure that customers use the services only when they value them at least as much as they cost to produce. Such charges should motivate the firm to control its costs and, one hopes, to provide as much capacity as the customer's request." (Gómez-Ibáñez 2003, p.58).

That said, the ideal pricing regime needs to account for the fact that roads are very large pieces of 'sunk capital' and economies of scale mean that incremental costs are below average costs whenever there's spare capacity. That fact creates two classic problems. First, pricing at incremental cost—the economist's ideal—won't recover total costs over time, so the operator needs another revenue source. Second, incremental cost is volatile: it looks low when the facility isn't full (because much of the outlay is sunk), but it spikes when the facility hits capacity and expansion is required (e.g. an additional lane is required on a highway when congestion becomes unbearable), (Gómez-Ibáñez 2003).

Because roads have high fixed costs and relatively low variable costs, pure MC pricing will not recover total costs, especially for major capital-intensive projects like freeways or tunnels. Governments therefore blend approaches: use marginal charges where feasible (e.g. congestion, road wear), while employing average charges (registration, fuel taxes, tolls) to ensure revenue adequacy. The challenge is to design systems that keep things simple, minimises efficiency losses while still keeping networks financially sustainable.

In practice, this means when considering pricing regimes to recoup social costs:

- For public roads, multi-part tariffs (annual registration + fuel excise + congestion charge + road damage charge).
  - Mass–distance charging for heavy vehicles, reflecting pavement wear (close to MC).
  - Distance-based charging for EVs that don't pay fuel excise tax.
  - Fuel excise for broad-based cost recovery from carbon-based vehicles (AC/MC elements).
  - Registration fees for fixed-cost recovery (administration, signage, lighting), but kept modest to avoid significantly distorting usage (AC).

In short, SMC pricing is superior for efficiency and demand management, but cannot be the sole cost recovery instrument in a capital-intensive sector because MC will generally be less than AC. The policy task is to blend marginal and average cost instruments into a hybrid framework that balances efficiency, equity, and revenue adequacy.

Sources: Gómez-Ibáñez (2004), OECD (2019), Varian (1992), Winston (1991, 2013).

11.3 Road pricing reform in practice

Set against ideal road pricing principles, Australia's current road pricing model, while much improved on previous decades, is economically inefficient, fiscally unsustainable, and distortionary. Reliance on fixed annual vehicle registration, a carbon-based fuel excise, selective tolling, and low public transport fares means prices have little relation to the real marginal social costs road users impose—congestion, wear, emissions—or to the economic value of network capacity. This results in cross-subsidies (with many users paying either too much or too little), persistent congestion, and escalating taxpayer-funded subsidies—such as Queensland's barely-priced public transport system, which now requires multi-billion-dollar annual transfers with no attention to targeting economic need. [90]

11.3.1 Passenger cars and light commercial vehicles

For passenger vehicles, there should be three charges.

- Access to the network fee (i.e. an annual registration charge kept to a minimum to reflect and fund the fixed costs of providing the road network 24/7).

[90] Registration fees would still be charged to account for the fixed cost of road network provision. Congestion price revenue is not expected to cover the fixed and variable costs of network provision. Hypothecation of congestion revenues for network investment to reduce congestion is not an economic requirement, however it is arguably a political requirement.

- Distance-based charging (either fuel excise for carbon-based vehicles, or a distance-based charge for EVs).[91]

- Congestion charging via time-of-day tolls on the most congested capital city routes.

- Private tolls would remain under existing contractual settings.

11.3.2 Heavy road freight vehicles

For heavy road freight vehicles, further incremental reform of the current system is required. All levels of government have agreed to the objective of more cost-reflective pricing principles in accordance with the December 2015 decision to reform the way the heavy vehicle user charge is set and collected.[92] In a 2017 review, the Department of Infrastructure, Regional Development and Communications found:

> *The system we presently use for setting the heavy vehicle user charge is not working well. While the National Transport Commission produces a recommended price in accordance with its stated principles, usually this recommendation is not accepted by governments and, instead, a price is agreed through political negotiation (DIRDC, 2017).*

While the current PAYGO model is based on sound pricing principles, in effect, it is not producing optimal outcomes. In practice under PAYGO:

- Costs are apportioned across vehicle classes according to detailed cost allocation rules, using expenditure data from state and territory road agencies (disaggregated into 14 categories) and local government expenditure reported by the ABS (NTC, 2018).

- The revenue is collected through a combination of annual registration fees, which account for roughly 40 per cent of the total, and a fuel-based road user charge levied by the Commonwealth on diesel consumption.

- PAYGO smooths charges over time by using seven-year averages of both road expenditure and vehicle usage. This averaging prevents annual fluctuations in charges due to short-term shifts in spending or fleet composition, and helps to ensure that heavy vehicles contribute not only to pavement wear but also to common road services such as rest bays, lighting and signage.

- In May 2023, Transport Ministers agreed to a series of annual 6 per cent increases to both the road user charge and the roads component of registration fees for the period 2023–24 to 2025–26, commencing on 1 July 2023 (NTC 2024).

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[91] We have not considered how distance-based charging for EVs would work in practice but it is certainly technologically feasible. It would need to be undertaken at the national level following the Vanderstock decision in the High Court of Australia, which precluded the State of Victoria charging "a duty of excise" in the form of a distance-based charge on EVs. See here: https://www.hcourt.gov.au/cases-and-judgments/cases/decided/case-m612021

[92] In December 2015, the Council of Australian Governments agreed to accelerate Heavy Vehicle Road Reform (HVRR) and investigate the next steps to transition to independent price regulation of heavy vehicle charges.

Despite its national consistency, the PAYGO model has been criticised for its limitations. The most significant criticism is that the seven-year moving average framework is inherently backward-looking, with charges set on the basis of historical expenditure rather than forward-looking costs. This weakens the investment signal and risks embedding inefficiencies. Engineering evidence shows that pavement damage rises roughly with the fourth power of axle load, yet PAYGO only partially reflects this reality. As a result, smaller and lighter trucks can cross-subsidise the road wear caused by larger, heavier vehicles (Box 11-2).

Box 11-2 Why PAYGO charges are not perfectly efficient

Why PAYGO charges are only partially efficient

i. PAYGO is backward-looking:

Charges are based on historic expenditure reported by states, averaged over seven years. This smooths volatility, but it doesn't reflect forward-looking costs (for example, the need for thicker pavements if more A-triples operate on a corridor). This means that while charges roughly recover past costs, they don't send strong investment signals about the future.[93]

ii. Pavement damage is underpriced:

Engineering studies confirm that pavement wear increases roughly with axle load raised to the fourth power. Smaller trucks often end up cross-subsidising the largest trucks, because the PAYGO averaging process dilutes the extreme damage that high-mass vehicles inflict on a per-axle basis. That's why economists and engineers favour mass–distance charging, which aligns charges directly with road wear.

iii. Partial coverage of externalities:

PAYGO is limited to road damage. It doesn't incorporate the marginal costs of congestion, accident risk, emissions or noise, all of which are significant for heavy vehicles operating in urban freight corridors. As Winston (1991) and Gómez-Ibáñez (2004) point out, ignoring these externalities leads to mispricing, modal distortions, and inefficient investment.

iv. Revenue vs efficiency tension:

Around 40% of charges are paid via registration and 60% via diesel excise. This mix makes sense administratively, but it weakens the price signal to use vehicles efficiently. A truck that runs 200,000 km pays the same rego as one that runs 20,000 km, so high-usage operators are underpriced relative to the costs they impose. This is not to rule out registration fees as one component of a multi-part tariff. Registration fees should cover the costs of access to the network.

v. Political compromises:

93 This point assumes the same freight operator through time. If a freight operator is on the verge of retirement, then it is debatable why why that current truck operator should pay now for stronger roads and bridges that will be built later on, to cater to heavier trucks when they are approved. It is almost universal that private investment is not financed by users, but by borrowing or equity investors, and later recouped from users of that investment. Hence, why should public investment be funded by users before those users get access to the improved roads? In that sense, a backward-looking pricing regime may be more efficient than a forward-looking regime.

Governments have long tried to keep freight costs "competitive" by not fully charging road trains and large heavy freight vehicle combinations in proportion to their pavement damage. The 2023 agreement to raise charges by 6% annually for three years reflects the political balancing act between road cost recovery and freight industry concerns about inflationary pressure. But there is no free lunch here — somebody, being the Australian taxpayer, always makes up the difference.

vi. Bottom line:

The current PAYGO-based charges are consistent and nationally harmonised, and they do raise enough revenue to broadly cover the arterial road cost base. But they are not economically efficient: they underprice the most damaging heavy freight vehicles, ignore congestion and emissions, and fail to give forward-looking investment signals.[94]

That's why the National Transport Commission (NTC) continues to work on mass–distance charging trials and why multiple reviews (Productivity Commission 2017, 2022; Infrastructure Australia 2019) argue for reform. A properly designed mass–distance–location charging framework would be much closer to "fair and reasonable," both in terms of aligning charges with true costs and in improving long-run productivity.

Source: PAYGO model user manual – version 2.2 May 2018. National Transport Commission.

