Cost Competitiveness of Zero-Emission Trucks in Australia

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Green Hydrogen for Road Transport in WA-FEnEx CRC

Pourandokht Naseri, Mauricio Di Lorenzo, Craig E. Buckley, ***"Projected Cost Competitiveness of Zero-Emission Trucks in Australia", Under Submission***

Researchers

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Sustainable Built Environment National Research Centre Australia

BGC ATCO mainroads Western Australia

Photo courtesy of Main Roads WA

Green Hydrogen for Road Transport in WA- FEnEx CRC

FUTURE ENERGY EXPORTS Cooperative Research Centre

Our key objectives include:

1. Evaluating the **cost competitiveness** of H2 trucks
2. **Market** Analysis in Australia
3. Hydrogen Refuelling Station network Perth -Pilbara.
4. **Life-cycle** analysis
5. Developing a **hydrogen delivery framework**: production-refuelling stations
6. **Pilot**


Photo courtesy of Main Roads WA

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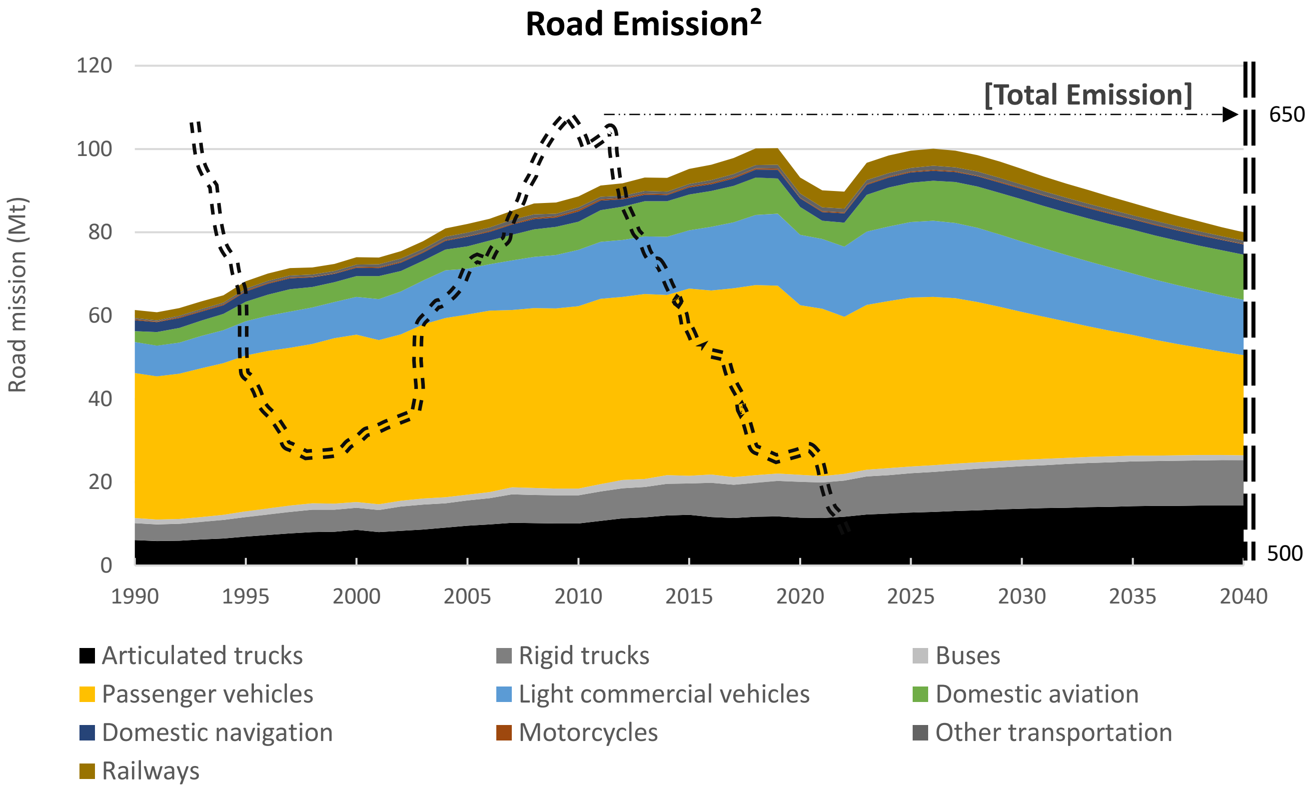
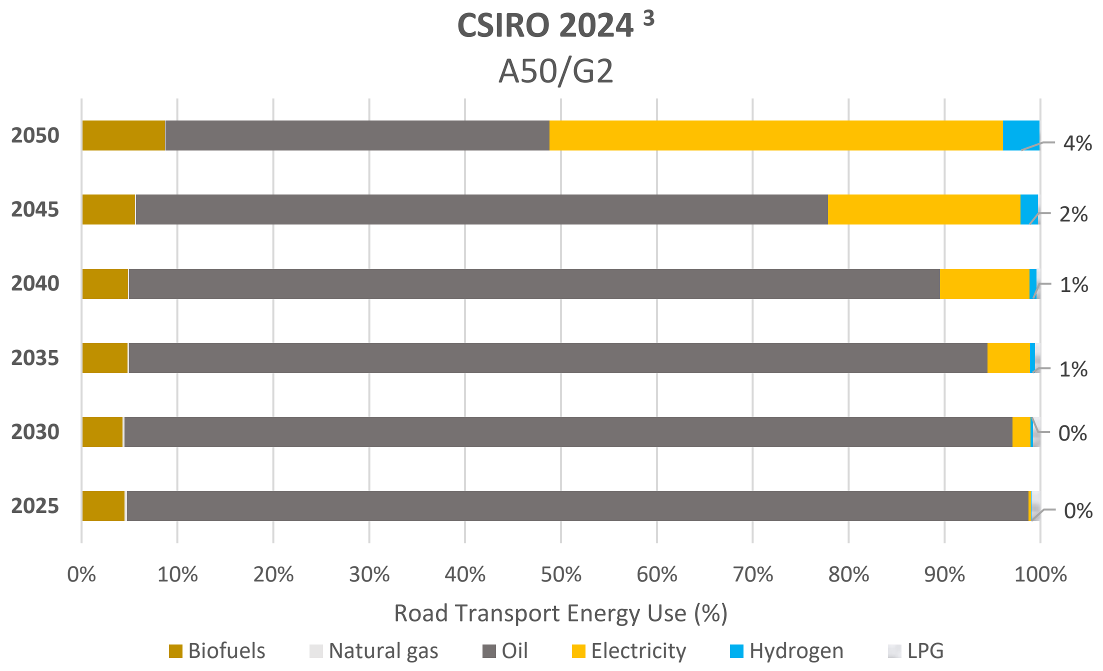
Australia Emissions: Total and Transport

