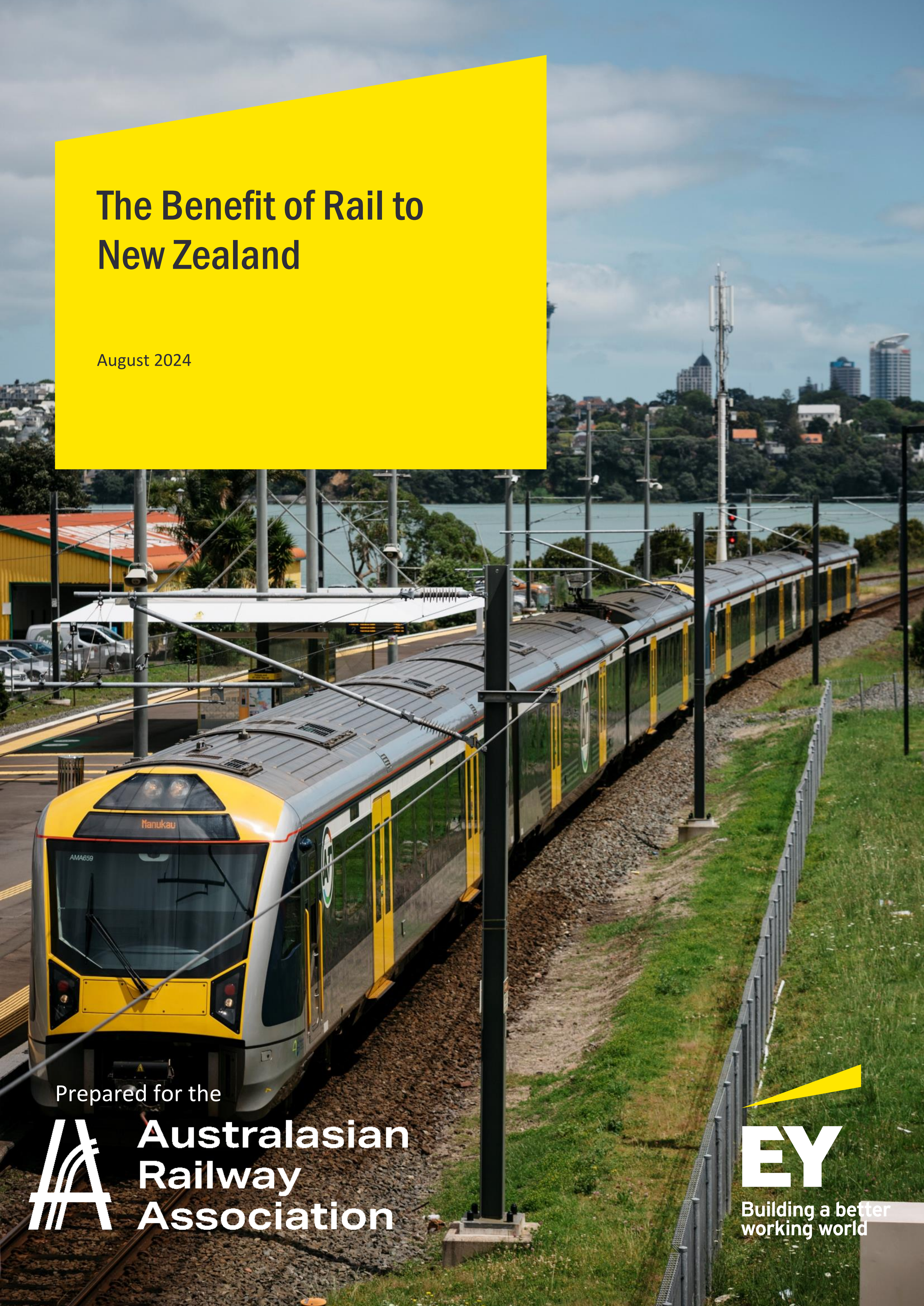

The Benefit of Rail to New Zealand

August 2024

Prepared for the
Australasian Railway Association

EY
Building a better working world

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Front cover image credit: Auckland Council

Executive Summary

Since the 1880s, rail has played an important role in the social and economic life of New Zealand. Over time, that role has changed, developed, and evolved. The dynamic and integrated nature of rail services means that the full breadth of benefits is difficult to fully conceptualise. This report brings together a range of economic methodologies for estimating the benefit that rail generates for Aotearoa, such as the reduced congestion resulting from fewer truck movements, or the additional employment generated from cost savings for freight.

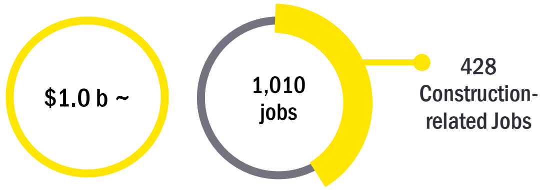
Rail makes a critical contribution to the New Zealand economy, acting as a foundation for regional supply chains, boosting productivity, and reinforcing domestic output. This research estimates that rail provides almost $3.3 billion in value to New Zealand each year, when effects on individuals and the national economy are considered. “Value” is defined using Treasury guidance and represents economic benefits in the form of real resource use or other observable impacts on New Zealanders. This value is considered additive to the direct economic contribution of rail through its baseline activities (such as GDP impacts from the operation of KiwiRail).

Applying a dynamic model of the New Zealand economy, in addition to best-practice appraisal tools, permits the computation of rail benefits in monetised (dollar) terms. These benefits not only estimate real benefits for New Zealanders through factors such as avoided health impacts of pollution, but also measure the impact of the rail sector on New Zealand freight services, supply chains, and other sectors and industries.

In aggregate, we estimate that the existence of rail services contributes **$3.3 billion** to New Zealand each year, comprising approximately $1 billion in Gross Domestic Product (GDP) benefits as well as $2.3 billion of economic externality impacts. All values are in net terms, such that results represent the difference between rail and road impacts.

Estimated benefit of rail to New Zealand

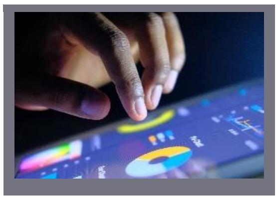
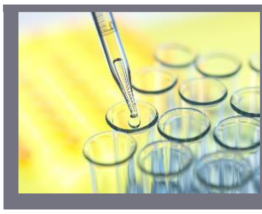
Rail transport leads to New Zealand realising almost an additional $1 billion in GDP and 1,010 jobs annually, based on economic impact analysis. This uplift in GDP includes the stimulation of net exports by approximately $97 million across a variety of New Zealand firms, arising from the price-competitiveness realised from the productivity benefits that rail provides. This is additional to the everyday activity that occurs for the operation of rail. Effects for the private sector are concentrated in the construction sector, wholesale and retail trade, as well as dairy and coal. These macroeconomic effects consider wider implications for employment, competition and productivity, and thus are considered in addition to the externality benefits.



GDP gains from rail efficiency

Additional job creation

While macro-economic impacts speak to economy-wide effects coming from productivity gains associated with rail, externality benefits consider the “real” benefits of using rail over road. Externality benefit categories are defined and explained in the following table. These benefits are “bottom-up”, in the sense of affecting individual New Zealanders. They predominantly consist of externalities, defined as costs or benefits affecting third parties that are not involved in the transaction or decision - for example, a pedestrian experiencing lung disease due to diesel exhaust fumes.

Rail Externality Benefits by Category	
	**Time and congestion savings ($1,533m per year)**: The absence of rail would cause dramatic increases in road traffic. Because highway and bus capacities are limited, urban land transport networks in New Zealand would essentially be crippled.
	**Avoid adverse health effects ($291m per year):** Diesel reliant heavy vehicles emit dangerous pollutants that limit lung development in children, increase susceptibility to infections and asthma, aggravate heart conditions, and reduce life expectancy.
	**Fuel and maintenance ($268m per year)[1]:** Heavy trucks are responsible for the majority of damage to New Zealand roads, as stress increases exponentially with axle weight. Repairs and resurfacing can be performed less frequently and at lower cost, as railway networks are more durable and cheaper to maintain. Trends towards larger, heavier trucks can be expected to exacerbate these differences over time. Rail freight and metro services also offer considerable efficiencies in the volume of petrol and diesel required for operation. Replacing these services would require over 146 million litres of additional fossil fuels to be consumed each year.
	**Avoided crashes, deaths, and serious injuries ($161m per annum)**: Rail travel involves significantly fewer crashes than road, due to the lack of structured operating environment and level of driver training. An absence of rail would lead to 8 more deaths and 202 additional serious and minor injuries combined through road crashes each year.
	**Mitigate domestic greenhouse gas emissions ($36m per annum)**: Reduced road travel leads to 400,000 fewer tonnes of carbon dioxide equivalent each year. The cost of these emissions is additional to local health impacts as gases such as carbon dioxide have a radiative forcing effect, contributing to anthropogenic climate change.

This report builds on and expands analysis performed by EY in previous years, most notably the 2021 Value of Rail report. It draws on contemporary New Zealand government appraisal guidance (which also reflects global best practice), sophisticated urban traffic modelling, and computable general equilibrium modelling. These techniques are combined to create an overall estimate of the value to New Zealand offered by rail services, based on a transparent and consistent methodology.

[1] Note that fuel and maintenance costs only partially meet the definition of an economic externality, as a proportion of these costs are paid by those participating in the transaction (e.g., freight firms purchasing diesel fuel). They nevertheless represent "real" resource costs, in line with Cost Benefit Analysis guidance published by the New Zealand treasury.

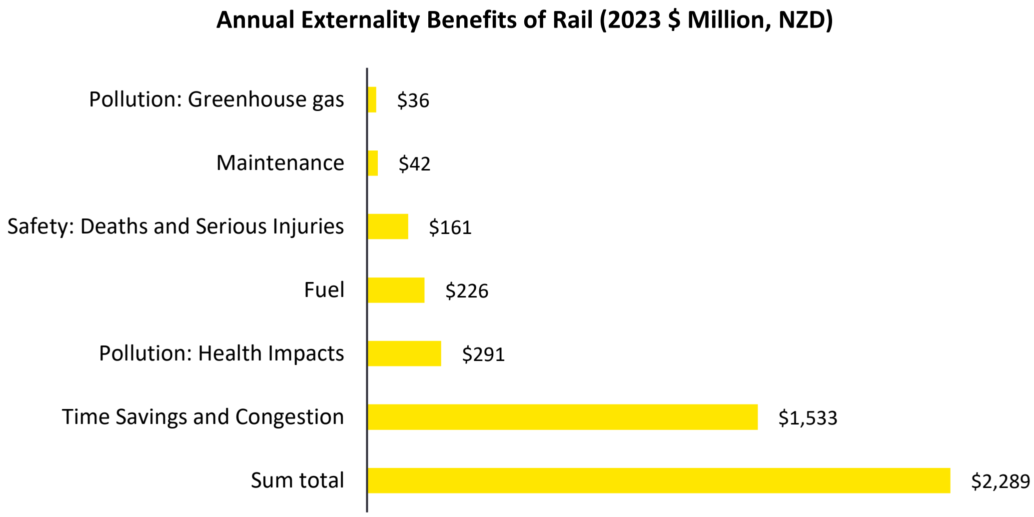


Figure 1: Externality benefit of rail, 2023.

Calculations are based on FY23 (financial year 22/23), so this figure can be expected to grow over time, in response to increases in urban populations, public transit movements, and freight volumes. 2023 freight and passenger volumes are below the levels underpinning the 2021 Value of Rail report, reflecting the long-term effects of COVID-19, major weather events, and the subdued domestic economy.

Results indicate an increase in rail benefits over time when considering a "per unit" basis. This reflects research published over the past five years, as well as contemporary infrastructure spending and urban traffic modelling, recommending an updated set of monetised values. Examples include the health implications of emissions in urban areas[2], as well as updates to Waka Kotahi, NZ Transport Agency's (NZTA) expected cost of deaths and serious injuries[3].

These results demonstrate the variety of avenues through which rail services contribute to the wellbeing of New Zealanders, as well as the productivity and competitiveness of our economy. We note that this list of benefits is not exhaustive, and the estimate of total value would increase if other impacts such as land value uplift, tourism, relative infrastructure costs, resilience, or long-term supply chain performance were considered.

Similarly, a 2023 estimate represents a single point in time, and does not consider New Zealand's increasing urban population or expected growth in freight volumes and the ongoing post-COVID recovery of metro passenger volumes.

It is evident that rail offers considerable economic value, even when only approaching it from its externality value. Moreover, the benefits that rail provides to New Zealand exceed traditional core outcomes, and extend to health, savings for local government, and stability for urban transport networks.