11.3.3 Recommendation

Reviews stretching back more than a decade have recommended a shift to a more cost-reflective mass–distance charging framework, which would directly link charges to vehicle weight and distance travelled.

We strongly support this policy reform. More cost reflective mass-distance charging would provide clearer incentives for efficient fleet choices, reduce cross-subsidies, and better align revenues with the costs imposed on the network. While the NTC has developed proposals to move in this direction, progress has been slow, constrained by concerns about freight costs, interstate competitiveness, and political sensitivity around charging reform.

[94] Notwithstanding the point made in the above footnote.

12 Rail reform

12.1 Introduction

This section sets out the key reform priorities specific to passenger and freight rail.[95]

12.2 Passenger rail

Passenger rail in Australia faces a range of structural, financial, and planning constraints that limit its ability to contribute more effectively to urban mobility and transport productivity.

12.2.1 Rebalance network expansion, maintenance and modernisation

Australia's passenger rail task could be better served by fixing and improving what we have before adding more passenger rail track. The highest, most reliable returns typically come from state-of-good-repair (SOGR) programs — track, power, drainage and structures — paired with brownfield capacity upgrades such as modern signalling, turn-back and junction works, dwell-time reductions, and accessible stations.

When maintenance is deferred, reliability slips, cancellations rise, and patronage growth stalls; every new kilometre built onto an ever-depreciating core network spreads scarce resources thinner and bakes in higher life-cycle costs. This matters when PT fares are below (or well below) economically efficient prices. By contrast, targeted renewal and greater digital control (ETCS/ATO) squeeze more trains through existing corridors, lift safety and recovery after incidents, and harden lines against heat, flood and fire risk. This is not easily done along corridors that also accommodate freight rail.

That said, heavy rail expansion still matters in growth areas (such as North Brisbane to the Sunshine Coast), but it should follow—not precede—credible evidence that the core network is efficient, reliable, resilient and used well. Moreover, lower-cost bus and light rail options should be considered as interim steps before demographic and economic growth demand new heavy rail links.

Light rail is a low cost, efficient intermediate transport service options that, while ubiquitous in inner Melbourne, is becoming increasingly important in inner Sydney, Canberra and the Gold Coast. Deeply integrated light + heavy rail networks maximise use and value — for instance, connecting the Gold Coast light rail network to the heavy rail connection at Robina, linking into Brisbane's heavy rail network.

[95] Cross-cutting recommendations related to public infrastructure investment processes are addressed in Section **Error! Reference source not found.**.

- Melbourne's tram network (light rail by any practical measure) is the largest in the world, covering most inner and middle suburbs with dense stop spacing and very high service frequency should be seen as an exemplar for other Australian capital cities.[96]

Other areas of focus for suburban passenger rail networks include:

- Remove remaining key rail level crossings to reduce delays and improve safety in metropolitan areas.

- Raise rail bridge heights in coordination with State road agencies to at least 5 metres. There are still too many accidents on low height rail bridges that impede road network efficiency, especially in SEQ.

In summary, the priorities, therefore, should focus on:

- *Focus on SOGR first: clear the maintenance backlog and fund renewal each year to avoid costly step-changes later.*

- *Improve reliability and capacity on existing lines: rollout modern signalling and operations (ETCS/ATO, turnbacks, junction and timetable recasts), dwell-time reduction, and incident clearance improvements deliver more services, sooner, at lower risk than new corridors.*

- *Cost-effective universal access and safety: programmatic station upgrades (lifts/ramps, wayfinding), platform re-alignment and PSDs where justified; targeted level-crossing risk treatments rather than blanket megaprojects.*

- *Climate resilience: drainage, scour, heat management and fire-hardening to reduce closures and recovery time.*

- *Only when the passenger network is operating efficiently and costs are being recovered then, selective expansion: extend to growth areas when brownfield options are exhausted and business cases show durable demand, operating funds, and integration with buses and active travel.*

    - *Favour light rail before heavy rail in order to minimise fiscal costs and risks.*

12.3 Freight rail

Rail freight export services in Australia are highly efficient (see discussion at section 7). Our recommendations focus on Australia's rail freight import supply chain, especially in relation to intermodal efficiency.

[96] Elsewhere in Australia, light rail is corridor-based rather than citywide: Sydney (Inner West + CBD & Southeast lines), Gold Coast (G:link), Canberra (Stage 1 City–Gungahlin), Newcastle (CBD loop), and Adelaide (Glenelg line with city extensions).

12.3.1 Policy reform priorities

We identify six reform priorities that together try to address the intermodal inefficiency problem and provide a roadmap to improve rail freight efficiency.

Getting more out of the existing network will require:

(i) Scaling back the Melbourne to Brisbane Inland Rail project to find cost savings and refocussing investment on intermodal connectivity.

(ii) Build network resilience and reliability: new investment should target resilience upgrades, asset management strategies, and faster recovery after disruptions. This is especially important if the frequency of extreme weather events increases.

(iii) Digital train control systems (e.g. ATMS, ETCS): these systems should be rolled out across freight routes that interact with the suburban passenger rail network (so that the trains can operate closer together without crashing into each other), with seamless interfaces between jurisdictions.

- *Automated train scheduling across networks to optimise train pathing, handovers, and real-time operations.*

(iv) Promote beneficial operational harmonisation – Continue to harmonise national operating standards to the most optimal level (neither a race to the top or a race to the bottom), enforced by a central body with authority to mandate harmonisation where consensus cannot be reached. Harmonisation – done intelligently – would cut duplication, improve safety, and allow rail operators to run seamlessly across jurisdictions.

(v) Reform economic assessment frameworks – Update cost–benefit methodologies to properly reflect rail's external benefits (emissions, congestion, safety, resilience) and the true costs of heavy road freight. This would support more rational investment decisions.

(vi) Expand freight data collection and disclosure – Expand the National Freight Data Hub into a comprehensive, open platform for freight performance and demand data, giving operators, governments, and investors a stronger evidence base for planning and investment. There will be a need to revisit the reluctance of commercial freight operators to share their data.

(vii) Focus on long-term corridor protection, ensuring freight capacity is not eroded by encroachment from urban development or new passenger services, and keeping the costs of expansion in built up urban areas lower than otherwise (as per the National Freight and Supply Chain Strategy, 2024).

Part 4 Potential gains from Transport sector reform

13 Size of the prize

13.1 Introduction

This section sets out the potential gains from productivity uplifts and selected reforms in the Transport sector, with a focus on measuring the market impacts in the form of uplift in economic activity (measured through GDP) and employment outcomes. Specifically, we have analysed three hypothetical uplift scenarios:

- The 'size of the prize': Investigating the possible economic dividend to a reversal of the recent decline in productivity, as described in Section 4.

- Better project selection and cost management: Addressing the persistent overspend and under delivery in Transport infrastructure delivery, particularly born out of a bias to megaprojects, as described in Section 5.

- Reforms to reduce congestion: Estimating the dividends to addressing avoidable congestion, outlined in Section 6.

An important caveat to the modelling is that we assume the achievement of the reforms required to boost productivity are costless. In reality, all reform involves some costs — especially upfront costs — in terms of reorganising how we do things. Examples of potential costs may include:

- Reforming Infrastructure Australia to promote better investment decisions may require more taxpayer-funded staffing and other resources to review project proposals.

- Implementing mass-distance and time of day tolls across Australia's road network would require significant upfront investment in telematics technology.

While these costs haven't been estimated as part of this modelling exercise, in our view it is reasonable to assume that the costs are relatively small compared to the potential gains. Moreover, reforms that cost more than the likely benefits would not proceed. In other words, the potential gain from reform sets the limit on the costs that would be logically borne to ensure the achievement of a net economic benefit.

13.2 The size of the prize

13.2.1 What we did

First, we've estimated the potential total 'size of the prize' as a return to 2012-13 productivity levels. In Section 4, we set out the Transport sector's poor productivity performance over the past 15 years. Based on that analysis, we estimate the economic gain if the sector returned to 2012-13 productivity levels.

Second, we've suggested three primary channels to boost productivity, as follows:

(i) Better public infrastructure investment decisions made by the Commonwealth and State and Territory governments in the Transport sector.

(ii) An improved transport sector pricing regime, including mass-distance based pricing for freight, distance-based pricing for passenger vehicles and congestion pricing for both freight and passenger vehicles on Australia's most congested roads.

(iii) A more flexible and responsive regulatory environment that could, for example, accelerate the take-up of large heavy freight AVs and, hence, boost productivity in the freight sector.