Replacing diesel with green hydrogen will reduce CO2 emissions by 57% in road transport nationally[4].
By 2050, over 40% of road transport energy use will be through fossil fuels.[3]





¹ DCCEEW 2020, State and territory greenhouse gas inventories: annual emissions
² DCCEEW 2024, Australia's Emission Projections
³ CSIRO, 2024, Modelling sectoral pathways to net-zero emission
⁴ Aus. Gov (ABS), 2020 Survey of Motor Vehicle Use.

Road Transport

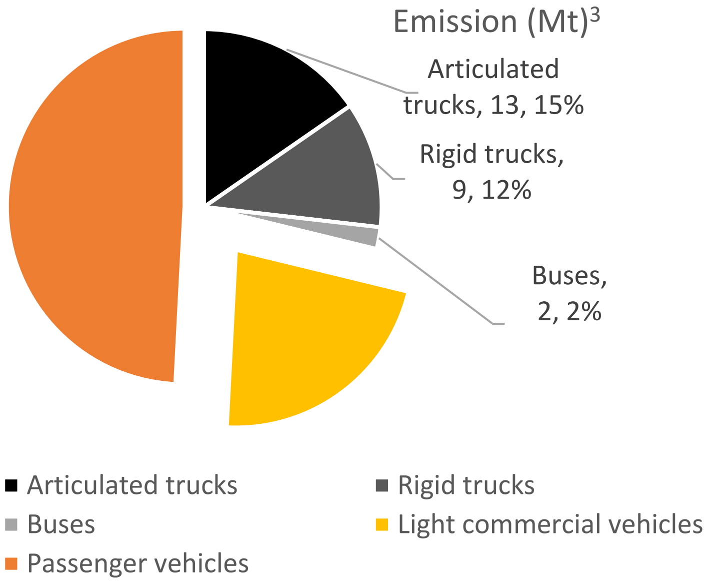
Heavy-duty vehicles in Aus.:
- <4% of vehicles population [1, 2]
- 29% of Road emissions[3]

Vehicles		Weight (tonne)	Population (%) [1,2]
	Rigid Trucks (Light + Heavy)	3.5[6]-30[7]	2.7%
	Articulated Trucks	40-60[8] (3-122.5)	0.5%
	Buses	5.2 [9.1]-25[9.2]	0.5

Challenge Remains

Articulated Trucks
(1[St] : WA: *up to 122.5 t, **200+ t** outback)
2[nd] Mexico: **75.5 t!**

P. Hudson



[5] GVM for light commercial vehicles: up to 3.5t. BITRE, 2017, "Light commercial vehicle safety- Information Sheet"
[6a] GVM for light-Medium rigid trucks starting at 3.5 t, National Transport Insurance, 2024, "Do you know your truck types?", [6b] under 4.5-16.5 GVM for light Rigid trucks,
[7] GVM for heavy rigid trucks 15-30 t: National Heavy Vehicle Regulator, 2016, *National heavy vehicle mass and dimension limits*
[8] GVM for articulated trucks up to 122.5 t: National Heavy Vehicle Regulator, 2019, *Common Heavy Freight Vehicle Configurations,*
[8.2] over 3t and Number Distribution ABS 2021
[9] GVM for buses: 5.2 tonne (mini-bus) -25t (NTC, 2018, for a 3-axle bus). For buses 19 t (Eudy 2019), 18t Foton (2024), 18t Diesel (ARCC, 2023) ,

1 Aus. Gov. (BITRE), 2023, Road Vehicles, Australia
2 ABS-Number Motor Vehicle Census s, 2021
3 DCCEEW, 2024, Australia's emissions projections 2024

Zero-emission: road transport?

