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Decarbonising Australia's road freight network

MARCH 2026

Contents

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Note: All dollar figures are Australian dollars unless indicated otherwise.

Executive summary

Road freight underpins the Australian economy and is driving increasing emissions in the transport sector.

Trucks deliver everything from groceries to households, to agricultural products to ports for export. As Australia's economy grows, so does our freight task. Our freight task is forecast to grow by 15% by 2050.

Emissions in the transport sector grew 0.3 Mt CO_2-e in 2025. Emissions in all other sectors fell. This increase is being driven by road freight which is set to overtake passenger vehicle emissions by 2039.

There is a narrow window for action: nearly a third of vehicles will be replaced in the next decade.

More than 40% of Australia's light commercial vehicles are over 12 years old. Over 37% of rigid and articulated trucks are over 15 years old. If retiring rigid trucks are replaced by BEVs instead of ICE vehicles, Australia could reduce emissions by 73 Mt CO_2-e over the next 15 years. This is equivalent to 16% of our total 2024 net emissions.

Current policy settings have Australia on the wrong track.

Battery electric vehicles (BEVs) represent just 0.7% of new truck sales compared to 20% in China, 7% in Germany and 2% in the UK. Current projections show internal combustion engine (ICE) truck numbers are expected to continue rising for the next 6 years. This will make future decarbonisation much costlier.

Electrification is the most prospective decarbonisation solution for the majority of road freight.

BEVs already offer the lowest total cost of ownership for rigid trucks, depending on use cases, and are expected to be significantly cheaper across all truck types by 2030.

BEVs reduce our reliance on imported energy and deliver the lowest lifecycle emissions.

BEVs' use of domestically produced energy can eliminate imported fuel reliance and our vulnerability to oil shocks. The GDP and inflation impacts from the Iran war's higher oil prices would be a fifth smaller if the policy reforms in this report were implemented. Our fuel reserves would similarly be a fifth larger through reduced demand.

While other fuels and technologies, such as low-carbon liquid fuels, deliver some emissions reductions, BEVs deliver the lowest lifecycle emissions. BEV lifecycle emissions are forecast to fall a further 33% and 48% for rigid and articulated trucks respectively by 2030 as the Australian energy grid decarbonises.

BEVs can already meet payload and distance requirements for urban and most regional cohorts.

77% of trips today can be covered by BEVs based on distance and payloads. This will increase to 88% by 2030 as the technology frontier for BEVs improves. Other solutions such as low-carbon liquid fuels will continue to play an important role for hard-to-electrify truck cohorts.

A policy suite that targets cost, infrastructure and operational barriers could add an additional 1.5 million BEV trucks to the road by 2050 and be cost neutral for the budget.

While lifecycle costs are often lower for BEVs, high upfront costs are prohibitive, particularly for small businesses which represent 90% of trucking sector businesses. Limited charging infrastructure and regulations are also significant barriers to adoption.

Regulatory policies, such as introducing concessions for weight thresholds, are low-cost, high-impact policies to support BEV adoption. The introduction of an efficiently priced road user charge could fund targeted subsidies.

These policies will deliver productivity benefits, GDP growth and employment growth.

These policies will drive productivity and deliver $138 billion in economic growth and an additional 900 thousand jobs by 2050. This does not include the substantial benefits of increased fuel sovereignty during crises.

Greater BEV adoption will reduce emissions, save lives and reduce externality costs.

Improving BEV adoption will reduce emissions by 181 Mt CO_2-e by 2050 – equivalent to 41% of Australia's 2025 annual emissions. These policies would save 3,300 lives and reduce externality costs associated with heavy vehicles by $18.5 billion by 2050.

1 **A critical window is closing for Australia to capture significant benefits from freight decarbonisation**

2 Electrification is the most prospective technology to modernise Australia's freight fleet

3 Freight cohorts face unique barriers to battery electric vehicle adoption, with the urban cohorts the most ready

4 Targeted policies can increase electrification by 25%, supporting $138B in economic growth, and abating 181Mt CO_2-e by 2050

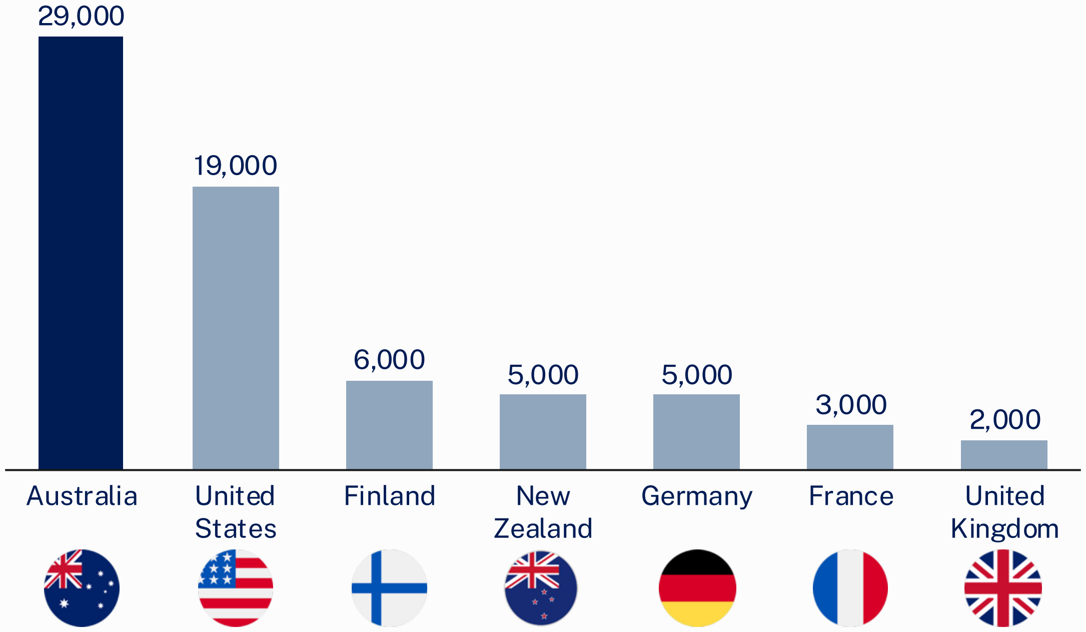
5 Appendix

Freight is critical to Australia's economy, and its importance will continue to grow over the next 25 years

Freight activity, selected comparator countries

Tonne-kilometres per capita, 2024

Australia's freight activity per capita is the highest in the OECD, with 29,000 tonne-kilometres of freight moved per capita in 2024.[1] The freight sector is key to accessing global markets and serving local communities given its geography and dispersed population.[2]

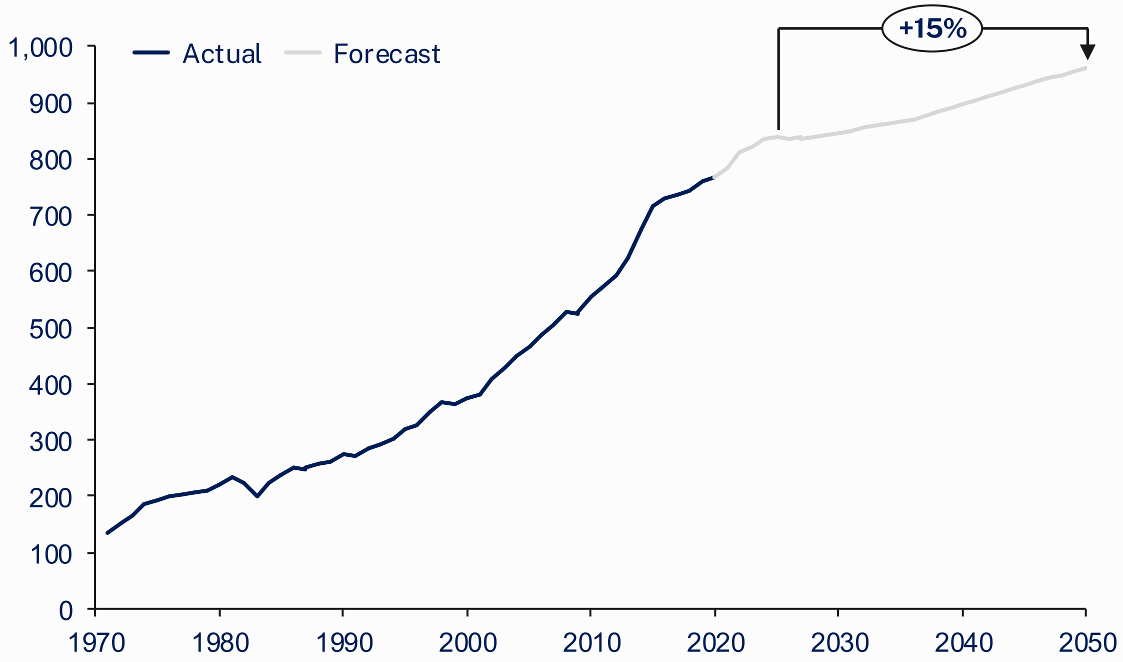


Note: 1. Freight activities include road, rail and maritime tasks. Comparator countries are similarly advanced economies. OECD data is used for consistency, except Australia's maritime (BITRE, 2025) and U.S. maritime (BTS, 2023), where OECD has no data. U.S. road, UK maritime and Australia's maritime are all from 2023, the most recent available. New Zealand's maritime task is excluded due to lack of reliable data and is therefore underestimated.
Source: 2. OECD (2024) *Population;* OECD (2024) *Freight Transport;* Mandala analysis.

Historical and forecast aggregate total freight task[1]

Billion tonne-kilometres, 1971-2050

Australia's freight sector is expanding. This is due to population growth, rising e-commerce, major infrastructure investment, and strong global demand for Australian bulk commodities and agricultural products.[2]



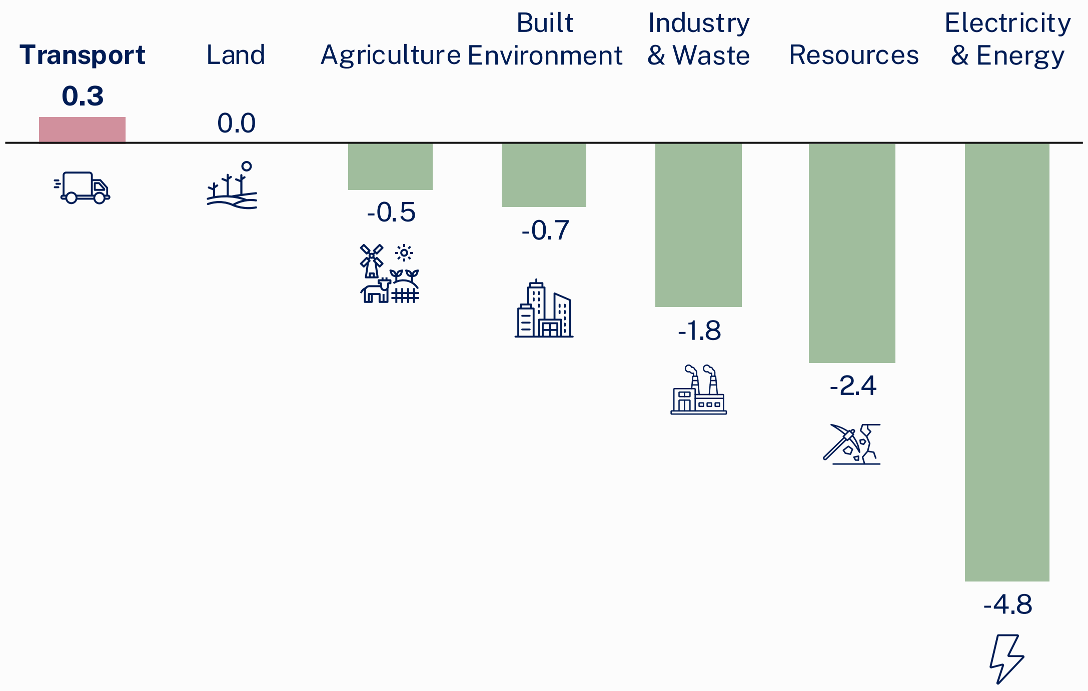
Note: 1. Forecasting from 2022 is the latest data from this source.
Source: 2. BITRE (2022) *Australian Aggregate Freight Forecasts;* Mandala analysis.

Transport emissions rise as most sectors decarbonise, and road freight accounts for 86% of transport emissions from freight

Sectoral emissions reductions progress

Mt CO_2-e growth, 2025

Transport emissions grew by 0.3 Mt CO_2-e in 2025, in contrast to all other sectors where emissions were either stable or falling**.** Curbing growth in road freight emissions is critical to meeting Australia's emissions reductions targets.

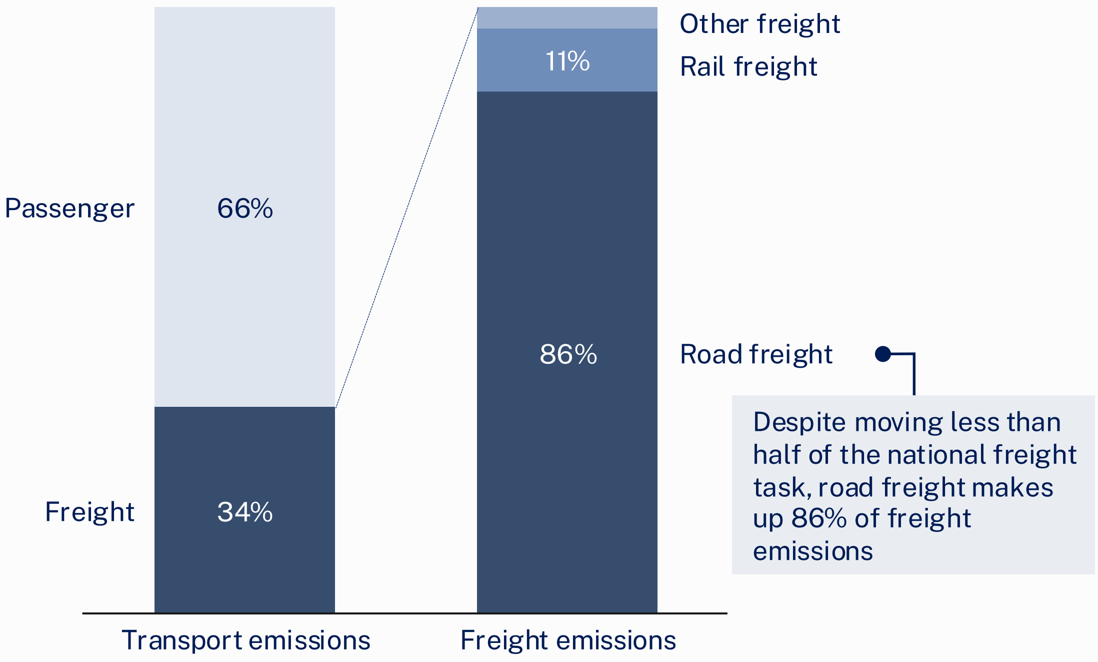


Source: Climate Change Authority (2025) *Annual Progress Report;* Mandala analysis.

Australian emissions by sector

Share of total emissions, 2024

While passenger emissions currently make up most of total transport emissions, this share has been decreasing over time. In contrast, freight emissions continue to grow both in absolute and relative terms.



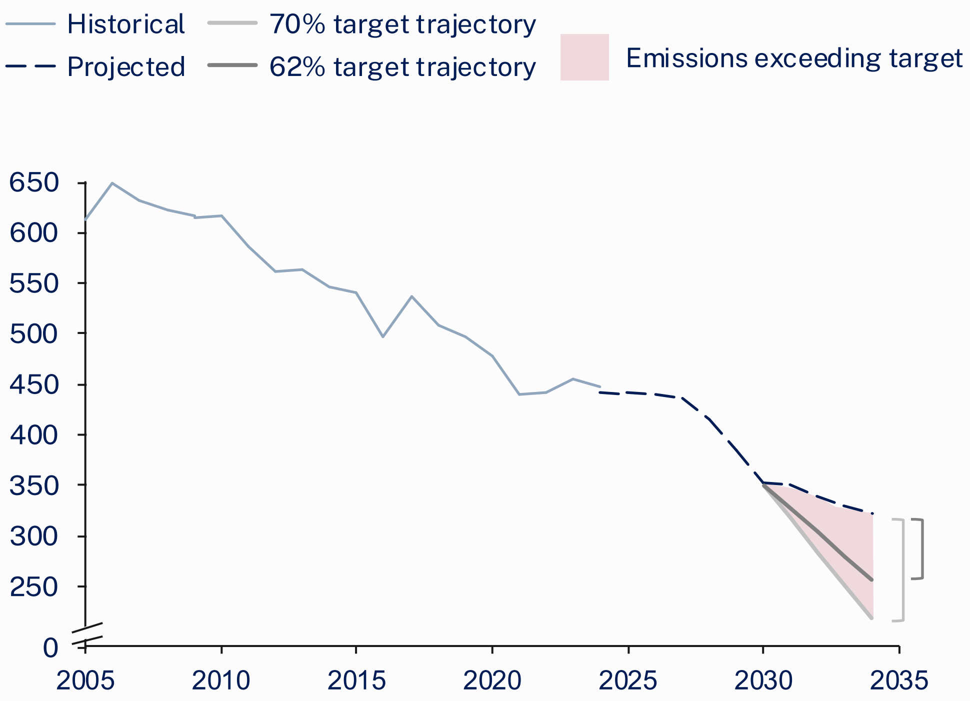
Source: DCCEEW (2025) *National Greenhouse Gas Inventory;* BITRE (2025) *Transport Energy and Environment – Yearbook 2024;* Mandala analysis.

The freight sector could put Australia's 2035 emissions reductions target at risk and erode the achievements of reducing emissions in passenger transport

Historical and projected national emissions

Mt CO_2-e, 2005-2034

Latest projections show Australia will miss 2035 emissions reductions targets by between 65 and 105 Mt CO_2-e.[1] To achieve the target of 70% below 2005 levels, Australia must more than triple the pace of emissions reductions compared with the average rate of the past five years.[2]

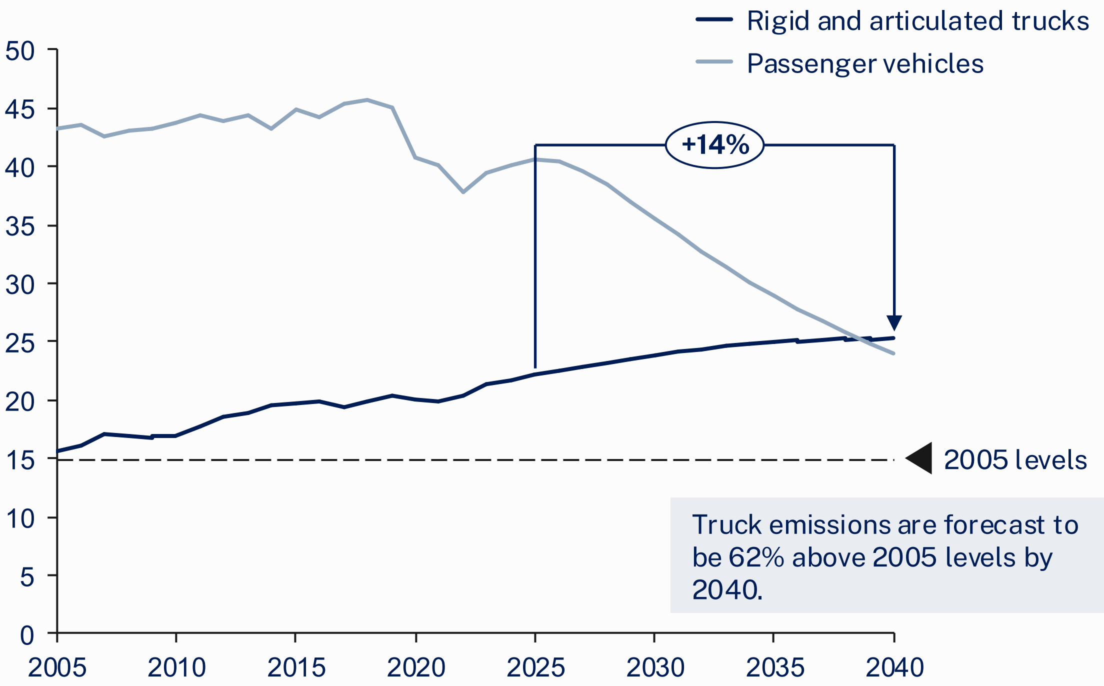


Source: 1. Climate Change Authority (2025) *2035 Emissions Reductions Target Report*; 2. DCCEEW (2025) *Annual Climate Change Statement*; Mandala analysis.

Forecast transport emissions in Australia

Mt CO_2-e, 2005-2040

Road freight emissions are projected to grow 14% by 2040, overtaking passenger vehicles in Mt CO_2-e. Unlike other sectors with mature reduction pathways, freight emissions will keep rising, undermining broader economy-wide efforts.[1]



Truck emissions are forecast to be 62% above 2005 levels by 2040.