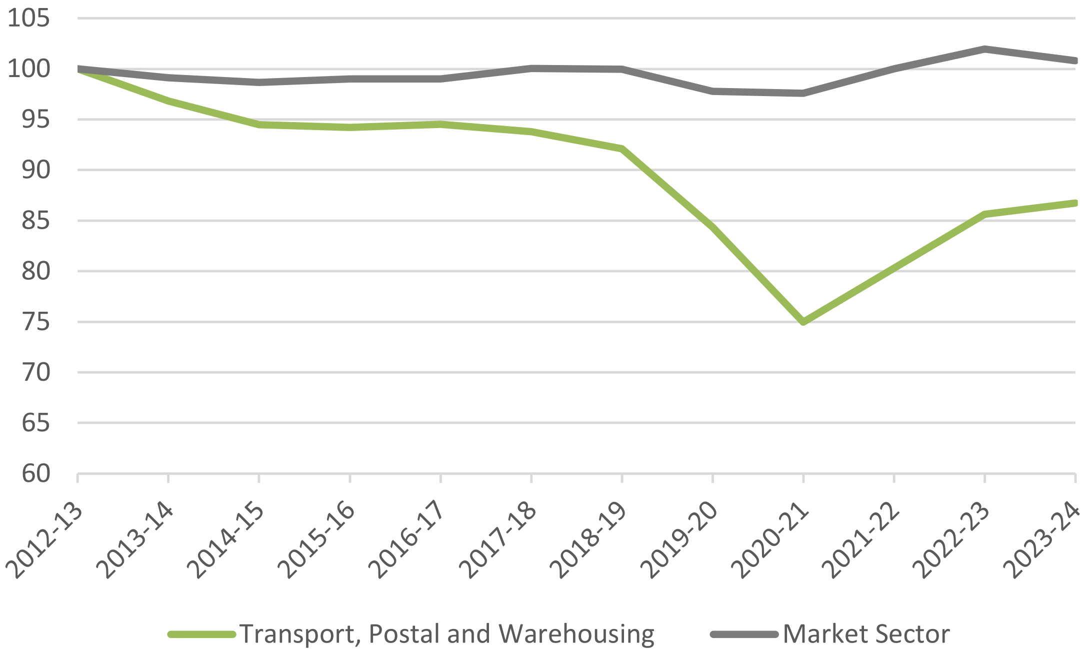
13.2.2 What we modelled

In this scenario, we examine the potential economic benefits of reversing the decline in MFP levels observed in the Transport, Postal and Warehousing sector compared to the market sector since 2012-13. According to the ABS, the Transport sector's productivity index declined by around 13 per cent over the period, from a base of 100 to approximately 87 in 2023-24.[97, 98]

This decline is clear to see against the average for the market sector in Figure 13-1 below. The large dip and subsequent bounce back in productivity performance between 2020 and 2022 is related to the Covid era restrictions placed on the Australian economy. Prior to Covid, transport sector MFP had already declined to its most recent level, hence we are satisfied that comparing the 2012-13 figure to 2023-24 provides an accurate representation of the sector's decline in productivity performance.

[97] ABS Estimates of Industry Multifactor Productivity, Australia (2025).
[98] Re-indexed to 100 in 2012-13.

Figure 13-1 MFP growth in the transport and market sectors, 2012-13 to 2023-24



Source: ABS (2024) Experimental estimates of multifactor productivity. Note: The Market Sector estimate includes the Transport sector, hence the gap between the two lines in the figure would be otherwise wider.

The size of the prize scenario models the effect of clawing back this lost productivity by 2030 and then continuing to grow at the market sector productivity growth rate. This provides a sense of the size of the potential prize from reversing the decade long decline in Transport sector MFP.[99]

The scenario is silent on the actual mechanisms required to achieve this outcome. Returning to 2012-13 MFP levels would require a combination of a range of initiatives including policy reform, pricing reform, technological adoption, infrastructure improvements, greater intermodal efficiency in freight, and more effective integration of freight and passenger systems. We discuss the main likely channels further below.

13.2.3 Estimated impacts

The economic benefits of a recovery in productivity levels flow well beyond the Transport sector itself.

- Productivity improvements lower the effective costs of moving goods and people, enhancing competitiveness for freight operators and logistics providers, while also reducing travel times and costs for private transport users.

[99] It would be unrealistic to model an instantaneous return to market sector productivity levels, therefore we have modelled the return over a five-year period — 2026 to 2030.

- As transport services are a critical intermediate input for most industries, gains in this sector propagate across the economy, raising output and supporting higher living standards.

By framing the scenario around restoring lost productivity, the analysis highlights both the scale of the challenge and the potential rewards. The results provide a benchmark for policymakers and industry stakeholders, showing the economic upside if targeted interventions were successful in reversing the decline and positioning the sector on a stronger productivity growth trajectory — proxied by long-run market sector growth — through to 2030 and beyond.

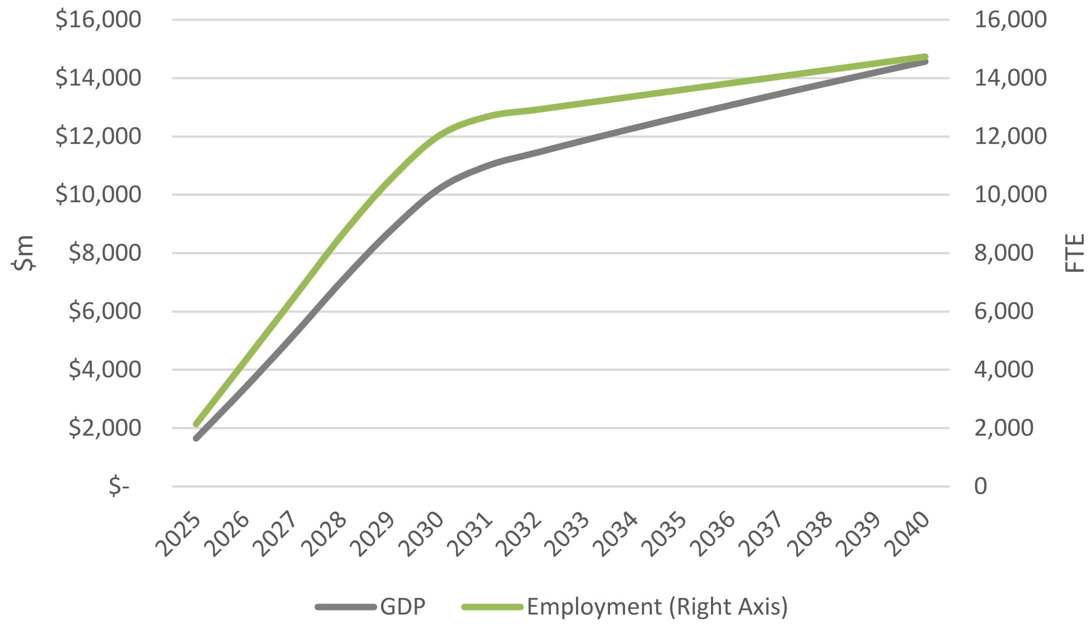
The size of the prize estimate sets the maximum cost that society should be willing to pay to obtain that prize. If the prize can be gained more cheaply, then society makes a net gain.

The economic dividends of restoring lost MFP in the transport sector are significant — **with a return to 2012-13 MFP levels, which were 13 per cent higher, GDP in the year 2040 would be higher by $14.6 billion alone, and worth $86.2 billion to the Australian economy in net present values over the modelling horizon (2026 to 2040)**[100]. These macroeconomic upsides are coupled with an average increase in employment over that period of 11,300 full time equivalent positions.

In Figure 13-2 below, GDP and employment rise steeply relative to the baseline as the Transport sector enjoys higher productivity growth levels over the period 2025-26 to 2029-30. After the initial five-year return to historical levels of productivity, productivity growth is then maintained at long-run market sector growth rates, with the longer run growth in economic outcomes driven by a newly revitalised transport sector operating against the backdrop of broader and continued growth in the Australian economy.

[100] The modelling horizon is from 2025-26 to 2039-2040, with all net present values calculated using a 7% real discount rate.

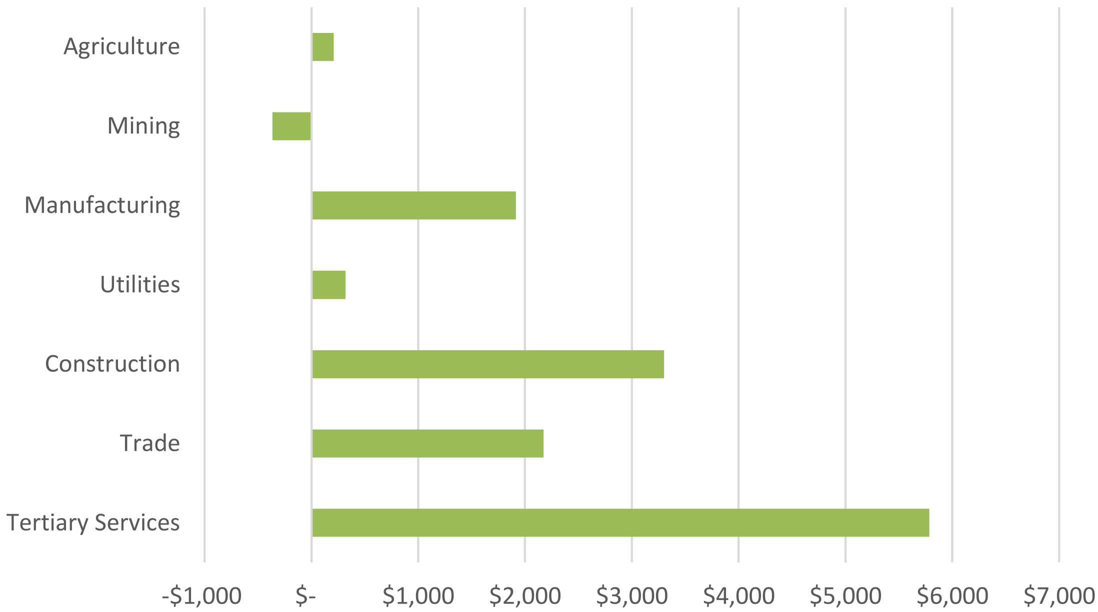
Figure 13-2 Macroeconomic outcomes, size of the prize scenario



Source: Qaive macroeconomic modelling.