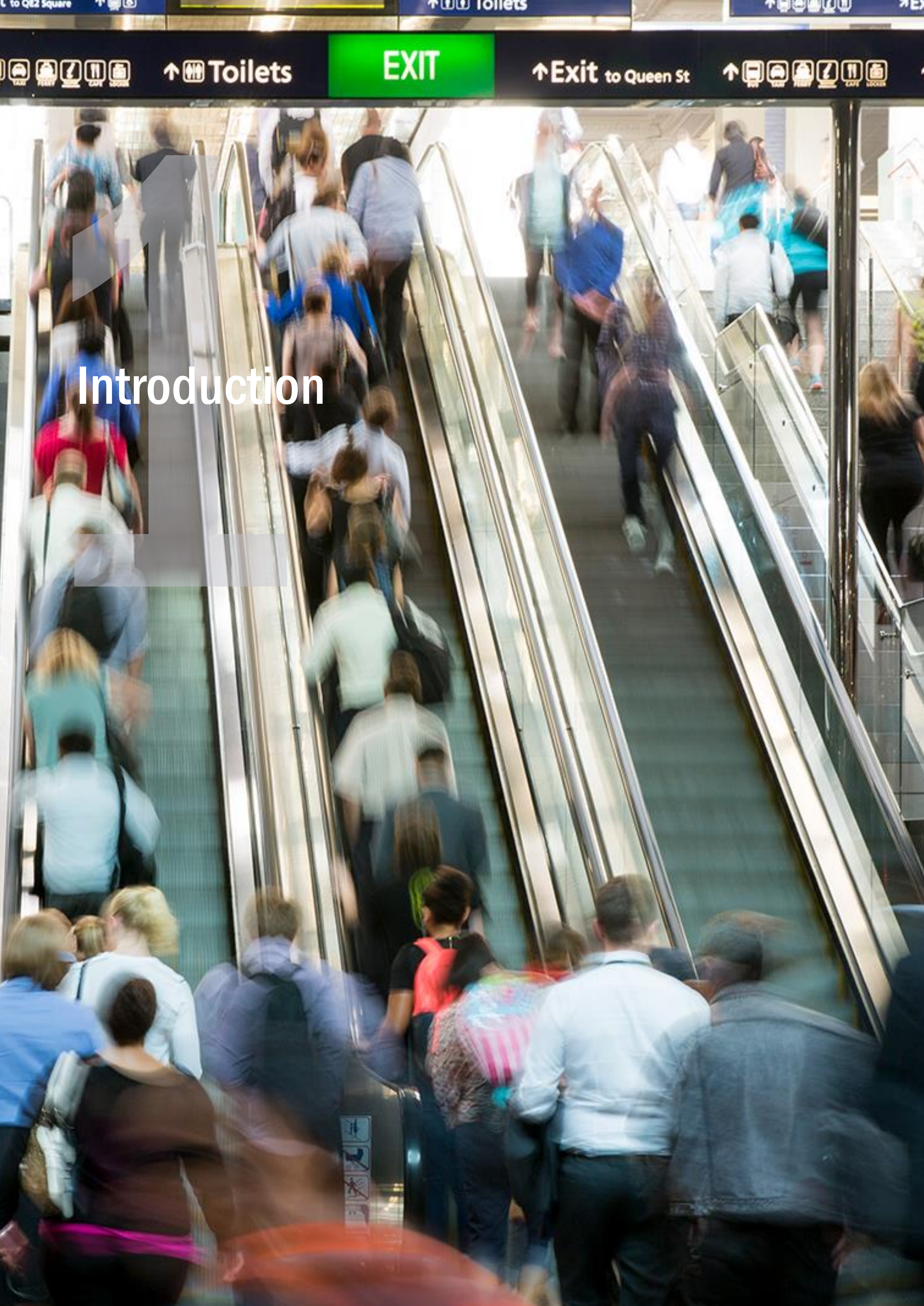
This report concludes with a discussion of potential policy implications for Government to consider. Macroeconomic modelling indicates that rail provides considerable support for industry and economic development in New Zealand, making it an important lever with which to influence productivity and export-led growth.

From a cost benefit analysis perspective, the magnitude of externality benefits indicates that rail investment represents value for money to New Zealand. Moreover, the benefits of rail increasingly extend beyond the transport sector. For example, offering cost savings to the New Zealand healthcare system, and supporting the financial sustainability of local government.

[2] Emissions Impossible (2022), *Health and air pollution in New Zealand 2016 (HAPINZ 3.0).*

[3] Waka Kotahi, NZ Transport Agency (2024). *Monetised benefits and costs manual v1.7.*

1 Introduction



1. Introduction

The Australasian Railway Association (ARA) commissioned Ernst & Young (EY) to estimate the benefit that rail provides to New Zealand. This analysis updates and expands upon previous modelling exercises commissioned by the New Zealand Transport Agency (NZTA), Ministry of Transport (MoT), and KiwiRail. Results represent a single-year valuation of the economic benefits of rail, based on FY23[4].

Rail as a mode of transport plays a vital role in the stability and efficiency of New Zealand's transport network. Rail also contributes to economic growth, industry competitiveness, and regional development across New Zealand's economy. Published government guidance such as the Monetised Benefits and Costs Manual (MBCM) allows for diverse selection of social, environmental, and economic impacts to be measured in dollar terms.

This study seeks to estimate the total, net public benefit of rail by modelling road network operations in the absence of any rail transport. While based on a stylised scenario, such an approach provides a transparent and accessible means of quantifying the differences between road and rail transport. Out of scope are long-term operational costs (e.g., mothballing or disposal of the existing network), KiwiRail's non-rail assets, as well as second-order effects that might result from more vehicles being on the road. It also does not capture wider economic impacts such as the value of land use change, particularly efficiency and social gains through concentration of activity around areas of increased accessibility.

We note that this report and associated modelling utilises cost benefit analysis and economic impact analysis, with the intention of exploring the contributions of rail services to New Zealanders and the New Zealand economy[5]. This report summarises the findings from our analysis regarding the benefit of rail for New Zealand, and considers:

- The macroeconomic impacts associated with rail with respect to changes in job years and GDP.
- The externality benefits that rail offers through reducing road volumes, considering factors such as reduced greenhouse gas emissions, avoided pollutants, time savings, lower fuel spend, reduced travel-related fatalities, and maintenance benefits.

This study is not a full business case or economic forecast. While the methodology is consistent with economic appraisal guidance, it does not attempt to capture all the strategic, financial, commercial, capital expenditure, or infrastructure-management implications of discontinuing rail services in New Zealand. Rail travel (freight and metro) provides a wider range of value to the New Zealand economy than what is captured through this analysis. For example, land use benefits, contributions to urban business, agglomeration benefits, and wider economic impacts are not estimated as part of our analysis.

Additionally, we note that rail offers a variety of non-monetised benefits that cannot be measured in dollar terms. These include contributions to sustainability, option value, regional connectivity, and urban accessibility. As a result, monetised estimates based on appraisal guidance is likely to underestimate total impacts. More detail of modelling scope, assumptions, and caveats can be found in Appendix A.

The "no-rail" scenario has been developed as a point in time estimate. The outputs of the modelling represent values for a single year and do not measure effects over time (i.e. a cumulative build-up of benefits is not calculated). A Business Case analysis period, for example collating costs and benefits over a 40-year period, would likely result in a much higher estimate of net value.

In summary, this report aims to contextualise our results for the current state of New Zealand, exploring:

- The aggregate value that rail provides to New Zealand.
- The comparative advantages of rail and road.
- Future policy implications associated with rail.

In doing so, we aspire to further the national conversation around the contribution that rail makes to New Zealanders, as well as the ways in which it supports a more resilient, efficient, and productive economy.

[4] Defined as 1st July '22 to 30th June '23.
[5] This analysis should not be relied upon for any other purpose and does not constitute formal advice. EY disclaims all responsibility and liability (including, without limitation, for any direct or indirect or consequential costs, loss or damage or loss of profits) arising from anything done or omitted to be done by any party in reliance, whether wholly or partially, on any of the information. Any party that relies on the information does so at its own risk.

2 State of rail in New Zealand

2. State of rail in New Zealand

2.1 Rail and the economy

Rail plays a pivotal role in New Zealand, both as a mode of passenger transport and a core part of commercial supply chains. The rail industry is owned and regulated by the New Zealand Government, with KiwiRail existing as a State-Owned Enterprise, responsible for freight and tourism passenger services on the national rail network, as well the operation of three inter-island ferries. A summary of the entities involved in the New Zealand transport system is provided below:

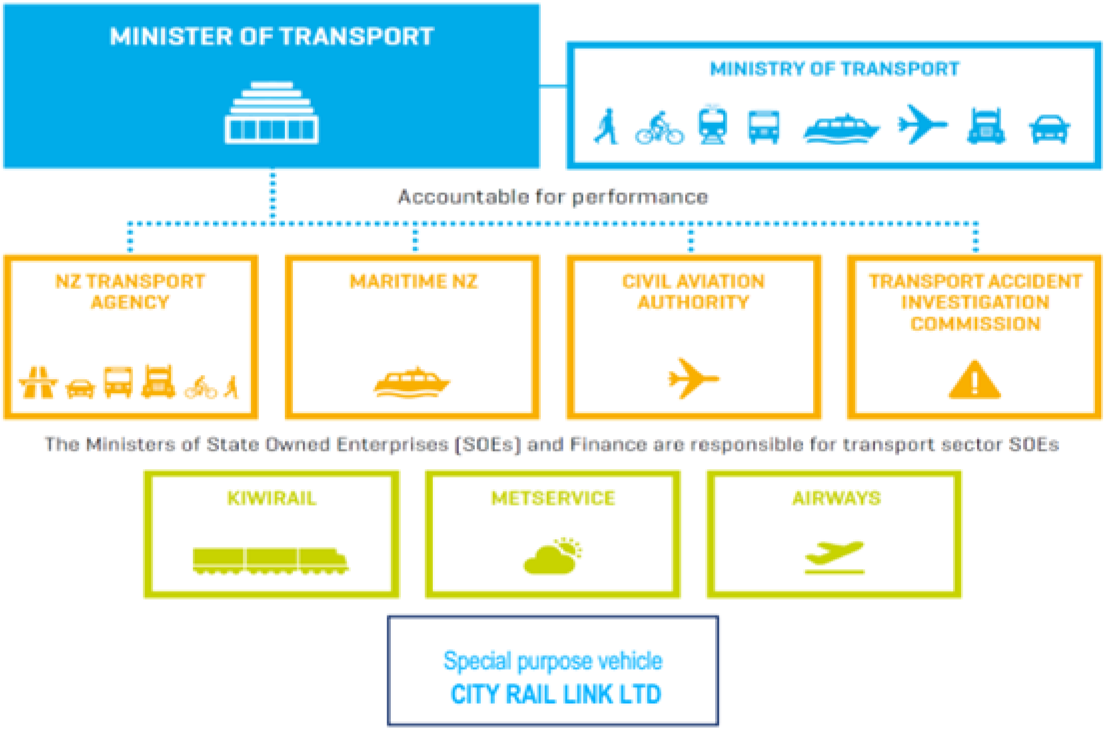


Figure 2: Entities involved within the New Zealand transport system (Ministry of Transport 2023: Briefing to the Incoming Minister (System)).

Specific Crown entities and organisations that play a role in rail services include:

- **KiwiRail:** A state-owned enterprise, acting as the overarching asset manager for New Zealand's rail network as well an operator of freight, ferry, property, and tourism and inter-regional commuter businesses. KiwiRail currently employs approximately 5,000 individuals, spread across several offices and hubs in New Zealand.
- **Local transport authorities:** namely, **Auckland Transport (AT)** and **Greater Wellington Regional Council (GWRC)**, own the passenger rollingstock and are responsible for contracting private operators to deliver metro services.
- **Auckland One Rail**: The private operator of Auckland's metro rail system, providing daily train services for customers within the city, with approximately 150 employees. Prior to 2022, the service was run by Transdev Auckland.
- **Transdev Wellington**: The private operator managing passenger rail services in Wellington, providing regular train services for residents and visitors in that region. Metlink employs around 430 people.
- **City Rail Link Limited**: A schedule 4A Crown Entity with the governance, operational, and financial responsibility for the City Rail Link project.
- **Transport Accident Investigation Commission**: An independent Crown entity which acts as a standing commission of inquiry and determines circumstances and causes of certain rail occurrences.

2.2 Network and infrastructure

Comprising over 3,700 of mainline track, over 1,300 bridges, and about 100 tunnels[6], New Zealand's rail network acts as critical infrastructure for both freight and people movements across New Zealand. Rail freight services support New Zealand's supply chain, providing cost-effective transportation for primary, intermediate, and final goods. Domestic freight movements extend to major New Zealand ports, key industry sites, and inland transport nodes such as distribution centres. Rail also supports mass transit of people in dense metropolitan areas, as well as domestic tourism across New Zealand.

The physical rail network represents a critical component of the nation's transportation infrastructure. While the asset itself is owned by the Crown, management responsibilities lie with KiwiRail. As the overarching asset manager, KiwiRail is accountable for the upkeep and maintenance of rail infrastructure (which includes tracks and rail stations). This is of great importance, as their conditions are closely tied to the safety and reliability of rail services. Furthermore, KiwiRail regulates and provides access to the rail network for various service operators to ensure network usage is efficient and able to meet the demands of freight and metro services.