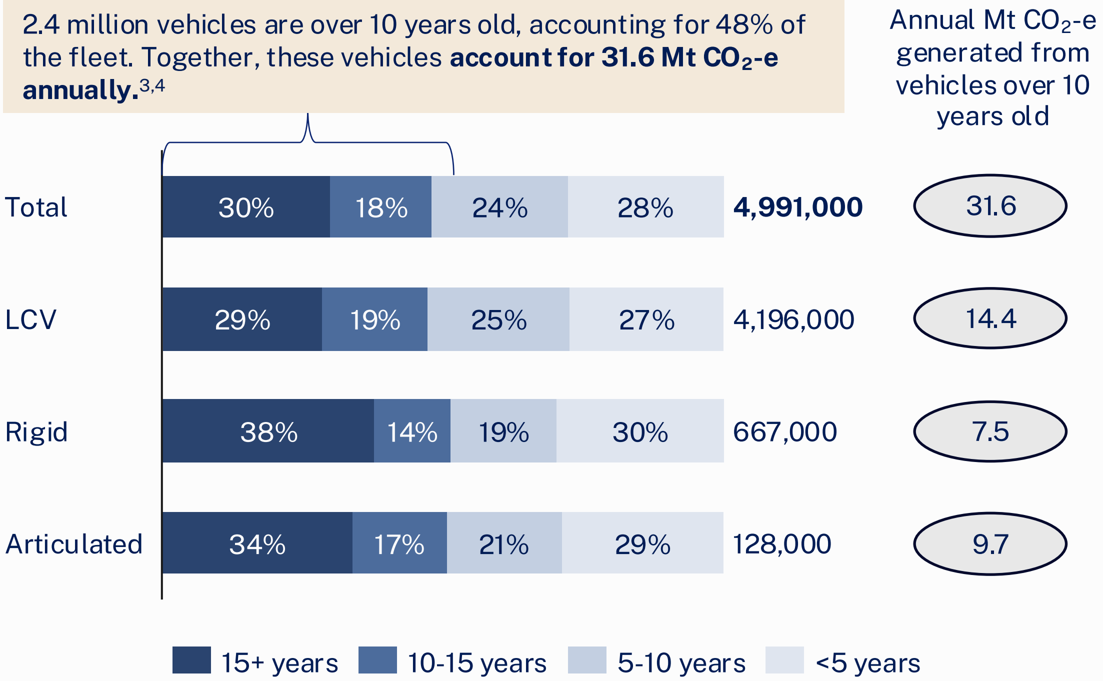
Note: 1. BITRE (2025) *Australian Infrastructure and Transport Statistics – Yearbook 2024*;
Source: DCCEEW (2025) *Australia's emissions projections 2025*; Mandala analysis.

Australia's road freight sector is at an inflection point: nearly a third of vehicles could be replaced in the coming years

Overview of freight fleet age, by vehicle type

Share of trucks, 2025 fleet

By 2030, 43% of the freight fleet could be older than 15 years, highlighting the significant upgrade cycle that is approaching.[1,2] Australia's road freight fleet age averages 11.8 years.[2]

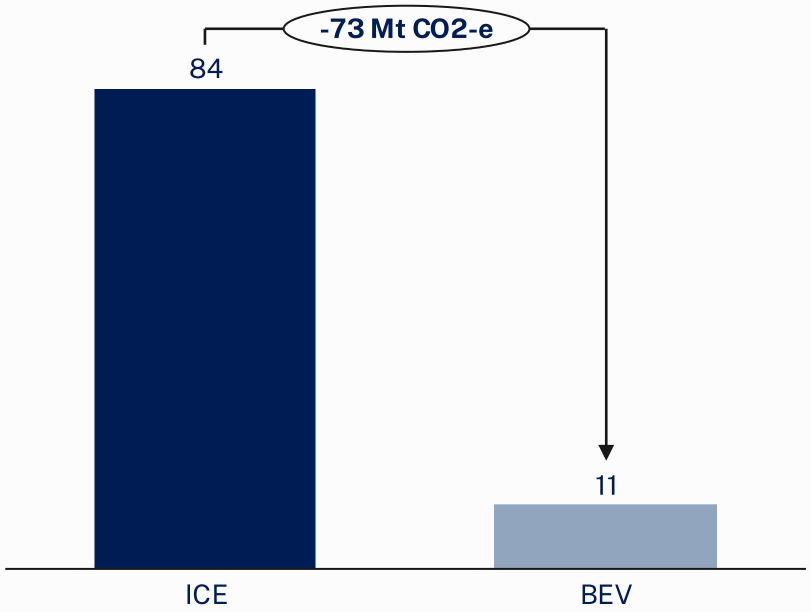


Note: 1. Fleet projection in 2030 is from AEMO (2025) and Mandala analysis.
Source: 2. BITRE (2025) *Road Vehicles, Australia*; 3. DCCEEW (2024) *Australian National Greenhouse Accounts Factors;* 4. ABS (2020) *Survey of Motor Vehicle Use;* Mandala analysis.

Additional emissions from replacing retired rigid trucks

Mt CO_2-e from ICE vs. BEV replacement in 2025

If retiring rigid trucks are replaced by BEVs instead of ICE vehicles, Australia could reduce emissions by 73 Mt CO_2-e over the next 15 years. This is equivalent to 16% of our total 2024 net emissions.

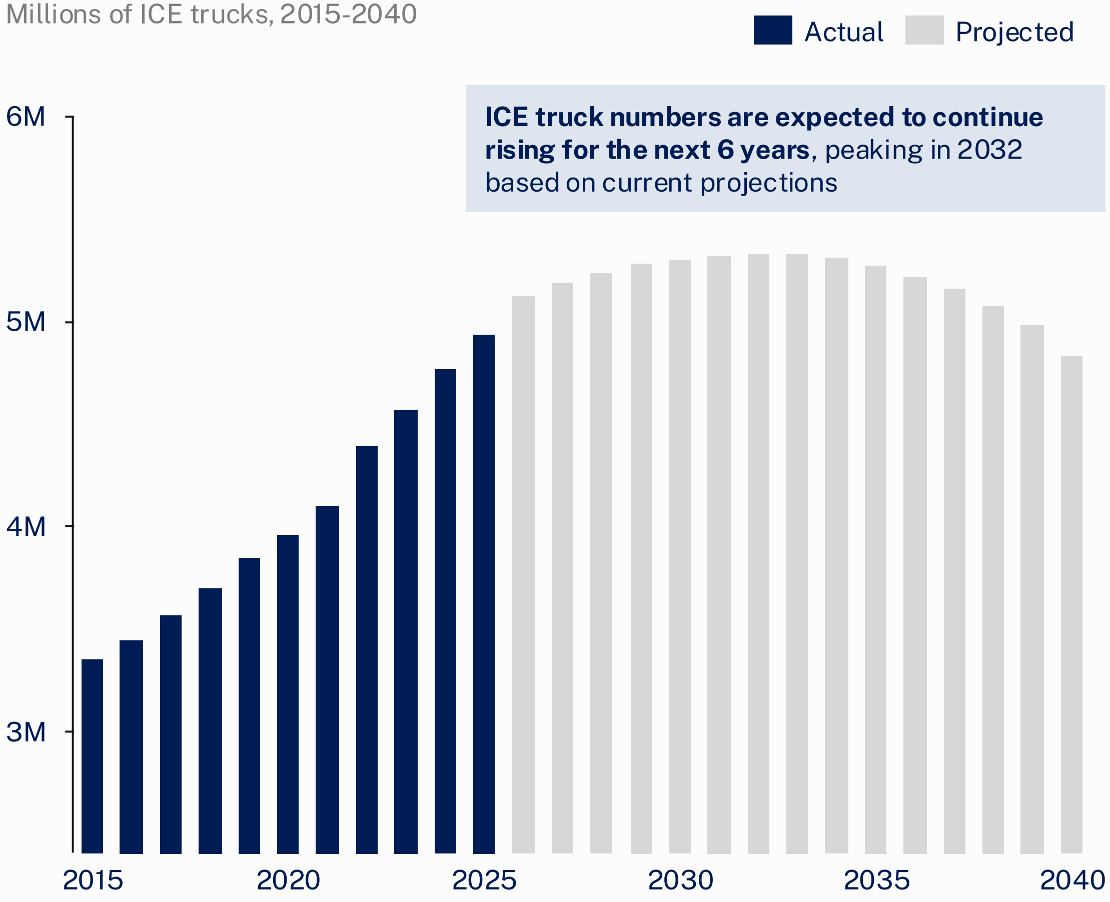


Source: DCCEEW (2024) *Australian National Greenhouse Accounts Factors*; TNO (2022) *Techno-economic Uptake Potential of Zero-emission Trucks in Europe*; ABS (2020) *Survey of Motor Vehicle Use*; DCCEEW (2025) *Australia's emissions projections*; ABS (2025) *Emissions Reduction*; Mandala analysis.

Australia is on the wrong road: the number of internal combustion engine trucks is expected to continue to increase for the next six years on current trends

Forecast ICE trucks in Australia[1]

Millions of ICE trucks, 2015-2040

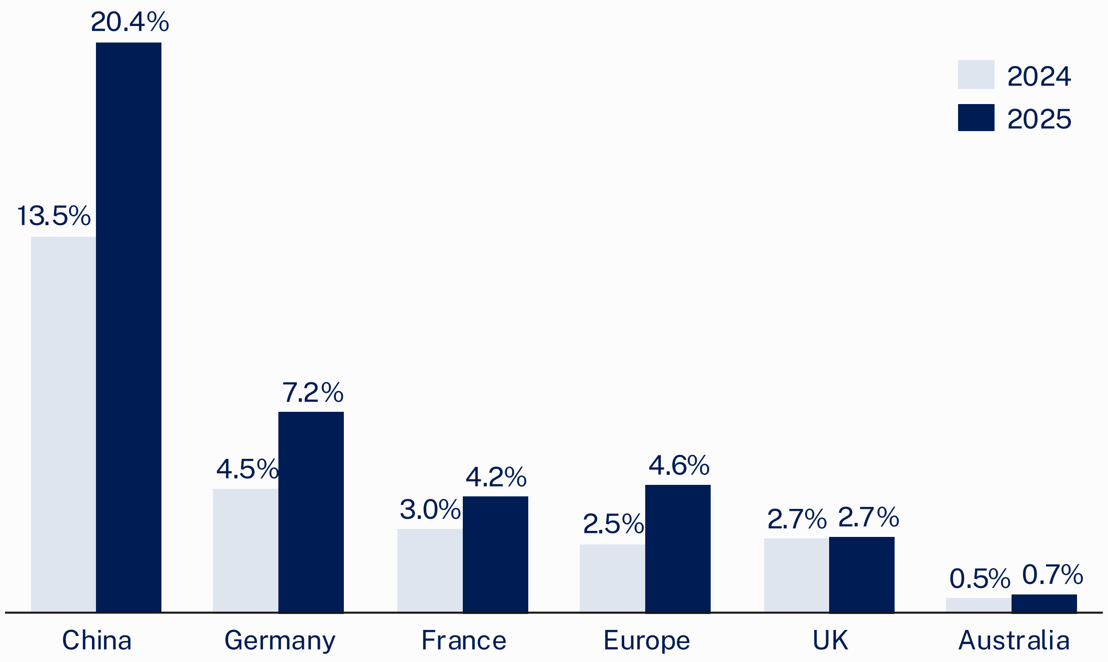


Note: 1. Fleet projections from AEMO (2025) and Mandala analysis. Includes LCVs, rigid, and articulated trucks. Source: ABS (2020) *Motor Vehicle Census, Australia*; BITRE (2025) *Road Vehicles, Australia*; AEMO (2024) *Electric Vehicle Workbook;* Mandala analysis.

Share of BEV truck sales[1]

% of sales, 2024-2025

Fewer than 400 BEV trucks were sold in Australia in 2025. Slow EV truck sales risk locking in emissions growth for decades, as trucks nearing replacement default to diesel, extending fossil fuel use well into the 2040s.



Note: 1. Truck defined as vehicles above 3.5 tonnes to maintain consistency across data sources; Source: Truck Industry Council (2026) *Low and Zero Emissions Truck Sales;* BITRE (2025) *Road Vehicles, Australia;* UK DVLA (2026) *Vehicle licensing statistics data tables;* ICCT (2025a, 2026) *Race to zero: European heavy-duty vehicle market development quarterly;* (2025b, 2025c) *Zero-emission Medium- And Heavy-duty Vehicle Market In China;* Mandala analysis.

Accelerating freight decarbonisation could deliver broad environmental, economic, and health benefits to Australia

Key benefit categories	Description
Improving productivity	▪ Electric trucks deliver lower operating costs per kilometre through fewer moving parts, cheaper fuel, and lower maintenance costs. With policy intervention, they could also avoid curfews and geographic restrictions (through reduced noise levels) that limit diesel vehicles. ▪ Greater telemetry outputs in electric vehicle fleets can also improve route optimisation and logistics efficiency, enabling better planning and resource allocation.
Advancing energy sovereignty	▪ Shifting heavy transport from imported diesel to domestically produced electricity and hydrogen reduces exposure to geopolitical risks and international supply disruptions affecting global oil markets. ▪ Australia holds just 30 days of diesel reserves.[1] Reducing diesel demand through decarbonisation stretches reserves further for uses where no alternative exists, while also cutting costs and easing living pressures.[2]
Supporting resilience in uncertain times	▪ Fleet modernisation creates demand for domestic manufacturing of electric vehicle components, batteries, and hydrogen fuel cells, leveraging Australia's abundant critical minerals to build local supply chains.[3] ▪ Developing new maintenance and servicing industries for modern fleet technologies will require skilled workforce development, creating opportunities for secure employment in emerging sectors.
Easing cost-of-living pressures	▪ Lower freight operating costs for BEVs can flow through to lower prices for consumer goods. Lower reliance on diesel shields household budgets from oil price shocks that could be passed directly onto consumers.[4] ▪ Regional and remote areas with long supply chains stand to gain the most from lower distribution costs, while new industries create jobs with potential for secure, well-paid employment.
Reducing emissions and improved health outcomes	▪ Freight decarbonisation delivers substantial emission reductions that help Australia meet its international obligations, while early infrastructure investment in heavy transport creates enabling infrastructure that supports cascading decarbonisation of other transport modes. ▪ Phasing away from internal combustion decreases occupational injuries and death from particulate matter exposure, as well as engine noise and vibration related stress and hearing loss.[5]

Source: 1. International Business Times (2026): *Australia Fuel Crisis Deepens in March 2026: Panic Buying, Soaring Prices and Supply Warnings*; 2. ABC (2025) *Australia's Oil Refineries Will Need Government Support to Avoid a Reliance on Fuel Imports*; 3. DCCEEW (2025) *Electricity and Energy Sector Plan 2025*; 4. AFR (2026) *Truckies' Warning: Prepare to Pay More for Bananas, Avos, Mangoes*; 5. DCCEEW (2025) *Reducing Transport Emissions*; Mandala analysis.

Most road freight decarbonisation will be through improvements in vehicles, but avoidance and modal shift can also help reduce emissions

Overview of freight decarbonisation approaches

Vehicle technology improvement offers the most direct opportunity for policy intervention on freight emissions.[1] Under the Avoid-Shift-Improve framework, freight emissions fall through reducing demand, shifting to rail or maritime, or improving vehicle technology. But given Australia's geography and dispersed population, a substantial road freight task will remain regardless — making vehicle technology improvement essential.

Avoid

Reduce consumption

Reducing total freight activity through circular economy practices that lower demand for new goods.[4]

Streamline logistics

Optimising logistics and routes to move goods with fewer vehicle kilometres.

Shift

Modal shift

The transfer of freight from road-based internal combustion trucks to electrified rail networks and maritime freight.[5]

A sustained 1% reduction in consumption and 5% reduction in freight task would abate 4.2% of freight emissions by 2050.[2] Moving interstate bulk road freight on to rail networks where feasible would further reduce freight emissions by 1.4%.[3]

Improve

Battery electric vehicles (BEV)

Vehicles powered entirely by electricity stored in batteries, producing zero direct emissions during operation.

Solid-state batteries and battery swapping are emerging innovations that could significantly extend the range and practicality of heavy-duty BEV trucks.[6]

Fuel cell electric vehicle (FCEV)

Vehicles powered by hydrogen fuel cells that generate electricity through a chemical reaction, producing only water vapour as a byproduct.

Low-carbon liquid fuels (LCLF)

An umbrella term for low-carbon fuels – derived from sources such as biological feedstocks – that can replace or blend with diesel in existing ICE vehicles with minimal or no engine modification.

Key subtypes include biodiesel (FAME), renewable diesel (HVO), and synthetic e-fuels.

Focus of analysis

Note: 1. Hybrid electric vehicles are excluded from the improvement solutions as they represent an incremental improvement to existing ICE technology and a higher-emission solution relative to BEVs.; 2. Reductions in freight task can be achieved through route planning, load consolidation, and fewer empty haul trips. 3. Bulk interstate road freight transported along freight corridors adjacent to existing rail infrastructure was identified as best positioned for mode shift and removal from the road.

Source: 4. DCCEEW (2024) *Australia's Circular Economy Framework*; 5. Maritime Union of Australia (2024) *NSW Freight Policy Reform: Interim Directions;* 6. Joshi et al. (2025) *A comprehensive review of solid-state batteries; AFR (2025) Charging v swapping: China at the EV crossroads;* Mandala analysis.

We assessed potential decarbonisation solutions against cost, emissions impact and supply chain risk to identify the best technology solution for truck cohorts

Approach for assessing potential technology solutions

Step 1: Identify scope of decarbonisation solutions for assessment

Three decarbonisation solutions were identified for road freight analysis, based on the most prominent technology pathways available to date to be compared against diesel

Decarbonisation technologies identified

- Battery Electric Vehicles (BEV)
- Fuel Cell Electric Vehicles (FCEV)
- Low-Carbon Liquid Fuels (LCLF)

vs.

Diesel

Step 2: Assess and rank decarbonisation solutions based on a set of criteria

Decarbonisation solutions were assessed based on three criteria including cost, supply chain risk and emissions impact

Assessment criteria

Total cost of ownership + Supply chain risk + Total emissions impact

Best decarbonisation solutions for road freight

Step 3: Identify the best available decarbonisation solution that each truck cohort can adopt

Five truck cohorts were identified based on key fleet characteristics including location, duty cycle and type of truck used

Key cohorts

1. Urban light
2. Urban heavy
3. Regional haul
4. Private industrial
5. Long-haul & remote

Each of these cohorts are then assessed based on the distance and payload to understand best available decarbonisation solution

Best technology for each cohort assessed by:

- Distance
- Payload

Electrification is the primary decarbonisation solution for the majority of road freight, with LCLF playing a role in hard-to-electrify segments

High-level evaluation of freight decarbonisation pathways

BEVs offer the strongest decarbonisation pathway. They deliver the greatest emissions reduction at the lowest cost while also strengthening Australia's supply chain resilience and energy sovereignty. LCLFs will be needed for specific use cases where electrification is challenging.

Stronger | Moderate | Weaker

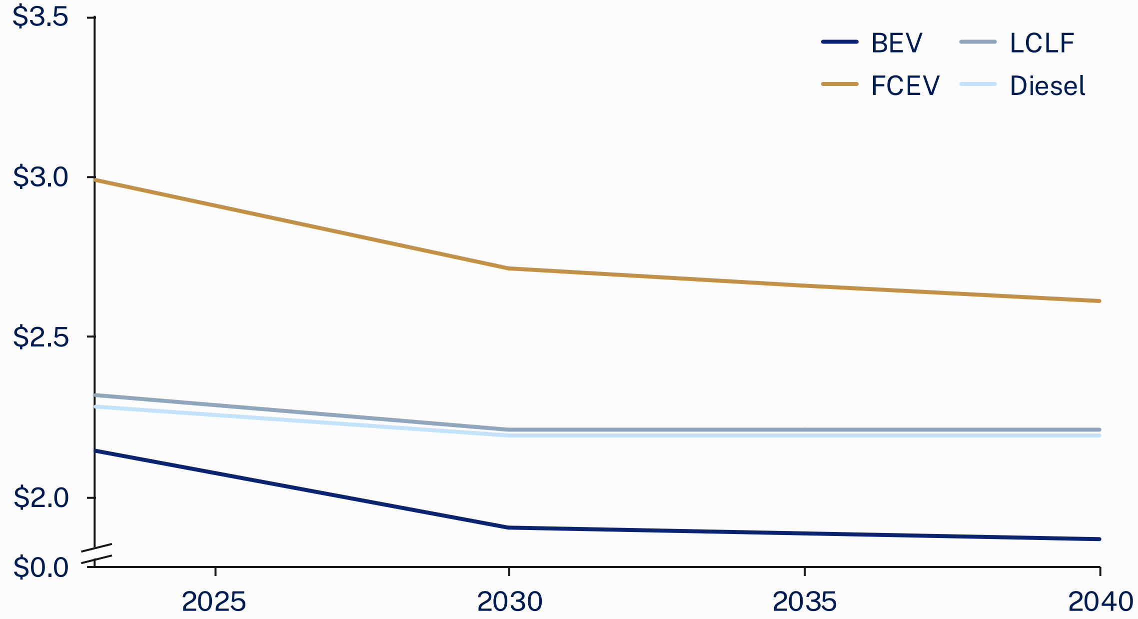
Technology	Criteria				Assessment summary (See next pages for more detail)
	Current potential			Future potential	
	A Total cost of ownership	B Supply chain risk	C Total emissions impact		
Battery Electric Vehicles (BEV)	Stronger	Stronger	Stronger	Stronger	BEVs deliver the greatest emissions reductions at the lowest cost. The technology also supports fuel sovereignty due to energy being domestically sourced from the grid. BEVs are already a viable technology solution for most truck use cases.[1] But they will require significant deployment of charging infrastructure to reach full potential.
Fuel Cell Electric Vehicles (FCEV)	Weaker	Moderate	Weaker	Moderate	FCEVs face high costs and technological barriers that restrict adoption. FCEVs may fill specific long-haul niches where battery range is constrained. Limited hydrogen supply, absence of refuelling infrastructure, and efficiency disadvantages will restrict large-scale deployment in the near term.[2]
Low-Carbon Liquid Fuels (LCLF)	Moderate	Weaker	Moderate	Stronger	LCLFs reduce emissions and use existing technology but face high ongoing costs. They may serve niche segments where BEVs are not yet viable.[3] Australia holds substantial untapped feedstock resources that could support domestic LCLF production at scale.[4] However, building this capacity will take time and sustained policy support.