Figure 13-3 shows the increase in industry output in 2030 for the other industries that rely on transport services relative to the counterfactual or business as usual (BAU) scenario, with all industries enjoying the benefits of access to a more productive transport sector.

Figure 13-3 Change in industry output in 2030, $m, size of the prize scenario



Source: Qaive macroeconomic modelling. Note: Tertiary services include Information Media and Telecommunications; Professional, Scientific and Technical Services; Administrative and Support Services; Arts and Recreation Services; Other Services.

In the sections below, we set out the modelling of the scenarios that would, in our view, most likely contribute to a return to higher productivity levels in the Transport sector.

13.3 Better project selection and cost management

13.3.1 What we modelled

As we discussed in Section 5, the economic and social benefits of public investment in Australia's Transport network is a fundamental driver of sector performance, GDP and living standards.

- The upfront capital investment requirements for new road and rail projects are often priced in the billions, if not tens of billions, of dollars with megaprojects taking an increasingly larger share of total annual public infrastructure investment (Grattan, 2020).[101] It goes without saying that taxpayers expect good investment decisions to be made.

We used a number of publicly available information sources including Infrastructure Australia's Business Case Evaluation Reports and the Grattan Institute's 2020 report 'The rise of megaprojects' to estimate an average of cost overruns on major Transport sector infrastructure projects.

- Grattan finds that on average delivered costs are 21 per cent higher than initially estimated.[102] Further, in 2020 at the time that report was delivered, the combined delivery cost of just six megaprojects – the West Gate Tunnel, Cross River Rail, Inland Rail, Sydney Metro City & Southwest, North East Link and WestConnex – was $24.4 billion or over 50% higher than initially promised.

- Based on the most recent figures available the combined cost overrun has increased to approximately $104 billion, more than triple the initial combined estimate, and bringing the average benefit cost ratio down from 1.43 to only 0.45.

- This average benefit cost ratio (BCR) is potentially still optimistic, as it doesn't allow for any optimism bias in the benefits (e.g. customer demand growth) of the projects (Flyvbjerg, 2009).

It is clear from the available evidence that BCR bias is systemic and, given current governance frameworks, largely unavoidable. Large projects suffer from systemic BCR inflation of up to 300%, meaning most project would not be undertaken if their BCR's were calculated correctly in the first place. If capital is constrained, which it ultimately is, then the optimism bias in the BCR creates a capital rationing inefficiency problem, the consequence of which is that smaller projects with higher returns cannot be funded and hence do not get implemented.

Against this backdrop, our 'Promised Benefits' scenario analysis estimates the economic upside if transport infrastructure projects actually achieved the benefits forecast at the time

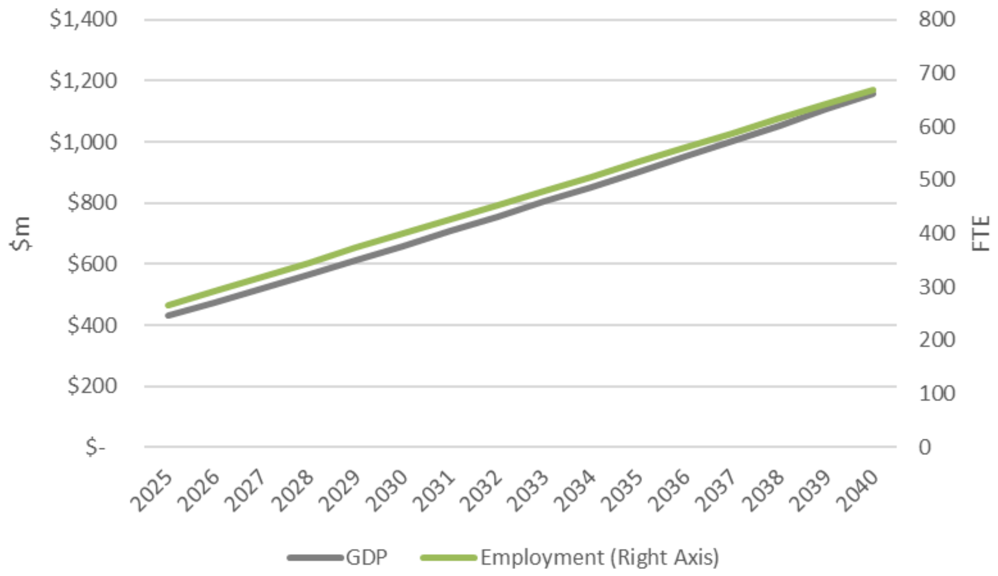
[101] Public investment in the Transport sector is discussed in section 5.
[102] For all projects valued over $20m.

of commitment. This approach provides a benchmark against which to measure the effectiveness of infrastructure delivery and highlights the economic opportunity associated with improving project selection, planning, and execution.

13.3.2 Modelling results

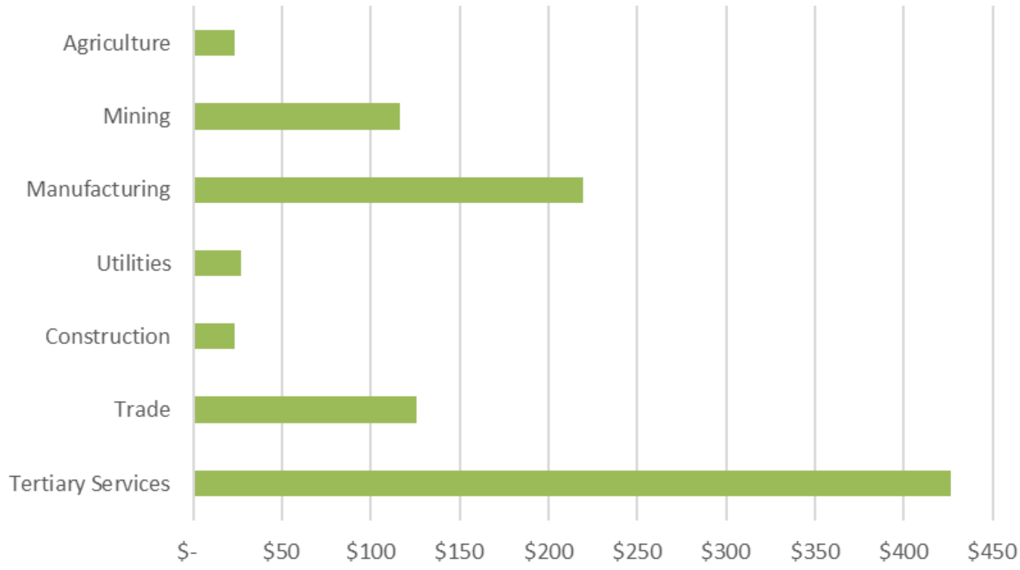
It is not surprising that improving the performance of public expenditure of this scale on transport infrastructure brings big benefits to the Australian economy. **In 2030 GDP is $660 million higher than it would otherwise have been, with a net present value increase in GDP over the modelling horizon of $6.7 billion.** Again, the improved macroeconomic environment also improves employment in the Australian economy, with an average increase of 470 FTE over the modelling period (Figure 13-4).

Figure 13-4 Macroeconomic outcomes, promised benefits scenario



Source: Qaive macroeconomic modelling.

Figure 13-5 Change in industry output in 2030, $m, size of the prize scenario



Source: Qaive macroeconomic modelling.

13.3.2.1 Cross-checking the macroeconomic modelling

We undertook a 'sanity check' on the results of the macroeconomic modelling, as follows.

- The value of transport construction work is estimated by BITRE to be $51 billion in 2023-24 (public + private).
- The value of infrastructure construction work done for the Public Sector in 2023-24 was $38.9 billion.
- Based on our review of IA Business Cases, and the work of Branigan (2016), Grattan (2020) and Flyvbjerg (2013), we assumed the current $38.9 billion annual investment achieves a 1.1x average BCR on current annual public capex expenditure.
- Assume same amount of spending but instead assume a true 1.2x BCR on average for the total $38.9 billion in public capital investment by reprioritising away from megaprojects and towards smaller incremental higher-value projects.
- Then annual economic welfare benefits would be $3.9 billion higher than BAU. The NPV (7%) from 2025 to 2040 would total $35.4 billion over the modelling period — an estimate well above the estimate produced above using the CGE modelling approach.
- Note, BCR is based on a welfare (not GDP) measure and is therefore a broader estimate.
    - According to the ABS, the passenger-freight road use split is roughly 70-30 in favour of passenger vehicles in terms of total kilometres travelled.[103]

[103] See ABS (2020), Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2020 (cat. no. 9208.0). In 2019-20, passenger vehicles travelled 162,983 kilometres accounting for 68.3% of total kilometres travelled.

