NATROAD

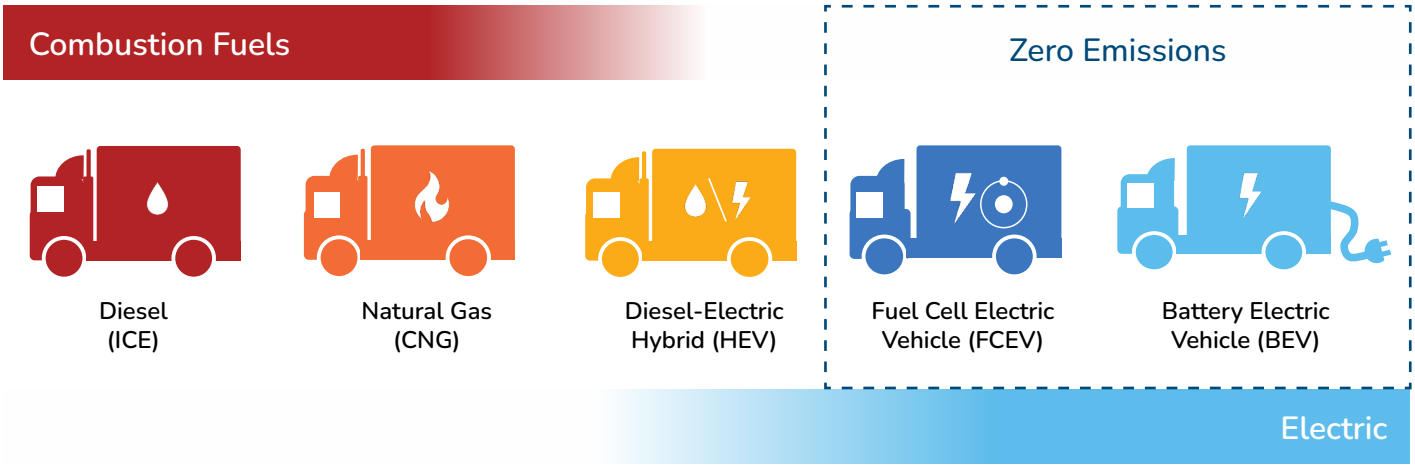
Get Fleet Fit
Fact sheet

Low-Emission Trucks

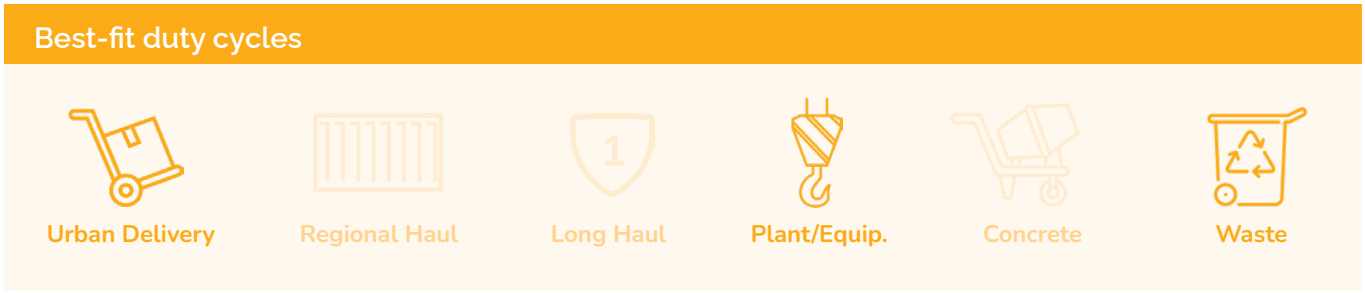
No engine noise, no fumes, power from the sun... zero emission trucks are on the road now.

"Low emissions", "zero emissions", "EVs", "hybrids" – it seems there are a hundred different names for the technology slowly transforming the trucking industry. What they all have in common though is a decreasing reliance on the diesel drivetrains so familiar to Australia's trucking industry, and an increasing reliance on an electric drivetrain. Zero Emissions trucks (right-hand side of the figure below) don't use any diesel technology and have zero tailpipe emissions.

For the next little while, buying a low-emission truck will still be one of the more expensive ways to save fuel and lower emissions. Here are the **4 major technologies** you are likely to have heard about, some of which you're going to hear a lot more about in the years ahead.



1. Natural Gas Vehicles



Natural gas is mainly methane – a lower-carbon, cleaner-burning fuel than diesel. Trucks powered by natural gas carry it as either compressed gas (CNG) or cryogenic liquid (LNG). The gas replaces some or all the diesel depending on the extent of modifications to the engine and fuel system (e.g. dual-fuel or spark-ignited engine). It still operates as an internal combustion engine, so tailpipe emissions are still produced, but fewer than running on diesel.

Generally, CNG is cheaper than diesel but prices fluctuate in the global market. Natural gas stores less energy than diesel though, so you use more of it, and can't go as far on a similar sized fuel tank.