Source: 1. ARENA/ AECOM (2025) *Electrifying Road Freight report;* 2. CSIRO (2023) *Hydrogen vehicle refuelling infrastructure: priorities and opportunities for Australia;* 3. CSIRO (2026) *Energy resilience: Australia's alternative fuel opportunities;* 4. CEFC (2025). *Refined Ambitions: Exploring Australia's Low Carbon Liquid Fuel Potential;* Mandala analysis.

A: BEVs already offer the lowest total cost of ownership for rigid trucks and are expected to be cheaper across all truck types by 2030

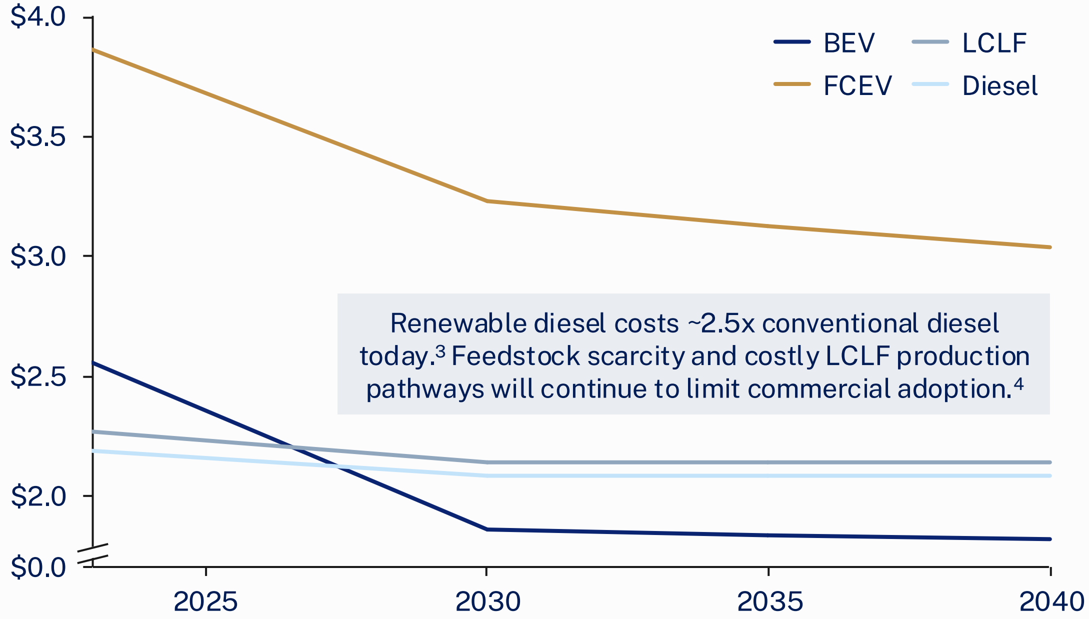
Total cost of ownership of rigid trucks, by technology type[1,2]

AUD per km for rigid trucks, GVM 5t-7.5t, 2023-2040



Total cost of ownership of articulated trucks, by technology type[2]

AUD per km for articulated trucks, GVM > 16t, 2023-2040



LCVs have been excluded from the above analysis due to limited low-carbon alternatives for this segment. However, **BEVs are cheaper than diesel for LCVs even without subsidies,** and therefore cheaper than LCLFs, which cost twice as much as diesel.[5,3] FCEV LCVs are not commercially available in Australia.[6]

Note: 1. TCO estimates are based on the ICCT (2023) with adjustments to FCEVs, converted to 2025 AUD using EU CPI and the 2025 AUD/EUR exchange rate. See Appendix for further details on assumptions and methodology used. 2. BEVs undercut diesel for rigid trucks in TCOs, where the battery cost premium is modest and quickly recovered through fuel and maintenance savings. For articulated trucks, BEVs only become cost-competitive once prices of their larger batteries fall sharply (expected around 2030). Australia's relatively high diesel prices would reinforce both conclusions. EFF (2025) suggests BEVs' TCOs are 9% cheaper than diesel, reinforcing our conclusion.

Source: 3. Climate Leaders Coalition (2024) *Navigating the Scalability of Technology Pathways in Australia*; 4. CEFC (2025) *Refined Ambitions: Exploring Australia's Low Carbon Liquid Fuel Potential*; 5. Transport & Energy (2022) *E-vans: Cheaper, Greener, and in Demand*; 6. Green Vehicle Guide (2026) *Hydrogen Fuel Cell Vehicles*; Mandala analysis.

Falling battery prices are making electric trucks significantly cheaper to buy

Batteries form a significant portion of upfront BEV costs. The battery represents almost 50% of the upfront price for articulated BEVs.[1] This means that battery price movements translate directly and substantially into vehicle affordability.

Global battery prices are 77% lower than 10 years ago. Battery pack prices have fallen steadily, dropping 20% in 2024 and a further 8% in 2025 to $167/kWh, driven by technology improvements and market competition.[2,3]

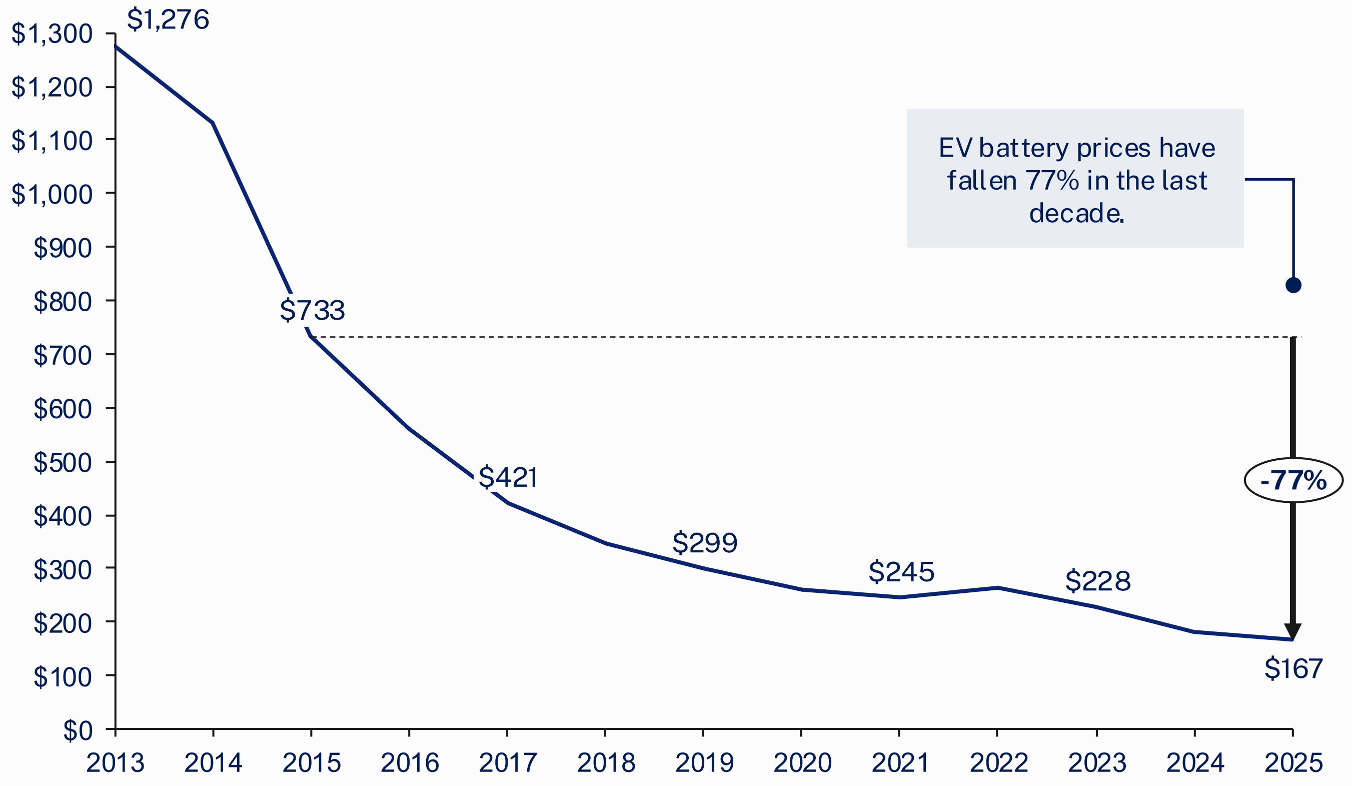
Global market dynamics may accelerate this further. Chinese battery pack prices are already 56% below European levels, and changes to American trade policy are redirecting Chinese exports to other markets.[3] This places additional downward pressure on battery prices on the global market, making batteries more affordable in the medium-term future.

Upfront prices of BEVs will fall as batteries become cheaper. The battery's share of vehicle cost will drop from 50% today to 35% by 2030.[3] The upfront purchase price of a heavy-duty BEV truck could fall by 15–35% in the next five years.

Source: 1. IEA (2025) *Global EV Outlook 2025;* BloombergNEF (2024) *Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour; 3.* BloombergNEF (2025) *Lithium-Ion Battery Pack Prices Fall to $108 Per Kilowatt-Hour, Despite Rising Metal Prices;* Mandala analysis.

Global average lithium-ion battery prices per kWh

AUD per kWh, 2013-2025



Source: BloombergNEF (2025) *Lithium-Ion Battery Pack Prices Fall to $108 Per Kilowatt-Hour, Despite Rising Metal Prices;* Mandala analysis.

B: Electrifying Australia's road freight will reduce our reliance on imported energy, securing our supply chains and increasing our sovereignty

Summary of supply chain and sovereignty risks associated with each technology type

Lower risk | Moderate risk | Higher risk

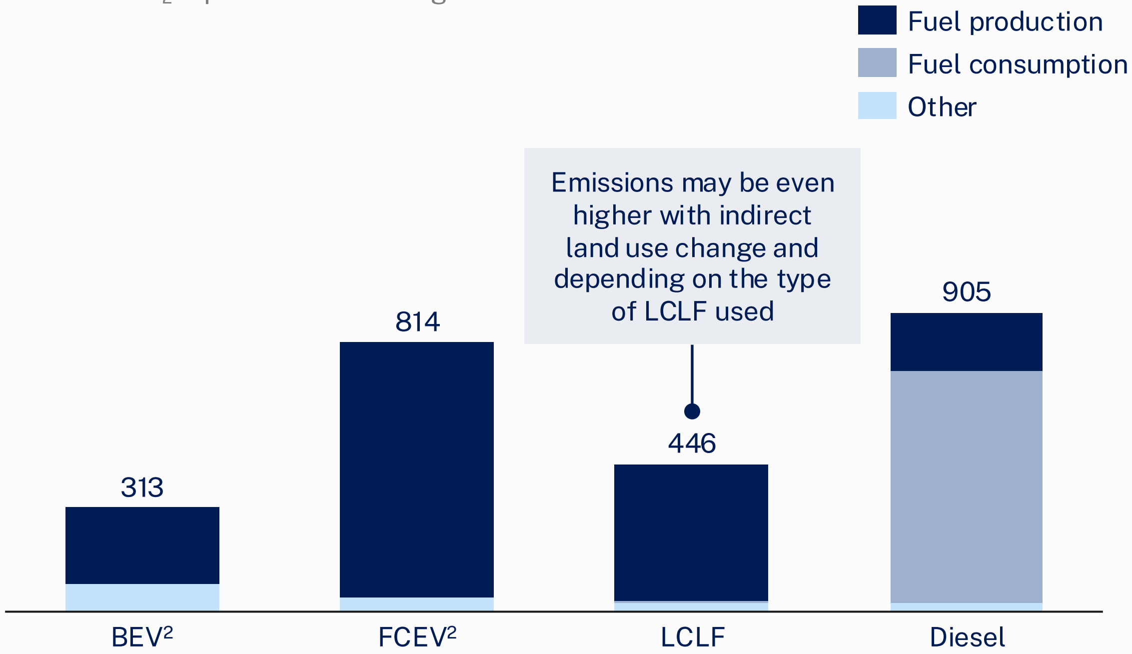
Technology	BEV	FCEV	LCLF	Diesel
Supply chain risk	**BEVs' use of domestically produced energy reduces exposure to supply chain disruptions and price volatility.** This will increase as the energy grid becomes renewables dominated.[1] Australia's 2023 truck width increase has removed a key barrier to global BEV supply.	**Hydrogen can be produced domestically using renewable electricity.** However, Australia's hydrogen production capacity remains limited.[5]	**Demand for LCLFs will greatly exceed supply capacity in the medium term.** Aviation alone will consume 69% of global LCLF supply in 2030.[8] Scaling domestic LCLF production will require production incentives, certification, and blending mandates.[9]	**Diesel ICE trucks use imported petroleum, directly exposing Australia to global oil supply shocks.** Ongoing instability in the Middle East highlights the national security risks of relying on foreign oil supply chains.[12]
Energy sovereignty risk	**BEVs draw from the domestic grid, eliminating imported fuel reliance and the vulnerability to oil supply shocks.**[2] ICE drivers now face a 40% surge in fuel prices from the Middle East conflict, on top of Australia's fragile 30-day diesel reserve.[3,4]	**Hydrogen offers high energy sovereignty potential.** Australia's renewable energy enables fuel self-sufficiency for FCEVs, increasing energy security.[6] However, high costs and limited refuelling infrastructure remain significant hurdles.[7]	**Australia does not currently produce advanced biofuels or e-fuels, including renewable diesel.**[10] Australia exports $3.9 billion in raw LCLF feedstocks yet imports 80% of its liquid fuel.[9] This could change in the medium-term as the Government has committed $1.35 billion to stimulate domestic LCLF production.[11]	**Australia relies heavily on imports for crude oil and refined petroleum products.**[13] In 2025, Australia imported $26.3 billion of diesel.[14]

Source: 1. AEMO (2026) *Quarterly Energy Dynamics Q4 2025*; 2. ABS Energy Account (2025), *Australia Energy Account 2023-24*; 3. Guardian (2026) *Australians can Expect High Fuel Costs to Linger for Far Longer than the War in Iran*; 4. International Business Times (2026): *Australia Fuel Crisis Deepens in March 2026: Panic Buying, Soaring Prices and Supply Warnings*; 5. CSIRO (2026) *New Report to Accelerate Australia's Hydrogen-powered Transport Future*; 6. AEMC (2026) *Hydrogen: the New Australian Manufacturing Export Industry and the Implications for the National Electricity Market (NEM)*; 7. S&P Global (2025) *Hydrogen-powered Vehicles Face a Rough Road*; 8. CATF (2025) *Aviation could Consume almost All Available Biofuel for Decarbonisation*; 9. CEFC (2025) *Refined Ambitions: Exploring Australia's Low Carbon Liquid Fuel Potential*; 10. DITRDCSA (2024) *Low Carbon Liquid Fuels*; 11. DCCEEW (2025) *New production Incentive for Low Carbon Liquid Fuels*; 12. Electric Vehicle Council (2026) *Retaining Electric Car Discount Key to Shielding Australians from Soaring Petrol Prices*; 13. Geoscience Australia (2025) *Production and Trade*; 14. DCCEEW (2025) *Australian Petroleum Statistics*; Mandala analysis.

C: BEVs already deliver the lowest lifecycle emissions for rigid and articulated vehicles, with improvements expected to continue for all technologies

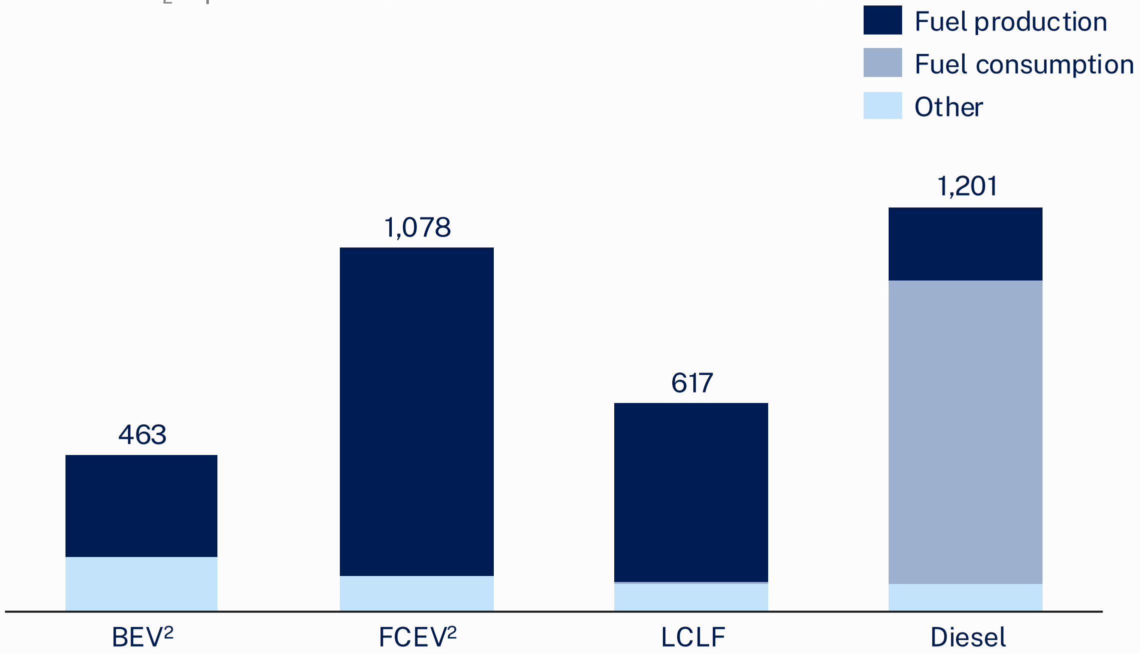
Lifecycle greenhouse gas emissions of rigid trucks[1], by technology type

Grams of CO_2-e per km for a 12-t rigid truck manufactured in 2021



Lifecycle greenhouse gas emissions of articulated trucks[1], by technology type

Grams of CO_2-e per km for a 40-t tractor-tailer manufactured in 2021



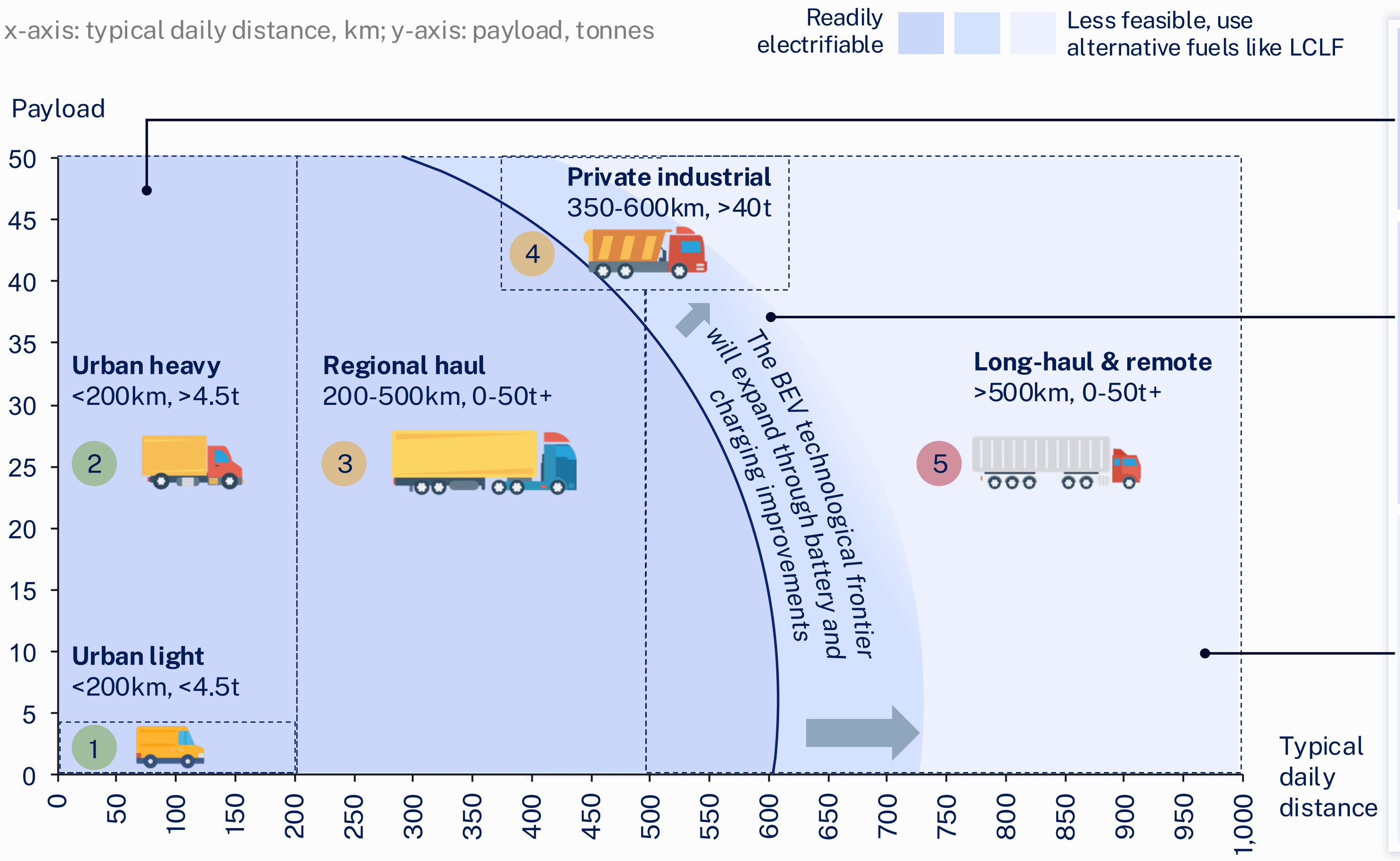
BEVs already outperform all other technologies on lifecycle emissions in 2021, with emissions falling a further 33% for rigid and 48% for articulated trucks by 2030.[3] FCEVs are also improving significantly, reaching comparable emission levels to BEVs by 2030.[3] LCLFs' emissions remain 1.3-1.6 times higher than that of BEVs in 2030. LCLFs can also produce higher toxic gas emissions (NO_x) than diesel, posing additional risks to local air quality and public health. [4]

Note: 1. The 'other' category contains vehicle production and maintenance. Diesel production, LCLF and diesel consumption emissions are drawn from DCCEEW (2024). LCLF production emission is from Renewable Energy Directive III (2024), reported as a weighted average across hydrotreated vegetable oil types. The remaining estimates are based on O'Connell et al. (2023). 2. BEV emissions assume the projected grid mix; FCEV emissions assume grey hydrogen, which accounted for 72.1% of global hydrogen supply in 2025 (Global Market Insights, 2025). Both reflect the more realistic energy source for each technology in 2021. 3. O'Connell et al. (2023) reports technology-specific emissions in 2030. BEVs on renewables have similar total emissions of FCEVs on green hydrogen in 2021; BEVs on renewables have the lowest emissions across all technologies in 2030.
Source: 4. ICCT (2021) *Air Quality Impacts of Biodiesel in the United States*; Mandala analysis.