    - Take 30% as the GDP benefit (i.e. welfare benefit = 70%), we get $10.6 billion GDP benefit (NPV, 7%) 2025 to 2040.
- Therefore, we are confident that the macroeconomic modelling estimate is a reasonable approximation of the potential GDP gain from better large-scale public project selection.

13.4 Reducing congestion

13.4.1 What we modelled

Urban traffic congestion imposes a range of measurable costs on road users and the broader community, which we discuss in Section 6. As traffic volumes rise, the capacity of metropolitan road networks becomes increasingly strained, leading to slower vehicle speeds, longer travel times, and reduced reliability (BITRE, 2015). Under congested conditions, each additional trip or increment of travel can impose external costs on other road users—delays that would not occur in free-flowing conditions.

These costs manifest in several key ways:

- Time costs: road users lose more time while travelling, both for private and business trips.
- Vehicle operating costs: stop-start driving, idling, queuing and reduced average speeds increase fuel consumption, engine wear, labour and maintenance costs.
- Air pollution and emissions: congestion raises emissions per kilometre by operating under less efficient engine regimes.[104]

In this scenario, we attempt to estimate the economic benefits of a stylised congestion reduction scenario. As we discussed in Section 6, it is not feasible (nor necessarily beneficial) to eliminate congestion on all roads in metropolitan Australia (since the costs of reducing congestion to zero are likely to significantly exceed benefits).[105]

- We model a scenario where a time and/or traffic load dependent pricing strategy is placed on half of the existing tolled roads that already cover 10.4% of VKT in metropolitan areas. We take this approach because the telematics infrastructure is already in place, with the remaining half able to be priced by 2030. [106,107]
- We readily acknowledge that the choices passenger and freight vehicles make will have both positive and negative effects for GDP and social welfare.

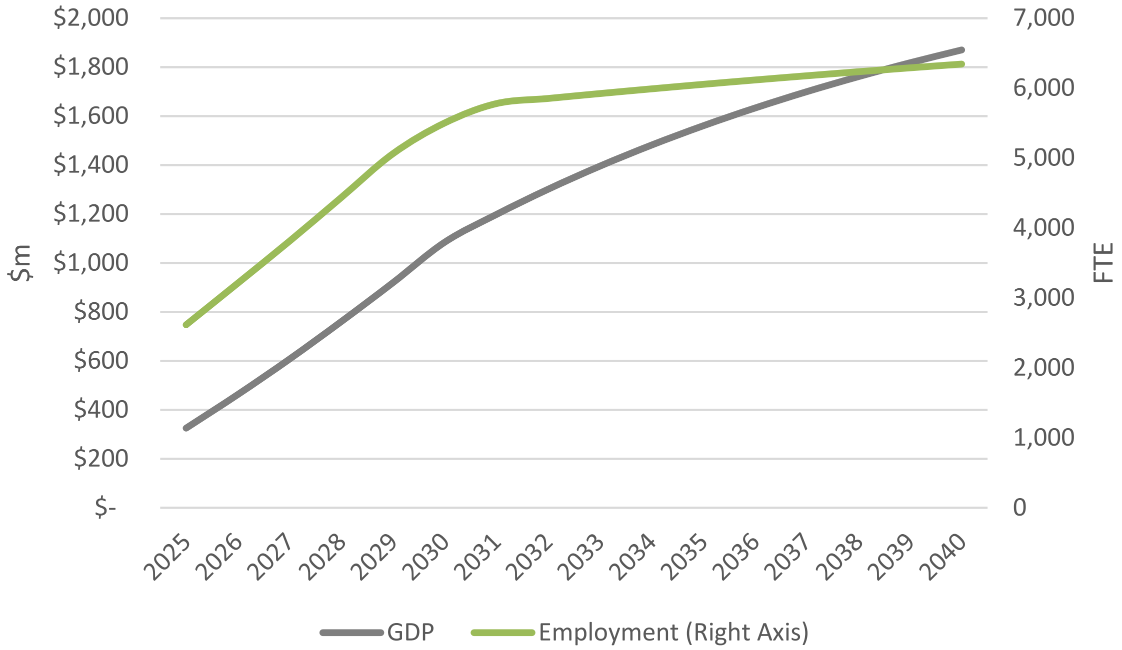
[104] See section 6 for a fuller discussion of congestion and its economic and social costs.
[105] In simple terms, if we accept the BITRE estimate of the costs of congestion to be, say, $25 billion, absent road pricing or other reforms it would likely cost several times that figure to build sufficient road capacity to eliminate all congestion and, hence, congestion costs.
[106] In this scenario we do not address potential challenges around long-term contracting arrangements (or similar) that may be in place.
[107] Or, an equivalent level of VKT on roads not currently tolled.

- We assume that freight vehicles will be more likely to pay the additional toll.
- We assume that some passenger vehicles will take alternative un-tolled routes adding to congestion on those roads, while other passenger vehicles to choose to shift to PT or carpool (reducing the number of cars on the road) or avoid the trip altogether.

- Overall, we estimate a net benefit from the faster travel times and isolate the freight component of that benefit (using the 70/30 passenger/freight split), which directly contributes to GDP.

This scenario drives major benefits for the Australian economy. **GDP in the year 2030 alone is $1.1 billion higher than it would otherwise have been in the business as usual (BAU) scenario, with a net present value increase in GDP over the modelling horizon of $11.9 billion compared to the BAU**. Accompanying this is an average increase in employment of 1,300 full time equivalent positions.

Figure 13-6 Macroeconomic outcomes, congestion busting scenario



Source: Qaive macroeconomic modelling.

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Appendix A: The potential of Autonomous Vehicles

A.1 Introduction

Autonomous heavy vehicles have clear potential to lower the delivered cost of road freight, but the gains will likely take time to materialise, arrive in stages and depend crucially on the regulatory environment.

- In the short-run, connected and automated driver-assistance features — eco-driving, adaptive cruise and two-truck platoons on suitable highway corridors (e.g. inland highways with very low passenger demand relative to freight) — can reduce fuel consumption and smooth hub and warehousing operations, yielding single-digit to low-teens percentage reductions in unit costs.

- The step-change in cost reductions arrives with Level-4 "hub-to-hub" operations on divided highways: removing the driver on the intercity leg, lifting tractor utilisation, and streamlining maintenance and scheduling.[108]

- Credible studies place order-of-magnitude 20–30 per cent per-mile savings for long-haul lanes, with an upper bound nearer ~40 per cent as the operational design domain (ODD) expands and handover frictions fall. Importantly, these are lane-level gains; system-wide averages scale with corridor coverage, adoption, and price pass-through. (CIE, 2021).

A.2 Current trials

Australian trials of heavy freight vehicle AVs are at a very early stage.

- The Australian Army's leader–follower autonomous convoys have run on public roads in Victoria, while private pilots (such as Transurban's work on CityLink) point to the hub-to-hub model as the near-term benchmark.[109]

Internationally, commercial driverless trucking is now operating on the Dallas–Houston corridor, signalling day-and-night viability on divided highways.[110] Adoption shares of roughly 10-15 per cent of the U.S. heavy-duty truck fleet by 2035 are being proposed.

A.3 Cost reduction studies

Cost reduction studies treat autonomous trucks as a cost-reducing productivity shock to the road-freight margin (i.e. profit or value-added generated), phased in over time. Also, the wage share of operating costs is expected to fall, although human input in terms of computer

[108] Tractor utilisation refers to the productivity of the Prime Mover in terms of productive hours and km travelled.
[109] https://www.defence.gov.au/news-events/news/2023-06-09/armys-autonomous-truck-convoy-first
[110] https://ir.aurora.tech/news-events/press-releases/detail/119/aurora-begins-commercial-driverless-trucking-in-texas-ushering-in-a-new-era-of-freight

hardware and software will likely still be essential. In Australia, AV uptake is assumed to be slow through to 2030 and then to scale-up to mid-century as operational design domains widen, fleets turn over and confidence in AV safety grows (CIE, 2021).

- Cost per lane-km savings in long-haul trucking translate into lower delivered prices for goods and, once coverage and adoption are material, into higher GDP.
- Studies generally apply a unit-cost (or equivalently, factor-augmenting productivity) shock by deployment stage—near-term ADAS/platooning, medium-term Level-4 hub-to-hub, longer-term expanded L4/L5—and then scale the effect by:
    - the share of tonne-kilometres that lie on covered corridors;
    - the adoption share on those corridors (e.g. by applying a S-curve type take-up trajectory to, say, long-haul highways first then first/last mile urban legs later); and
    - the pass-through from carrier costs to freight rates (see Table A-1).

The macroeconomic impact of AVs hinges on regulatory enablement — that is, without the right regulatory environment the productivity gains from AV technology will not be realised. An end-to-end in-service safety regime, clear liability and insurance settings, and nationally consistent operating rules are prerequisites for moving from pilots to commercial services to productivity gains to increases in GDP. The NTC in coordination with the States and Territories is progressing on the regulatory front, but there's more work to do.