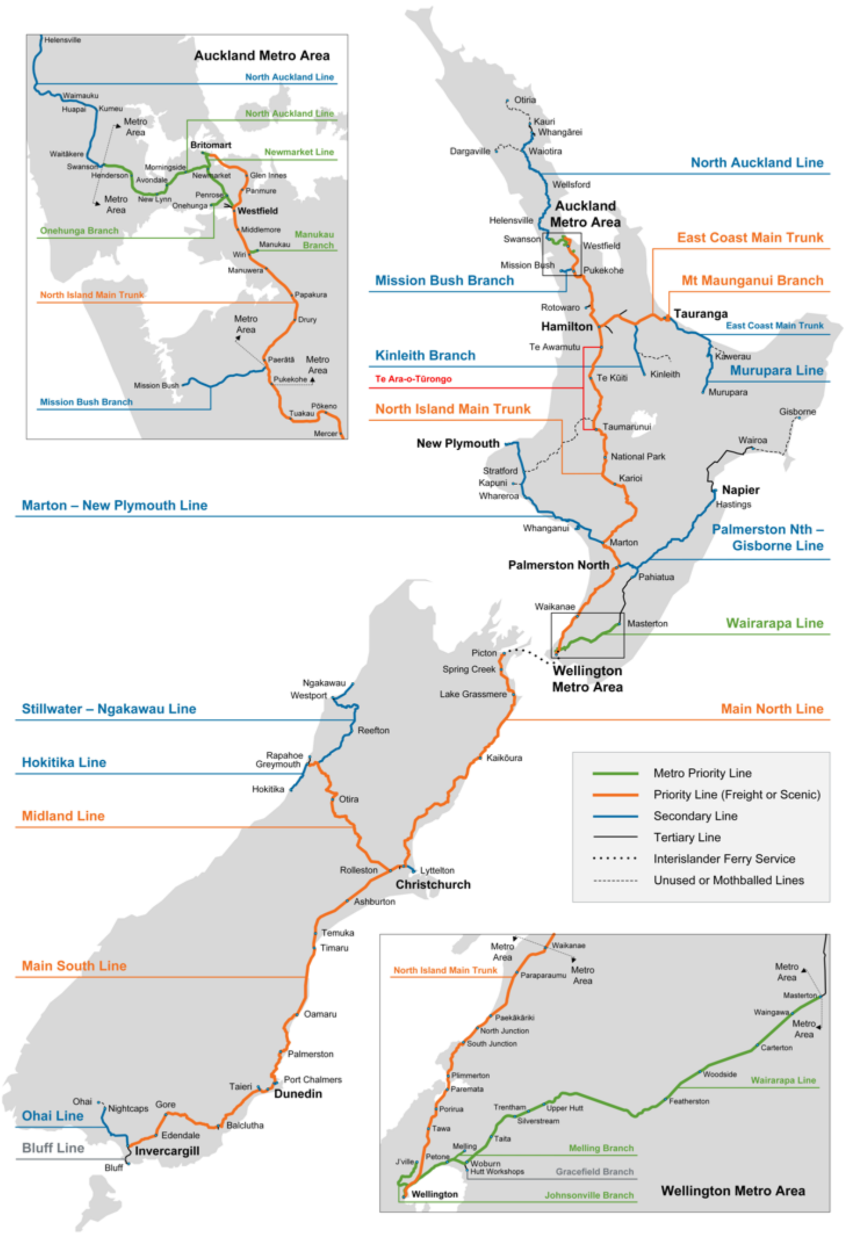


Figure 3: New Zealand's rail network (obtained from KiwiRail).

6 https://www.kiwirail.co.nz/assets/Uploads/documents/Rail-Network-Investment-Programme-July-2021.pdf

2.3 Rail freight volumes

In 2023, 17 million tonnes of freight were shipped by rail. Freight volumes across New Zealand have yet to recover to pre-pandemic levels. In addition to COVID-19, natural disasters such as Cyclone Gabriel and the January 2023 Auckland floods caused significant disruption. Growth is expected to return with the slow stabilisation of the world economy, and the reinvigoration for the economies of international trade partners such as China.

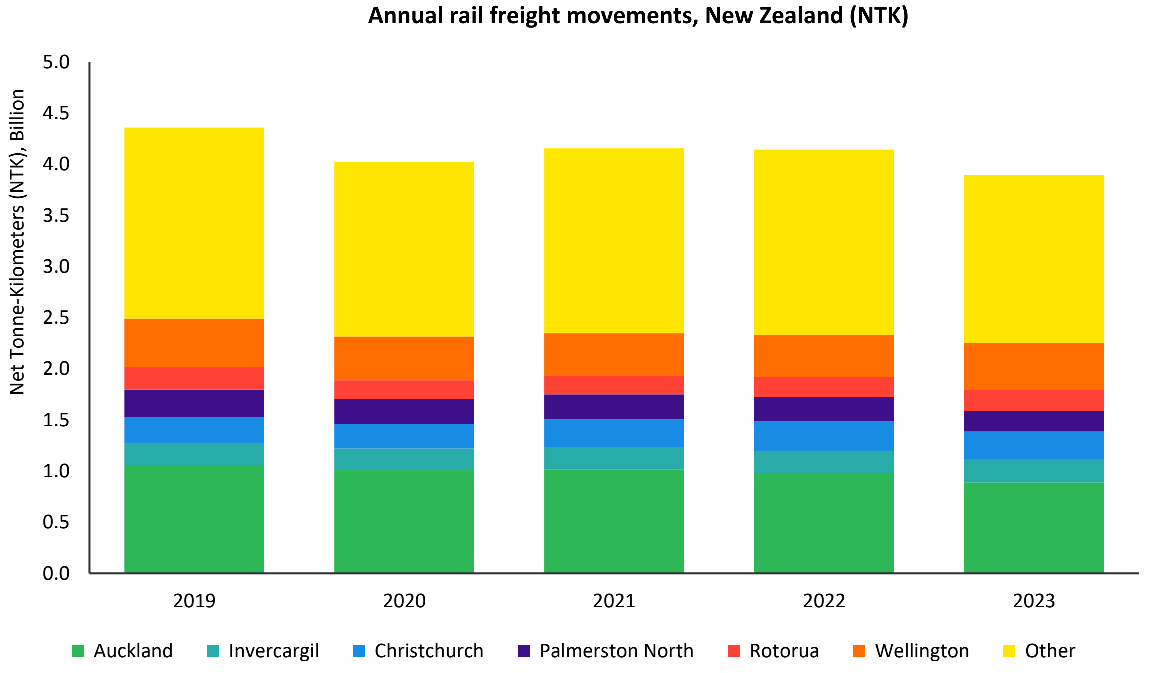


Figure 4: Annual freight movements (NTK).

2.4 Rail patronage

Auckland and Wellington realised 12.4 million and 11.3 million metro journeys respectively during 2023. While patronage has not yet returned to pre-COVID levels, metro growth is following an upwards trajectory, with both Auckland and Wellington realising a 20 per cent growth in overall metro rail usage from the previous year.

While Wellington is on the cusp of returning to pre-pandemic journey volumes, having seen predictable, consistent growth over the past two years, Auckland has experienced a more modest pace of recovery. This may reflect significant reconstruction work during 2021-2023, including closure of the Eastern Line for nine months. Despite that, Auckland realised the same level of growth as the prior year, and with the soon-to-be opened City Rail Link (CRL), patronage is expected to increase further.

For example, a 2023 Rail Programme Business Case forecasts that the increased attractiveness of Auckland rail could bring a 3.6-fold increase over the next 30 years, relative to pre-COVID patronage levels[7]. This is expected to result from incorporating customer growth strategies, which focus on meeting user needs and implement needed infrastructure upgrades to both modernise the current transport experience and increase reliability of the service.

[7] Auckland Rail Programme Business Case, KiwiRail.

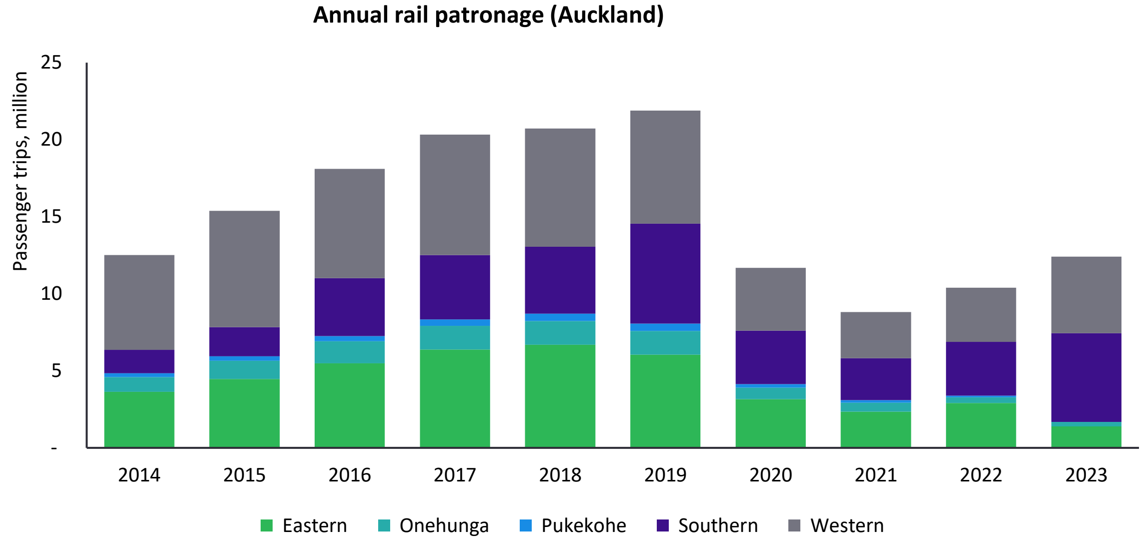


Figure 5: Annual rail patronage by line, Auckland.

In a similar vein, Wellington Metlink has initiated the Future Rail projects. This has resulted in significant track capacity enhancements and funding approvals for 18 new 4-car hybrid units. This will result in higher frequencies of peak-time services by 2026, and further increase transport resilience[8].

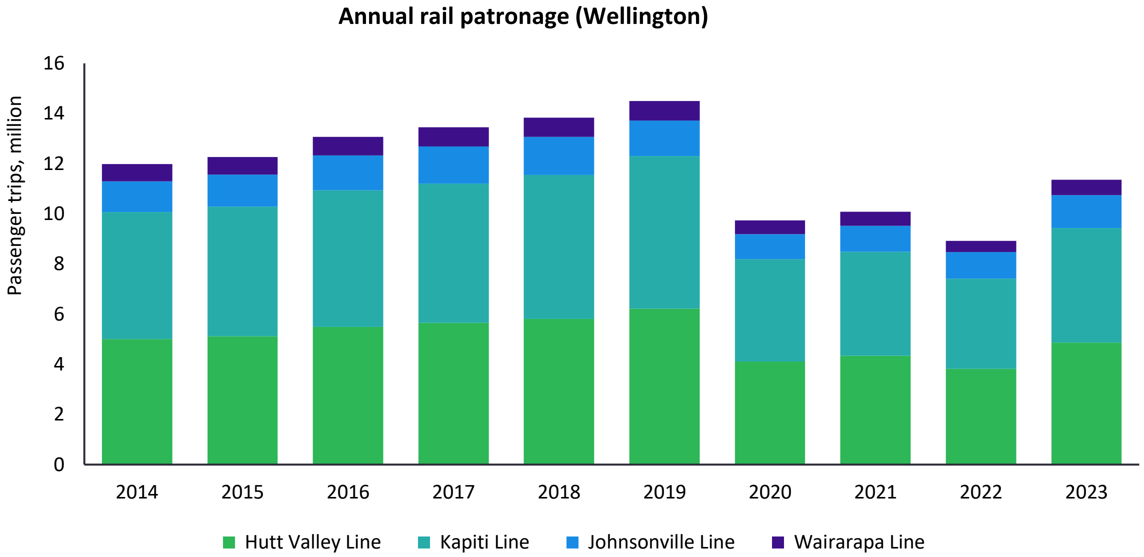


Figure 6: Annual rail patronage by line, Wellington.

[8] Future Rail » Metlink.

2.5 Future trajectory of investment

The rail industry recognises the importance of maintaining existing infrastructure as well as identifying opportunities for future investment and high-value growth. The previous Government's commitment, as set out in the New Zealand Rail Plan 2021, proposed to take the rail network out of its state of "managed decline" and agreed to provide stable future investments for growth in the rail industry.

Both the previous Government and wider industry recognised significant remedial investment is required and contributed to the new funding and planning platform to recoup the wide-ranging and long-term benefits of rail. The Rail Plan's strategic investment priorities were focused on restoring rail freight, looking to enable KiwiRail's commercial growth and to further support metro rail network growth alongside the paced recovery of demand for public transport.

This new funding model has delivered promising results as KiwiRail achieves a higher operating surplus and an improved operating position. This has the potential to deliver improved performance following the implementation and integration of new network, systems, and rollingstock assets.