BEV technologies can meet payload and distance requirements for urban cohorts, with regional haul and some private industrial fleets becoming more viable

Indicative viability for freight electrification by trip distance and payload

x-axis: typical daily distance, km; y-axis: payload, tonnes



Wave 1: Urban light and urban heavy cohorts are readily electrifiable, with minimal barriers.

Wave 2: Much of regional haul and some private industrial cohorts are electrifiable but will need further technology improvements and support for further adoption.

Wave 3: Long-haul & remote cohorts are currently less feasible & require technological improvements in BEVs to achieve adoption. These hard-to-electrify cohorts should use LCLFs until BEVs become viable.

Key takeaways

- **77% of trips today can be covered by BEVs based on distance and payload.**[1] Urban light, urban heavy as well as some regional haul and private industrial cohorts BEV solutions are viable. This coverage will increase to **88% of all trips by 2030 as the technology frontier for BEVs** moves outwards due to improvements in battery and charging technologies.[2,3]
- For cohorts such long-haul, as well as some private industrial and regional haul, **BEV solutions are currently not viable** for distances and payloads required. **Alternative solutions such as LCLF** should be used for these **hard-to-abate, hard-to-electrify cohorts** until BEV technologies become viable.

Source: 1. Anthony Wiskich (2025) *Slow and Steady Wins the Race: How Autonomy Facilitates Long-Haul Truck Electrification*; 2. ElectroiQ (2025) *Electric Truck Statistics By Technology, Regions, Sales And Facts*; 3. IRENA (2025) *Trends in heavy-duty electric vehicles*; Calstart (2025) *ZETI data explorer*; EV Council (2025) *State of EVs*; ARENA/ AECOM (2025) *Electrifying Road Freight Report*; National Research Council Canada (2023) *Battery technologies for Electric Long-haul Trucks*; McKinsey (2024) *Commercial Vehicle Compendium*; Mandala analysis.

Battery electric vehicles are helping IKEA Australia achieve a zero emissions future

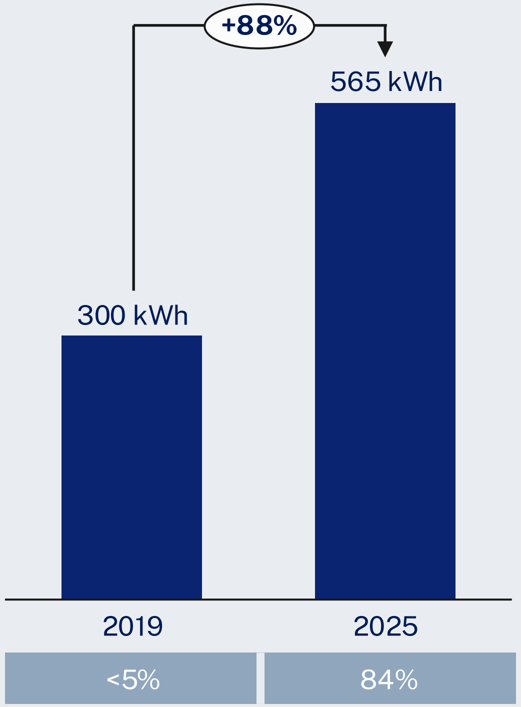
Maximum battery capacity of an IKEA delivery truck[1]

kWh of an 18.6-tonne Volvo FL Electric, 2019 vs 2025[2,3]

Battery capacity of the Volvo FL Electric has improved 88%, from 300 kWh to 565 kWh, pushing operational range from 300 km to 450 km on a single charge.[2,3]

Longer range made more routes viable. IKEA Australia completed 84% of trips using BEVs in 2025, up from less than 5% in 2019. The fleet grew from 7 to 120 BEVs, covering almost all metro deliveries.[5,6]

Regional routes are the remaining challenge. 10% of trips are still not viable for BEVs. One key barrier is the lack of charging infrastructure for commercial and heavy vehicles on regional routes.[6]



Shares of orders delivered by BEVs[6]

Source: 1. Volvo (2025) *Volvo Trucks Australia Delivers First Gen 3 FL Electric To IKEA*; 2. Volvo (2019) *Product guide*; 3. Volvo (2025) *Volvo FL Electric*; 4. IKEA (2025) *New Volvo Long-range Electric Trucks for IKEA Zero Emissions Deliveries*; 5. Fleet Auto News (2019) *IKEA Australia Drives the Switch to Electric Vehicles for Home Delivery*; 6. IKEA (2026) *Impacts of Heavy Vehicle Reform.*; Mandala analysis.

New charging solutions cut charging times and extend the maximum range constrained by batteries of BEVs

Technologies such as fast charging, and battery swapping will extend battery electric vehicles' range beyond urban freight.

Megawatt Charging System (MCS)

- MCS is a newly developed, high-power charging solution for long-haul trips. MCS delivers over 1 megawatt, roughly double current charging speeds.[1]
- With improved battery capacity and MCS, charging stops can be reduced and timed to align with drivers' mandatory breaks, making long-haul regional BEV trips more practical. Commercial availability in Australia is expected from 2026.[2]

Battery Swapping

- Battery swapping replaces depleted EV batteries with fully charged ones in about five minutes, comparable to a diesel refuel.[3] It increases truck utilisation and improves profit margins for fleet operators.[4]
- The technology is popular in China's heavy vehicle sector. Sales of swap-capable vehicles reached 29,569 in 2024, up 94% year-on-year.[5] It accelerates electric heavy-duty truck adoption even without the large public charging networks.

Source: 1. Scania (2025) *Megawatt charging – All You Need to Know*; 2. Fleet EV news (2025) *Megawatt Charging is Coming to Australia – Delta Says within 12 Months*; 3. InsideEVs (2025) *China's Electric Truck Sales Are About To Take Off: CATL*; 4. IEEFA (2025) *Urging Electric Truck Sales Stall China's LNG Trucking Boom*; 5. ICCT (2025) *Zero-emission Medium- and Heavy-duty Vehicle Market in China, 2024.*; Mandala analysis.

The road freight sector is diverse and can be broadly segmented into key cohorts based on their operational characteristics to understand technology feasibility

Road freight characteristics by cohort

Cohorts are segmented based on operational characteristics, grouping vehicles with similar duty cycles and daily distances. Trucks are classified according to their primary use as reported in the ABS Motor Vehicle Use Survey. Some operational overlap exists between cohorts, as trucks may perform tasks outside their primary classification.

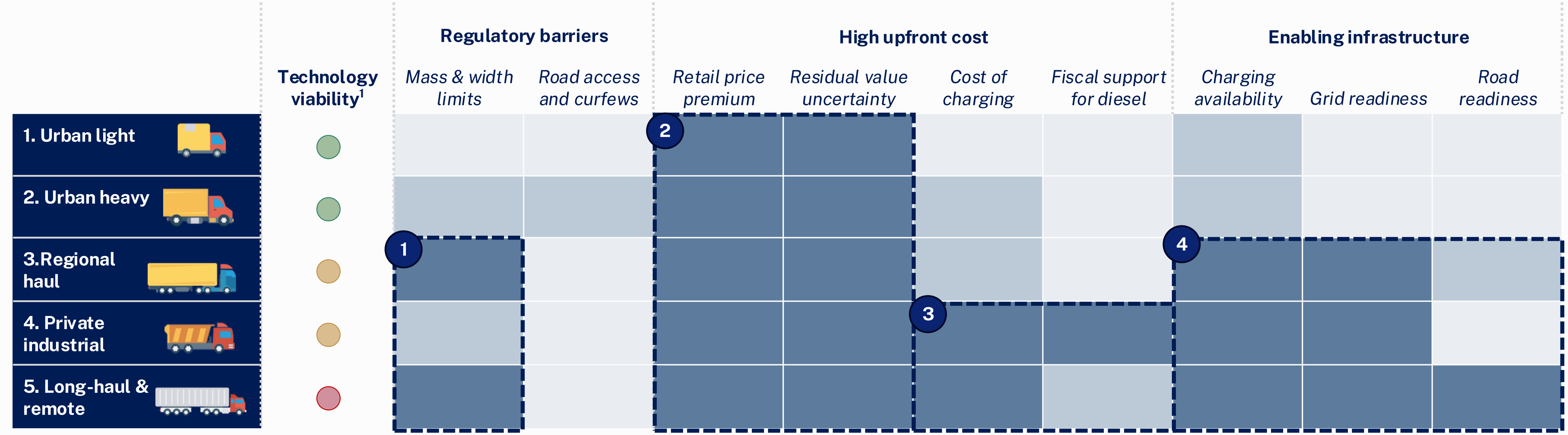
Cohort	Operational characteristics	Examples	Number of vehicles[1]			Annual tonne-kilometres	Key commodities carried *Share of annual tonnes*
			LCVs[2]	Rigid	Articulated		
1. Urban light	LCVs which drive less than 200km in a day, making frequent stops and returning to a base daily.	Last mile-delivery and distribution for small businesses.	2,700k	Nil	Nil	6 billion	1. Tools of trade (57%) 2. Manufactured goods (16%) 3. Machinery and transport equipment (4%)
2. Urban heavy	Predominantly rigid and some articulated trucks that drive less than 200km in a day, returning to a base each day.	Examples include supermarket distribution, port drayage and waste collection.	Nil	420k	28k	58 billion	1. Inedible raw materials, except fuels (22%) 2. Manufactured goods (19%) 3. Food and live animals (12%)
3. Regional haul	Mix of light and heavy vehicles that transport goods 200-500km, across 1-2 destinations in a day, returning to a base daily.	Examples include trips between farms, regional warehouses, and cities.	965k	142k	47k	84 billion	1. Manufactured goods (20%) 2. Inedible raw materials, except fuels (17%) 3. Food and live animals (12%)
4. Private industrial	Road trains and articulated trucks that move heavy bulk commodities predominantly on private roads, typically returning to a base daily.	Examples include large mining and agricultural operations.	Not available[3]				1. Raw materials and natural resources (67%) 2. Agriculture and food (12%) 3. Machinery and equipment 4%)
5. Long-haul & remote	Mix of light and heavy vehicles that transport goods over 500km in a day, typically interstate, making overnight or multi-day journeys.	Typically involves moving bulk goods between major freight hubs.	215k	30k	42k	74 billion	1. Manufactured goods (21%) 2. Inedible raw materials, except fuels (15%) 3. Food and live animals (14%)

Note: 1. Vehicle data derived from km distribution across cohorts and vehicle types, provided as indicative estimates. Commodity share for industrial cohort approximated from Fuel Tax Credit data.; 2. LCV refers to light commercial vehicles.; 3. Private industrial vehicles operate outside some public registration and reporting frameworks, so fleet composition, utilisation, and emissions data are not systematically collected.; Source: ABS (2020) *Motor Vehicle Use Survey*; Parliamentary Budget Office (2022) *Fuel Taxation in Australia;* Mandala analysis.

There are nine key barriers to adoption of BEVs spanning regulatory constraints, cost and infrastructure, with urban cohorts facing the lowest barriers

Summary of barriers to BEV adoption faced by freight cohorts

Lower barrier | Higher barrier



1 BEV weight penalties create a particular barrier for mass-limited trucks under current regulations, reducing payload capacity and undermining the commercial case for adoption in weight-sensitive operations.

2 All cohorts will face significant upfront costs with the retail price for BEVs currently more expensive than ICE, despite some BEVs having lower life-time costs. This creates cash-flow challenges for smaller operators who make up a large share of the sector. Residual value uncertainty compounds this further.

3 Private and long-haul trucks face high upfront charging infrastructure costs. Fast chargers require significant transmission and distribution investments that can be particularly costly in regional areas. For private industrial use, fuel tax credits also disincentivise switching to BEVs.

4 Regional and long-haul operators require en route charging infrastructure that does not yet exist at sufficient scale, compounding the challenge of multi-shift operations that cannot rely on overnight depot charging alone.

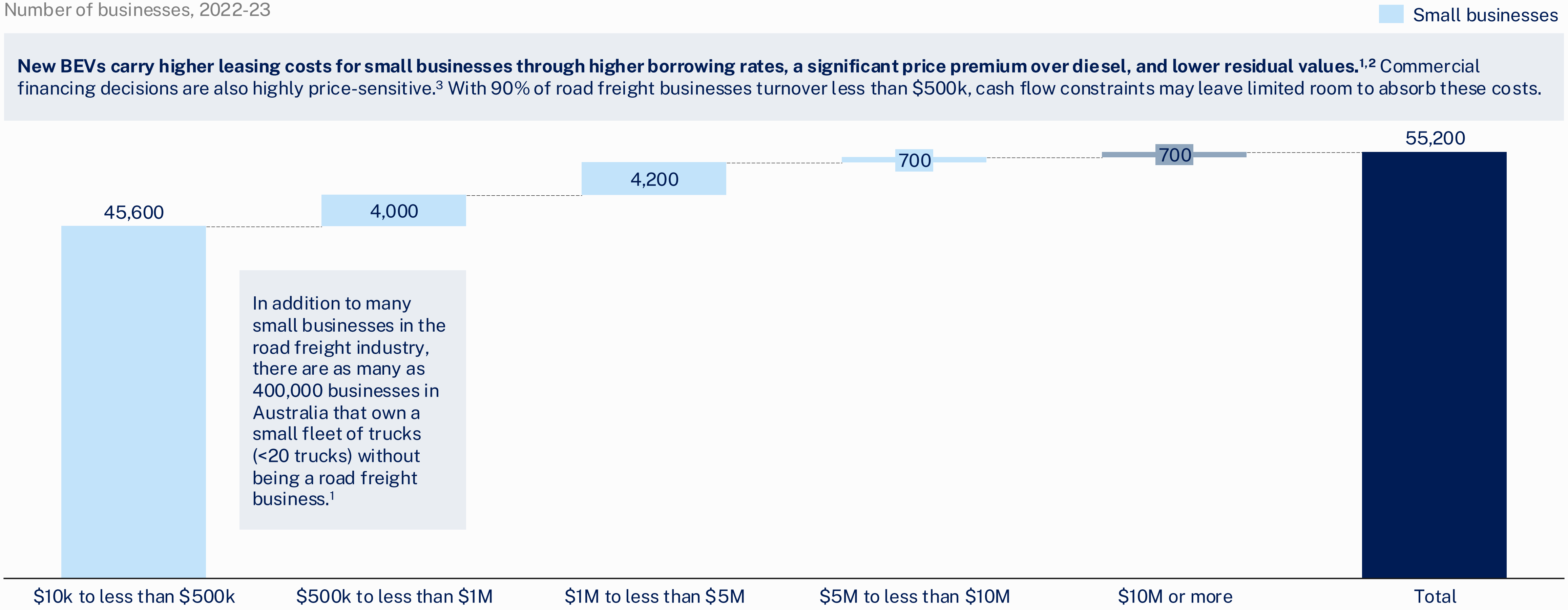
Note: 1. Technology viability focuses on the potential role of BEVs, as it has been identified as the prioritised technology from analysis in Chapter 2.

Compounding financing costs put BEVs further out of reach for freight operators, and 90% have an annual turnover of less than $500k

Road freight transport businesses by annual turnover range

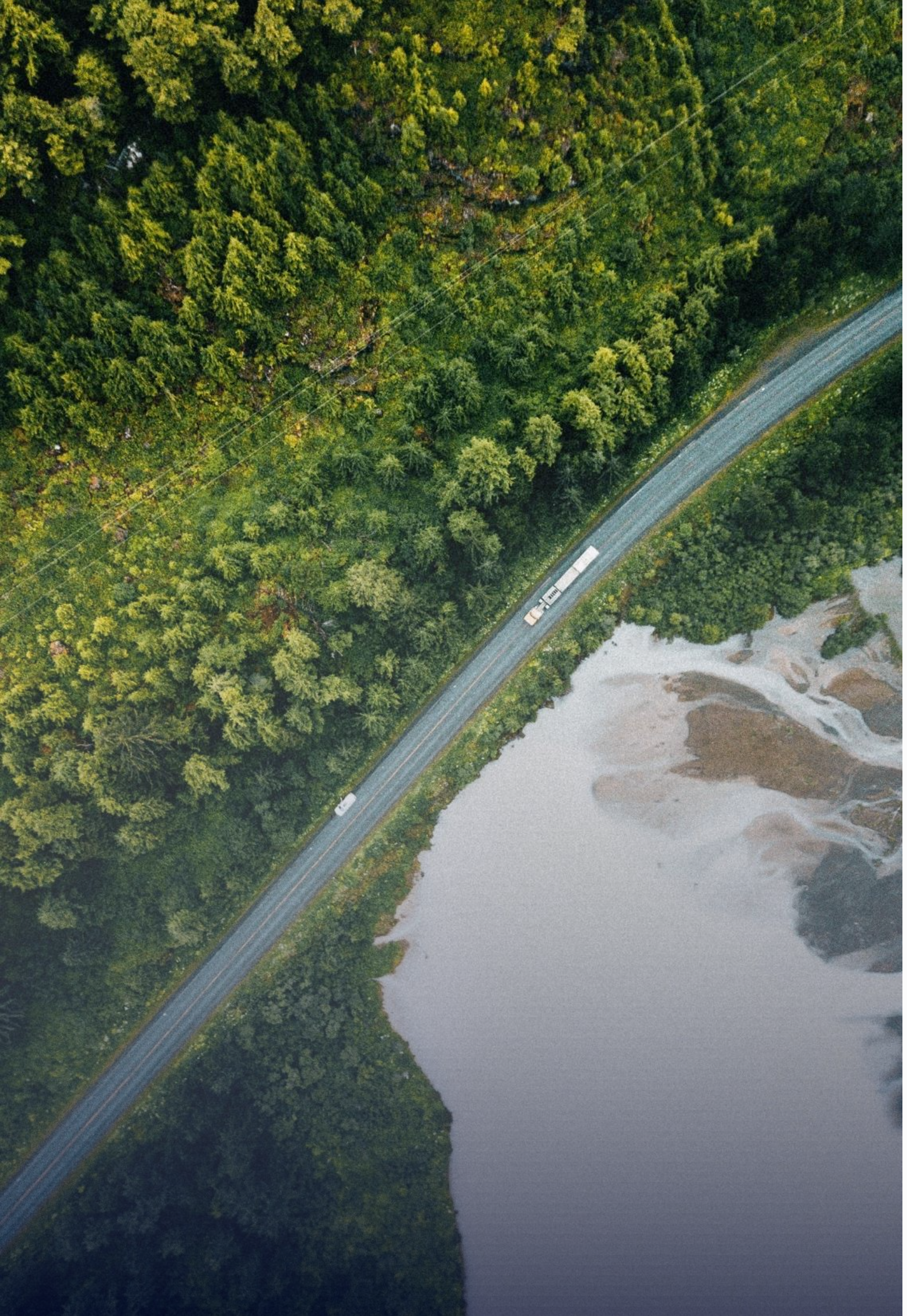
Number of businesses, 2022-23

New BEVs carry higher leasing costs for small businesses through higher borrowing rates, a significant price premium over diesel, and lower residual values.[1,2] Commercial financing decisions are also highly price-sensitive.[3] With 90% of road freight businesses turnover less than $500k, cash flow constraints may leave limited room to absorb these costs.



In addition to many small businesses in the road freight industry, there are as many as 400,000 businesses in Australia that own a small fleet of trucks (<20 trucks) without being a road freight business.[1]

Source: 1. RBA (2025) *Small Business Economic and Financial Conditions*; 2. CEFC (2026) *CEFC and Volvo Group Boost Battery Electric Tucks by Driving Down Costs*; 3. AFIA (2026) *Electric and Hybrid Vehicle Finance Surges to $7.37 Billion as Policy Rollback Threatens Momentum*;
Source: ATO (2025) *Taxation Statistics*; ARENA/ AECOM (2025) *Electrifying Road Freight Report*; Mandala analysis.