Complementary rules and regulations must be thought through carefully in order the accelerate/optimise take-up rates:

- permissions for platooning;
- harmonised access for high-productivity vehicles;
- practical hub siting at city fringe;
- sensible curfew and speed-management policies; and
- road-user charging that supports efficient deployment.

With those rails in place, corridor pilots can scale, and lane-level savings become economy-wide improvements rather than isolated demonstrations.

Table A-1 Cost reduction studies

Deployment stage (representative ODD)	What changes	Suggested shock (Δ unit cost / ↑ productivity)	Key evidence
Near term (now–2030): ADAS & platooning on	Eco-driving, adaptive cruise; 2-	5–12%	Fuel savings ~4–10% from eco-driving & platooning;

highways; human-driven but connected	truck platoons on suitable corridors		insurance/safety gains modest at this stage.
Medium term (≈2030–2038): L4 "hub-to-hub" driverless on limited access highways, transfer hubs at edges of cities	Labour partially removed on intercity legs; higher utilisation; some fuel gains	20–30% (central: 25%)	ITF/OECD: "operating cost reductions for long-distance freight in the order of 30% are possible" with driverless; fuel 4–10% typical; labour ~35–45% of cost base but not fully eliminated.
Longer term (post-2038/2040): expanded L4/L5 (fewer transfers, larger ODDs)	Labour largely removed on long haul; streamlined hub costs; higher asset utilisation	35–45% (upper: ~42%)	McKinsey: ~42% per-mile TCO reduction for heavy duty trucks on long routes under driverless hub-to-hub, even after AV kit & control-centre costs.

Source: The CIE and WSP (2021), ITF, McKinsey, OECD.

A.4 Macroeconomic impact studies

In the CIE/WSP paper for the Commonwealth Government, a stylised 30 per cent productivity lift in road freight (principally from removing driver costs on long-haul legs) is implemented in a CGE framework.

- The CIE/WSP results imply that **a 10 per cent improvement in freight productivity reduces consumer prices by about 1.5 per cent and raises GDP by around 1.0 per cent**. In other words, freight efficiency passes through to the prices households and firms face, and the gains are amplified across the economy because transport is an input into almost everything (The CIE and WSP 2021).

These improvements are plausible for the following reasons.

- Labour typically represents 35–45% of long-haul trucking costs; even if only half of those costs fall away initially—because remote oversight, transfers and supervision remain—that alone, yields something like ~20% operating-cost relief on the driverless legs.

- Fuel and energy savings from automated eco-driving and platooning commonly sit in the ~4–10% range on highways, with higher figures possible as platooning stacks mature.

- Removing fatigue constraints increases asset utilisation, allowing more hours per day per tractor and, in some settings, fewer vehicles to complete the same task (with maintenance offsets).

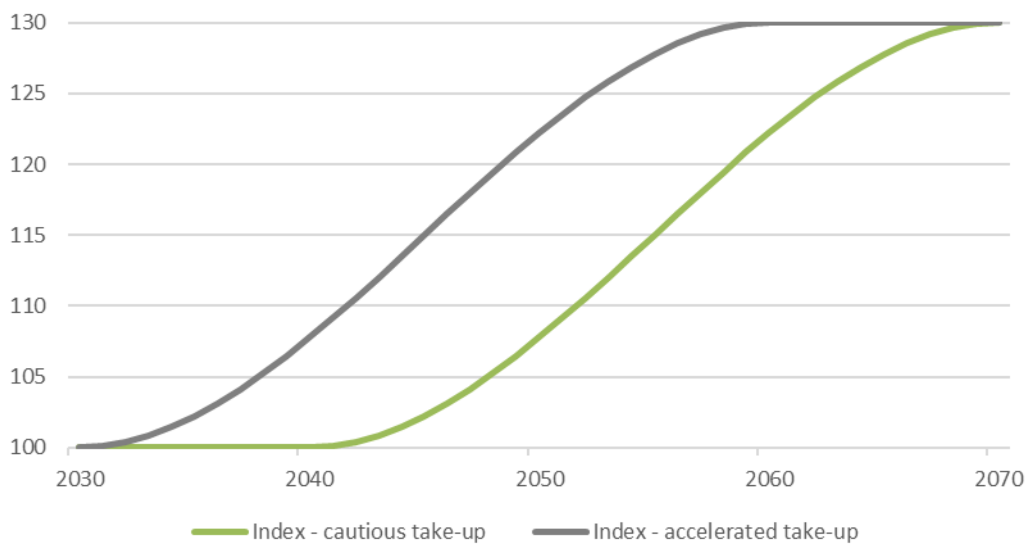
- Insurance premia should also fall over time if loss data confirms safety gains, although that depends on regulatory acceptance and empirical performance (ITF/OECD).

A.5 Our modelling results

In order to test the potential future impacts of automated vehicle deployment, we have implemented two stylised scenarios based on the analysis undertaken by The CIE and WSP (2021), with an extended modelling horizon compared to our analysis in Section 7.

Under our scenarios, we calibrate to the possibility of a 30 percent productivity improvement in the road transport sector, with a S-curve profile that commences gradually and is fully achieved over a 30-year period. This take-up is assumed to commence from 2040 in our 'cautious take-up' scenario, or 10 years earlier in 2030 in our 'accelerated take-up' scenario, as demonstrated in Figure A-1 below. This profile is chosen simply to proxy a slow replacement of stock once the combination of technical progress and regulatory approval allow for broader implementation beyond the narrow, ringfenced examples (for example, in limited industrial applications) currently observed.

Figure A-1 Road transport productivity improvement, relative to baseline.



It should be noted that a shock of this type is very large compared to those implemented in previous sections, and the time period over which it is implemented allows for a long period of capital adjustment in the Australian economy. Consequently, the economic impacts are also very large.

Figure A-2 (below) shows the increase in GDP and aggregate economy wide employment as a result of this shock. By 2070, the improved productivity (and resulting decrease in the price of road transport) increases GDP and employment by $78.3 billion and 40,100 FTE with respect to the baseline in the cautious take-up scenario, representing percentage increases of 1.2% and 0.15% respectively, with an increase in household consumption increases in 2070 of $52.7 billion – nearly $1,000 per capita. In net present value terms, the increase in GDP over the period to 2070 is $85.6 billion.

These strongly positive results are replicated and strengthened under the accelerated take-up scenario, with increases in GDP and economy wide employment of $80.1 billion and 40,900

FTE respectively in 2070, and an increase in household consumption of $54.2 billion in 2070, all measured as differences against baseline. More telling is the increase in the net present value of the total GDP increase to 2070, with the earlier adoption increasing the net present value of GDP to an uplift of $184.2 billion

Figure A-2 Economic impacts of AV uptake – cautious take-up

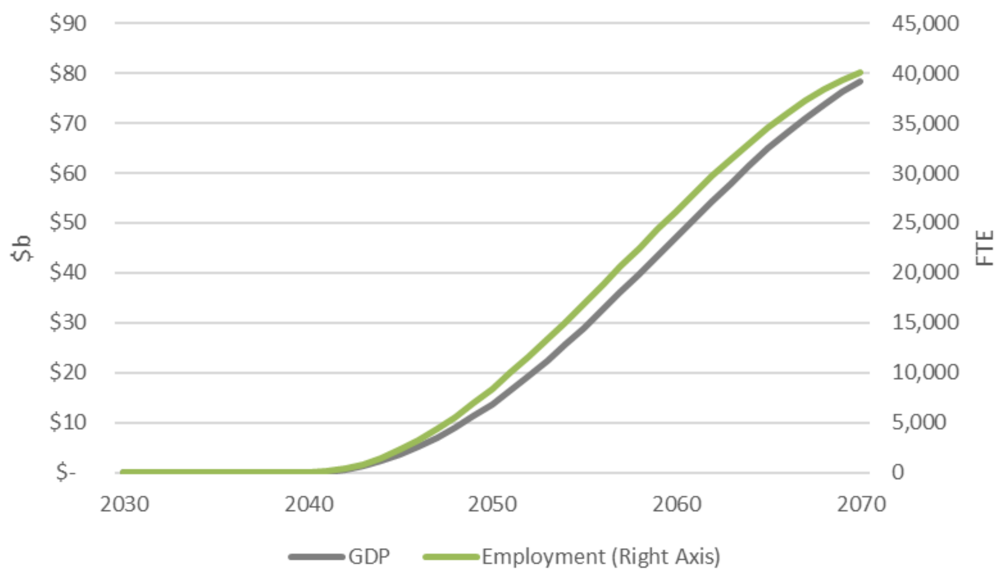
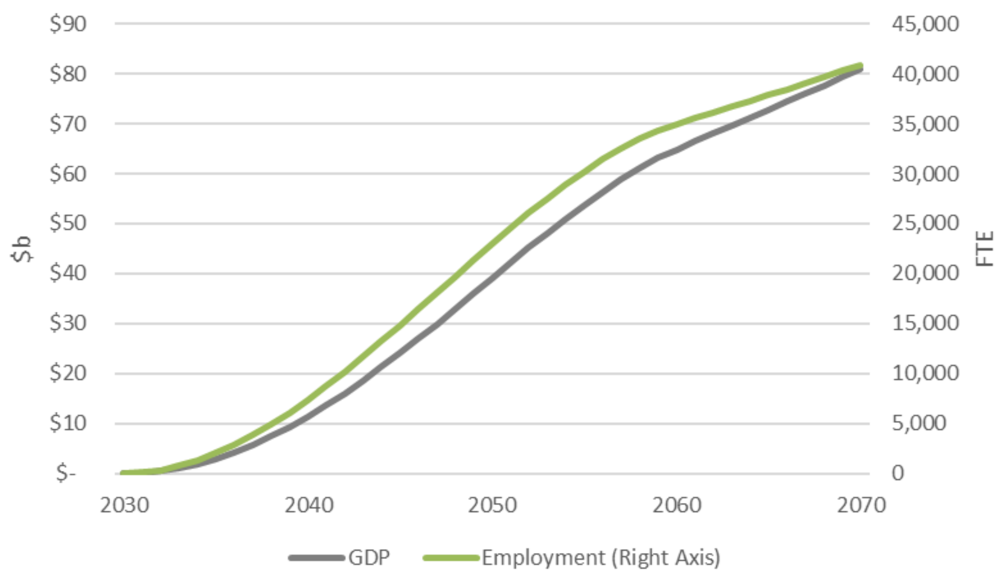