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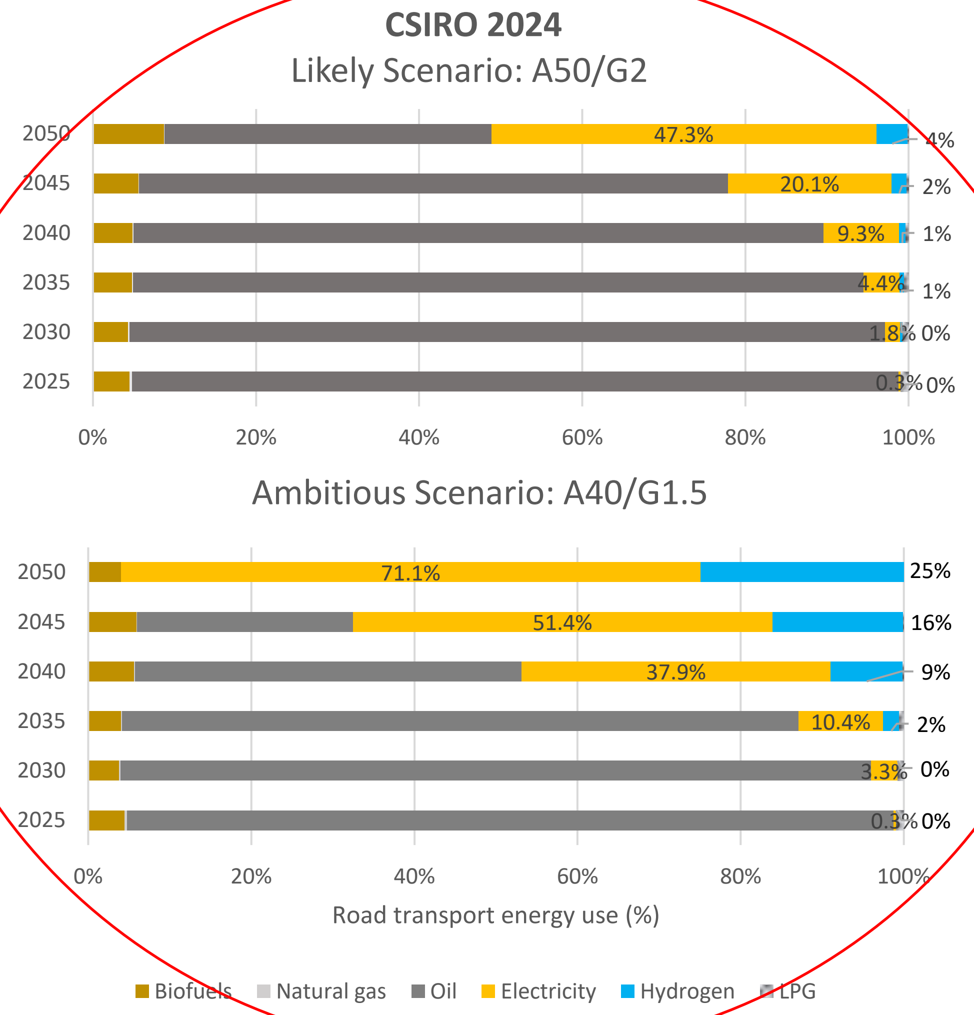
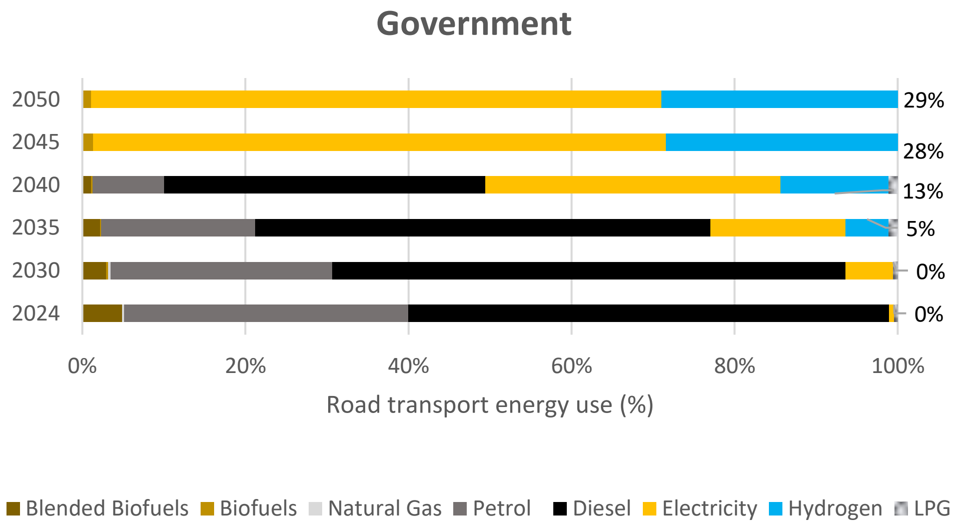