1 A critical window is closing for Australia to capture significant benefits from freight decarbonisation

2 Electrification is the most prospective technology to modernise Australia's freight fleet

3 Freight cohorts face unique barriers to battery electric vehicle adoption, with the urban cohorts the most ready

4 Targeted policies can increase electrification by 25%, supporting $138B in economic growth, and abating 181Mt CO_2-e by 2050

5 Appendix

We have identified sequencing and barriers to assess policy solutions aligned with policy principles to inform a package of policy solutions

Approach for identifying and quantifying policy solutions

Goal: How can government support accelerated up take of Zero-Emissions Heavy Vehicles (ZEHVs) to minimise environmental and health impacts and maximise economic and sovereignty benefits

1 Focus on road freight sectors that can decarbonise now

Short-term
Urban light, urban heavy and some regional cohorts are ready to electrify now

Medium-term
Regional cohorts, private industrial and some long-haul cohorts will need some additional support to electrify

Long-term
Regional and long-haul cohorts should use alternative fuels like LCLF until battery technology is viable

2 Identify barriers to decarbonisation

Operational and regulatory constraints

High relative cost

Enabling infrastructure

3 Identify and assess policies that address barriers

We identified over 20 policies through consultation and desktop research which we then narrowed down based on

Design principles
- Fiscal costs balanced with public benefits
- Simplicity and certainty
- Sustainable economic growth
- Consistency and coordination
- Equity and accessibility

Efficacy and existing evidence
- Academic literature
- Real world examples

Quantify policy uplift and environmental, social, and economic impacts

Policymakers should set targets, kick-start BEV uptake, and scale infrastructure, as well as future-proofing policy and the government's fiscal position long-term

Guiding policy design principles

- Simplicity and certainty
- Consistency and coordination
- Sustainable economic growth
- Equity and accessibility
- Fiscal costs balanced with public benefits

Recommendations

Recommendation	
01 Set sector targets and ambition	**1.1.** Reform Australia's Heavy Vehicle Emissions Standard to align with international CO_2 intensity benchmarks
02 Ensure policy is fit-for-purpose	**2.1.** Remove noise curfews and provide priority lanes for BEVs **2.2.** Provide weight threshold concessions **2.3.** Harmonised dimension laws
03 Kick-start widespread adoption through reducing ownership costs	**3.1.** Leverage CEFC and ARENA funding to de-risk residual value (RV) **3.2.** Provide subsidies for small businesses
04 Scale infrastructure to support increased adoption	**4.1.** Fund phase 1 of a national charging and refuelling plan **4.2.** Ensure public charging facilities are accessible for larger vehicles **4.3.** Provide subsidies to support infrastructure rollout **4.4.** Streamline planning and investment for charging infrastructure **4.5.** Upgrade roads to withstand higher loads
05 Future-proof government fiscal position	**5.1.** Phase out the current Heavy Vehicle RUC and replace with a per-km charge that includes comprehensive externalities

Sequenced by key cohorts

Short-term (0-2 years)
Urban light, urban heavy and some regional cohorts

Medium-term (3-5 years)
Regional cohorts, private industrial and some long-haul cohorts

Long-term (6+ years)
Regional and long-haul cohorts

Supported by other abatement solutions and enabling settings

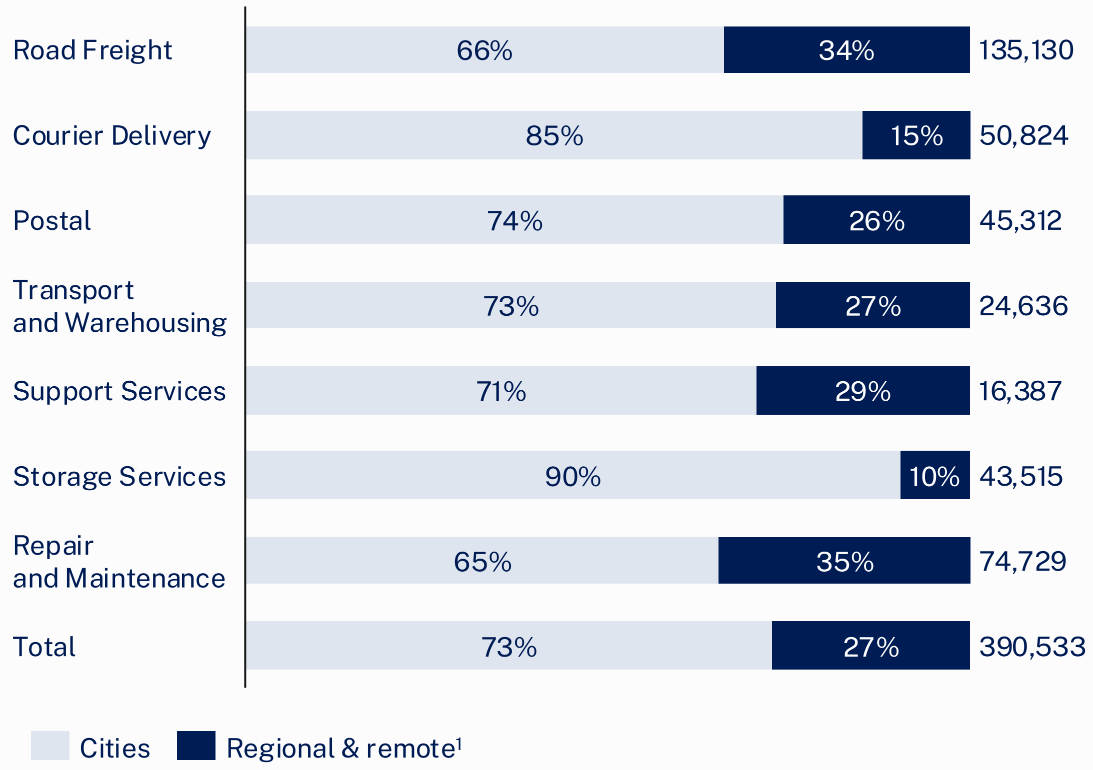
- Optimise route planning and reduce consumption
- Shift freight to rail and maritime solutions
- Leverage LCLF for hard-to-electrify cohorts
- Provide supporting skills and retraining pathways
- Design policy with industry and workers

Equity and accessibility must take into consideration that almost a third of freight jobs are outside cities, where infrastructure needs are higher

Spatial distribution of transport workers

Persons, 2021

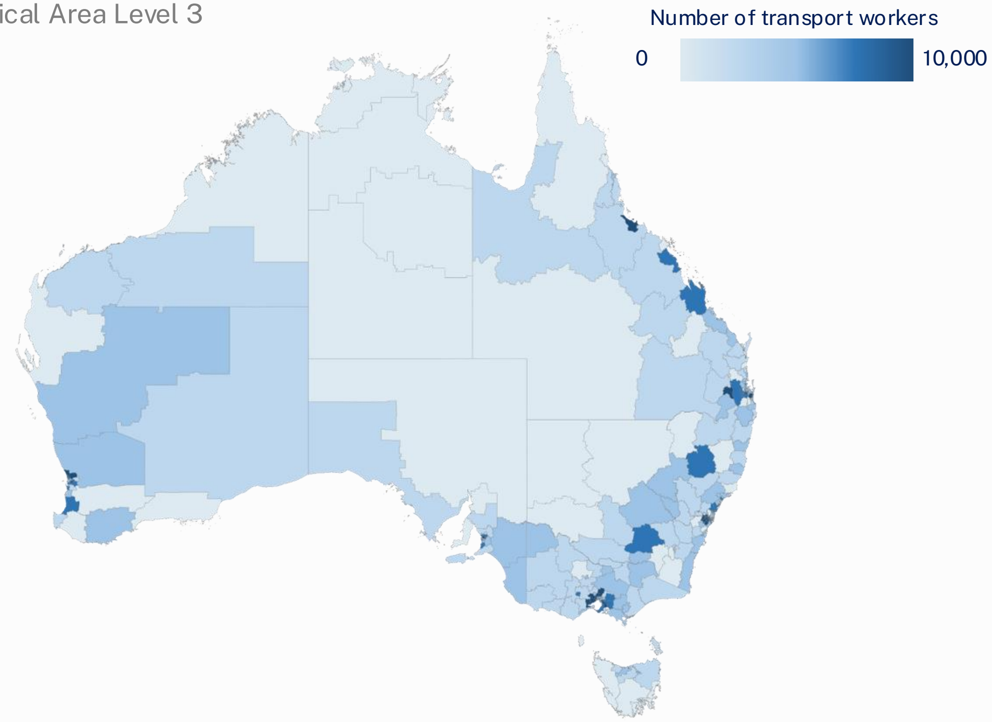
27% of freight transport workers live in regional and remote areas, including 34% of road freight drivers, and 35% of repair and maintenance staff.



Note: Includes inner region, outer region, remote and very remote
Source: ABS (2021) *Census of Population and Housing;* Mandala analysis.

Distribution of transport workers by place of work

By Statistical Area Level 3



The transport workforce is integral for supporting this transition. Key considerations when designing policy for BEV adoption include:

- Consulting **drivers and owner-operators in policy design** processes
- Ensuring **fair transition tests** are applied to policy design
- Enabling **skills and retraining pathways** for the transitioning workforce
- Making sure stimulus packages are tied to **employment standards**
- Promoting **worker safety**

Source: ABS (2021) *Census of Population and Housing;* Mandala analysis.

Reforming Australia's Heavy Vehicle Emissions Standard and adjusting regulatory settings will be essential foundations for BEV adoption

	Policy description	Key barrier and mechanism	Timing
Set sector targets and ambition 01	Reform the Heavy Vehicle Emissions Standard to require a 45% reduction in fleet-average CO_2 intensity by 2035 and 90% by 2045, to align with international benchmarks.[1]	• Australia offers 2–3.7x fewer rigid and articulated BEVs than comparable markets.[2] An emissions standard creates regulatory pull for manufacturers to allocate zero-emission models to Australia. • Introducing primary legislation via DITRDCSA and DCCEEW could create the supply certainty needed, extending the existing HVES/NVES framework to heavy vehicles and aligning with the EU, Canada, and Japan.	
Ensure policy is fit-for-purpose 02	Exempt BEVs from commercial vehicle curfews and allow access to existing bus and priority lanes.	• Current curfews prevent BEVs from leveraging their quieter operation for off-peak deliveries. • State and territory road authorities could implement exemptions, with national oversight through DITRDCSA.	
	Grant BEV weight concessions so that battery mass does not reduce payload capacity or restrict road access.	• BEVs weigh ~27% more than diesel equivalents, limiting payload and road access.[3] • NHVR could replace the current state-by-state exemption patchwork with a national framework that would eliminate the payload penalty across jurisdictions.	
	Increase maximum BEV trailer width from 2.5m to 2.55m, aligning with US standards.	• The 2.5m limit on trailers forces costly aftermarket modifications to internationally compliant BEVs. This reduces model availability in Australia and reduces price competition. • DITRDCSA, NHVR and state road authorities could lead implementation.	

Long-term (6+ years)

Medium-term (3-5 years)

Short-term (0-2 years)

Source: 1. European Commission (2025) *Heavy-duty Vehicles CO2 Emissions And Fuel Efficiency;* 2. Comparison based on electric trucks available in Canada, the U.S., Poland, and Norway, CALSTART (2025) *ZETI Data Explorer.;* 3. Comparison between rigid Volvo FL 4x2 Electric and Volvo FL818 4x2 equivalents, as from Volvo Model range; Mandala analysis.

Addressing cost and infrastructure barriers through targeted subsidies will help to scale up BEV adoption

	Policy description	Key barrier and mechanism	Timing
Kick-start widespread adoption through reducing ownership costs (03)	Scale CEFC and ARENA funding to provide residual value guarantees for BEV truck operators.	• Operators cannot reliably forecast BEV resale values, increasing perceived financial risk and effective TCO. • A scalable government-backed guarantee that builds on the $70M CEFC-Volvo program could remove this barrier as a used BEV market develops.[1]	Short-term
	Provide small businesses (under $1M turnover) replacing trucks over 15 years old a 10% point-of-sale voucher for a new BEV.	• BEV upfront costs frequently exceed double diesel equivalents, creating a binding capital constraint for small operators who represent 90% of road freight businesses.[2,3] • A federal voucher delivered via supplier/importer at point of sale could eliminate operator administrative burden.	Short-term
Scale infrastructure to support increased adoption (04)	Fund ARENA/AECOM's national charging hub plan and develop a National Charging and Refuelling Plan, prioritising freight corridors via the Infrastructure Investment Program.	• Australia needs 165 more ultra-fast charging hubs; en route fast charging is absent from regional and interstate corridors.[3] • Without a national plan, fragmented deployment will leave long-haul routes commercially unviable for BEVs.	Medium-term
	Redesign public charging stations so LCVs and rigid trucks can charge alongside passenger BEVs.	• Existing public chargers are designed for passenger vehicles and exclude larger freight vehicles. • Standardising DCCEEW's minimum operating standards across state and local governments within 5 years could reduce range anxiety and downtime for freight operators.[4]	Short-term
	Provide a capped 25% capital grant for depot charging at businesses with fewer than 50 trucks; fast-track planning approvals.	• Depot fast chargers cost $40K–$100K per unit, placing private charging out of reach for most small operators.[5] • A federal capital subsidy directly lowers this barrier, while fast-tracked planning approvals remove a large non-financial constraint.	Short-term

Timing scale: Short-term (0-2 years); Medium-term (3-5 years); Long-term (6+ years)

Source: 1. CEFC (2025) *CEFC and Volvo Group Boost Battery Electric Tucks by Driving Down Costs*; 2. ATO (2025) *Taxation Statistics*; 3. ARENA/ AECOM (2025) *Electrifying Road Freight Report*; 4. DCCEEW (2023) *Minimum Operating Standards for Government-supported Public Electric Vehicle Charging Infrastructure*; 5. EVSE (2018), *How Much Does It Cost to Install an EV Charging Station?*; Mandala analysis.

Timely, suitable infrastructure as well as future-proofing the government's fiscal position will set up the long-term viability of BEVs

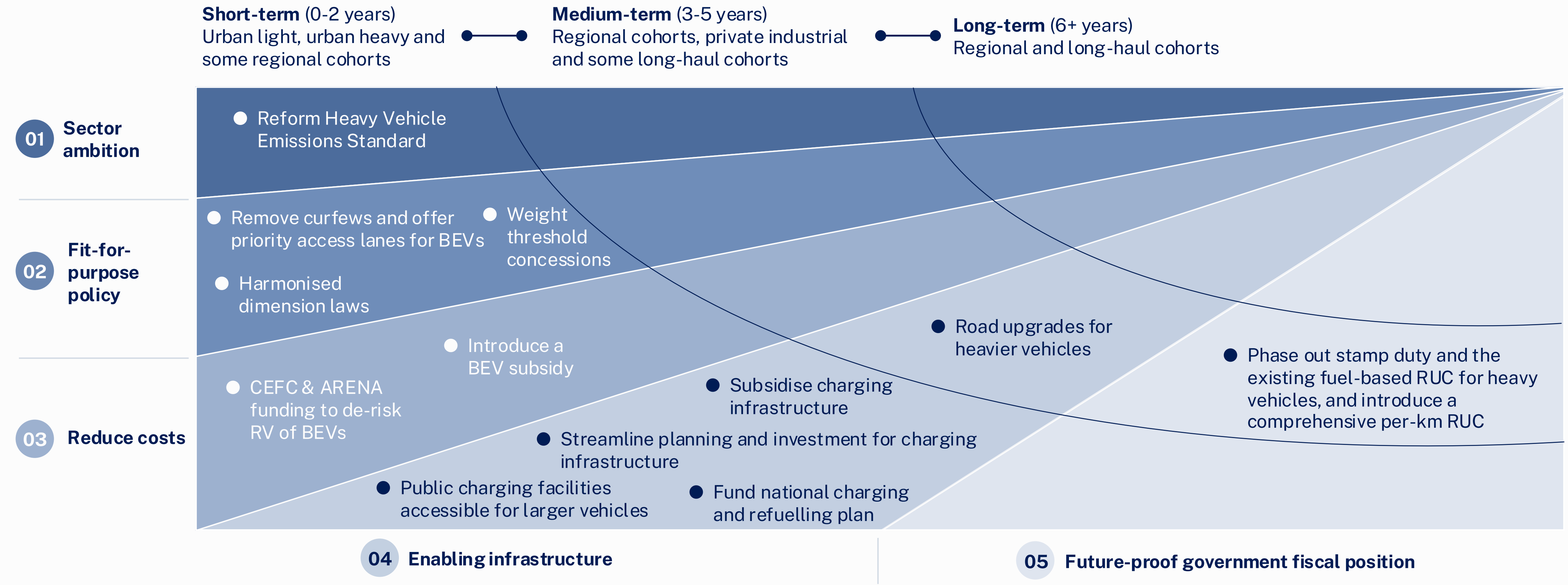
	Policy description	Key barrier and mechanism
Scale infrastructure to support increased adoption 04	Fast-track charging approvals and require DNSPs to publish network capacity information publicly.	• Inconsistent grid capacity data and fragmented approvals across states deter investment in charging infrastructure. • Requiring DNSPs to share network visibility data and extending NSW's planning exemption model nationally could accelerate deployment.[1]
	Designate road and bridge upgrades on key freight corridors as nationally significant infrastructure, funded via the Infrastructure Investment Program.	• BEVs are ~27% heavier than diesel equivalents and accelerate road degradation by 20–40%.[2] • Unclear access policies across jurisdictions create risk for operators considering fleet transition, particularly for regional and long-haul segments.
Future-proof government fiscal position 05	Replace the Heavy Vehicle Road User Charge with a per-km RUC that factors in externalities, alongside the removal of stamp duty for rigid and articulated trucks. This could take place in 5 years time, phased in over 5 years to avoid creating additional costs to industry.	• The current fuel-based RUC does not account for differences in technology, road usage or externalities. • A correctly priced per-km RUC could support BEV adoption and would account for externalities including road damage and emissions. Combined with the removal of stamp duty and the removal of the existing Heavy Vehicle RUC, it would also be revenue-raising overall.

Timing

Source: 1. NSW Legislation (2025) *State Environmental Planning Policy (Transport and Infrastructure) 2021*; 2. Low et al. (2023) *The Hidden Costs of Road Maintenance due to the Increased Weight of Battery and Hydrogen Trucks and Buses – a Perspective.*; Mandala analysis.

Government should make changes to regulation, and introduce incentives for vehicles and charging infrastructure, before tackling reform to tax settings

Sequencing of policy recommendations

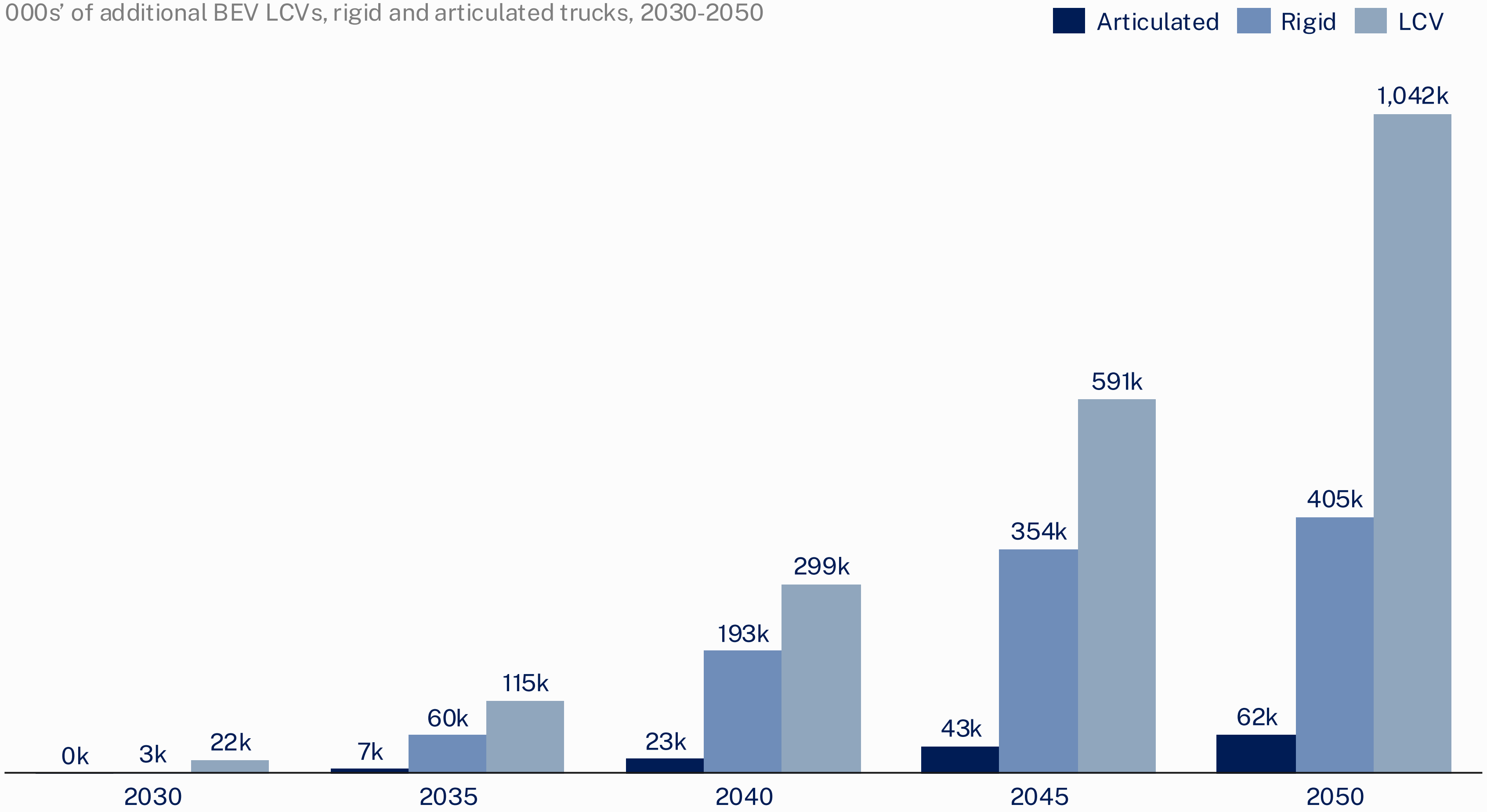


Note: 1. Private industrial heavy vehicles (e.g. mining, construction, and agricultural fleet vehicles operating off public roads) are not included in the analysis.
Source: Mandala analysis.