Nonetheless, a balanced view should also note that funding challenges may act as a barrier to effective rail operations in the short- to medium-term, based on the most recent Crown investment figures. With planned expenditure concentrated in the next two years, it is not clear that post-2026/2027 investment will be sufficient to maintain or improve performance[9].

	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
	$m	$m	$m	$m	$m	$m	$m	$m	$m
To KiwiRail Group									
Capital - Commercial investment	483	729	790	861	721	741	789	259	144
Non-commercial rail investment	64	171	69	84	52	26	12	10	-
Rail Network Investment Programme	-	-	287	455	631	709	452	-	-
Capital - loans and equity	174	-	-	-	-	-	-	-	-
Other Projects	79	26	6	-	4	9	-	-	-
Others									
Auckland City Rail Link	258	396	431	561	296	349	184	74	75
Auckland Light Rail	-	-	-	-	70	10	-	-	-
Total	1,058	1,322	1,583	1,961	1,774	1,844	1,437	343	219

Figure 7: Vote Transport Rail Funding, Budget 2024.

Additionally, the Government Policy Statement (GPS)[10] on Land Transport 2024 has indicated a funding allocation between $20 million and $570 million for rail operations and maintenance over the period from 2027/2028 to 2029/2030[11].

	GPS 2024 funding ranges ($m)						Forecast funding ranges ($m)			
	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34
Upper	630	560	560	570	570	570	580	580	580	580
Lower	360	360	20	20	20	20	20	20	20	20

Figure 8: Government Policy Statement on Land Transport 2024 – rail activity class funding range.

This funding is intended to be packaged as the Rail Network Investment Programme (RNIP), a strategic plan that consists of a three-year investment programme and a 10-year investment forecast of rail operational costs and capital expenditures[12].

[9] Estimates of Appropriations 2024/25 - Economic Development and Infrastructure Sector, Vote Transport.
[10] We emphasise that the GPS is still being finalised, and thus, values are subject to change.
[11] Government Policy Statement on land transport – June 2024.
[12] Rail Network Investment Programme (RNIP) | KiwiRail.

2.6 Outlook

The rail industry and network enable efficient and reliable movement of freight goods and people. The connectivity between two islands, major ports and regions contributes to both the national economic prosperity and regional economic growth. Rail also contributes to the functioning of dense metropolitan cities that sees paced recovery of demand as the impact of COVID lockdowns subside.

Additionally, the existence of metro rail supports further housing intensification. The availability of an easily accessible, reliable, and rapid public transit option would encourage intensification, especially for areas which are close in proximity to rail stations. In Auckland, this is stated as an explicit goal under the public transport and land use integration policy[13].

While New Zealand is still combating the long-term effects of COVID-19 on both metro transport and freight, the current state of rail can be summarised as a promising path to recovery. Supporting the growth in patronage movement in major cities and increasing freight volumes through significant investment will result in the restoration of a resilient, reliable and safe rail network, thus realising massive economic gains.

[13] Auckland's Draft Regional Public Transport Plan 2023-2031.

3 Macroeconomic impacts

3. Macroeconomic impacts

This section provides an overview of the economy-wide impacts of rail services in New Zealand. The presented analysis incorporates the perspectives that KiwiRail holds regarding potential ramifications for the removal of rail. As described in the previous section, rail carries 17 million tonnes of freight across the country each year, spread across a variety of regions and industries. Significant contributions to GDP and employment can be expected from the sector as a result.

This form of economic impact analysis provides an additional lens with which to consider the benefits of rail to New Zealanders. While the externality benefits consider the impacts directly resulting from changes in transport mode (i.e. effects associated with the change in movements for rail and road in NTK and VKT respectively), macroeconomic impacts estimate the flow-on and sector-specific effects associated with replacing all rail movements with road. This includes the impacts on the economy arising from changes in cost and productivity. These two forms of analysis provide distinct assessments, and thus are not considered double-counting.

3.1 Methodology

Macroeconomic impacts are estimated using EY's computable general equilibrium (CGE) model. This involves exploring how New Zealand firms and consumers would change their behaviour in response to a one-off change in transport costs and rail sector employment. Modelling involves a four-step process, as summarised below:

4 – Employment effects

Associated with the change in output will be a change in employment. Total sector employment will change depending on how they are impacted by the shock (e.g., changes in wage competitiveness / job demand).

5 – Govt. revenue

Both the output changes and employment effects will have flow-on impacts for government revenue through changes in tax income. This will have negative effects for total government expenditure and investment.

6 – Further outcomes

Changes in government expenditure has further impacts on a range of New Zealand's sectors. These impacts compound with the first-order effects and result in further output and employment changes.

1 – Remove rail

We simulate a world in which rail no longer exists. All rail movements are replaced with equivalent road volumes, and New Zealand realises the changes in economic cost associated with the new road services.

2 – Industry costs

The changes in economic cost resultant from movement redirection then flow to a variety of New Zealand sectors. Players (firms) in these sectors then change their behaviour to reflect the increased economic costs.

3 – Output changes

As economic costs encompass financial impacts, businesses will change their total level of output (GDP impact) depending on sector-specific factors.

Figure 10: CGE specific steps for identifying the benefit of rail.

1. **Confirming the base case.** This involves quantifying the status of New Zealand's economy in 2023. This is informed by data sources such as StatsNZ input-output publications. Unlike previous Value of Rail reports, this extends beyond transport-sector inputs, and takes account of supply chains and other markets across New Zealand.

2. **Input shock development.** CGE modelling requires some type of one-off, economic "shock" to modify the base case, such that net effects on the New Zealand economy can be evaluated. For this study, we have incorporated guidance from industry and focused the shock solely on freight movements. This is likely to underestimate the total impacts associated with the removal of rail and assumes that limitations such as capacity constraints within the trucking sector are non-existent.

3. **Sector attribution.** Modelling is designed to consider the implications of increased costs across New Zealand sectors and regions, such that the "shock" will affect some parts of the economy more than others. The most affected industries include wholesale (and retail) trade[14], dairy and coal.

4. **Impact calculation.** The new equilibrium for supply chains and other local markets are calculated, providing an indication of how economic outcomes would change in response to the external shock. This includes changes in levels of spending and employment across industries, such as a decrease in manufacturing production in response to increased freight costs. The model ultimately estimates impacts in terms of GDP (total output of goods and services in New Zealand), as well as employment (the number of available jobs).

We note that the "shock" used within our modelling was developed with guidance from industry and reflects their perspectives on the wider economic linkages that would arise from a "no rail" scenario. It does not consider limitations on certain sectors, such as a lack of freight operators, capacity constraints both for the roading network, and the demographic of employees within road freight. Thus, the presented effect is likely to be understating the benefit that rail brings to New Zealand, and should be considered as a lower bound, with a heavy focus on freight.

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[14] Note that wholesale (i.e., business-to-business transactions for bulk goods), and retail / consumer trade (i.e., business-to-consumer transactions) are aggregated into a wholesaling category. This aggregation is a function of the established classification system used for the underlying database.

The size of the "economic shock", estimated as part of methodology step 2, is summarised below. Wholesale and retail trade and processed foods (dairy and meat) are most heavily affected by a lack of rail in New Zealand, reflecting their reliance on large-scale freight services. Impacts also extend to other parts of the transport sector, and these effects ripple throughout other crucial sectors, such as manufacturing (pulp and paper, steel, fertiliser), agriculture, and coal exports.

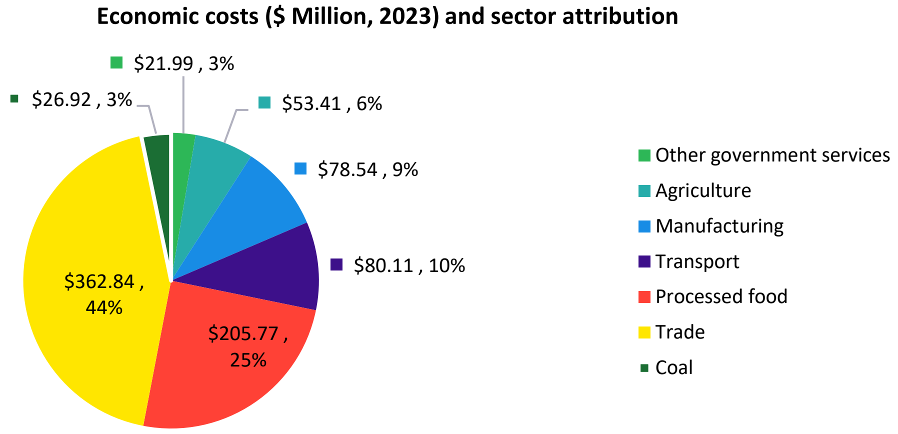


Figure 11: Economic shock associated with the removal of rail services in New Zealand.

The decrease in cost provided by rail is passed on to consumers, thus increasing the living standards of New Zealanders (in the form of consumer surplus, government expenditure, additional investment and increases in net exports), and raising national GDP by approximately $1 billion ($972m) annually. The rail sector also provides an annual gain of 1,010 full-time equivalent jobs (FTE) across a range of industries. This annual gain is a net effect, taking account of additional jobs within some industries and fewer jobs in others. A disaggregated summary is provided below:

Sector	Expected change in employment (FTE)
Transport	-63
Coal exports	+34
Dairy	+39
Wholesale / retail trade	+279
Construction	+428
Other	+293
Total	**+1010**

Figure 12 Change in Employment (FTE).

The reduction in transport jobs reflects the productivity increases associated with rail. If all rail freight services in New Zealand were shifted to road, additional employment would be required within the road sector for that demand to be absorbed.

Additionally, with respect to job changes resulting from a "no-rail" reality, we note that these changes in employment would also be the net effect. The removal of rail would naturally be associated with the removal of rail-related jobs (e.g. employment at KiwiRail or train conductors for metro services). However, the individuals who held these positions would be redirected to other jobs within the transport sector (or similar), thus having no impact on employment (as the net effect would be zero). The additional created jobs associated with rail are the ones that extend beyond the ones that exist solely from the rail sector (i.e. KiwiRail and other related entities), but rather jobs resulting from the associated productivity gains realised from rail.

When evaluating productivity impacts, industry wage or salary levels are regularly treated as a proxy for economic contribution [15]. From a macroeconomic perspective, comparing median earnings associated with rail transport to road transport implies that on average, rail transport jobs are more productive than road transport work. This is a particularly pertinent point, as while our results demonstrate the change in total FTEs with regards to sector, it cannot identify changes within the sector (i.e., the redirection of jobs from road transport to rail). However, part of our applied "no-rail" scenario involves the discontinuation of rail sector jobs. Given that to be true, any redirection effect that occurs for workers in road transport from the existence of rail will have a positive productivity impact.

Sector	Median earnings (2022)
Dairy cattle farming	$61,860
Wholesale trade	$63,470
Road transport	$62,380
Forestry and logging	$67,560
Central government services	$76,170
Rail transport	$76,790

Figure 13: Sector Average Wage, StatsNZ (2022).

Rail's job creation injects an estimated $65m into the economy through increased wages. The existence of rail also raises wages by roughly 1.53 per cent on average, as a result of the cost savings associated with using rail. This translates to a yearly salary increase of $1,152 per job. While extrapolating this to the entire economy would be simplistic, modelling results indicate that New Zealanders employed in rail-reliant industries (e.g. wholesale trade, dairy, transport, manufacturing, and coal) experience benefits at or exceeding this level.

[15] This is supported by considerable empirical literature, such as Cahuc et al (2006) and Barth et al (2014).

3.2 Key sector overview

This section provides a short summary of the industries which are most dependent upon rail services in New Zealand, based on the results of macroeconomic modelling. It is intended to provide context for the economic impact analysis outputs and highlight industry-specific effects through key figures. More detail about GDP and employment impacts can be found in the accompanying appendix.

When considering the sector impacts for job creation, there are two big winners. The first is the construction sector. Construction realises large amounts of job creation, with the sector seeing close to 428 FTE being created annually. While this is a flow on effect arising from efficiencies occurring throughout the economy, this type of indirect impact of rail should not be ignored. The second big winner is the wholesale and retail trade sector. The reduction of transport costs and the increase in efficiency that rail offers results in the creation of approximately 279 additional FTE jobs annually for the sector.

Construction

- The existence of rail provides economic value to the construction sector through flow on intermediate impacts.
- Flow on effects from other sectors result in higher government tax revenues (through increased consumption), resulting in increased investment.
- Rail has radical impacts on construction, by stimulating the creation of **428 additional FTE jobs** within the construction industry, and **promoting $149m of investment**.

Wholesale and retail trade

- Approximately 50 per cent of rail freight supports wholesale and retail trade, with it allowing businesses to realise large commercial gains. The end consumers will also often enjoy the economic surpluses generated from transport cost reductions.
- Rail contributes **$399m annually to wholesale and retail trade** in terms of GDP output.
- The efficiency gains generated from rail also increase employment within the sector, creating approximately **279 additional FTE jobs** annually.