1. **By 2050, only 47%** of Road Energy Use can be provided by batteries [1].
2. Zero emission in road transport is feasible though **H2 adoption[2].**

1 CSIRO, 2024, Modelling sectoral pathways to net-zero emission
2 Aus. Gov. (DCCEEW), 2024, Australian National Hydrogen Strategy



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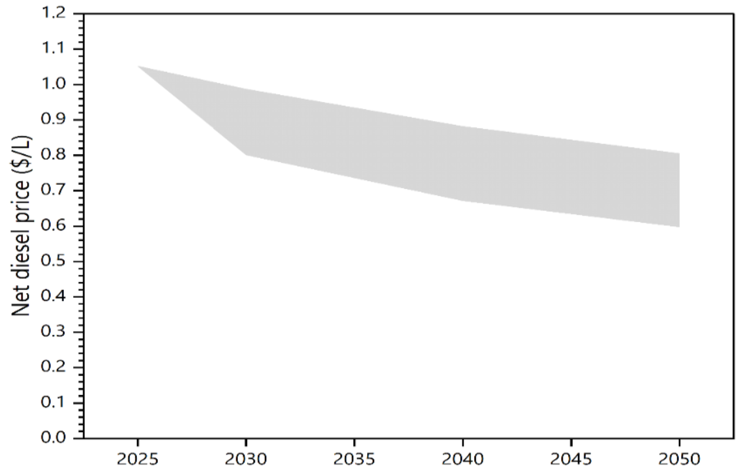
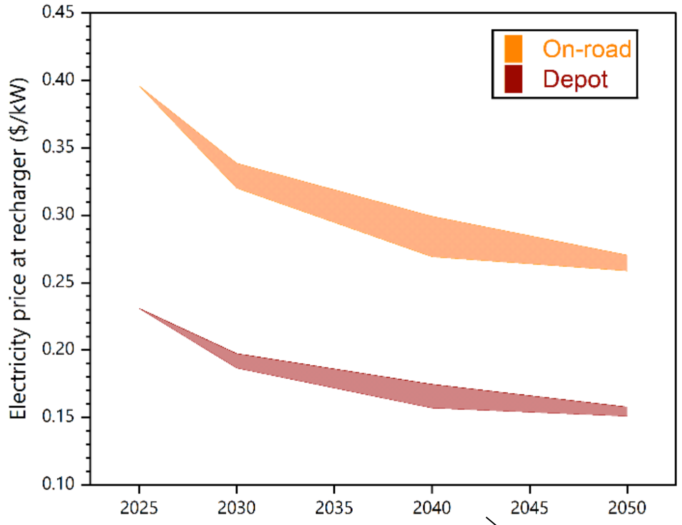
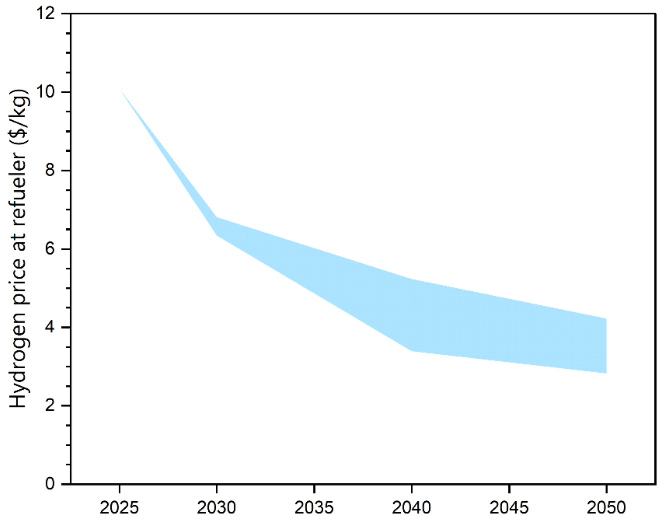
Fuel Cost:
Important Factor in Total Cost of Ownership of Trucks