Implementing the above reforms could facilitate over 1.5M additional trucks on the road over the next 25 years, primarily for LCVs and rigid trucks

Additional BEV LCVs and trucks under the policy scenario[1]

000s' of additional BEV LCVs, rigid and articulated trucks, 2030-2050



Scenario	Description
Policy scenario	• **Australia implements a comprehensive set of policies to support electrification** • Economic conditions and freight task follow AEMO's Step Change scenario • EV uptake increases above the baseline scenario across truck types
Baseline scenario	• **Based on AEMO's Step Change and Progressive Change scenarios**[2] • Economic conditions and freight task follow the Step Change scenario • EV uptake follows the Progressive Change scenario – representing realistic technology cost forecasts and supply chain constraints

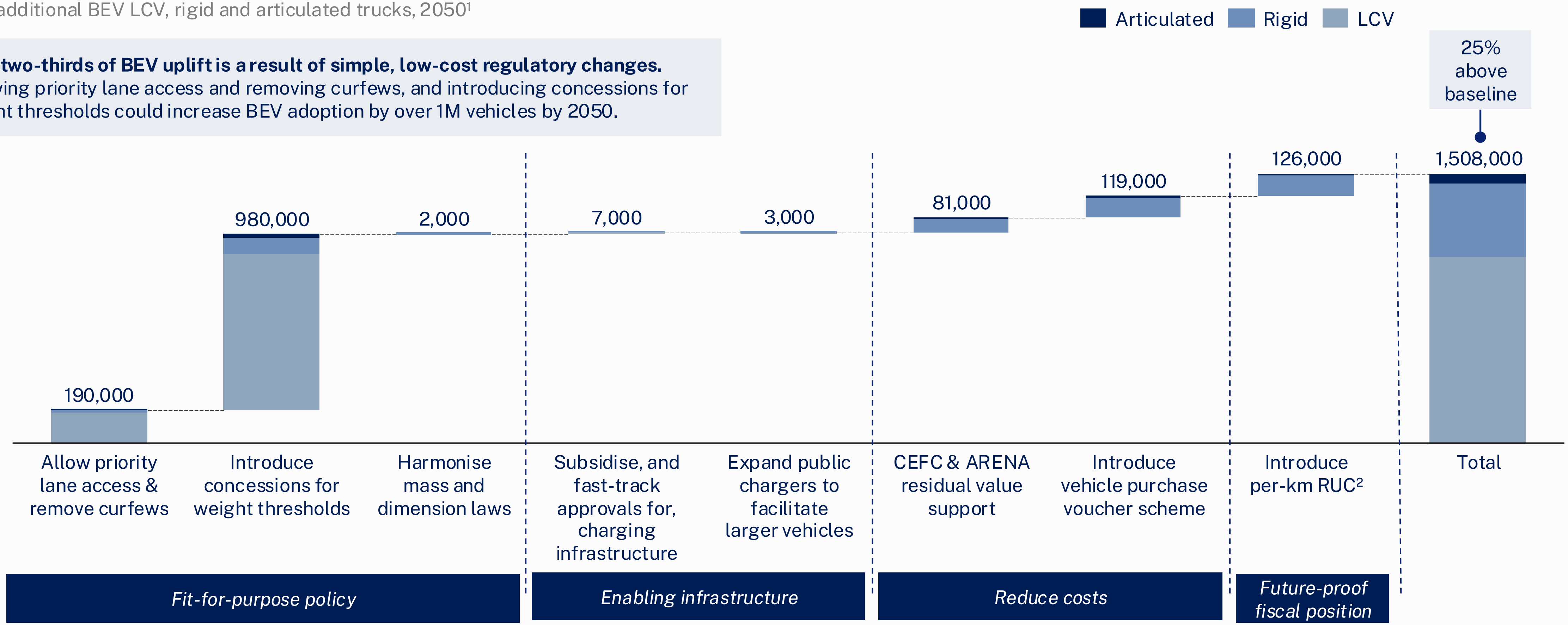
Note: 1. Number of vehicles includes LCVs, rigid and articulated trucks. 2. AEMO's scenarios account for policies that are legislated or have material funding allocated in a jurisdictional budget, in line with NER 5.22.3(b).
Source: AEMO (2026) *Detailed Electric Vehicle Databook*; Mandala analysis.

Implementing these policies will put over 1.5M additional BEVs on the road by 2050, with cost support, priority lanes, mass dimensions and a RUC driving uplift

Additional EV trucks as a result of each policy

No. of additional BEV LCV, rigid and articulated trucks, 2050[1]

Over two-thirds of BEV uplift is a result of simple, low-cost regulatory changes. Allowing priority lane access and removing curfews, and introducing concessions for weight thresholds could increase BEV adoption by over 1M vehicles by 2050.



Note: 1. Contribution of each of the policies to the final 2050 number of additional BEVs; 2. Phase out the current Heavy Vehicle RUC and stamp duty, and replace with a per-km charge that includes comprehensive externalities.
Source: Mandala analysis.

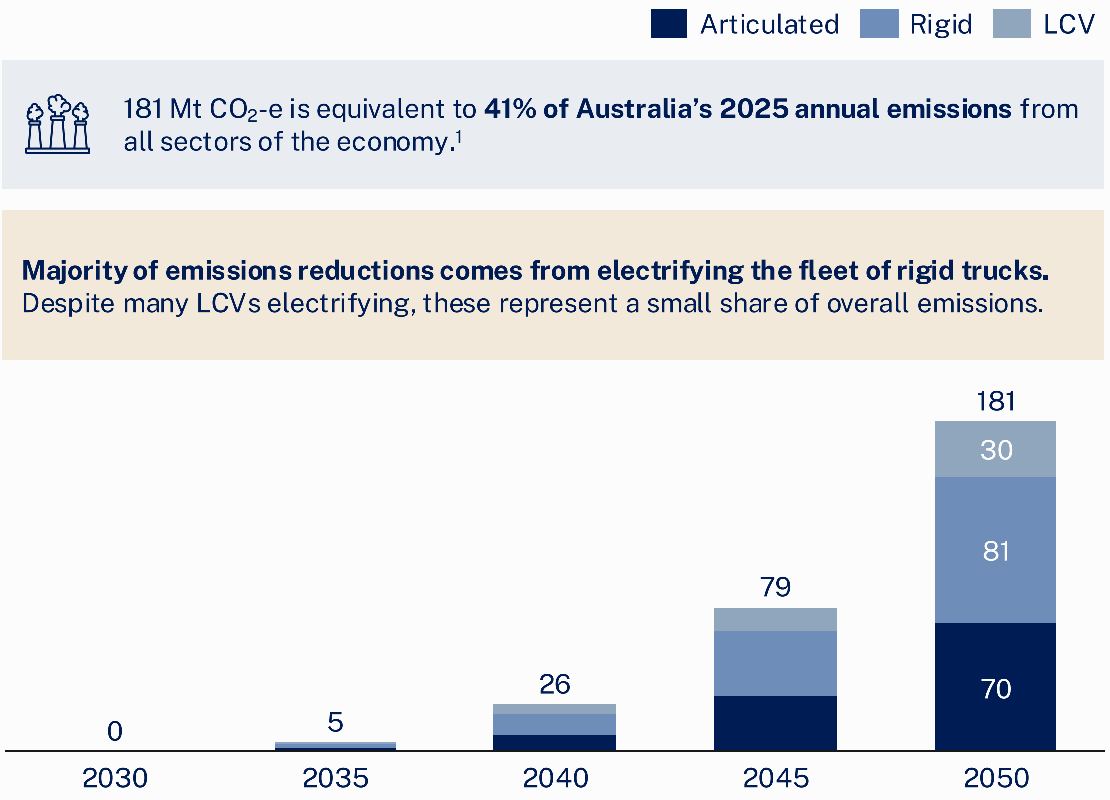
Acting now could reduce emissions by 181 Mt CO_2-e and see Australia save $18.5B in air pollution, soil and water, and noise externality costs by 2050

Cumulative emissions reduced

Mt CO_2-e abated, 2030-2050, cumulative, Policy scenario relative to the baseline

181 Mt CO_2-e is equivalent to **41% of Australia's 2025 annual emissions** from all sectors of the economy.[1]

Majority of emissions reductions comes from electrifying the fleet of rigid trucks. Despite many LCVs electrifying, these represent a small share of overall emissions.



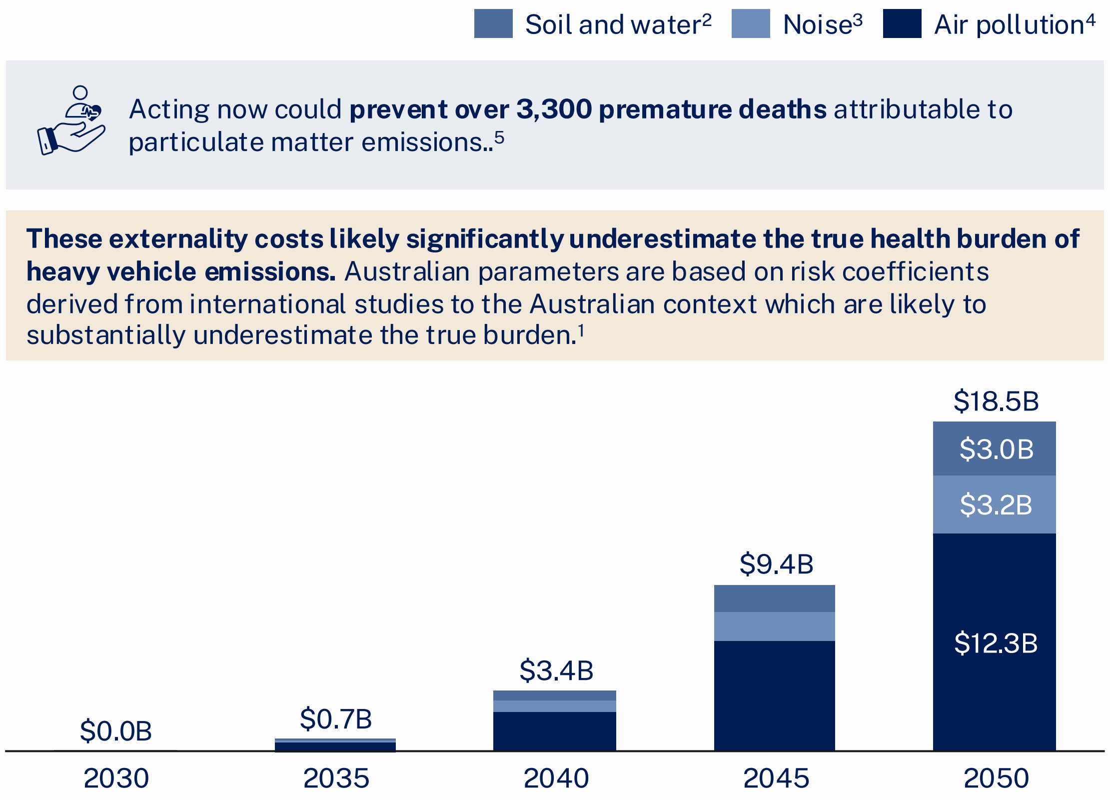
Note: 1. DCCEEW (2025) *National Greenhouse Gas Inventory Quarterly Update: June 2025*
Source: DCCEEW (2024) *Australia's emissions projections 2024*; Mandala analysis.

Cumulative externality costs saved

Externality costs saved, 2030-2050, cumulative, Policy scenario relative to the baseline

Acting now could **prevent over 3,300 premature deaths** attributable to particulate matter emissions..[5]

These externality costs likely significantly underestimate the true health burden of heavy vehicle emissions. Australian parameters are based on risk coefficients derived from international studies to the Australian context which are likely to substantially underestimate the true burden.[1]

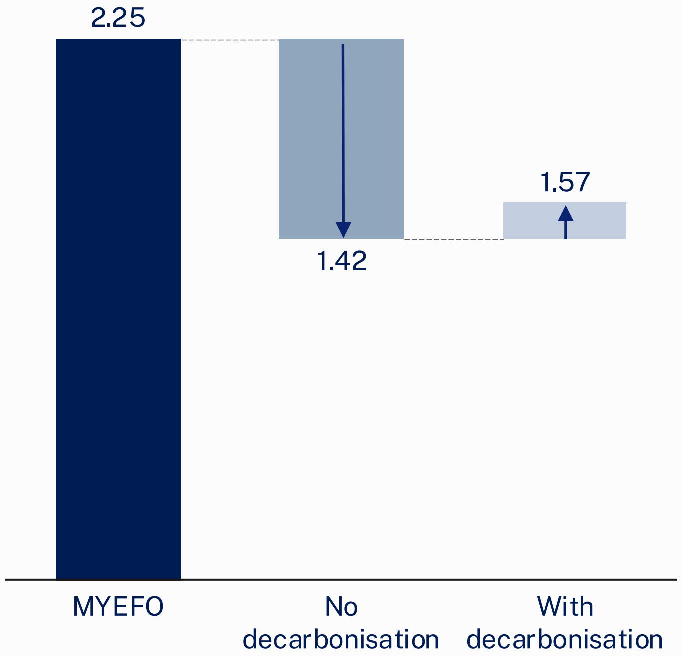


Note: 1. Walter & Liu (2025, unpublished) *The Unpriced Burden: Heavy vehicle emissions and the $6.2 billion health cost*; 2. Soil and water pollution covers the environmental cost of road-related contaminant runoff such as engine oil leakage and disposal; 3. Noise pollution captures the disutility of traffic noise to nearby residents; 4. Air pollution is the cost of harmful pollutant emissions from vehicle exhaust — carbon, hydrocarbons, nitrogen oxides, and particulate matter.; 5. Borchers-Arriagada et al. (2025) *The mortality burden attributable to $PM_{2.5}$ and NO_2 from all sources and traffic-related air pollution in Australia;*
Source: Transport for NSW (2025) *Economic Parameter Values*; Mandala analysis.

Global oil shocks push down Australia's economic growth and pull up inflation and unemployment, but a decarbonised freight network softens the impacts

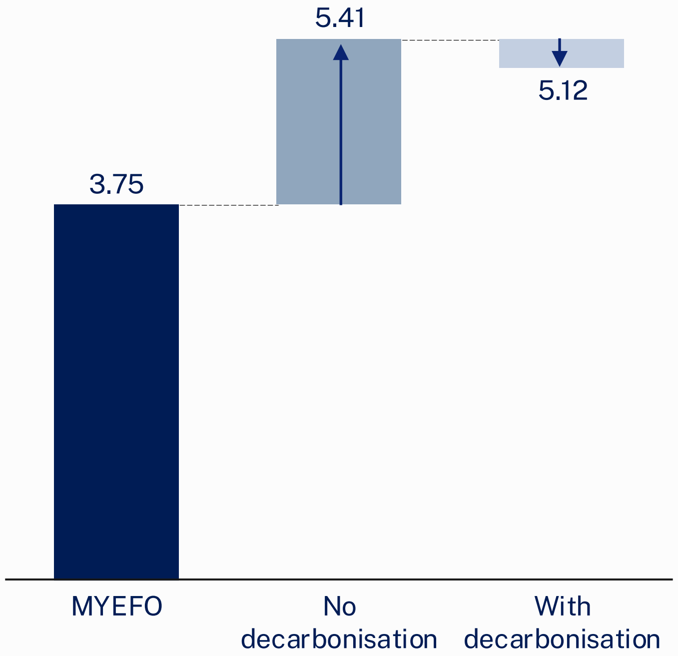
Real GDP

Percentage change first year after the shock



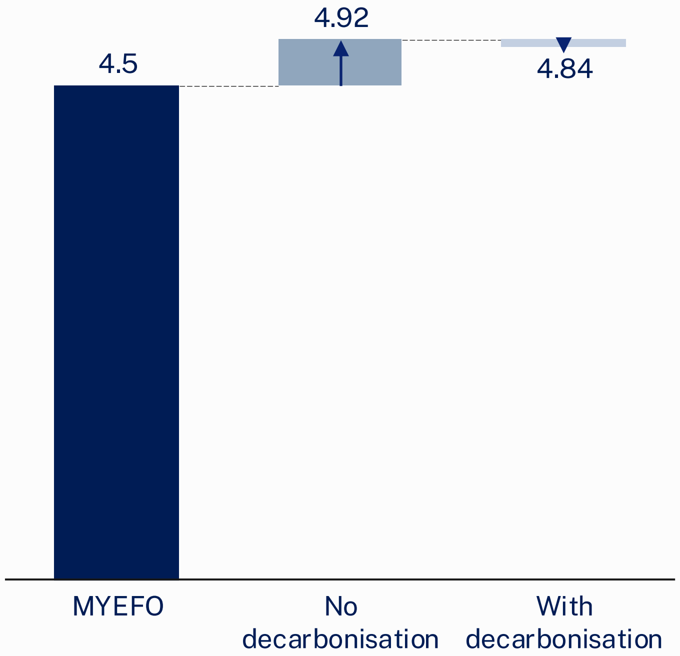
Inflation

Percentage change first year after the shock



Unemployment

Percentage change first year after the shock



The impact of oil shocks on the Australian economy depends on a range of variables, including how much oil prices increase, how long they stay elevated, the responses from households and businesses, the responses from other oil producing nations, and the responses of governments. The above analysis assumes that global oil prices remain 75% above where they were at the beginning of 2026. It assumes they remain elevated for two years after which they return to baseline. It assumes no hoarding from households or businesses and assumes a lagged ability of alternative oil producing nations to increase their supply.

Sources: Parliamentary Budget Office (2025) *Mid-Year Economic and Fiscal Outlook, 2025-26*; IMF (2017) *Working Paper WP/17/196: Oil prices and inflation dynamics: Evidence from advanced and developing economies*; Mandala analysis.

Implementing these policies would drive $138B in productivity improvements and create 900k additional jobs across the Australian economy by 2050

GDP and jobs uplift associated with BEV adoption productivity improvements

Should Australia seize the EV freight opportunity and implement the policies required to overcome the cost, regulatory, and operational constraints, the productivity and flow-on benefits would be significant.

Productivity benefits are driven by:

- **Greater torque** in EVs means trucks can go faster up hills, cutting trip times by up to 12%.
- **Total cost of ownership** represents lower costs for operators as EV prices fall.
- **Priority lanes** allow trucks to reduce travel times in urban areas during peak hours.
- **Health benefits** from fewer particulate matter emissions increases labour productivity.
- **Charging at points of loading** and unloading can save time at the bowser, particularly for LCVs.

Productivity uplift

GDP increase

A productivity increase in the road freight sector through adopting more efficient BEVs would drive an increase in GDP.

$138B cumulative increase in GDP[1]

Jobs benefit

The productivity and GDP uplifts would have flow-on benefits to the labour market, creating 900,000 additional jobs by 2050.

900k additional jobs[2]

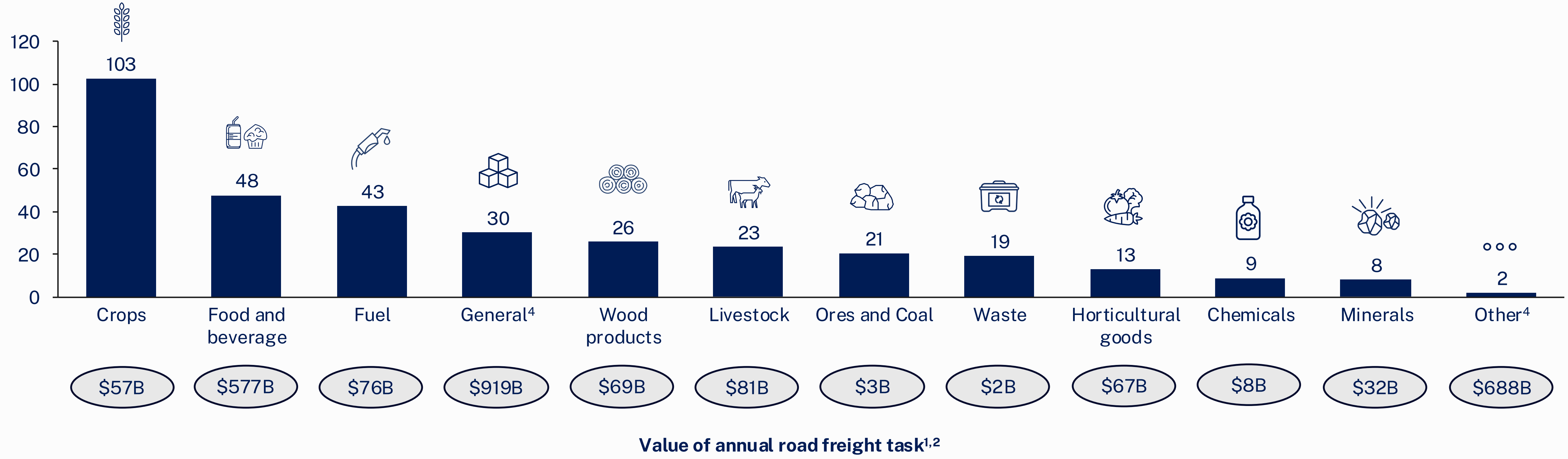
Notes: 1. Cumulative 2026-2050 GDP increase.; 2. Additional jobs created in 2050 as a result of productivity and GDP increases.
Source: G-Cubed Computable General Equilibrium Model; ABS (2025) *Australian Industry;* The Economist (2025) *Service stations are getting a glow-up*; PV Magazine (2025) *Electric truck achieves 480 kilometre delivery on single charge*; Mandala analysis.

Boosting productivity in freight has spillovers across the economy for households and businesses

Annual volumes, total (bulk and non-bulk) road freight

Million tonnes, most recent representative year[1]

Road freight predominantly carries crops, food and beverage, and fuel, along with a range of other commodities – with annual freight task value totalling $2.6T[2,3]. This movement of goods supports Australian consumers, industry, and exports. Efficiency gains in road freight lower input costs across these supply chains, with flow-on productivity benefits for consumers and businesses economy-wide.