Dairy

- Rail acts as the primary freight transport mode for dairy products, with certain distribution centres (such as Fonterra's Mosgiel Distribution Centre) being wholly reliant on rail.
- The **dairy sector contributes an additional $212m annually by using rail as a transport mode** for dairy processing and freight movement.
- Further economic activity and job creation would be induced through the entire supply chain, aggregated into other sectors, creating approximately **39 additional FTE jobs** annually.

Coal exports

- Coal is primarily transported by rail for both export and domestic use purposes, with approximately 10 per cent of rail freight volumes being attributable to the sector.
- **Rail contributes $45m annually to coal** in terms of GDP output through the reduction of transport costs.
- These lower costs result in greater efficiencies, creating **34 additional FTE jobs annually**.

3.3 Rail contribution to NZ GDP

Under a macro-economic lens, rail offers the most competitive form of freight transport for the goods and geographies currently making use of this mode. In the alternative world, a shift from rail to road would drastically increase short-term operator costs, particularly for industries and regions that are reliant on rail freight. The observed levels of competition within the road freight sector suggest end consumers will receive a significant cost saving from using rail. Through passing on cost savings as consumer surplus, this would increase aggregate demand throughout the country in the form of consumption. This naturally results in increase in business activity and, by extension, business profits. **Our results estimate that annually, rail stimulates consumption by $578.1m.**

The retail trade sector also enjoys significant benefits from rail. The underlying logic would be that these reductions in costs are passed on to the end consumer as consumer surplus[16], but the increase in consumption associated with such reductions in cost result in higher levels of profit for participating businesses. The reduction in transport costs creates approximately 279 FTE jobs annually. The wide range of goods and activities that this sector encompasses reinforces the breadth and importance of rail on New Zealand, as it permeates throughout all consumer activities, increasing material standards of living.

The economic impacts of rail in New Zealand also extend to investment, export growth and government expenditure. While all these benefits technically form part of GDP, they offer distinct contributions to the competitiveness and productivity of New Zealand firms in the long term. These effects have flow-on implications for job creation, above and beyond the benefits described above.

NZ GDP contribution category	Change in output (2023 dollars)
Consumption	$578.1m
Government expenditure	$72.6m
Investment	$225.2m
Net exports	$97.0m
Total GDP impact	**$972.9m**

Figure 14: GDP impact breakdown.

These results highlight the wide-ranging and highly integrated nature of rail within the New Zealand economy. In aggregate, the rail sector contributes $972.9m in macroeconomic benefits to the New Zealand economy, and results in the creation of at least 1,010 jobs. As described above, these benefits affect industries that are critical to export-led growth in New Zealand, as well as influencing the affordability of goods and services.

[16] This is well supported by standard neoclassical micro-economic theory.

4 The externality benefit of rail

4. The externality benefit of rail

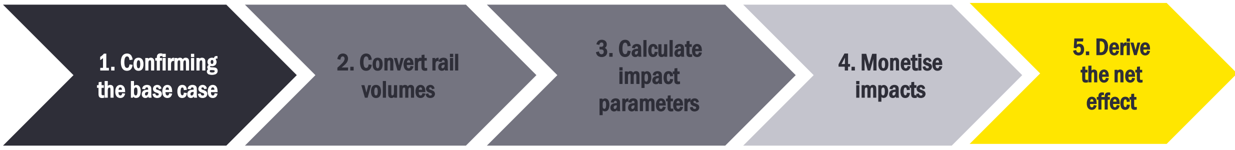
This section provides a high-level overview of our modelling methodology, with results split by relevant categories and factors, and some preliminary policy implications. These findings are also drawn on in the final section, where we evaluate the aggregate benefit of rail for New Zealand.

As described above, this study applies a “counterfactual” methodology, assessing a hypothetical scenario in which freight and urban rail metro services do not exist in New Zealand. We assume that contemporary freight and metro volumes must instead travel on equivalent road networks, then quantify the implications for wellbeing and resource use.

Note that two sensitivity analyses have been performed, in response to discussions with New Zealand industry experts. The results of this analysis are briefly described below, and detailed explanations can be found in Appendix A.

4.1 Methodology overview

Our externality modelling methodology follows the same logic as the previous iterations of Value of Rail analysis:



1. **Confirming the base case**. This step involves developing an appropriate counterfactual for New Zealand’s land transport system for a given point in time. Analysis includes confirming growth forecasts for areas in which recent data is unavailable, or account for exogenous shocks that have affected relevant transport modes (such as natural disasters cutting off a region). For the analysis in this paper, we have set our base case to the year FY23 and use unadjusted real values from that time period to inform our inputs.

2. **Convert rail volumes**. Having established an appropriate baseline for rail volumes, we proceed to estimate the equivalent quantum of road movements necessary to offset the lack of rail services (both freight and urban metro travel). In more technical terms, this involves a linear transformation of given rail Net Tonne-Kilometres (NTKs) to equal road VKTs, using pre-agreed upon conversion factors. Due to a change in reporting, previously used rail-to-road adjustments no longer hold (e.g., route-by-route distance adjustments), thus we assume that rail NTKs lead to an equivalent amount of road NTKs. This is likely to underestimate the total movements required, as we do not assume changes associated with differences in track-corridor lengths.

3. **Calculate impact parameters.** For this step, we traditionally rely on published (and often publicly available) data sources to derive appropriate costs, benefits, and other measures associated with rail and road. This then allows us to extrapolate the marginal effect for an additional unit of movement for each of those transport modes, which we use to estimate the total impact associated with the removal of rail. We would like to note that for this analysis, KiwiRail has provided a majority of the impact parameters. The specific sources will be noted both throughout the main body and the appendix (for sensitivity specific parameters).

4. **Monetise impacts.** To aggregate individual impacts, we convert them into monetised values using government best practice guidance. This allows for like-to-like comparisons between road and rail, and also estimates the externality effect as a single, digestible figure.

5. **Derive the net effect.** Monetisation provides an externality estimate for rail and road. From here, we derive the difference in impacts by mode, which provides the net effect, and thus the externality value that rail provides to New Zealand. This approach also permits results to be disaggregated into impacts by road vehicle type, as well as metro vs. freight implications.

4.2 Findings

The largest net benefits are derived from:

- Time savings and reduced congestion effects, contributing 67 per cent to total externality benefits.
- Avoided health impacts of pollution, making up roughly 13 per cent of total externality benefits.
- Reduced fuel consumption, contributing 10 per cent to the total externality benefit.

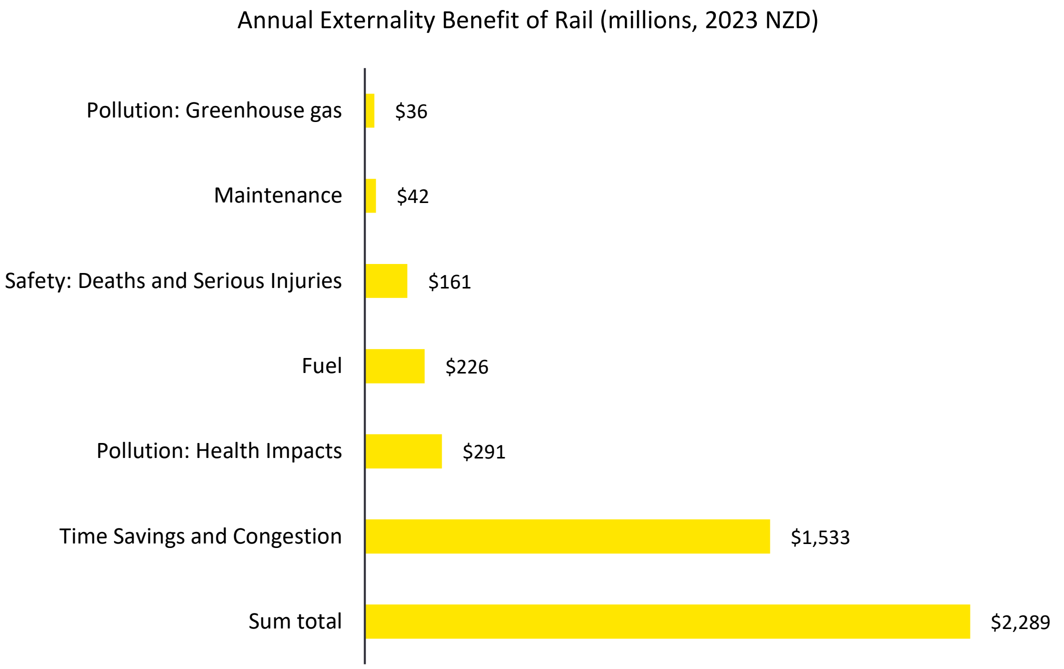


Figure 15: Annual externality benefit of rail (2023 $ Million, NZD).

Throughout our analysis, we will be referring to changes in passenger and light commercial vehicle movements under the aggregate term of LCVs and freight truck movements as HCVs (heavy commercial vehicles).

4.2.1 Pollution: Health impacts

As per the MBCM:

> *"Vehicle emissions are a complex mixture of gases and particles, with... harmful air pollutants, which cause adverse health effects and have local impacts, such as particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO2), carbon monoxide (CO), sulphur dioxide (SO_2) and volatile organic compounds".*

Rail provides New Zealand with $291 million in health benefits as a result of avoided emissions each year. This result primarily reflects a decrease in particulate matter ($PM_{2.5}$) and Nitrogen oxides (NO_X). Note that this category is distinct from greenhouse gas related costs, with non-local emissions impacts discussed in a separate section below.

$PM_{2.5}$, NO_X, CO, and VOC savings are calculated on a net basis, with the benefits representing the difference in emissions between road and rail impacts. In contrast SO_2 is not emitted by diesel rail engines in material quantities, hence these benefits are calculated using road (thus in gross terms of) emissions only.

Both Rail and Road emission factors were provided by KiwiRail, in order to account for recent changes in the locomotive fleet, and to align with internal analysis.

The impacts associated with individual vehicle emissions are summarised below. Consistent with NZTA guidance, light vehicle (LCV) and heavy vehicle (HCV) emissions are measured on a distance basis (grams per kilometre travelled, or VKT). Rail-related emissions are measured on a weight basis (grams per net tonne kilometre, or NTK).

	Type of vehicle emission				
	$PM_{2.5}$ emissions	NO_x emissions	CO emissions	VOC emissions	SO_2 emissions
LCV / Passenger (g/km)	0.0222	0.339	0.970	0.0585	<0.00
HCV (g/km)	0.186	3.99	1.34	0.113	<0.00
Rail (tonnes/NTK)	0.00000002	0.00000026	0.00000014	0.00000004	N/A

Figure 16: Pollution, emissions factor by type, mode, and vehicle category.

Using the total change in movement for each mode, we derive the tonnes of gas that would be emitted if rail were to not exist. As described above, this is a net impact for the bulk of vehicle emissions, such that increases in road emissions is partially offset by a decrease in rail emissions.

Updated government monetisation guidance has included a re-valuation of the size of health impacts, as well as recommending separate values be applied to dangerous pollutants in an urban vs. rural setting. Intuitively, health damages associated with pollution will be higher in urban areas due to the denser population. Annual emissions impacts categorised by geography are summarised in the table below.

		LCV / passenger	HCV	Rail	Net change (total per annum)
Impact category	$PM_{2.5}$ (Urban, tonnes)	7.73	13.81	-8.53	13.01
	NO_x (Urban, tonnes)	117.39	296.18	-146.68	266.88
	CO (Urban, tonnes)	335.69	99.73	-79.03	356.39
	VOC (Urban, tonnes)	20.26	8.35	-21.04	7.58
	SO_2 (Urban, tonnes)	0.47	0.55	-	1.02
	$PM_{2.5}$ (Rural, tonnes)	-	65.15	-50.39	14.76
	NO_x (Rural, tonnes)	-	1,396.98	-866.74	530.24
	CO (Rural, tonnes)	-	470.38	-466.96	3.42
	VOC (Rural, tonnes)	-	39.40	-124.30	-84.90
	SO_2 (Rural, tonnes)	-	2.58	-	2.58

Figure 17 Pollution: Health Impact Factors (Rural and Urban).

As described by methodology step 4 above, quantitative impact measures are converted to dollar terms using New Zealand government appraisal guidance. Net annual benefits, by type of pollutant and geographic location, are summarised in the table below:

Impact Category	Urban (net annual benefit, $m)	Rural (net annual benefit, $m)
Particulate matter ($PM_{2.5}$)	$12.67	$0.83
Nitrogen oxide (NO_x)	$263.41	$14.53
Carbon monoxide (CO)	<$0.00	<$0.00
Volatile organic compounds (VOC)	$0.01	-$0.01
Sulphur dioxide (SO_2)	$0.05	<$0.00

Figure 18: Pollution, health impacts split by urban and rural attribution (2023 $m, NZD).

The scale of these benefits reflect that rail engines emit substantially less than road vehicles on an equivalent volume basis. Moreover, significant net decreases in emissions are concentrated in urban areas, where gases such as nitrogen oxides can be expected to cause significant damage.