- **Fuel Cost=Production + Gaseous/Grid Transport + Refuelling Station/Recharger**
- **$=USD**







$$Net\ Diesel\ Price\left(\frac{\$}{L}\right) = \frac{CO}{CO_0}.\ (Pump\ Price + RUC - Excise + AdBlue)$$

$$Fuel\ Cost = Fuel\ Cost_0 \times \left(\frac{CC}{CC_0}\right)^{-b}$$

Source:
AEMO, 2022 - ACIL-Allen 2024
AIP, 2025
NTC Cost model, 2020, data base

Source:
NREL 2024, Ledna, Muratori et al.
RAC, 2025
PlugShare 2025

Source:
CSIRO, 2024, National Hydrogen Strategy
Argonne National Lab, 2017, , Reddi, K., et al. "Impact of hydrogen refueling configurations and market parameters on the refueling cost of hydrogen."
H2Pathways Tool: Simulation by authors

Fuel Cost: H2 Pathways Simulation Tool by FEnEx

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Hydrogen Pathways

NAVIGATION

- Home
- Modelling tool
- Help & Info
- User

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The Hydrogen Pathways App

Introduction

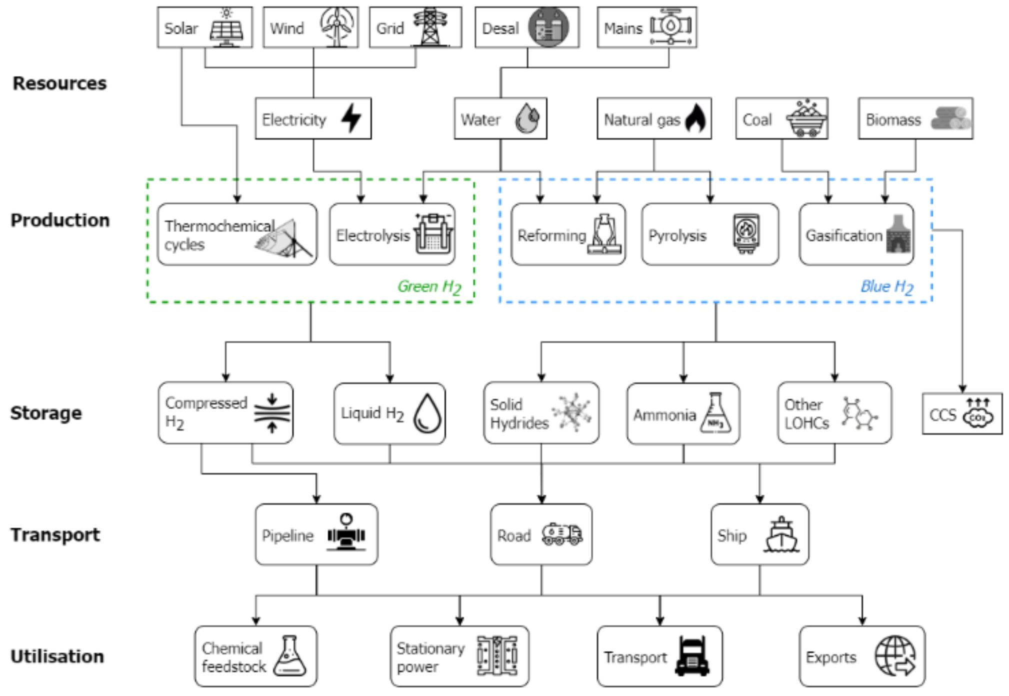
Welcome to Hydrogen Pathways, our hydrogen supply chain tool, designed to help you estimate costs and emissions across the supply chain. As the world transitions towards a low-carbon economy, hydrogen is emerging as a promising energy vector that can play a significant role in decarbonizing various sectors, including transportation, industry and power generation. Our website provides a comprehensive and user-friendly platform to explore the different stages of the hydrogen supply chain, including production, storage, transport and utilisation, and to assess the environmental and economic impacts of each stage. Whether you are a policy maker, investor, or industry expert, our website can help you make informed decisions about the deployment of hydrogen in your operations.

To use the hydrogen supply chain tool, please login or register.

Help & Info

- Get help on using and troubleshooting the tool.
- See our website disclaimer

https://h2pathways.azurewebsites.net/



The website has been developed in collaboration with the following organisations:

UWA PERTH · AUSTRALIA
wood.
MINERAL RESOURCES
HORIZON POWER

Operation of Trucks

GVM/GCM	15-t	22.5-t	42.5-t
Truck class	 3 axle rigid truck	 2 axle rigid truck	 3 axle rigid truck +dog trailer
Refuelling Scenario	Depot charging		On-road charging
Ownership time (yrs*) [NTC, 2020], *Truck resold	6	6	8
Annual distance travelled (km/a)	50,000	70,000	200,000