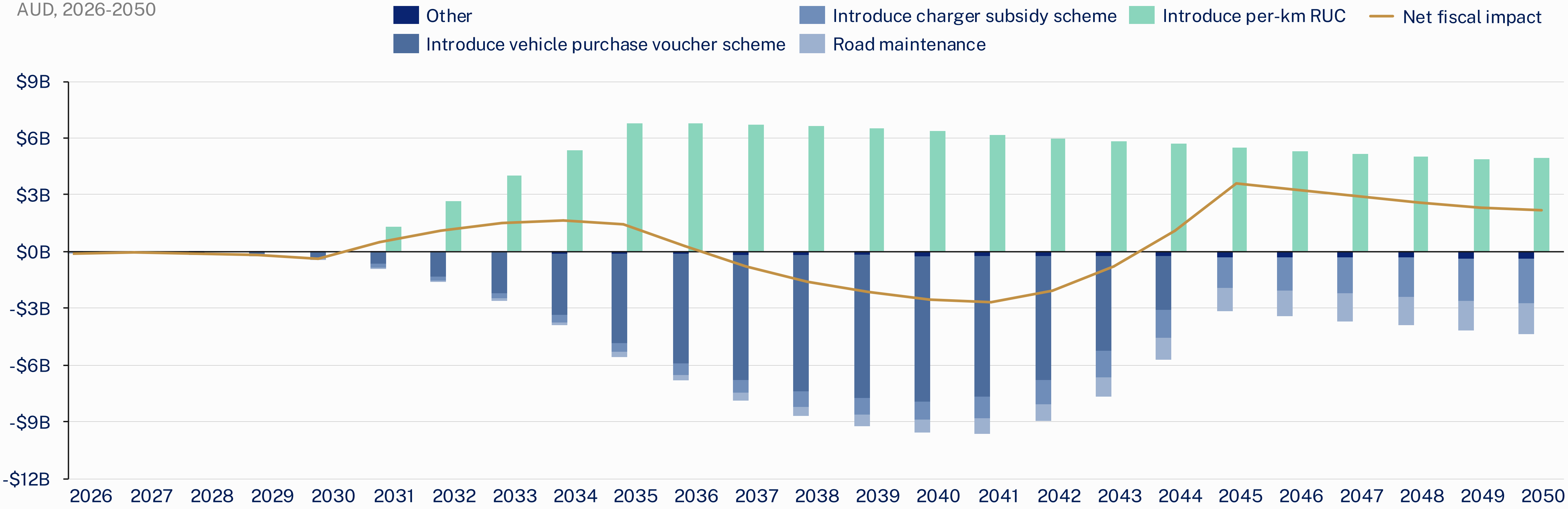


Note: 1. Data for commodities sourced from CSIRO Transport Network Strategic Investment Tool (TraNSIT), based on the most recent year where data is available; 2. Annual road freight task value is the total monetary value of goods transported by road freight operations in a given year.; 3. Total freight task value is indicative but not exact due to reporting variations in TraNSIT data.; 4. 'General' includes general household goods and other essential retail. 'Other' includes health related goods and vehicles.;
Source: CSIRO (2025) *Supply Chain Transport and Logistics Dashboard;* Mandala analysis.

This suite of policies will have a positive fiscal impact in the short-term and in the long-run, with a fiscal outlay required in the medium-term to support the transition

Fiscal impact of truck electrification policies

AUD, 2026-2050



Note: Road damage costings show the additional forecast road maintenance associated with battery heavy vehicles. These are indicative only, due to the complexity of accurately estimating these costs. Factors such as different battery placement in vehicles, varying conditions of road networks and fleet penetration across different locations create significant variability. The NHVR's Freight PASS tool and the NTC's FLCB process will provide more insight into expected road costs, however this information is not yet available. Importantly, this additional information may also affect per-km charges for the RUC. Nevertheless, we still expect to see a fiscal surplus from charges on externalities such as CO_2-e emissions from ICE trucks on roads, which will in turn help fund costed policy initiatives.

Source: Mandala analysis.

1 A critical window is closing for Australia to capture significant benefits from freight decarbonisation

2 Electrification is the most prospective technology to modernise Australia's freight fleet

3 Freight cohorts face unique barriers to battery electric vehicle adoption, with the urban cohorts the most ready

4 Targeted policies can increase electrification by 25%, supporting $138B in economic growth, and abating 181Mt CO_2-e by 2050

5 **Appendix**

Further sub-segmentation of the five cohorts allows further insight into how barriers impact truck segments based on different characteristics

High-level summary of approach to freight segmentation (NOT EXHAUSTIVE)

Informs high-level cohorts: These characteristics provide a high-level overview of how freight is used, helping inform the ultimate 'waves' of adoption.

Informs other segments that may be impacted by barriers: In addition to the factors that inform high-level cohorts, further specifications and fleet characteristics enable more nuanced characterisation of barriers.

Area	Daily distance	Duty cycle	Payload	Vehicle type	Vehicle age	Depot vs. non-depot	Type of goods	Use case	Nature of trips	Operating hours	Fleet size	Business turnover
Metro	<200km	Back to base daily	<4.5t GVM	LCV	<5yrs	Depot charging	Bulk (dry)	Postage & delivery	Frequent start-stop	Peak	<5	<$50k
Regional	200-500km	Base to hub	4.5t - 15t GVM	Rigid	5-10yrs	Non-depot charging	Bulk (liquid)	Waste collection	Some start-stops	Off-peak	5-10	$50k-<200k
Remote	500-800km	Hub to hub	>15t GVM	Articulated (non-HPV)	11-15yrs		Non-bulk (dry)	Const-ruction	Minimal start-stop		11-50	$200k-<2m
	>800km			Articulated (HPV)	>15yrs		Non bulk (ref)	Port drayage			>50	$2m-<5m
							Roll on roll off	Mining				$5m-<10m
							Cement	Agriculture				>$10m

1. Urban light
2. Urban heavy
3. Regional haul
4. Private industrial
5. Long-haul & remote

Source: Mandala analysis.

Mass and width limits disincentivise adoption of BEVs, with road access factors currently impacting viability for some truck cohorts

	Mass and width limits	Road access and curfews
Barrier	**Battery mass adds significant vehicle weight, reducing payload capacity. Truck width laws limit uptake of BEVs built to wider international standards.** • BEV trucks weigh 27% more than their ICE comparators, reducing payload capacity, where constrained by road mass limits.[1] • Truck trailer width laws restrict BEVs built to international standards, reducing truck model options. Australia offers 2–3.7x fewer heavy truck options than comparable markets.[2,3] This reduces competitive pricing pressure for suppliers and forces trade-offs between payload and insulation in refrigerated applications. • Urban LCV tasks are volume-limited rather than mass-limited. This makes battery weight a minor barrier.	**Access restrictions for heavier electric freight vehicles vary across jurisdictions, creating regulatory uncertainty. Curfews block operators from leveraging BEV quiet operation for night-hour deliveries, removing a potential productivity gain.** • Weight restrictions and infrastructure policy on regional routes remain unclear for heavier zero-emission vehicles. • BEVs offer quieter operation, creating opportunity for night-time deliveries. Current curfews prevent operators from acting on this advantage.
Impacted sub-segments	• Urban refrigerated freight • Regional and long-haul mass-limited freight	• Urban freight on delivery and last-mile routes

Est. number of vehicles impacted (% of type)	Mass and width limits: LCV	Mass and width limits: Rigid	Mass and width limits: Artic.	Mass and width limits: Total	Road access and curfews: LCV	Road access and curfews: Rigid	Road access and curfews: Artic.	Road access and curfews: Total
	900K vehicles (23%)	440K vehicles (73%)	90K vehicles (76%)	1.4M vehicles (31%)	450K vehicles (11%)	160K vehicles (28%)	10K vehicles (9%)	620K vehicles (13%)

Source: 1. Comparison between rigid Volvo FL 4x2 Electric and Volvo FL818 4x2 equivalents, as from Volvo Model range, Mandala analysis; 2. ARENA/ AECOM (2025) *Electrifying Road Freight report*; 3. Comparison based on electric trucks available in Canada, the U.S., Poland, and Norway, CALSTART (2025) *ZETI Data Explorer.*; Mandala analysis.

Retail price premiums can make BEVs harder to access for smaller operators, alongside residual value risk, charging infrastructure costs and diesel subsidies

	Retail price premium	Residual value uncertainty	Cost of charging	Fiscal support for diesel
Barrier	**Small businesses face cash flow constraints that make the initial capital outlay prohibitively expensive.** • BEV upfront costs frequently exceed double the price of diesel equivalents.[2] • The capital burden is heaviest for small businesses transitioning from used ICE vehicles to new electric LCVs. Small businesses typically turn over under $1M annually and operate fewer than 10 vehicles.[3] • Private industrial enterprises carry greater capital capacity, partially offsetting this barrier.	**Operators cannot reliably forecast BEV resale values, increasing perceived financial risk, and slowing investment decisions.** • Residual value uncertainty makes total cost of ownership higher since lenders cannot project future value reliably.[5] • Limited studies on long-term battery performance under intensive use prevent operators from modelling asset depreciation. • This risk is most acute in long-haul and regional applications with heavier duty cycles.	**Operators must fund charging infrastructure in addition to vehicle acquisition.** • Installing private charging infrastructure can cost between $40,000 and $100,000 per fast-charger.[6] Slow and overnight chargers cost $1000-$3500 each.[6] • This adds further costs for many operators looking to purchase a BEV. • Public charging costs are also prohibitive for 98% of the freight industry.[7] Prices are volatile due to electricity demand charges and surge pricing.[8]	**The government's fuel tax credit for diesel totalled $10.2B in 2024–25, creating a direct disincentive for private industrial operators to decarbonise.[1,9]** • Credits reduce diesel costs for on-road operators like long-haul carriers and off-road operators like mining and agricultural businesses. • This weakens the financial case for switching to BEVs.
Impacted sub-segments	• Small businesses and owner-operators	• Rigid and articulated trucks along regional and long-haul routes	• Operators expected to rely on depot charging facilities	• Regional and long-haul freight operators

Est. number of vehicles impacted (% of type)	Retail price premium	Residual value uncertainty				Cost of charging				Fiscal support for diesel			
		LCV	**Rigid**	**Artic.**	**Total**	**LCV**	**Rigid**	**Artic.**	**Total**	**LCV**	**Rigid**	**Artic.**	**Total**
	90% of freight operators are small businesses with annual turnover under $500K.[4]	-	590K vehic. (100%)	90K vehic. (76%)	680K vehic. (15%)	2.8M vehic. (72%)	426K vehic. (72%)	66K vehic. (55%)	3.3M vehic. (71%)	1.2M vehic. (30%)	170K vehic. (29%)	90K vehic. (76%)	1.4M vehic. (31%)

Note: 1. Private industrial heavy vehicles (e.g. mining, construction, and agricultural fleet vehicles operating off public roads) are not included in the analysis.

Source: 2. Energy Futures Foundation (2025) *Securing Australia's Net Zero Future through Clean Freight*; 3. ABS (2021) *Motor Vehicle Census*; 4. ARENA/ AECOM (2025) *Electrifying Road Freight report*; 5. CEFC (2025) *CEFC and Volvo Group Boost Battery Electric Trucks by Driving Down Costs*; 6. EVSE (2018), *How Much Does It Cost to Install an EV Charging Station?*; 7. ARENA (2025) *Electrifying Road Freight: Australia's Blueprint for a Cleaner Transport Future*; 8. Luo and Wang (2025) *The Impacts of Rate Surge on Electric Vehicle Charging Behaviors: Evidence from California*; 9. PBO (2025) *Budget 2025-26 Budget Paper No. 1: Budget Strategy and Outlook*; Mandala analysis.

The physical infrastructure required to support BEV adoption across Australian freight segments remains limited, particularly outside urban areas

	Charging availability	Grid readiness	Road readiness
Barrier	**Public charging networks remain insufficient for multi-shift and long-haul use. En route fast charging is absent along regional and interstate corridors.** • Overnight depot charging works well for fixed-base urban operators. Public networks still fall short for depot-free operators. • Most trucks offer under 400km range; some routes exceed 500km daily, making fast, en route charging essential.[2] • Australia needs 165 more charging hubs; fast and megawatt charging deployment lags international peers.[3] Inadequate charging infrastructure, increases delays and reduces productivity.	**Electricity networks lack sufficient capacity to support freight electrification in many locations.** • Transmission and distribution networks lack the megawatt-scale charging capacity required on regional and long-haul corridors.[2] • Urban networks and remote networks that support private mining and agricultural operations may also require localised upgrades.[1] • Deeper collaboration with DNSPs is essential as operators and Electric Vehicle Supply Equipment (EVSE) maintainers struggle to plan investments without better insight into infrastructure.[2]	**Increased road wear, weight restrictions, and access policies for heavier zero-emission vehicles remain unclear or unresolved across jurisdictions.** • BEV trucks weigh 27% more than ICE comparators and accelerate road degradation by 20–40%.[4,5] • Interstate routes may require infrastructure works to accommodate increased BEV mass.[6] • Access restrictions for heavier electrified freight vehicles vary across local government areas, and policy remains underdeveloped on regional routes.[7]
Impacted sub-segments	• Operators without fixed depots • Multi-shift urban freight operations (postage and last-mile freight movement) • Regional and long-haul freight movers	• Regional and long-haul operators along freight corridors	• Mass-limited regional and long-haul freight operations

Est. number of vehicles impacted (% of type)	LCV	Rigid	Artic.	Total
Charging availability	1M vehicles (25%)	150K vehicles (25%)	50K vehicles (43%)	1.2M vehicles (26%)
Grid readiness	1.2M vehicles (30%)	170K vehicles (29%)	90K vehicles (76%)	1.4M vehicles (31%)
Road readiness	900K vehicles (23%)	440K vehicles (73%)	90K vehicles (76%)	1.4M vehicles (31%)

Note: 1. Private industrial heavy vehicles (e.g. mining, construction, and agricultural fleet vehicles operating off public roads) are not included in the analysis.
Source: 2. EV Council (2025) *State of EVs*; 3. ARENA/ AECOM (2025) *Electrifying Road Freight report*; 4. Comparison between rigid Volvo FL 4x2 Electric and Volvo FL818 4x2 equivalents, as from Volvo Model range, Mandala analysis; 5. Low et al. (2023) *The Hidden Costs of Road Maintenance due to the Increased Weight of Battery and Hydrogen Trucks and Buses – a Perspective.*; 6. Austroads (2025) *Decarbonising Road Freight: Balancing Infrastructure, Environment, and Economy*; 7. HVIA (2024) *Queensland Network Map for BEV*; Mandala analysis.

Policy deep-dives (1/6): Setting sales targets will provide the necessary ambition for the sector, and noise curfews will accelerate BEV adoption

1. Set sector targets and ambition

1 Reform Australia's Heavy Vehicle Emissions Standard to align with international CO_2 intensity benchmarks

Policy description & potential implementation

Reform the Heavy Vehicle Emissions Standard to require a 45% reduction in fleet-average CO_2 intensity by 2035 and 90% by 2045, to align with international benchmarks.[1]

- Australia's existing HVES covers PM2.5/NOx but not CO_2.[2]
- Australia offers 2–3.7x fewer rigid and articulated BEVs than comparable markets (Canada, US, Poland, Norway), limiting competition and keeping prices high. A reformed emissions standard creates regulatory pull for manufacturers to allocate zero-emission models to Australia.
- Introducing primary legislation via Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCSA) and Department of Climate Change, Energy, and Environment and Water (DCCEEW) to extend the current HVES/NVES to heavy vehicles would provide manufacturers with supply side certainties.

Example policies

- The EU adopted regulation (EU) 2019/1242 setting CO_2 emission performance standards for new heavy-duty vehicles, setting CO_2 emission performance standards for new heavy-duty vehicles, requiring a 45% reduction in average fleet emissions by 2030 and 90% by 2040.[1]
- Canada's heavy-duty vehicle regulations require a 30% reduction in GHG emissions by 2030 compared to 2005 levels.[1]

2. Ensure policy is fit-for-purpose

1 Remove noise curfews and provide priority lanes for BEVs

Policy description & potential implementation

Allow BEVs to access existing bus or priority lanes and be exempt from local curfews preventing commercial vehicle access at off-peak times.

- Evidence has shown that priority lanes can drive significant uptake for BEVs. Additionally, current curfews for commercial vehicles are fragmented and would impact BEVs, despite being much quieter.
- This initiative would be implemented by state and territory road authorities and local councils, with the potential for some national oversight.

Example policies

- Netherlands zero emission zones gave BEVs access unavailable to diesel trucks, accelerating inner-city delivery companies to use zero-emission vehicles.[3]
- NSW relaxed curfews for essential services during the pandemic (BEVs were included).[4]
- NSW gave BEVs access to transit T2 and T3 lanes until 30 June 2027.[5]

Source: 1. European Commission (2025) *Lorries, buses and coaches*; Government of Canada (2018) *Regulations Amending the Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations and Other Regulations Made Under the Canadian Environmental Protection Act, 1999*; 2. DITRDCSA (2025) *Euro VI for heavy vehicles*; 3. Netherlands Enterprise Agency (2026) *Zero-emission Zones in the Netherlands*; 4. Electric Vehicle Council (2021) *Electric Trucks: Keeping Shelves Stocked in a Net Zero World*; 5. NSW Government (2024) *When Can a Battery or Hydrogen Fuel Cell EV Use Transit Lanes?*; Mandala analysis.

Policy deep-dives (2/6): Streamlining regulation on weight and dimension laws as well as introducing priority lanes will incentivise BEV uptake

2. Ensure policy is fit-for-purpose

	2 Provide weight threshold concessions	3 Harmonise dimension laws
Policy description & potential implementation	Grant BEVs weight threshold concessions so that added battery mass does not restrict road access or reduce payload capacity. • BEVs can be 27% heavier than diesel equivalents, limiting the roads they can access and the loads they can carry. A 1-2 tonne steer axle concession would offset this penalty and support BEV uptake.[1] • Implementation would occur through the NHVR alongside state and territory authorities, replacing the current state-by-state exemption patchwork with a national framework.	Increase the maximum vehicle width for BEVs and trailers with additional safety features from 2.5m to 2.55m, aligning with US standards and the EU's refrigerated vehicle limit. ▪ 2.5m limit forces costly aftermarket modifications to imported BEVs. Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCSA) estimates $439M in total operator savings with alignment.[5] ▪ Implementation would be led by DITRDCSA, NHVR, and state road authorities.
Example policies	▪ Netherlands gave B-licence exemption, allowing zero-emission vans up to 4.25 tonnes to be driven on a standard licence (normally capped at 3.5 tonnes).[2] ▪ NSW let class 3 BEVs exceed the normal mass limits regulation.[3] ▪ QLD provides BEVs access to selected Queensland state-controlled and local roads.[4]	▪ EU applies 2.55 metre standard freely across member states, enabling wider vehicles to enter markets without modification.[6] ▪ Australia increased the overall width limit from 2.50 to 2.55 metres for new rigid or cab chassis trucks and prime movers.[7]

Source: 1. US Dept. of Energy (2019) *Natural Gas Vehicle (NGV) and Electric Vehicle (EV) Weight Exemption;* European Union (2019) *COUNCIL DIRECTIVE 96/53/EC;* 2. Netherlands Enterprise Agency (2026) *Driving Heavy Sustainable Vehicles Allowed with B Driving Licence*; 3. NHVR (2024) *New South Wales Class 3 Zero Emission Vehicle Mass and Dimension Exemption Notice Operator's Guide*; 4. NHVR (2025) *Queensland Zero Emission Heavy Vehicle Permit-Based Scheme*; 5. DITRDCSA (2023) *Impact Analysis of Options for Maximum Overall Width*; 6. EUR-Lex (2021) *Authorised Maximum Dimensions and Weights for Trucks, Buses and Coaches*; 7. NHVR (2023) *2.55m Wide Heavy Vehicles.*; Mandala analysis.

Policy deep-dives (3/6): Reducing residual value risk for OEMs as well as providing subsidies for small businesses can help kick-start BEV adoption

3. Kick-start widespread adoption through reducing ownership costs

1 Leverage CEFC and ARENA funding to de-risk residual value (RV) of BEVs

Policy description & potential implementation

Use Clean Energy Finance Corporation (CEFC) loan facilities and Australian Renewable Energy Agency (ARENA) grants to provide residual value guarantees and support mechanisms that reduce the financial risk of BEV truck ownership for freight operators. This would be a scalable program and involve arrangements set out between the Original Equipment Manufacturer (OEM) and the CEFC and ARENA. This program could build off the CEFC's current arrangement with Volvo.

- Operators and lenders cannot reliably forecast the resale value of BEVs at the end of a lease or ownership period due to an absent used BEV market. This makes investment decisions riskier. A government-backed residual value guarantee (RVG) over the next two decades removes this barrier as a market for used BEV develops and could build on the CEFC-Volvo program currently in place.

Example policies

- The CEFC's December 2025 $70M financing package with Volvo Group Australia includes an explicit residual value support mechanism alongside interest rate discounts of up to 0.5%.[1]
- Early modelling indicates BEVs can reach parity with diesel over a standard lease term, at a cost of abatement of $43.88/t$CO_2$-e.[2]

2 Provide subsidies for small businesses

Policy description & potential implementation

Provide small businesses (<$1M turnover) with trucks over 15 years old a point-of-sale voucher to subsidise BEV replacement.

- BEV upfront costs can be more than twice that of diesel equivalents. The high upfront costs make EVs less attractive to small businesses which are more likely to face capital constraints. A capped Federal Government voucher offering a 10% discount on a new BEV truck chassis could be held flat for a decade and then phased out over the next decade. Structuring the voucher program through supplier/importer point-of-sale mechanism would eliminate operator administrative burden.