Figure A-3 Economic impacts of AV uptake – accelerated take-up



A.6 Conclusions and caveats

The benefits from autonomous road freight are real but conditional. The NTC 'is on the job', with the development of an end-to-end regulatory framework — including the forthcoming Automated Vehicle Safety Law and a national in-service regulator expected to commence by end-2026 — designed to enable commercial deployment under defined operating conditions.

The benefits of AVs are expected to arrive first where the task is simplest and the risks to community are lowest — on long, divided highways dominated by freight vehicles — and only later in cities, where complex Operational Design Domains (ODDs), passenger vehicle, motorbike, pedestrian and cyclist interactions, and night-time curfews constrain when and where AV systems could operate. That means urban pickup and delivery will lag interstate long-haul, so any projections of the impact of AVs should maintain segment-specific assumptions.

Trials and early deployment also carry transition costs that partially offset savings. Vehicles need AV kits and redundancy software engineers; logistics operators need mapped transfer hubs, tele-operations centres, training, and new maintenance regimes; and regulators will require monitoring and assurance activities that are likely to add to industry overhead costs.[111] These costs are front-loaded and tend to dilute per-kilometre gains until fleets scale and processes standardise. Accordingly, in our modelling we assumed more modest near-term gains and larger net benefits only in the medium to longer term.

That said, there is no doubt that the potential economic gains from AVs in road freight will be significant at a macroeconomic scale.

[111] This assumes that any new national regulator will charge industry levies to recoup costs.

Appendix B BITRE Congestion methodology

B.1 BITRE congestion cost measurement methodology

The BITRE utilise telematics technology to measure rates of congestion in its annual freight congestion series. BITRE's methodological framework to estimate congestion costs was developed in 2007 to inform the Urban Congestion Review, commissioned by COAG in 2006.[112] Updates to BITREs initial congestion cost estimates are based on the same methodology, although the technology to monitor network traffic congestion has evolved markedly.

The BITRE define congestion as traffic movement speeds less than "free running time". For example, if vehicles are moving at 20 km/h and "free running" is defined as 60 km/h (e.g. driving across town at 2am in a 60 km/h zone), then the measured rate of congestion is the additional time required to complete the journey at the lower speed relative to the free running time (BITRE 2007, 2008).

In terms of measuring (or monetising) congestion costs, BITRE define the concept of the "avoided costs of congestion" or "the costs of doing nothing about congestion". This measure is trying to isolate the social welfare cost of congestion. BITRE put it this way:

> *Therefore, the primary values derived by this study to refer to the 'social costs of congestion' are the estimated deadweight losses (DWLs) associated with a particular congestion level—which, reiterating, give a measure of the costs of doing nothing about congestion or the avoidable costs of traffic congestion. That is, DWL valuations give an estimate of how much total costs (for time lost and other wasted resources) could be reduced if traffic volumes were reduced to the economically optimal level. This optimal level is defined as the traffic volume (and distribution) that would result if, for a given travel demand, the generalised cost that motorists based their trip decisions on was equal to the marginal travel cost rather than on their private, individual travel costs (i.e. on the current average generalised travel cost). That is, if through an appropriate transport demand management or pricing instrument, each motorist choosing to enter already congested traffic had to take account of not only their personal travel time costs, but also the cost of all the extra delay that their entry into the traffic stream is likely to impose on others. (BTRE 2007, p. 11).*

In rough terms, the breakdown of BITRE's congestion cost estimate is:

- 37% private time costs.
- 38% business time costs.

[112] See here: https://www.bitre.gov.au/sites/default/files/cr_001_COAG_Urban_Congestion_Review_Report.pdf

- That is, about three-quarters of measured costs are time costs.
- 13% vehicle operating costs.
- 12% air pollution. (BTRE, 2008).

BITRE has readily acknowledged the limitations of its estimates, which use ‘aggregate’ rather than ‘network’ simulation models and are, therefore, provided as “order of magnitude” evaluations (BITRE 2007, p.2).

> *The complex nature of congestion effects leads to reasonable levels of uncertainty in such cost estimations. (BITRE 2007, p.XV).*

The BITRE highlight several aspects of modelling uncertainty.

- How drivers will respond to peak congestion. For instance, the extent of peak-spreading of traffic volumes in the future (especially considering some major urban freeways are already operating at close to full capacity during the peak hours).
- The potentially very wide variation in passenger and freight vehicles value of time. That is, what value do different parts of the community place on their time (for example, whether people value waiting time more highly than trip time reliability; whether delays during various trip purposes are felt more strongly than during others; or whether delay during longer trips is worse than during shorter trips). In other words, the BITRE acknowledged that it was difficult to determine the most suitable dollar value for an hour of time lost to congestion delay (either for business road use or for private travel), and to resolve what proportions of urban trips are time-sensitive.
- What exactly is a non-congested running time? When calculating how much delay congestion causes, recorded average traffic speeds must be compared with a less-congested benchmark speed (such as the free-flow speed—how fast a car is able to travel at, on that particular road link, if no other vehicles are present). For actual road systems, the definition and estimation of such speeds is typically complicated and fairly approximate and needs to account for stated speed limits. That said, Google Maps for example can provide reliable and accurate estimates of non-congested travel times for any road segment in the world within milliseconds of the request being made.
- The BITRE base case scenario for congestion cost projections assumes that an increase of about one per cent per annum (in total available lane-kilometres) would be representative of long-term road provision trends for our capital cities. This assumption is embedded into projections of future costs of avoidable congestion (say, in 2030).
- In terms of forecasting future congestion costs, demographic effects—which can influence not only total demand levels but also elements of trip distribution (for example, peak spreading of trips may increase in the future at even faster rates, as the average age of the population and retirement rates increase, and a growing

proportion of travellers are not constrained to travel during the standard work-day peak hour). Aggregate BITRE traffic flow modelling did not account for these types of effects. Moreover, the modelling framework did not anticipate the switch to working from home for a significant proportion of the Australian labour force, which was accelerated by the Covid-era restrictions.

- The possible flow-on effects and costs of urban congestion in terms of urban form. The costs primarily relate to estimated valuations of excess travel time for road users (with some allowance for the inefficiency of vehicle engine operation under stop-start conditions, leading to higher rates of fuel consumption and pollutant emissions). However, there is a series of other possible consequences of urban congestion—ranging from some businesses having to re-locate or close (due to restrictions on their operations from congestion delays), to widespread psychological stress and irritation from coping with heavy traffic levels, to reducing the efficiency of public transit and the attractiveness of transit or non-motorised transport options. The BITRE did not estimate the costs of these wider impacts.

Taken together, sensitivity analysis suggests that the true costs of avoidable congestion could be between almost half the central point estimate to almost double the estimate. Therefore, before progressing with road pricing reform, getting a better handle on the true costs of avoidable congestion is recommended.

B.2 How to make progress on congestion

Before introducing congestion charges, it's worth re-thinking the BITRE approach to measuring the costs of avoidable congestion and also clearly defining what is the 'optimal' amount of congestion that should be targeted.

The BITRE (2007) method remains a useful scale indicator, but by its own description it is an aggregate, order-of-magnitude approach that is definition-sensitive, valuation-heavy, and not suited to corridor-specific policy design. With subsequent (post-2007) changes to in-vehicle utility, work patterns, fleet technology and the availability of telematics, the parameters that drive the totals—values of time, reliability, speed–flow, behavioural elasticities—should be re-estimated using contemporary data. As the BITRE readily acknowledged:

> *The main disadvantages relate to congestion being such a non-linear, inhomogeneous and stochastic process that highly accurate assessments of its impacts can really only be accomplished using detailed network models. As yet, however, there are no complete estimates of the cost of congestion (for Australian cities) using a network modelling approach. (BITRE 2007, p.2).*

We recommend that the BITRE be tasked with undertaking a comprehensive update of its methodology to estimate congestion costs. Given the core BITRE methodology was created in 2007, several parameters likely need re-estimation.