- Interviews
- Literature

Total Cost of Ownership Simulation: Methodology

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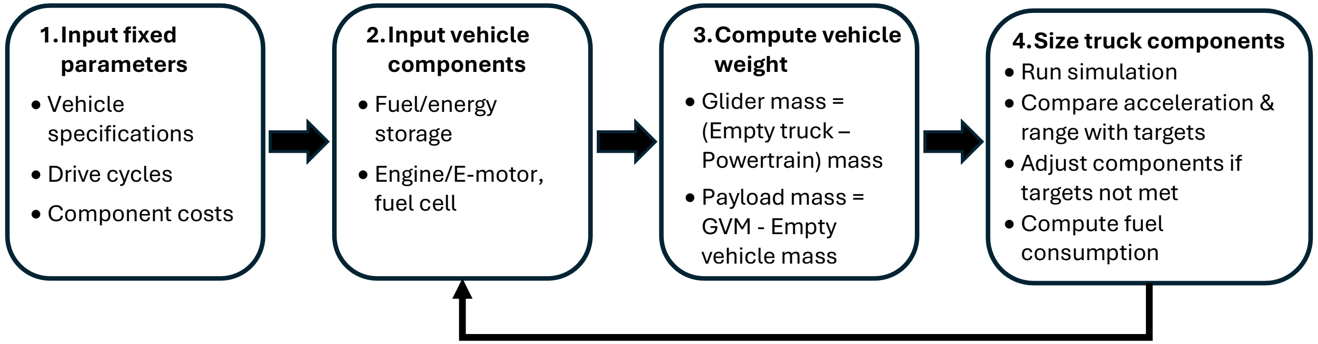
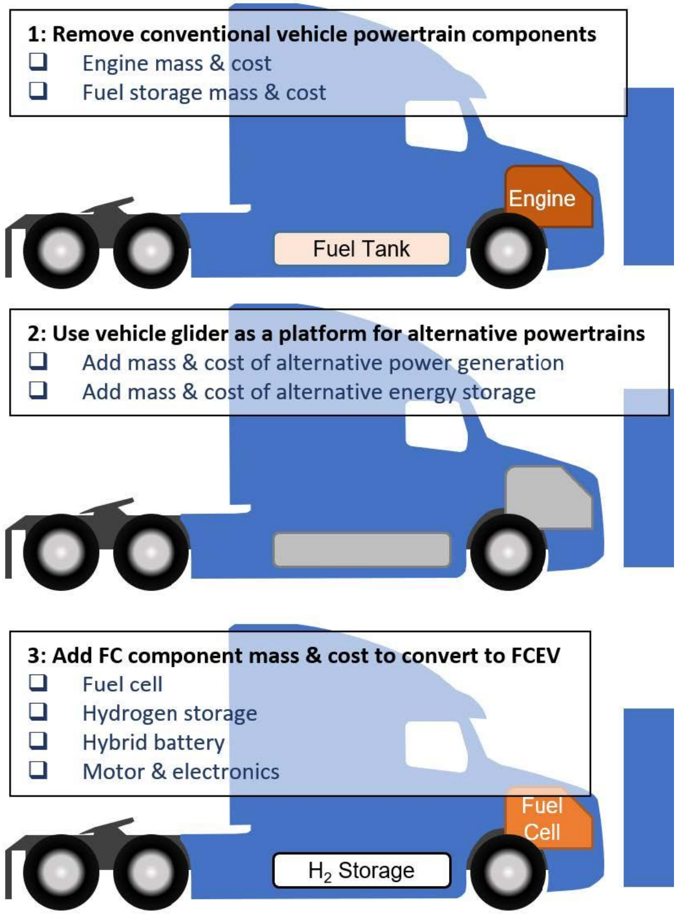
Important Simulation Parameters

1. Range (400 km)
2. Truck Mass (GVM= empty truck+ load)
3. Drive Cycles matching each truck class
4. Fuel/Electricity price at pump/charger
5. Operation (e.g. Maintenance, Wage, Insurance)
6. Re-sale / End of life cost





We used FASTSim tool: Developed National Renewable Energy Laboratory (US government) (NREL)

Fuel Consumption (Australia vs World)