Natural gas trucks were the great green hope two decades ago, but the fuel has been overshadowed by more advanced zero emission technologies. Most major truck manufacturers in Australia are no longer offering factory-fitted gas drivetrains and public refuelling stations are now rare.

Access all the resources here

Natural Gas Vehicles pros and cons

Pros	Cons
✓ Can be cheaper fuel than diesel (lower opex).	✗ Few truck models available.
✓ Lower emissions than diesel.	✗ Higher purchase price than a diesel truck.
✓ Similar refuelling time to diesel.	✗ No refuelling network/infrastructure.
✓ Australian derived fuel (no need to import).	✗ Lower driving range.
	✗ Emissions reductions vary by technology.

2. Diesel-Electric Hybrids (HEVs)

Best-fit duty cycles

As the name suggests, diesel-electric hybrids combine a traditional diesel engine with a small battery and electric motor. Think of them as super-efficient combustion engine vehicles – the battery improves fuel efficiency by supporting the diesel engine and recapturing power through regenerative braking. The battery can't be charged from an external electricity source – you only refuel a HEV with diesel.

Hybrid technology has been available in Australia for more than a decade however is currently only offered by one truck manufacturer. While still a tiny share of the overall truck market, around 200 hybrid trucks were sold in 2023. They require no charging infrastructure, no changes to operations, and can be used the same way as a diesel truck.

Diesel-Electric Hybrids (HEVs) pros and cons

Pros	Cons
✓ No new refuelling infrastructure needed.	✗ Higher purchase price than diesel.
✓ Fuel efficient & cost savings.	✗ Still relies on diesel and price changes.
✓ Familiar diesel-based operations.	✗ Only a small emissions reduction.
✓ Fast-refuelling; no extra downtime.	✗ Availability limited to lower GVM trucks.

3. Battery Electric Vehicles (BEVs)

Best-fit duty cycles

BEVs draw their energy exclusively from onboard batteries to power an electric motor. For truck applications, there can be several on-board battery modules, depending on the specification. Unlike hybrids, BEV batteries must be recharged by plugging into mains power.

Fully charging a completely flat battery could take days via an AC single-phase general power outlet, so battery electric trucks usually need higher-powered chargers. For most depot-based vehicles running one shift overnight charging via three-phase power (22kW) may be sufficient to fully charge a battery. For daytime top-up charging on vehicles travelling longer distances, DC charging (e.g. 50-250kW) can be used to charge more quickly or to serve multiple trucks. Fast chargers are more expensive to install and if you're charging several trucks at once at the same depot you may even need a costly upgrade to your grid connection. The fastest charging option will likely be seen at highway stops of the future with manufacturers planning for and demonstrating megawatt (>1000kW) charging stations. These will be able to recharge a BEV truck in 20 to 60 minutes.

The actual time it takes to charge a battery electric truck depends on several factors:

- The power of the charger (e.g. 250kW): this grabs all the headlines because it is the limit of how much energy can be transferred to the truck under ideal conditions.
- The battery management system (BMS) limits the power going into the truck to protect battery health: most BEV trucks today are limited to 150kW or less regardless of charger power.
- How full/empty the battery is, called its 'state-of-charge' (SoC). Battery health suffers if you regularly drain to very low levels, so best practice is to cycle between 20% and 80% or 90%. The BMS varies the power it accepts during the recharge to keep the battery temperature within limits – generally the higher the SoC, the slower it charges, so the last 10% can take longest.

BEV trucks have arrived in Australia and are growing in popularity, particularly in the light- and medium-duty segments. With around 200 sold commercially in 2023, BEV trucks are still a fraction of overall truck sales though new models and improved technology are arriving almost every month.

Battery Electric Vehicles (BEVs) pros and cons

Pros	Cons
✓ Very fuel efficient; no diesel refuelling.	✗ Higher purchase price (2-3x diesel trucks).
✓ Lower opex (electricity price vs diesel price).	✗ Downtime for charging large batteries.
✓ Zero tailpipe emissions.	✗ Requires chargers & related infrastructure.
✓ Powered by existing electricity grid.	✗ May require expensive electricity upgrades.
✓ Market coverage growing (~15 models).	✗ Payload penalty (heavy on-board batteries).

4. Fuel Cell Electric Vehicles (FCEVs)

Best-fit duty cycles

An FCEV drivetrain is powered by electricity (like a BEV), the difference is the energy is stored onboard as hydrogen. An on-board fuel cell converts hydrogen into electricity with the only by-product being water. FCEVs are refuelled from a hydrogen dispenser (as high-pressure gas or liquid), which fills large on-board tanks feeding the hydrogen into the fuel cell to generate the electricity. Hydrogen gas must be kept under very high pressure, or if in liquid form it needs to be very cold, so tanks need to be sturdy and they take up a lot of space. The FCEV system uses a battery to store, balance, and deploy electricity to the motor. The battery is much smaller than a BEV and not externally charged.

Some companies are experimenting with burning hydrogen directly in a combustion engine either with or without diesel (Read more on the Get Fleet Fit Fuel Swtiching fact sheet). This technology is less efficient than a fuel cell however several Original Equipment Manufacturer (OEMs) are investing heavily to determine if it can be commercialised in the future.