4.2.2 Time and congestion savings

Traffic modelling permits investigation of impacts on the road network if rail services were no longer available in New Zealand. In essence, Auckland and Wellington experts predict a dramatic increase in travel times and road congestion.

The bulk of time and congestion impacts occur in urban settings, reflecting the concentration of New Zealand metro rail services within Auckland and Wellington. A lack of rail as public transport is expected to lead to massive spikes in road congestion during peak commuting periods, as well as buses running above capacity.

Expected impacts are sourced from the Auckland Forecasting Centre (AFC) for the Auckland region. For Wellington, we have extrapolated from previous transport modelling outputs for the Wellington region and combined them with results from the Wellington Transport Analytics Unit (WTAU). This approach was agreed with KiwiRail. More detail of these sources can be found in Appendix A. In tangible terms, the absence of rail in urban settings is expected to lead to the following effects:

- Approximately **10.3 million additional hours** spent driving on Wellington roads each year.
- Over 8.8 **million additional hours** spent driving in Auckland each year.
- In aggregate, over **350 million of new road kilometres travelled** each year within the two urban centres (including heavy and light vehicles).

For average motorists, this means that:

- The average **Wellingtonian would see their daily commute take roughly 8% longer.**
- **Aucklanders would experience a time delay that is 20% higher than normal.**

Time and congestion impacts in other parts of New Zealand are calculated through an interregional benefit measure. This is material because, in the absence of rail, more than 3 billion additional net tonne kilometres would need to travel on New Zealand's regional road network each year. In the absence of local traffic models, rural congestion effects are monetised using a simplified per km value of $0.06 (a time-uplifted value which is consistent with previous Value of Rail studies).

Time savings and congestion reduction effects are the largest contributor to the total externality benefit of rail. We provide the disaggregated values for time savings and congestion below, providing the urban-rural split:

	Urban (net annual benefit, $m)	Rural (net annual benefit, $m)
Inter-regional benefit	-	$232.23
Urban benefit	$1,301.02	-

Figure 19: time savings and congestion split by urban and rural attribution (2023 $m, NZD).

These results reflect significantly updated and refined traffic modelling estimates, relative to previous Value of Rail studies. As these results are dependent on transport modelling outputs, we detail the technical notes within Appendix A.

4.2.3 Pollution: Greenhouse gases

As per the MBCM:

> *"Vehicle emissions are a complex mixture of gases and particles, with… greenhouse gases or climate pollutants, which cause global warming and have global impacts, for example carbon dioxide (CO_2), black carbon (BC) and methane (CH_4)".*

NZTA tools and guidance are used to estimate the total amount of greenhouse gas emissions resulting from both road and rail travel. Consistent with best practice, this is measured in tonnes of CO2-e (carbon dioxide equivalent).

Both road and rail emit some level of greenhouse gas, thus comparing the difference in CO2-e (i.e., net impacts) allows for a like-to-like evaluation between transport modes. Because greenhouse gas emissions create costs at a global scale (in contrast to pollutants with local health implications), monetisation values do not distinguish between urban and rural impacts.

NZTA's shadow price of carbon emissions is used for monetisation purposes. We apply the central price, while noting alternative values contained in published guidance below:

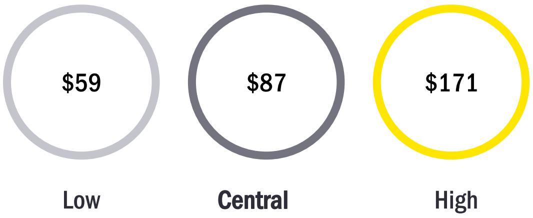


Figure 20: Shadow price of carbon emissions (2023, $ per tonne CO2-e, NZD).

Similar to calculating the health impacts of pollution, emission factors for rail were obtained from KiwiRail, whereas emission factors for road were derived from VEPM. Emissions factors for light vehicles, heavy vehicles, and rail transport are summarised below. The right-hand column presents total greenhouse gas emission each year, in gross and net terms.

	CO2-e emissions factor	Change in annual emissions (tonnes CO2-e)
LCV / passenger	254 g / km	88,237
HCV	1,008 g / km	427,529
Rail	0.000027 tonnes / NTK	-106,056
Net impact		**409.710**

Figure 21: Emission factors by transport mode and vehicle type.

In summary, **moving 3.9 billion NTKs on rail over road results in close to four times less emissions than would be produced if moving that equivalent volume on road**. As these are annual impacts, the impact on carbon budgets would be larger when multiple years are considered.

Sensitivity analysis for greenhouse gas emissions is provided in Appendix A. This sets out the implication of applying VEPM data to road vehicles, as opposed to Ministry for the Environment guidance.

4.2.4 Safety: death, serious injuries and avoided crashes

Safety impacts consider the average difference in crashes rates by mode. In general, shifting passengers and freight from rail to road implies a higher frequency of death and injury, based on historic data. As per the MBCM:

> *"A crash is a transport related event involving one or more… vehicles that occurs on the transport network that results in personal physical injury and/or damage to property".*

All incidents (for both road and rail) were drawn from NZTA's CAS database and filtered for the year of 2023. This database was used to maximise consistency, as opposed to rail-specific information which extends to industrial injuries and workplace accidents. Historic crashes by mode, for the year 2023, are summarised below:

	# Fatalities	# Serious injuries	# Minor injuries
LCV / passenger	312	2,138	10,795
HCV	57	182	706
Rail	1	2	7

Figure 22: Fatalities and Injuries per mode of transport (2023, NZTA CAS database).

The social cost of crashes, recommended by NZTA, is used to convert these impacts to dollar terms. Total annual benefits from rail in New Zealand, in the form of avoided crash and fatality costs, are summarised below:

	Fatalities (2023 dollars)	Serious injuries (2023 dollars)	Minor injuries (2023 dollars)
Monetisation (per incident)	$13,647,500	$720,697	$74,242

Figure 23: Social cost of crashes.

The presence of rail in New Zealand is expected to **save eight lives and avoid an additional 203 serious and minor injuries combined, for a total monetised benefit of $161m**. This estimate does not take account of increased road congestion or other dynamic behavioural changes, so likely represents a conservative estimate.

4.2.5 Maintenance and fuel costs

This category of benefits considers the relative resource requirements of rail and road transport. Consistent with the previous sections, it uses historic data to calculate the cost implications of shifting rail freight and metro services to New Zealand roads.

Maintenance requirements by mode are difficult to measure consistently, due to reporting not necessarily providing like-for-like expenditure categories (e.g. environmental damage, long-term versus short-term upkeep, and related infrastructure such as lighting).

Discussions with data experts were sought to maximise alignment and comparability, and have concluded that an equivalent total annual maintenance spend for road and rail would be $1,292m and $79m respectively, based on equivalent volumes.

Additionally, maintenance attribution must consider the diversity between light and heavy vehicle impacts. We first obtained total maintenance spend from the National Land Transport Fund annual report for 2022-23, identifying a total spend of $2,207m. From here, we used proportionality percentages from *Background to the road user charges (RUC) system*[17], to derive the approximate weighted attribution for LCVs and HCVs. Note that all the spend categories do not include maintenance, and thus we only inferred proportionality from pavement wear costs, and gross vehicle weight costs. This resulted in an approximate maintenance attribution of 25 per cent and 75 per cent for LCVs and HCVs respectively, which then was used to infer costs by vehicle type.

Fuel requirements are much more simple, and can be compared based on published annual fuel consumption levels, across vehicle types and class. While rail engines consume around 40 million litres of diesel fuel per year, shifting to road travel would increase fossil fuel consumption by 146 million litres. In net terms, **rail transport offers a savings of approximately 150 million litres of fossil fuels per year**. This would mean that **annually, rail takes 2,000 fuel tankers off the road.**

Diesel and petrol costs are monetised using published fuel price averages, excluding taxes and excise duties. Annual savings from fuel and maintenance costs are summarised in the table below:

[17] https://www.transport.govt.nz/assets/RUC-CAM.pdf

	Maintenance costs per annum ($m, 2023)	Fuel costs per annum ($m, 2023)
LCV / passenger	$2.6	$43.0
HCV	$117.6	$243.7
Rail	-$78.5	-$60.5
Net impact	**$41.7**	**$226.3**

Figure 24: Maintenance impacts per transport mode (2023 $m, NZD).

4.3 Comparison with 2019 study

The focus of this study has been providing an updated assessment of the benefit of rail in New Zealand. For this reason, modelling draws on a range of data sources and methodological approaches that were not available in 2019.

A high-level comparison of results is nevertheless provided in the table below. These should not be treated as a comparative like-for-like due to changes in government monetisation factors, a more conservative approach to mode conversions, the non-adjustment of rail volumes for exogenous events, and changes in transport modelling methodologies.

The biggest difference from the previous results lies within the change in rail volumes as a result of COVID-19. While rail volumes are still on the road of recovery, road volumes have rebounded relatively rapidly. This explains the decrease for some of the categories, such greenhouse gas and pollution, as well as maintenance, given that they are heavily dependent on movement volumes.

Offsetting the volume impacts is the increase in rates assigned to time and safety which were updated by NZTA through a new study conducted in 2021[18], as well as an increase in fuel prices.

Another large contributor to the differences in these results arise from the changes in traffic modelling scenarios. While the underlying technical detail of traffic modelling is beyond the scope of this report, the fundamental scenario that modelling was based off is categorically different, with many of the assumptions made for 2019 no longer being held after COVID. The 2023 transport modelling outputs have an array of updated and changed assumptions, attempting to more accurately reflect present day, and thus are likely to produce lower impacts. We note that both the current AFC and WTAU transport models are built with the underlying idea that rail is a core component of the transport network for each of these regions. Our analysis is relatively conceptual in nature, and obtaining outputs associated with a "no-rail" scenario pushed both models to its limits. Thus, while we rely on transport modelling for our analysis, they should be treated as indicative, with possible result fluctuations. This was true specifically for the WTAU modelling outputs, and thus they were used in conjunction with previous historic trends to estimate the total change in travel time and VKTs.

Impact category	Annual Value 2019 Study, $m, total	Annual Value 2023 Study, $m, total
Pollution: Greenhouse gas and health	$348 - $656	$327
Time savings and congestion	$939 - $1,054	$1,533
Maintenance and fuel	$324 - $329	$268
Safety: Deaths and Serious Injuries	$94 - $98	$161
Sum total	**$ 1,695 - $2,137**	**$2,290**

Figure 25: Comparison of 2019 and 2023 Study Results ($m, NZD).

[18] RR 698: Monetised benefits and costs manual parameter values research paper issued by NZTA

5 Policy implications

5. Policy implications

Although this study is primarily an economic evaluation exercise, results are also intended to inform discussions of the value of infrastructure investment in New Zealand, with potential implications for policy development and investment decision making.

Based on this analysis, we provide four thematic conclusions related to the role of rail New Zealand: The value for money offered by rail investment; support for New Zealand industry and regional development; the breadth of benefits; and opportunities to improve freight market efficiency.

5.1 Value for money

A described above, the monetised, bottom-up benefits of rail freight and metro services in New Zealand are estimated at over $2.3 billion per year. The majority of these impacts are "pure" economic externalities, in the sense that they affect individuals beyond those choosing to participate in the specific transactions (e.g. whether to commute via public transport or private vehicle). As a result, the benefits represent material value to New Zealand above and beyond the private costs incurred by individuals, such as fare prices.

When one-off capital grants are excluded, Crown funding levels exceed the resources allocated to rail through Vote Transport in 2024-2025. More significantly, the benefits are several times larger than 2027-2028 Crown funding ($219 million)[19].

This comparison indicates, at face value, that Government returns from providing more financial support for rail services in New Zealand, represents a strong return on investment. Although capital costs and franchising arrangements are not included in this study, and would make the investment decision making story more complex, the identification and quantification of the externality benefits provide a firm basis for assessing additional investment.

The benefit of rail in New Zealand can also be expected to scale with forecast increases in population. With net migration soaring to historic highs, the population forecasts used for developing monetisation factors are likely to underrepresent the true impacts. Using those values would under-estimate the benefit that rail brings to New Zealand, and New Zealand's residents. This further implies the current stated benefit would be on the low-range of total benefits, which strengthens the confidence decision-makers can have around the return on investment in rail in New Zealand.

Future funding questions aside, New Zealanders can be confident that contemporary investment in rail provides tangible, ongoing benefits to the country, significantly exceeding the investment required to operate and maintain the system. The potential to improve resilience and support population growth over time through improvements to the network reinforce this conclusion.

[19] New Zealand Treasury, 2024. *Economic Development and Infrastructure Sector – Estimates of Appropriations for the Government of New Zealand for the Year Ending 30 June 2025.* Appropriations by Purpose within Vote Transport, page 258.

5.2 Support to industry and economic development

This study provides an additional lens to the analysis of rail services, above and beyond bottom-up assessment completed in earlier exercises. Specifically, the macroeconomic (CGE) modelling offers insights into the effect of rail on industry costs, supply chain efficiencies, and New Zealand's economic performance. To reiterate the macroeconomic results above:

"Economic Impact Analysis concludes that the rail industry contributes $973 million annually to the New Zealand economy, and is responsible for the creation of 1,010 jobs[20]."