- Values of time & in-vehicle productivity: With more comfortable, connected cars (navigation, infotainment, mobile data), the disutility of time in traffic for some trip types has likely fallen, especially for passengers. That pushes toward lower VOT for discretionary trips and higher value of reliability for freight and schedule-critical trips—parameters the 2007 method could not observe directly.

- Reliability vs average delay: The method leans on average travel-time losses. Modern appraisal practice puts more weight on reliability/variability (90th-percentile times), which telematics and probe-vehicle data can now measure at scale.

- Better speed–flow data: Speed-flow curves in 2007 were largely generic. Today's GPS/telematics allow corridor-specific curves (by time of day, incident state, and vehicle class), improving both the marginal congestion cost estimate and the "optimal" comparator.

- Heterogeneity & behavioural response: The aggregate approach cannot capture alternative routes, mode and time-of-day choices by user group. Post-COVID travel patterns (hybrid work, shoulder spreading) and stated-preference + revealed-preference evidence would materially change elasticities and thus cost estimates.

- Freight vs passenger segmentation: Freight delay has high schedule-risk costs and knock-on inventory impacts that average-delay metrics blur. Segmented valuations by vehicle class, commodity, and delivery window are feasible now.

- Emissions/operating-cost parameters: The 2007 fuel and emissions factors are dated; the vehicle fleet, fuels and emission control tech have changed, so VOC and emissions externalities need re-estimation.

Appendix C The QGEM Model

C.1 Introduction

The macroeconomic consequences of the taxation reform scenarios in this report have been generated through a combination of industry personas designed to capture the probable behavioural responses at the firm level, in combination with a Computable General Equilibrium (CGE) model. CGE models are widely used tools for analysing the local, national global economic effects of policy changes, such as trade liberalization, environmental policies, and structural reforms. CGE models have a long history of usage in Australia (in particular), with frameworks of this type being demanded for use in a range of national and state approvals processes in particular.

The Qaive General Equilibrium (QGEM) model is Qaive's in-house Computable General Equilibrium (CGE) model.[113] QGEM model is a multi-region, multi-sector model that captures interactions between economies, markets, and industries, focusing on the flow of goods, services, and factors of production across regions and sectors.

QGEM is highly flexible and has been used to assess a wide range of policy interventions, including:

- **Project and infrastructure investment** (e.g., roads and water, mining investments, or major physical infrastructure)
- **Trade policies** (e.g., tariff changes, trade agreements)
- **Environmental policies** (e.g., carbon taxes, emission trading schemes)
- **Fiscal policy** (e.g., subsidies, taxes)
- **Structural reforms** (e.g., changes in labour market regulations)

The model provides detailed results on sectoral output, trade flows, factor prices, and welfare impacts across regions, making it useful for both global and regional policy analysis.

The QGEM model is built based on well-known and accepted functional forms, combined with parameters and data that constitute an approximation to the working structure of the global economy. The construction of the QGEM model draws initially on the GTAP7 model for the key structural definition, which has been further enhanced as described below.

C.2 Implementation for this analysis

For this analysis the QGEM model has been specified to separately represent an Australia and a Rest of World region. At the sectoral level, we have separately identified 14 economic sectors, as shown below in Table B-1. The sectors shown in Table B-1 have been chosen to

[113] Qaive and Tulipwood Economics have worked closely together on numerous current public policy issues, such as in housing, tax policy, international trade and transport policy.

allow for a balance between the faithful implementation of the industry personas and modelling tractability.

Table C-1 Sectoral specification of the QGEM model

Sector	ANZSIC correspondence
Agriculture	Agriculture, Forestry and Fishing
Coal	Mining
Oil	Mining
Gas	Mining
Other Mining	Mining
Manufacturing	Manufacturing
Electricity	Electricity, Gas, Water and Waste Services (excluding gas distribution)
Construction	Construction
Trade	Wholesale Trade; Retail Trade; Accommodation and Food Services
Transport	Transport, Postal and Warehousing
Finance, Insurance and Real Estate	Financial and Insurance Services; Rental, Hiring and Real Estate Services
Public Administration and Education	Public Administration and Safety; Education and Training
Human Health Services	Health Care and Social Assistance
Rest of Tertiary Services	Information Media and Telecommunications; Professional, Scientific and Technical Services; Administrative and Support Services; Arts and Recreation Services; Other Services

In addition to the regional and sectoral specification described above, additional validation has been undertaken to test model performance against other accepted analyses in the Australian context. Specifically, a suite of validation simulations has been undertaken to ensure that the QGEM model adequately replicates the marginal and average excess burden statistics reported in KPMG, 2009.

Finally, a small number of model customisations have been undertaken to permit the sector-specific investment scenarios described by the industry personas to be implemented in the QGEM model.

C.3 Detail on model structure

The following provides detail on the formal structure of the model, including the regional and sectoral scope of representation, the definition of representative agents and markets, and the nature of the model implementation.

Multi-Regional and Multi-Sectoral Representation

The QGEM model divides the global economy into multiple regions (typically countries or groups of countries) and sectors (for example, agriculture, manufacturing, services, etc.). Each region produces and consumes a variety of goods and services, which are exchanged both domestically and internationally. Trade flows between regions are captured, allowing for the analysis of the effects of trade policies, such as tariffs and quotas.

The QGEM model is based on the most recent iteration of the GTAP database, now in the 11th version with a base of 65 production sectors and 160 international regions, including 141 separately identified countries.

The QGEM model further extends the GTAP database by not only permitting highly flexible aggregations of the underlying 65 sectors and 160 regions, but also allowing both for custom disaggregation of sectors as required, and for disaggregation to include sub-national detail as required, including to structures such as state and territories, local government areas and commonwealth electoral divisions.

Input-Output Linkages

The model incorporates input-output linkages between sectors, meaning that each sector not only produces commodities but also consumes inputs from other sectors. For example, manufacturing may require agricultural products, energy, and services as inputs.

These linkages allow the model to capture the indirect effects of changes in one sector on others through supply chain relationships. As a consequence, a change in one sector (e.g., tariff reduction in agriculture) affects all other sectors and regions through changes in relative prices and income adjustments.

Factor Markets

Primary factors of production (that is, labour, capital, land and the natural resource) are specified to have a range of mobility possibilities and supply assumptions, with prices (such as wages and rents) used to clear factor markets on a period-by-period basis. Specifics by primary factor are as follows:

- The aggregate supply of labour (optionally, by gender and occupation) is governed by demographic inputs in the baseline scenario, and in the policy scenario by a labour supply elasticity with respect to the real wage. This elasticity may take on any real positive value or optionally be constrained to perfectly inelastic or perfectly elastic. The standard specification is for a labour supply elasticity of 0.15, consistent with the work of the Australian Treasury in (for example) TWP 2015-01.

- Aggregate supply of capital from one time period to the next is dictated by the combination of the stock from the previous time period, the level of investment in the previous time period, and the level of depreciation in that period

- Investment takes place in a global market in QGEM, allowing for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. Savings are converted into bonds that fund investment, which are distributed based on a constant elasticity of transformation function with respect to regional rates of return versus the global average.
- Endowments are region specific, with the model allowing for changes to endowments over time depending on the endowment and the specification of the modelling exercise.

Implementation framework

A range of software platforms are used for CGE models, including the GEMPACK/RunDynam suite, GAMS and Gauss. The QGEM model is instead solved within a Python software framework, drawing on a number of off-the-shelf packages including Pandas for data manipulation and the ‘scipy’ package for model solution.

In addition, the interface of the model is implemented in Microsoft Excel, enhancing usability and aiding in internal documentation of modelling, reducing the risk of modelling error, and allow for (for example) systematic sensitivity analysis.

Representation of Trade

The QGEM model adopts the Armington assumption, which differentiates products by their region of origin. This assumption means that products are imperfect substitutes based on where they are produced (e.g., wheat from Australia is considered different from wheat from Canada), with the strength of this assumption varying from product to product.

The adoption of this assumption allows for more realistic modelling of trade patterns and responses to policy changes, avoiding simple corner solutions.

The model also explicitly incorporates trade and transport margins, which represent the costs of moving goods between regions. These costs are crucial for understanding the true impact of trade policies and infrastructure changes on global trade patterns.

Consumer Preferences, Government and Savings

The QGEM model includes representation of households and governments through the implementation of a regional consumer agent and a regional government agent. Total factor income is allocated across the regional household, the regional government and savings according to a Cobb-Douglas (CD) specification.

Private demand is determined through a utility-maximizing behaviour framework subject to Constant Difference of Elasticities (CDE) function. The government agent again is represented as a utility maximising agent, subject to a Constant Elasticity of Substitution (CES) function.

The model calculates changes in welfare (e.g., equivalent variation) based on changes in consumption, income, and prices, allowing for the assessment of the distributional effects of policies across households and regions as required.