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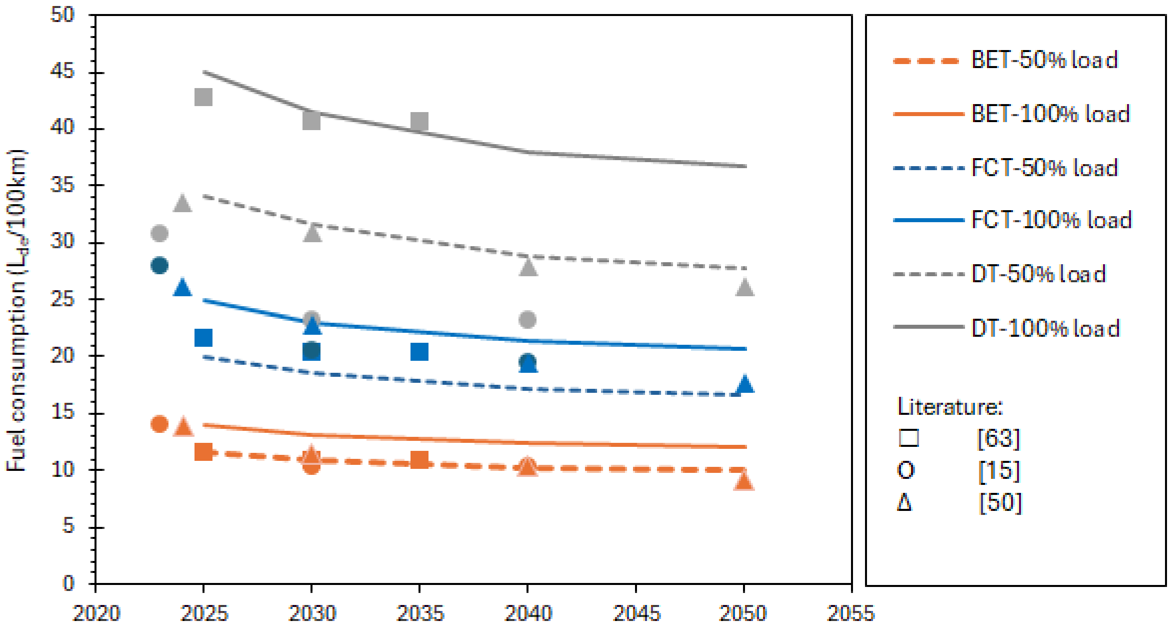
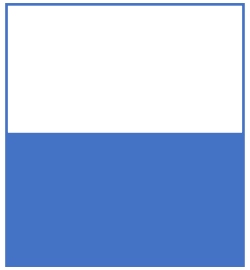
Fully Load Truck



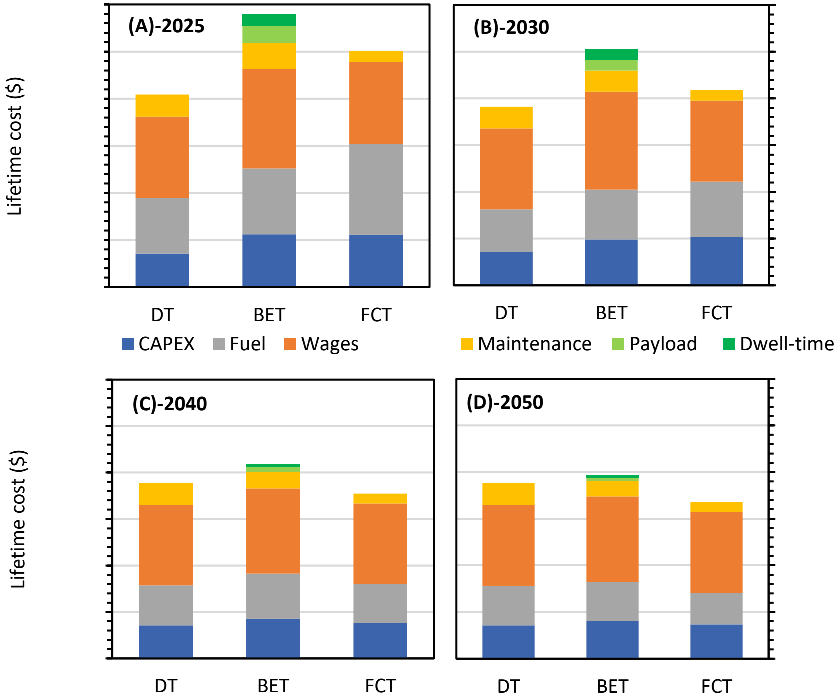


Half Load Truck

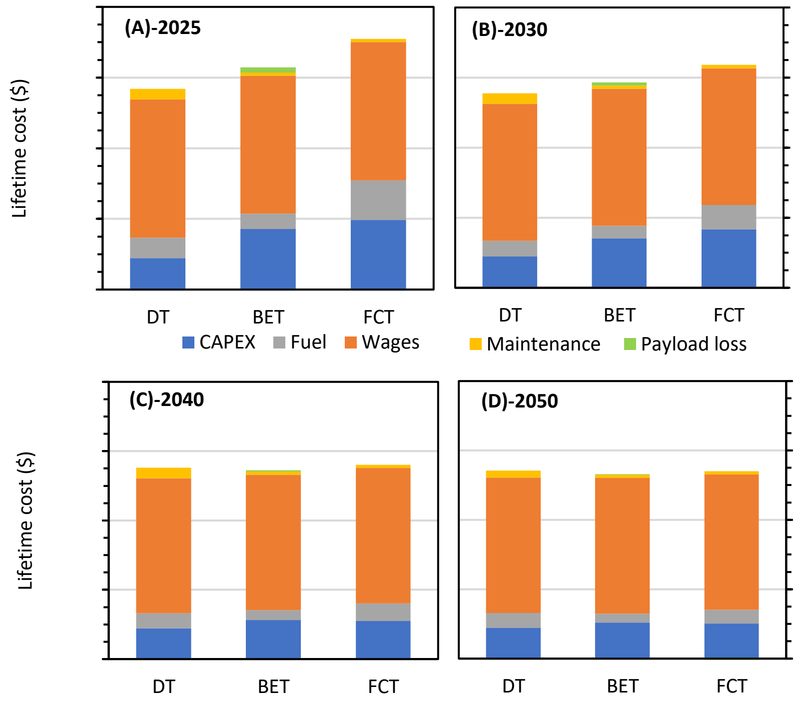
[63] California Air Resources Board, *Draft Advanced Clean Fleets Total Cost of Ownership Discussion Document*. 2021.
[15] Basma, H. and F. Rodriguez, *A total cost of ownership comparison of truck decarbonization pathways in Europe*. 2023, The International Council on Clean Transportation.
[51] Ledna, C., et al., *Assessing total cost of driving competitiveness of zero-emission trucks.* iScience, 2024. **27**(4): p. 109385.