Rail offers cost savings of $973m spread across sectors such as coal, wholesale and retail trade, dairy, road transport and forestry. This result has implications for economic development, particularly in light of the Government's commitment to lift New Zealand's productivity and economic growth to increase opportunities and prosperity for all. A lack of rail is expected to reduce export earnings and industry investment by over $320 million, which will have direct implications for New Zealand's ability to perform as an "Export Powerhouse".

New Zealand faces barriers to productivity and export-led growth due to its distance from important trading partners[21], relative to other countries. Low population and population density similarly means that New Zealand firms face lower levels of local competition, relative to overseas providers, and may struggle to achieve economies of scale. With such factors largely being out of control for any one entity, it is critical that the sector come together to identify opportunities for minimising the cost of connectivity and promoting greater efficiencies for supply chain operations within the country.

5.3 Benefits extending beyond "core" transport outcomes

Iterative analysis of the benefits of rail over time have illuminated the breadth of rail impacts in New Zealand, including a wide range of externalities affecting multiple sectors. Applying contemporary research by NZTA, as well as drawing on the latest economic and council data, has allowed monetised benefit modelling to be refined and strengthened.

The 2023 results indicate that, of the $2.3 billion in monetised externality benefits, one of the larger impact categories relates to human health, specifically the implications of tyre, break, and engine exhaust on disease and mortality. The cost of these emissions for New Zealand implies over $291 million per year in hospital visits, reduced lung development in children, increased medication use, as well as reduced life expectancy and death.

Urban analysis also highlights that rail is critical to the continued functionality of commercial networks and accessibility in Auckland and Wellington. Beyond the monetised cost of hours spent in traffic (which is estimated to be roughly $1.5 billion), modelling by local experts indicates that cities would essentially fail to function, in their current form, if rail networks were absent. Rail transport has the potential to dramatically influence urban development, including land use, the ability of industries to specialise, and housing affordability.

Third, with the challenges being faced by local government in New Zealand, opportunities to reduce maintenance costs are highly relevant to regional infrastructure and the quality of local council services. The $42 million in annual cost savings, identified above, can be expected to grow over time in proportion to road freight volumes and heavy vehicle size. Such savings allow road controlling authorities and other council organisations additional time and expenditure to respond to local needs.

The significance of these non-time-related benefits suggests that rail system investment should be thought of as an economic and social policy, in addition to support for the land transport network. It may be beneficial for government to consider rail services when considering wider policies such as air pollution in cities, urban development, energy security, and local government finance.

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[20] Note that if one were to interpret the annual impact of rail on employment, the creation of 1,010 jobs would be the equivalent of contributing 1,010 job years annually.

[21] While noted that New Zealand's physical distance to other international markets has a material impact on productivity, this can be counterbalanced by increased investment in infrastructure, to increase the efficiency associated with land-side logistics and supply chains (Productivity commission: Productivity by the numbers, July 2023).

5.4 Providing a "level playing field" for the freight market

Economic theory suggests that the appropriate role for government in a modern economy is to maintain efficient markets, as opposed to 'picking winners' or other forms of firm-specific support. This is because, all else being equal, firms and consumers are in the best position to decide on the freight and transport services they wish to purchase. In this situation, an arbitrary subsidy of certain transport modes or firms will lead to sub-optimal outcomes, potentially including low-value investment and / or decreases to industry competitiveness.

Externality analysis, within this study, indicates that rail services may be underutilised (or under-consumed) within New Zealand. This is because private decision makers are unlikely to reflect wider costs to the country - for example, implications for hospital admissions as a result different safety outcomes (road versus rail), in making freight or travel decisions.

Applying this "market failure" framework indicates that there may be opportunities to improve market efficiency and economic performance in New Zealand, via proportionate and evidence-based levels of rail funding. Ensuring funding reflects the size of externalities, such that the freight and travel prices faced by New Zealanders reflects true economic costs, has the potential to improve both economic and social outcomes.

Recognising that MoT have made great strides in pricing in externalities through the form of a funding and revenue system that better captures the externality costs associated with all forms of surface transport, it is still likely that road transport is under-priced in the terms of its true economic cost when accounting for all externalities. This would be true for a variety of reasons, statistical limitations and constraints in measurements. However, the "market failure" framework would indeed suggest that perhaps road freight is more over-consumed.

This approach does not imply that road freight does not play an important role in New Zealand supply chains, or that the sector should not be supported. For certain routes and sectors, the implementation of rail infrastructure may be impractical. Regional geography, limitations to infrastructure investment, and route-flexibility may be some reasons as to why rail is underutilised. Instead, an economic framework suggests that financial costs do not always provide the full story, and policy decisions should reflect full economic costs. From a less technical perspective, it can also be framed as levelling the playing field, such that different transport-service providers each "pay their fair share".

We recognise that a full examination of transport-sector charges and subsidies, for example the size of Road User Charges and similar tariffs relative to full economic costs, is outside the scope of this study. The analysis of externalities, provided above, is intended to support discussion of the forms of infrastructure that can best support New Zealand.

5.5 Conclusion

This study highlights the contribution of rail transportation to New Zealanders and the New Zealand economy. Economic analysis makes clear how rail acts as a foundation for regional supply chains, boosts productivity, and supports export earnings, as well as offering a wide range of resource savings and social benefits.

Consideration of macroeconomic effects identifies over $973 million in economic impacts and an additional $2.3 billion in bottom-up benefits. While these results are the combination of different analytical frameworks, they provide insight into the role of rail networks across New Zealand's urban centres, supply chains, and wider economy.

Results are provided to inform the debate surrounding transport investment decisions in New Zealand, including how infrastructure can best support the productivity of our industries, growth in our economy, and avoid costs to government.

Detail of our analysis, including input data sources, modelling assumptions, and sensitivity analysis, can be found in the accompanying appendix.

Appendix

Appendix A

This Appendix provides technical detail to support *The Benefit of Rail to New Zealand.* (2024Report). It does not provide any additional results or findings, but instead sets out the foundation for micro and macroeconomic modelling, supporting the transparency and replicability of analysis. The Appendix is primarily intended for traffic modellers, policy advisors, and other analysts interested in detailed methodology information. Information is split into three sections:

1. **Sensitivity analysis**: Discussions with government and industry experts has indicated that alternative modelling assumptions and source data, underpinning the externality analysis, offer a valid and informative set of value estimates.

2. **Economic impact analysis:** Elucidation of the Computable General Equilibrium (CGE) model that underpins macroeconomic benefits, quantified within the Report. It focusses on underlying principles, source data, and key features. The section concludes with a short discussion of New Zealand Treasury guidance, and implications for the appropriate treatment of CGE results.

3. **Limitations and caveats**: The value of rail is estimated using a counterfactual scenario for the year 2023, based on externality and output differentials. An alternative framing or conceptualisation of "value" would likely lead to a different result. This section highlights the key assumptions underpinning Report estimates, including inputs and parameters that rely on historic data.

We note that a full explanation of source data, for example the methodologies underpinning strategic traffic modelling, is not feasible to canvass within this appendix. Weblinks and references are provided throughout each section, to indicate where such information can be found.

1. Sensitivity analysis

This section considers the implications of alternative data sources that could reasonably be applied to externality benefit calculations. In cases such as transport-related greenhouse gas impacts, for example, both Ministry for the Environment (MfE) and Waka Kotahi NZ Transport Agency (NZTA) publish contemporary and robust estimates of emissions factors by vehicle type. With each database offering pros and cons in terms of applicability and appropriateness, it is ultimately a matter of judgement which source is given precedence.

Analysis in the 2024 Report reflects discussions with transport-sector experts across New Zealand, including traffic modelling teams, industry data owners, and key stakeholders (such as KiwiRail). It also builds on Value of Rail modelling completed to date, for example *The Value of Rail in New Zealand* report in 2021.

Maintaining the externality analysis methodology, wherever possible, ensures that the quality assurance provided by the Ministry of Transport, New Zealand Treasury, and an external peer reviewer is not lost. As discussed in Section 3 of this Appendix, changes to the 2021 externality analysis are limited to simplified rail to road freight mapping without any exogenous uplift, use of the Waka Kotahi NZ Transport Agency emissions tool, and the application of National Land Transport Fund (NLTF) data to quantify maintenance spending.

Sensitivity analysis focusses on elements of the methodology where the most evident and material uncertainty is present. Conceptually, the modelling of risk and uncertainty is an open-ended exercise, reflecting an immense volume of environmental, health, and land-transport related guidance being available across New Zealand and comparable countries.

We note that the primary methodology used in the externality modelling for our core analysis (as seen in the main body of the report) was heavily influenced by reported KiwiRail values for emissions. These effect sizes were calculated by KiwiRail to align with government emissions reporting (such as the values stated by MfE) and provided to us for use by KiwiRail.

Alternative Methodologies

With these objectives in mind, sensitivity analysis to support the 2024 Report consists of two alternative modelling approaches. Each are intended to demonstrate the implications of different modelling choices, in response to sources of uncertainty.

First, greenhouse gas emissions produced by road vehicles in New Zealand. As discussed above, government organisations in New Zealand publish a range of guidance documents and technical manuals for estimating the impacts of alternative transport modes. The two alternative sources of data are:

- *The Vehicle Emissions Prediction Model* (VEPM) has been developed by NZTA and Auckland Council to predict emissions from vehicles in the New Zealand fleet under typical road, traffic and operating conditions. The model provides estimates that are suitable for air quality assessments and regional emissions inventories[22].

- *Measuring emissions: A guide for organisations: 2024* is published by MfE to help organisations measure and report on their greenhouse gas emissions. The methodology is designed to align with New Zealand's international reporting requirements under the United Nations Framework Convention on Climate Change, as set out in New Zealand's Greenhouse Gas Inventory 1990–2022. The guide also aligns with the GHG Protocol Corporate Accounting and Reporting Standard, as well as ISO 14064-1:2018[23].

MfE data is arguably the more accurate data source, as it aligns with international standards, and is published by the New Zealand Government's primary adviser on environmental matters. The constraint, however, is limited information on emissions with direct impacts on human health such as particulate matter. It also includes limited flexibility with respect to transport-specific factors, such as temperature, vehicle speed, and trip length. In general, more steps and assumptions are match MfE guidance with other New Zealand datasets relevant to the benefit of rail.

VEPM provides an accessible and flexible vehicle fleet emissions modelling tool. It is explicitly recommended in industry-standard economic evaluation guidance (e.g., see page 56 of the Monetised Benefits and Costs Manual, or MBCM)[24]. The inclusion of 'standard' fleet parameters increases the transparency and consistency of transport-sector investment appraisal. VEPM does not extend to rail sector emissions, meaning it cannot be used as the sole source of environmental impact data. It is also inconsistent with the technical specifications agreed as part of KiwiRail rolling stock procurement processes, which instead align to international GHG reporting standards.

The primary results in the body of the 2024 Report are based on MfE and KiwiRail provided values, rather than VEPM. We provide the sensitivities for VEPM below. Note that VEPM results in a lower volume of benefits, making it the more conservative choice.

Scenario	Average emissions factor, heavy vehicle fleet	Annual greenhouse gas emissions savings (tonnes CO_2-e)	Annual greenhouse gas emissions savings, monetised (2023 dollars)
Vehicle Emissions Prediction Model	0.7kg CO_2-e / km	371,895	$32.4 million

Figure 26: Greenhouse gas emissions, sensitivity analysis.

Second, traffic modelling results for Wellington, specifically the expected mode shift between rail passenger travel and private vehicle trips. Due to limitations associated with the WTAU, the methodology that we used within our core analysis was a combination of both the contemporary Greater Wellington Regional Council (GWRC) estimates, alongside an extrapolation of historic values for relative trip proportionalities. This method was agreed to be the more realistic representation of what would occur in Wellington if rail were to be removed as a transport mode by KiwiRail and WTAU.

We note that while we have done analysis on the original WTAU outputs, it would be disingenuous to present them, not only due to the fact that they reflect a world which is inaccurate to reality, but also as it relies on pushing the existing model to a limit which it never was intended to reach.

[22] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/environment-and-sustainability-in-our-operations/environmental-technical-areas/air-quality/vehicle-emissions-prediction-model/
[23] https://environment.govt.nz/publications/measuring-emissions-a-guide-for-organisations-2024-detailed-guide/
[24] https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

2. Economic impact analysis

Computable General Equilibrium (CGE) models are a class of economic model developed originally out of Input Output (IO) models providing a causal, full system and theory driven framework for the assessment of a wide range of policy, project, and economic condition assessments.

As suggested in the name, CGE models provide an equilibrium representation of international and national economies in a chosen base year, including explicit treatment of (for example) primary factor markets, inter-industry purchases, and international trade flows. It is this initial equilibrium position which forms the starting point for a sequence of future projections of possible economic states, and it is by comparing these future pathways against each other that we can assess the impact of different policy choices on macroeconomic indicators such as GDP and employment.