FCEV trucks are currently being trialled in Australia, but commercial sales are still rare. There are several models offered by a handful of manufacturers with plans for many more in the future. There are also many announcements of future refuelling stations, but currently no connected network.

Fuel Cell Electric Vehicles (FCEVs) pros and cons

Pros	Cons
✔ More fuel efficient than diesel.	✕ Higher purchase price (3x diesel trucks).
✔ Zero tailpipe emissions.	✕ Much higher fuel cost (hydrogen); higher opex.
✔ Similar refuelling time to diesel.	✕ No hydrogen refuelling infrastructure in Aus.
	✕ Payload penalty (large hydrogen tanks).
	✕ Few models available in Aus. market.

Taking action

Regardless of the fuel or technology you're interested in, there are some basic steps you should take to understand which (if any) of these technologies suit your business. There's no getting around it, you'll need to do a lot of your own research and assessment because you're the only one that understands what your business needs and how it can change. Critical assessments include:

Availability – Can you get a truck with this technology in the way you want?

- The right size for your loads/task (e.g. hybrid may not be available for heavy GVM).
- The right brand or dealer in your area to ensure aftersales support.
- Access to fuel/energy to support a switch (e.g. public EV charging or closest hydrogen)
- If you only buy second-hand trucks, is the technology available in the used market?

Suitability – Can the technology do the required job?

There can be compromises associated with zero emission technologies including longer refuelling/recharging time, lower payload capacity (due to a heavier powertrain), and shorter driving range before needing recharging/refuelling. It's important to consider how these might affect your current operations, so be realistic:

- Understand your current operations and performance. Do you always use full payload capacity (running at maximum GVM) or are your trucks usually part-loaded or cubed out? How many kilometres do your trucks drive in a day? How much fuel do you use in a day, and what is the fuel economy of current fleet? Interrogate your data.
- Don't overestimate what the technology can do (e.g. claimed driving range of a BEV might be under ideal conditions so may not be achievable with your load/route).
- Don't overstate what you need e.g. if your daily schedule is less than 150km then looking for a 300km battery electric truck will add significant cost and reduce your available options. Similarly, if your drivers typically break for lunch during their shift or your freight isn't time sensitive, you probably don't need ultrafast charging.

Viability – The upfront price is a major barrier for new technologies. If you can get past the 'sticker shock' it's more important to assess the whole-of-life cost or total cost of ownership (TCO), because differences in the cost structure mean that the price premium (the cost over and above a diesel truck) might be paid back quickly. Be sure to include all standing costs like registration, finance and insurance (often different for a low emission technology), as well as running costs like fuel and scheduled maintenance (usually lower than diesel trucks).

Practicality – Anything is possible but is a switch to new technology practical and feasible without disrupting your business?

- Consider if you'll have to drive further to access recharging (BEV) or refuelling (FCEV or CNG) and what impact that will have on your drivers and your schedule.
- If your trucks are often moved between tasks and/or have to backup other customer contracts, then flexibility is likely more important than an 'average' or typical day.
- If you service your own trucks, will you be able to do that with a new technology?

Understanding the implications of a technology switch allows you to develop a plan – the most important step to a smooth change. The plan should articulate the things your business will do beyond just buying a new truck. It should cover capital/infrastructure upgrades (e.g. for charging/refuelling equipment), steps to engage with new suppliers/ experts, data collection, check-in points to assess progress, and concrete actions to support and train staff during the change.

At every step, don't be bound by past thinking. Consider adapting your operation or business to suit the limitations and opportunities of the technology if it can bring other benefits. For example:

- having electric trucks could help attract drivers in a very competitive market.
- rescheduling to accommodate a daytime top-up charge might provide an additional rest break to increase driver satisfaction or reduce fatigue risks.
- electric trucks could reduce downtime for scheduled maintenance.
- reallocating occasional long-distance trips to another truck may better balance workload.

Find out more

Cummins is finding ways to reduce greenhouse gas in the Internal Combustion Engine (ICE) by developing technologies focusing on advanced diesel, gas and hydrogen.

The Truck Industry Council released a report into the state of Low and Zero-Emission Trucks, including a list of available models.

A mining site in Queensland is trialling CNG in two trucks using a dual fuel drivetrain with diesel.

Hino is the undisputed leader in **diesel-electric hybrid trucks** in Australia. You can read one review of the Hino 300 Series.

ARENA has been providing government funding for battery electric truck trials, including NatRoad member, Team Global Express. Some funding for smaller, last-mile operators has also been announced.

The City of Newcastle is one of the latest to trial a **fuel cell electric truck**. Read more about the hydrogen-powered waste collection vehicle here.

Get Fleet Fit has been designed by NatRoad to guide truck operators towards improved fuel efficiency and reduced emissions in alignment with future government regulations and customer expectations. We've developed a 5-step roadmap to help create a clear, actionable plan for your business, plus more detailed information on important topics to help you along your unique journey.

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