Cost Components:
Fully Loaded

42.5 tonne truck

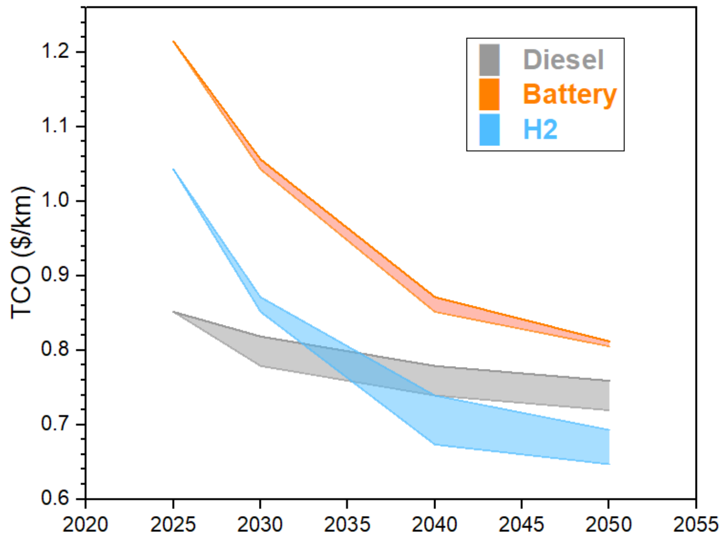


15.5 tonne truck



Total Cost of Ownership (TCO): Fully Loaded

42.5 tonne truck



Long-Haul Operation

Battery:

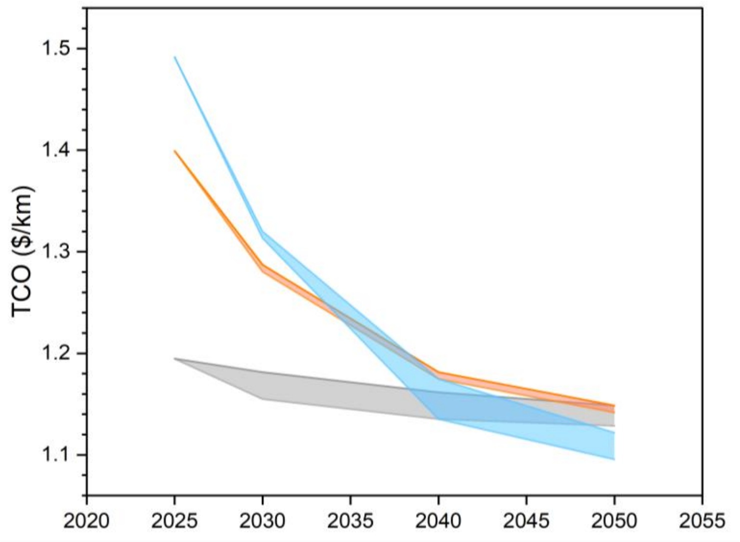
Time loss <100 min at 1.2 MW charger

Payload loss < 4 tonne

H2:

Payload gain < 1 tonne

15 tonne truck



Back-to-Base Operation

Battery:

Time loss 0 min, 350 kW charger

Payload loss < 2 tonne

H2:

Payload gain < 0.3 tonne

Summary

Pourandokht Naseri, Mauricio Di Lorenzo, Craig E. Buckley, *"Projected Cost Competitiveness of Zero-Emission Trucks in Australia" Under Submission*

1. Trucks Population <4% ←→ 30-40% of road emission
2. Net-zero for transport is possible through H_2 Adoption

   Only 47% of Road Energy Use can be provided by batteries.
3. Cost and Payload:
   1. Higher costs & payloads in Australia.
   2. Wages: Prime cost driver (45-60% of all costs)
   3. Zero-emission trucks cheaper than diesel by 2040-2050
   4. H_2 vs Battery:

      Now:

      Battery → short trips

      H2 → long-haul

      By 2050:

      H2 best for all operations
4. Pilot is important!

Thank You

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Curtin University

HSRG
Hydrogen Storage Research Group

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