Example policies

- New Zealand - LEHVF subsidises up to 25% of the retail chassis price for zero and low-emission heavy vehicles, with dual caps limiting support per operator and per importer annually.[3]
- Netherlands - AanZET provides tiered purchase subsidies of up to 29% of chassis cost, funded by truck levies and scaled by both vehicle size and business size.[4]
- Enova (Norway) awards competitive grants covering up to 60% of the price premium for zero-emission heavy vehicles.[5]

Source: 1. CEFC (2025) *CEFC and Volvo Group Boost Battery Electric Tucks by Driving Down Costs*; 2. Estimates from Energy Futures Foundation's calculations; 3. Energy Efficiency & Conservation Authority (2025) *Low Emissions Heavy Vehicle Fund*; 4.Netherlands Enterprise Agency (2026) *Purchase Subsidy Zero Emission Trucks AanZET*; 5. OECD (2022) *Norway's Evolving Incentives for Zero-emission Vehicles.*; Mandala analysis.

Policy deep-dives (4/6): Infrastructure barriers can be reduced by funding national green initiatives, improving charger accessibility, and subsidising chargers

4. Scale infrastructure to support increased adoption

	1 Fund phase 1 of a national charging and refuelling plan	2 Ensure public charging facilities are accessible for larger vehicles	3 Provide subsidies to support infrastructure rollout
Policy description & potential implementation	Approve and fund ARENA/AECOM's plan for charging hubs on key freight routes and develop a National Charging and Refuelling Plan. Prioritise investment in green freight corridors through the Infrastructure Investment Program. ▪ A 44% (from 379 to 544) increase in ultra-fast (100kW+) charging hubs is required to fully electrify Australian freight. Coordination is required to align transmission and distribution upgrades with hub rollout. Without a national plan, infrastructure deployment will remain fragmented and unable to support long-haul BEV operations.	Redesign existing public BEV charging stations so that light commercial vehicles and light rigid trucks can charge alongside passenger BEVs ▪ Standardising DCCEEW's recommendation for heavy vehicle charging in parking lots across State and Local Government jurisdictions within five years gives multi-shift and delivery operators reliable daytime top-up opportunities ▪ This reduces range anxiety and downtime.	Provide one-off grants to small businesses with fewer than 50 trucks to include charging facilities at depots and designate electric truck charging as priority infrastructure to accelerate planning approvals. ▪ While overnight and slow chargers are economical, private depot fast chargers cost $40,000–$100,000. This is out of reach for small operators. A capped 25% Federal capital subsidy directly lowers this barrier. ▪ Fast-tracking BEV infrastructure planning approvals removes a key non-financial barrier to charger deployment.
Example policies	▪ The Mediterranean Corridor is a Southern European freight route decarbonised in alignment with the Global Green Road Corridor Initiative. It also supports megawatt charging, allowing effective charging during mandated driver breaks.[1]	▪ The DCCEEW Minimum Operating Standards for Government-Supported Charging Infrastructure recommends designing parking lots with charging stations that allow at least one long heavy vehicle or towing vehicle to charge.[2]	▪ The Federal DRIVEN Charger Rebate distributes $40M in rebates between 2024–25 and 2027–28, on a demand-driven, first-come-first-served basis.[3] ▪ NSW BEV Fleet Charging Kick-Start subsidies and WA Charge Up grants provide up to 50% of port installation costs for depot, fleet, and workplace chargers.[4] ▪ NT issues a $2,500 rebate voucher to cover part of charger installation costs.[5]

Source: 1. Global drive to zero (2025) Mediterranean Green Corridor Announced, Two Additional Countries Plus the Australian Capital Territory Working Toward 100% New Zero-Emission Truck & Bus Sales by 2040; 2. DCCEEW (2023) *Minimum Operating Standards for Government-supported Public Electric Vehicle Charging Infrastructure*; 3. Australian Government Business Portal (2026) *DRIVEN Charger Rebate Stream*; 4. NSW Climate and Energy Action (2025) *EV Fleets Incentive: Kick-start Funding*; 5. NT Government (2025) *Electric Vehicle Charger (Residential and Business) Grants Scheme*; Mandala analysis.

Policy deep-dives (5/6): Streamlining planning and investment will provide assurance for charger rollout while road upgrades will support heavier BEVs

4. Scale infrastructure to support increased adoption

	4 Streamline planning and investment for charging infrastructure	5 Upgrade roads to withstand higher loads
Policy description & potential implementation	Fast-tracking approvals for charging and make network capacity information publicly available as well as mapping suitable poles for electricity networks for hosting EV charging infrastructure. This will help to accelerate and provide assurance for investment. ▪ There is currently inconsistent and incomplete information on network capacity and suitability of grid and transmission infrastructure to make informed and timely investments in charging infrastructure. Cooperation from DNSPs will help ensure that this information is available. While progress has been made in fast-tracking approvals in some states such as NSW, there are still inconsistencies between states on approvals.	Designate road and bridge upgrades on key regional and long-haul freight corridors as nationally significant infrastructure, funded through the federal Infrastructure Investment Program, to accommodate the higher axle weights some BEVs. ▪ BEV trucks weigh approximately 27% more than equivalent diesel trucks, and research estimates this accelerates road degradation by 20–40%. Uncertainty about weight access policies across jurisdictions creates risk for operators and discourages fleet transition. Targeted infrastructure upgrades surrounding designated freight corridors and clearer access policies remove this barrier for regional and long-haul segments.
Example policies	▪ EV charging installations across a wide range of private and public settings in NSW are exempt from planning approval requirements.[1] ▪ The UK Office of Gas and Electricity Markets (Ofgem) has set up expectations for Distributed Network Operators (DNOs) to share network visibility data in an open and consistent way to improve decision-making across the sector.[2]	▪ While not targeting BEVs, the NSW Bridges for the Bush program aims to improve road freight productivity by upgrading existing road infrastructure to accommodate heavier vehicles.[3] ▪ Sweden is aiming to upgrade its road network 2037 to accommodate electric high-capacity transport (weighing up to 74 tonne) combinations.[4]

Source: 1. NSW Legislation (2025) *State Environmental Planning Policy (Transport and Infrastructure) 2021*; 2. UK Ofgem (2025) *Ofgem outlines transformational framework for local electricity networks to deliver clean power and support growth*; 3. Transport for NSW (2023) *Bridges for the Bush program*; 4. VBG Group Truck Equipment (2025) *The Transition Enters its Next Phase Future Outlook 2026.*; Mandala analysis.

Policy deep-dives (6/6): Introducing a comprehensive per-km RUC in place of the existing fuel-based RUC can help drive investments for BEVs

5. Future-proof government fiscal position

1 Introduce a per-km RUC, and phase out stamp duty and the existing fuel-based RUC for heavy vehicles to offset price increases

Policy description & potential implementation

Transition from the existing per-litre RUC to a comprehensive per-km RUC, using a forward-looking cost base that includes a comprehensive set of environmental and health externalities. Remove stamp duty the existing fuel-based RUC for rigid and articulated trucks. The fuel-based RUC could be phased out by increasing the fuel tax credit for rigid and articulated trucks.

- The per-km RUC would include road damage, CO_2, and particulate matter pollution. These would be apportioned based on existing importer market standards including Japanese and USA-EPA regulations as an alternative pathway to the base UN-ECE. Kilometres travelled can be measured at regular service intervals.
- The current fuel consumption-based RUC is not set up to best account for differences in technologies used by operators and does not as accurately account for differences in road damage between vehicles.

Example policies

- Germany introduced CO_2 differentiation of the Heavy Goods Vehicle toll in 2023.[1]
- Switzerland will apply related heavy vehicle tax (LSVA) to electric trucks from 2029, but with a discount until 2035.[2]

Source: 1. Federal Ministry for Transport, Germany (2026) *The HGV Tolling Scheme*; 2. Mobility-360 (2025) *LSVA Fee for Electric Trucks from 2029.*; Mandala analysis.

Key assumptions and inputs for TCO calculations

Total cost of ownership (TCO) based on a 5-year operational life [1]

Technology	Retail price	Fuel = unit price × consumption per km	Maintenance	Road tolls & charges
BEV	▪ Retail price = direct manufacturing cost × (1 + indirect cost multipliers (ICMs))[2] ▪ ICMs cover R&D, distribution, warranty and markups ▪ Residual values (RV): based on truck lifetime and battery cycle degradation ▪ **Future price:** based on falling projected direct costs	▪ Unit price: grid electricity + depot infra + excise ▪ 100 % depot charging ▪ **Future fuel cost:** based on falling consumption	▪ 32% lower than diesel; unchanged across years	▪ Lower RUC to reflect lower emissions ▪ 80% kms travelled on tolled roads ▪ Tall rates depend on truck classes
FCEV	▪ Same approach to calculate the retail price and RV as BEV ▪ **Future price:** remain constant[3]	▪ **Unit price:** green H_2 production + refuelling infra + tax ▪ **Future fuel cost:** based on falling consumption and refuelling infra	▪ Same as diesel; ▪ Future: falling maintenance fee	▪ **Same as BEV:** Lower RUC to reflect lower emissions
LCLF	▪ Same as diesel ▪ Hydrotreated vegetable oil as the representative drop-in fuel	▪ **Unit price:** production cost + distribution + excise ▪ **Future fuel cost:** based on falling consumption	▪ Same as diesel	▪ Same as diesel
Diesel	▪ Observed market price ▪ **RV:** 7.5% annual depreciation + variable rate based on share of lifetime km travelled ▪ **Future price:** 8% rise due to emission compliance	▪ **2023:** (net diesel price incl. excise)[4]× consumption per km ▪ **2030:** based on falling consumption	▪ Unchanged across years	▪ Higher RUC due to higher emissions ▪ 80% kms travelled on tolled roads

- TCO also includes labour (gross salary, social security, travel allowances) and insurance (proportional to retail price). Both are fixed numbers across technologies and model years.
- Assumptions are listed for model base year 2023 and future year 2030. TCOs hardly change for all technologies after 2030.
- All future expenses are discounted assuming a discount rate of 9.5%.

Source: 1. Basma et al (2023) *A Total Cost of Ownership Comparison of Truck Decarbonisation Pathways in Europe*; 2. Xie et al (2023) *Purchase Costs of Zero-emission Trucks in the United States to Meet Future Phase 3 GHG Standards*; 4. DKV Mobility (2023) *Current Diesel Price Index*;
Note: 3. Modelling assumptions are formed by ICCT (2023) except for the FCEV retail prices. They are adjusted to be constant across model years due to limited production scale with more latest data and projections. FCEVs face scarce refuelling infrastructure and poor energy efficiency - requiring 2–2.5 times more energy input than BEVs per km – and are projected to reach only 0.5-3% in national fleet share by 2040; CSIRO (2024) *Global FCEV sales are 0.077% of their BEV sales in 2024*; SNE Research (2025) *Global FCEV Market Grows 24.4% YoY in 2025*; Benchmark Mineral Intelligence (2026) *Global EV sales reach 20.7 million units in 2025, growing by 20%*; Mandala analysis.

Quantifying BEV uplift and benefits for Australia's road freight sector follows four steps

Overview of methodology for calculating the impacts of policies targeting freight decarbonisation

	Identify base case and scope of analysis	Estimate the number of trucks impacted by policies	Quantify uplift of relevant policies	Calculate economic, environmental and health impacts of policies
Output	**Realistic base case to model policy changes against**	**Barriers analysis, policy development and segment sizing**	**Additional BEVs as a result of policy suite**	**Costs and benefits of policy suite across key dimensions**
Method	▪ Analysed the assumptions underpinning AEMO's scenarios and forecasts ▪ Created a bespoke base case incorporating AEMO's Progressive Change scenario and forecast freight demand ▪ Ensured these were consistent against other sources and methodologies	▪ Broke down trucks into segments and sub-segments based on factors including typical distance travelled, load size and type, route type and more to size each sub-segment ▪ Identified a comprehensive list of barriers to BEV adoption for each sub-segment ▪ Developed a policy suite corresponding to each barrier ▪ Matched each policy to the corresponding sub-segment to quantify impact	▪ For price-focused policies, relative price impacts between BEVs and ICE trucks were calculated for each policy proposal ▪ Price elasticities of demand were applied to these relative changes in prices to determine BEV uptake associated with each policy ▪ For infrastructure-targeting policies, an infrastructure availability elasticity of demand was developed and applied to determine BEV uptake	▪ The additional BEVs (and the associated decrease in ICE trucks) were applied to health and economic parameters to determine the benefits of increased electrification ▪ G-cubed CGE model was used to determine the GDP impact of increased electrification ▪ Emissions impact was modelled against the DCCEEW forecast for freight emissions
Key data sources	AEMO, CSIRO, DCCEEW, desktop research, Mandala analysis	ABS, ARENA, AECOM, ATO, CSIRO, NTA, desktop research, Mandala analysis	TfNSW, academic papers[1], ABS, ICCT, EFF, T&E, AEMO, desktop research, Mandala analysis	G-cubed, ABS, AEMO, DCCEEW, TfNSW, academic papers, desktop research, Mandala analysis

Source: 1. Cantillo et al. (2022) *Influencing factors of trucking companies' willingness to shift to alternative fuel vehicles;* Mandala analysis.

Assumptions and acknowledgements on policy baseline scenario based on AEMO

1 Assumptions in AEMO's baselines forecast

Economic and population forecast

- Moderate economic growth: annual Gross State Product growth is 1.5-2.0% to 2050
- Moderate population growth: 0.5-1.2% annually to 2050
- Historic relationship between economic and population growth, and road freight demand

Policies

- Model baseline applies NER clause 5.22.3 (b), which stipulates the inclusion of policies that have been enacted in legislation, or had material funding allocated (among other criteria)
- Minimum NVES compliance between 2026-2029 (55% BEV+PHEV sales by 2030, heavier reliance on hybrids)
- Victorian, Queensland, and South Australia 2030 EV targets are binding; other state targets may not be met
- Fringe Benefits Tax exemption remain
- ICE phase-out policies emerge gradually - new ICE vehicles unavailable by 2050, commercial services collapse by 2060

Technology costs and diffusion

- High fuel cell vehicle costs and slower cost reductions
- Higher relative technology costs and more supply chain challenges
- High potential for supply chain limitations to affect demand forecasts
- Lower consumer energy resource investments (batteries, PVs)
- Low long-term coordination

2 Uncertainties in the baseline

Demand-side uncertainties

- Current state-level disparities in EV adoption are assumed to persist, though future state policies on incentives, charging infrastructure or fleet mandates could shift uptake in lagging states.
- The projected decline in separate dwelling ownership constrains private overnight charging access for LCVs
- Second-hand EV market dynamics affecting new vehicle turnover rates

Supply-side uncertainties

- The timing of cost parity remains uncertain due to global inflation, trade protectionism against Chinese EVs, & legacy manufacturer hesitancy, which in turn creates uncertainty around when EVs reach the majority sales threshold that triggers accelerated ICE retirement
- The exact technology mix between low emissions vehicles required to meet the NVES target is uncertain, and based on assumptions of future manufacturer competition and consumer preference
- Supply chain constraints or vehicle manufacturing challenges that may limit supply of desired BEVs

Exogenous shock uncertainties

- Implications of extreme changes to fuel prices – such as the current shock – have not been incorporated into the baseline forecast.
- Trade and other geopolitical policy changes (such as tariffs on Chinese EVs)
- Grid capacity and network constraints that limit mass EV charging infrastructure

Source: CSIRO (2025) *Electric Vehicle Projections 2025, Commissioned for AEMO's Draft 2026 Forecasting Assumptions Update.*

Policy model key assumptions and inputs (1/3)

Modelled policies

Policy	Modelled scenario	Timing	Uplift mechanism	Costing method	Internal note on policy inclusion and implementation	Sources
Remove noise curfews and provide priority lanes for BEVs	Models a 6.1% direct demand uplift. Drawn from evidence on operational value of curfew and lane access, applied to urban cohorts.	2026-2050	Constant increase in demand for BEV	Burden of regulation and oversight – not costed	Noise curfews and priority lanes increase demand by removing operational restrictions on BEV trucks, providing a non-financial incentive.	AEMO, BITRE
Provide weight threshold concessions	Models a 10% reduction in TCO which represents an exemption of the payload penalty experienced by BEVs due to constricting weight limits.	2026-2050	Price elasticity of demand for BEV	Effective subsidy multiplied by reduction in number of eligible vehicles in each registration category	Models the removal of the payload penalty for BEVs caused by heavier batteries. This lowers the effective TCO by improving freight capacity parity with ICE trucks.	BITRE, NTC, ARENA
Harmonised dimension laws	Models a 0.2% and 0.1% decrease in TCO for Rigid and Articulated trucks respectively due to reduced aftermarket modification costs.	2026-2050	Price elasticity of demand for BEV	Annual regulatory costs as estimated by DITRDCSA	Harmonising mas and dimension laws will expand the operating capacity of EV trucks.	DITRDCSA, PMC, BITRE

Source: Mandala analysis.

Policy model key assumptions and inputs (2/3)

Modelled policies

Policy	Modelled scenario	Timing	Uplift mechanism	Costing method	Internal note on policy inclusion and implementation	Sources
Leverage CEFC and ARENA funding to de-risk residual value (RV) of BEVs	Models guaranteed RV of 17% (Rigid) and 14% (Artic.), mediated through a change in the TCO.	2026-2046 (phased out over last decade)	TCO price and cross-price elasticity for BEV and ICE trucks	Direct and opportunity cost of support multiplied by number of additional eligible trucks.	TCO impact was derived from EFF's RV model and Mandala analysis. The policy increases the residual value of EV trucks, decreasing their lifetime cost of ownership.	Desktop research, BITRE, EFF RV Model
Provide subsidies for small businesses	Models a 25% reduction in upfront price for eligible Rigid and Artic. Trucks, sized in line with international comparators.	2026-2046 (phased out over last decade)	Price elasticity of demand for BEV	Subsidy multiplied by vehicle price and number of additional eligible trucks.	Models the impact of an upfront price reduction. This lowers the TCO but also helps overcome the prohibiting factor of upfront financing for small businesses. This subsidy size is in line with NZ.	Desktop Research, New Zealand Govt.
Ensure public charging facilities are accessible for larger vehicles	Models a 31% increase in charger availability for Rigid trucks, due to an addition of 576 potential charging locations available to Rigid trucks.	2026-2050 (phased in over 5 years)	Infrastructure elasticity of demand for BEV	Opportunity cost to government of lost parking space multiplied by number of eligible charging facilities	This policy models the expansion of public car parks with chargers to allow rigid trucks, which currently do not fit in public car parks. This allows rigid trucks to use public chargers.	OpenStreetMaps, ARENA/AECOM, BITRE
Provide subsidies to support infrastructure rollout	Models an estimated 8.6% increase in charger availability for eligible trucks due to a 25% subsidy sized in line with comparators.	2026-2050 (phased in over a decade)	Infrastructure elasticity of demand for BEV	Subsidy multiplied by charger price and number of additional chargers	This policy provides a subsidy to businesses to purchase depot chargers. This lowers the cost of BEV adoption and decreases operational frictions for businesses.	Electric Vehicle Council, ARENA/AECOM, BITRE, desktop research, NSW Climate and Energy Action

Source: Mandala analysis.

Policy model key assumptions and inputs (3/3)

Modelled policies

Policy	Modelled scenario	Timing	Uplift mechanism	Costing method	Internal note on policy inclusion and implementation	Source
Introduce a new comprehensive per-km RUC	Introduction of a comprehensive RUC, models a 20% (Rigid) and 32% (Artic.) reduction in the TCO of BEVs.	2031-2050 (phased in over 5 years)	TCO price and cross-price elasticity for BEV and ICE trucks	Average KMs travelled by truck types multiplied by $/KM RUC, broken down by drivetrain type.	The RUC is introduced as a fiscally sustainable way to support emissions reductions and fund road infrastructure expenditure. Inclusions of the RUC are: • Road damage • Carbon emissions • Toxic gas emissions The parameters used in the RUC calculation were derived from the Transport for NSW Economic Parameter Values of externality costs, and the IPPC's carbon externality costs.	Transport for NSW, IPPC, NTC, BITRE, ARENA, IPPC
	Removal of stamp duty models a 2% reduction in the upfront cost for BEV Rigid and Artic. trucks from reduced stamp duty.	2031-2050 (phased in over 5 years)	Price elasticity of demand for BEV	Number of new trucks each year multiplied by the average stamp duty and average vehicle costs across truck types.	Stamp duty is removed to support BEV adoption and reduce the disincentive to invest in newer trucks. The fiscal cost of this is offset by the RUC.	ATO, BITRE, ABS, State & Territory Govt. Treasuries
	Removal of existing fuel-based RUC through increasing FTC models an 11% (Rigid) and 18% (Artic.) reduction in the TCO of ICE trucks due to lower fuel excise costs.	2031-2050 (phased in over 5 years)	TCO price and cross-price elasticity for BEV and ICE trucks	Litres of fuel consumed by trucks on public roads multiplied by the number of trucks, and average KMs travelled.	The introduction of a per-km RUC is partly offset by the removal of the existing fuel-based RUC which lowers running costs for ICE trucks, increasing their uptake relative to BEVs.	ATO, BITRE, ABS

Source: Mandala analysis.

CGE modelling approach

Inputs

1

Productivity uplift and increase in government expenditure

Calculated individually for each recommendation

G-cubed model[1]

2

- **A multi-country, multi-sector dynamic model** of the global economy with sophisticated econometric estimation. Accounts for both direct, indirect and offsetting effects
- **A general equilibrium model** which models flows of capital, jobs and economic activity as it moves between different sectors of the economy and between economies
- **Used widely by macroeconomists,** including the RBA, Treasury, IMF and other commercial and central banks

Key agents in the model:

1. Firms	2. Households
Firms across **6 sectors**, including services, mining, and energy	Households make economic decisions about e.g., consumption and labour supply
3. Government	**4. Central bank**
Governments spend money on goods and transfer payments, and receive tax revenue	Central banks make decisions about e.g., exchange rate, interest rate and inflation targets

G-cubed outputs

3

Aggregate economic activity (GDP) across the economy

Source: 1. McKibbin and Triggs (2018) *Modelling the G20.*; Mandala analysis.

MANDALA