As noted by Dixon in the Handbook of Computable General Equilibrium Modelling:

> *"CGE models are used in almost every part of the world to generate insights into the effects of policies and other shocks in the areas of trade, taxation, public expenditure, social security, demography, immigration, technology, labour markets, environment, resources, infrastructure and major-project expenditures, natural and man-made disasters, and financial crises. CGE modelling is the only practical way of quantifying these effects on industries, occupations, regions and socioeconomic groups."*

The primary data source for EYGEM model is the GTAP database, produced by Purdue University. The GTAP database is the most detailed, comprehensive, and widely used database of its type in the world, used by over 700 researchers worldwide. The database contains information on inter industry flows, trade, taxes and behavioural variables.

In this section we will describe the key features and structural underpinnings of the EY version of a global CGE model, the EY General Equilibrium Model (EYGEM), including a description of the economic foundations of the EYGEM model, the national accounting framework and behavioural assumptions.

Overview of the EYGEM model

The EYGEM model is a member of the Global Trade Analysis Project (GTAP)/Global Trade and Environmental Model (GTEM) family of CGE models which have a long history in the public and private sectors to assess the economic impact of projects and policies. As with most modelling frameworks it is natural to think about the model in terms of the data and structural components.

As with all CGE models, EYGEM is based on an underlying input-output or social accounting matrix, which is a standard representation of the national accounting frameworks applied by central statistical agencies globally and forms the basis for calculating well known macroeconomic variables such as gross domestic product. This foundational data describes how economies are linked through production, consumption, trade and investment flows.

Overlaying this system of national accounts are a set of standard behavioural structures that simulate real world decision making and are validated by established academic literature, providing the basis for forecasting responses to policy changes. For policy analysis, this incorporation of behavioural structures provides an advantage over traditional econometric approaches, particularly where historical examples or analogues of the policy being evaluated is not well represented in historical data (for example climate change policy).

The below points highlight the key features of the EYGEM model, ahead of a discussion of the economic theory underpinning the model:

- Direct linkages between industries and countries through purchases and sales of each other's goods and services.
- Inter industry linkages through purchases and sales of each other's goods and services.
- International linkages through the imports and exports of goods and services.
- Capacity constraints in primary factor markets, representing the finite availability of capital, labour, land and the natural resource (This is not accounted for in IO models).
- Behavioural mechanisms such as the responses to price changes.

Income

The model contains a "regional consumer" that receives all income from factor payments (labour, capital, land, and natural resources), taxes and net foreign income from borrowing (lending).

Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas utility function.

Consumption

Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.

Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a Cobb-Douglas utility function.

Production

Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a CES production function.

Producers are cost minimisers, and in doing so choose between domestic, imported and interstate intermediate inputs via a CRESH production function.

The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply. A labour supply elasticity of 0.15 is uniformly adopted for this analysis.

Investment

All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return.

Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions and minimises costs by choosing between domestic and imported sources for these goods via a CRESH production function.

Prices

Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).

For internationally traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But in relative terms imported goods from different regions are treated as closer substitutes than domestically produced goods and imported composites.

CGE Application

Manuals published by the New Zealand Treasury provides a clear indication of the appropriate uses for CGE modelling, in contrast to traditional cost-benefit analysis, or CBA (and by extension, externality assessment in the body of the 2024 Report). Treasury guidance specifies that:[25]

> *"Economic Impact Analysis (EIA) differs from CBA in that it measures the economic impact of a project, that is to say the activity generated, rather than the net benefit created. Because it measures the activity generated, it treats costs as a benefit... In contrast, a CBA would treat the expenditure on labour as a cost, recognising the fact that the labour is prevented from carrying out some other activity, ie, recognising its 'opportunity cost'....*
>
> *EIA can provide useful contextual information for decision-makers, but it is not suitable as a tool for measuring the balance of costs and benefits of a decision to society."*

Consistency with this guidance has been maintained by delineating CBA vs. EIA results in the body of the Report. While both forms of impacts represent tangible and distinct forms of benefit to the New Zealand economy, only the former considers the resource costs of transport activity from a willingness-to-pay perspective.

Business case processes that seek to align with New Zealand Treasury guidance should, therefore, focus on externality benefits. While adjustments would be necessary to ensure an appropriate analysis period is considered, and a business case need to consider the wider costs of government intervention, the methodology could act as a robust foundation for investment decision making.

CGE modelling offers insights to those interested in risks and opportunities to the wider New Zealand economy, including implications for productivity, competitiveness, and export-led growth. In our view, macroeconomic results are likely to offer value in the context of top-down economic performance, for example considering the relative contribution of different New Zealand industries to GDP. A wider discussion of policy implications can be found in the body of the Report.

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[25] https://www.treasury.govt.nz/sites/default/files/2015-07/cba-guide-jul15.pdf

3. Limitations and caveats

As discussed above, the 2024 Report relies on a range of modelling parameters and other assumptions. Results are a direct reflection of New Zealand source data, as well as appraisal guidance published by Waka Kothai NZ Transport Agency. Any change in core inputs, for example the rail to road truck conversion factor of 9.6 tonnes (rail NTKs to road KMs), would have direct and material implications for value estimates.

In summary, the 2024 Report is not a business case, commercial appraisal, or economic forecasting model. While the externality modelling is consistent with the principles of cost benefit analysis recommended by the New Zealand Treasury, results do not capture all the strategic, financial, commercial, capital cost, and infrastructure-management implications of discontinuing rail services in New Zealand.

Rail travel (freight and metro) provides a wider range of value to New Zealand economy than what is captured through this analysis, for example the increased reliability associated with rail services in response to road congestion, the resilience offered by additional freight routes across regions and supply chains, the capital expenditure associated with building additional road capacity, and the differential in private freight costs by mode.

Significant potential exists to explore additional benefits of rail in future studies, particularly non-monetised impacts such as urban planning, option value (where rail offers increased levels of accessibility), sustainability, and regional connectivity.

Another key assumption underpinning the report is reliance on a point-in-time methodology. Rail freight and road congestion modelling reflects 2023 data, and all outputs represent expected implications for a single 12-month period. Outputs do not measure effects over time, and additional calculations would be necessary to consider cumulative costs and / or benefits. A Business Case analysis period, for example collating costs and benefits over a 40-year period, would likely result in a much higher estimate of net value.

The list below details the key assumptions applied, as well as associated caveats and limitations:

- Rail freight volumes are based on financial year 2022-2023, provided by KiwiRail. No adjustment has been made to these volumes for specific rail-to-road length equivalents, or temporary impacts on volumes such as COVID-19. This results in a more conservative approach to freight volumes being applied, relative to previous Value of Rail studies.

- All dollar values are reported in 2023 terms, reflecting MBCM update factors. Monetisation factors are based on the MBCM v1.7, published May 2024[26].

- Benefits and externalities are defined broadly for the purposes of this report. The majority of bottom-up, monetised benefits meet the formal microeconomic definition of an externality, in the sense that they affect individuals beyond those choosing to participate in the specific transactions (e.g., whether to commute via public transport or private vehicle). However, categories such as fuel costs are less straightforward, and could arguably be described as a private cost (from a New Zealand point of view), or a common pool resource (from a global perspective). We consider that the use of the term is justified because all externality benefits represent changes in real resource uses, consistent with the New Zealand Treasury requirements.

- The study does not account for any behavioural change as a result of the differing scenarios, beyond the outputs of traffic modelling. Historic information, for example 2023 vehicle crash rates per kilometre travelled, is used as indication of expected future outcomes. Alternative results could be expected if an agent-based, micro-simulation, or otherwise dynamic framework for estimating future impacts was applied.

- Modelling assumes that all new trucks on the road consistently carry 9.6 tonnes and does not attempt to adjust for empty return trips, beyond what is already in the national average. Double handling of freight has not been considered.

- Traffic modelling results reflect a number of assumptions, consistent with the work of Auckland Forecasting Centre (AFC) and GWRC. Both the Auckland and Wellington transport modelling considered a base year of 2023 to reflect present day travel patterns and infrastructure capacity. Outputs reflect two scenarios, the first being the “base case” representing the status quo, then a “no rail” scenario. The differences between these two outputs provide an estimate of rail impacts, in the form of daily vehicle movements and travel time. We multiply these daily values by

[26] https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

261 (number of weekdays in a year) to estimate annualised values. Note that this annualisation factor reflects a recommendation from model owners, hence is considered more appropriate than generic MBCM values.

- More detail of urban traffic models can be found at the following links:

  - Auckland Forecasting Centre: https://www.aucklandforecastingcentre.org.nz/pdfs/ADTA_Model_Development_Report_v1.4.pdf

  - Greater Wellington Regional Council: https://wellingtontransportanalytics.co.nz/wp-content/uploads/2024/01/TN1-Wellington-Analytical-Tools-2019-21-Update-Specification-v2.pdf

- Congestion costs only include time delays and exclude any benefits of increased travel time reliability. Extending the analysis to consider such uncertainty would likely increase the estimated benefit of rail.

- Interregional congestion benefits are modelled on a simple per kilometre basis, consistent with previous studies. This makes up approximately 20 per cent of congestion- and time-related benefits. Given it represents the entirety of the South Island, as well as the North Island excluding Auckland and Wellington, it likely represents a conservative estimate of value.

- Safety impacts are based on national averages, i.e., the ratio of incidents divided by total NTKs/Kms. Rail deaths and injuries exclude non-crash events such as workplace injuries and accidents at sidings and terminal sites.

- Neither subnational safety profiles nor the cause of crashes is considered in the analysis. Similarly, the assessment does not consider the relationship between traffic volumes, congestion, and driver frustration. Greater congestion may in reality lead to a rate of crashes higher than historic averages would suggest.

- Maintenance costs are calculated on a per kilometre basis for road vehicles. Total maintenance spend is sourced from the NLTF, then apportioned to vehicle classes using Road User Charge (RUC) data. This resulted in an approximate maintenance attribution of 25 per cent and 75 per cent for light and heavy vehicles respectively.

- Emissions factors for GHGs and other road vehicle emissions were obtained from KiwiRail, which are intended to be in alignment with published MfE results for the year of 2023.

- As the MBCM does not specify a monetised value for PM_{10}, contemporary research by the UK government is applied [27]. This recommends the application of a conversion ratio between $PM_{2.5}$ and PM_{10}. We calculate New Zealand's average ratio to be 0.53 [28].

- Rail-related emissions are sourced directly from KiwiRail, in order to reflect contemporary engine and fleet data. Consistent with previous analysis, particulate matter is assumed to be exclusive to road, reflecting that research focuses on the effects of such emissions in enclosed environments.

- Air pollution impacts are calculated on a per-tonne basis and, beyond the urban / rural split recommended by the MBCM, do not account for sources, receptors, terrain or meteorology. NO_x and SO_x are calculated on a net basis (i.e. road emissions minus rail emissions). Particulate matter is assumed to be exclusive to road, reflecting that research focusses on the effects of such emissions in enclosed environments or diesel engines.

- Fuel prices are sourced from published MBIE data[29] and make use of average values for the year 2023. Petrol excise adjustments were also applied for petrol, with the at pump average price being $2.63.

- Our approach to CGE modelling is described in section 2, above, including economic foundations, the national accounting framework, and behavioural assumptions.

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[27] https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-impact-pathways-approach

[28] This is inferred from the observational data available in the *PM2.5 in New Zealand - Modelling the current levels of fine particulate air pollution* report, found https://environment.govt.nz/publications/pm2-5-in-new-zealand-modelling-the-current-levels-of-fine-particulate-air-pollution/

[29] https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices

4. Model output comparison table

Section 4.3 provides the comparative value differences between the 2019 and present externality benefits. For completionist purposes, we summarise the high-level methodological differences in the table below.

Topic	Value of Rail (2019) - EY	Benefit of Rail to New Zealand (2024) - EY
Macroeconomic impact analysis	Not analysed.	Performed using computable general equilibrium (CGE) modelling to estimate rail's impacts on: • GDP (adding $972m annually). • Employment (creating 1,010 jobs annually). This considers the productivity / cost benefits that rail transport has over road.
Externality analysis methodology	Total impact was calculated to be $2,136.58m in 2019 dollars. The Economic Evaluation Manual (EEM) was used for a majority of monetisation factors. This was deemed as best practice for that point in time.	Total impact was calculated to be $2,289m in 2023 dollars. The Monetised Benefits and Costs Manual (MBCM) was used for monetisation factors. This is currently considered best practice for transport evaluation.
NTK adjustments	Uplifted and adjusted for each line based on equivalent road distance. When considering total movements, 104% of rail volumes would be considered as the equivalent for road movements. Adjustments made for exogenous impacts (such as natural disasters).	No adjustments or uplifts made for rail volumes. No adjustments made for natural disasters (such as 2023 January floods and Cyclone Gabriel).
Transport modelling	Transport modelling inputs were based off a 2019 forecast / view.	Transport modelling inputs were based off a 2023 perspective / present day view, and consider the reduced volumes resulting from COVID and changes to working environments (such as an increase in work-from-home situations).

Figure 27: High level modelling differences.

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