The Future of Buses and Light Commercial Vehicles Is Electric – With Cost Parity Just Around the Corner

Electrification of commercial road transport is still nascent, but switching to the fast lane. We explore what this electric transformation might look like in the future, using Australia as an example.

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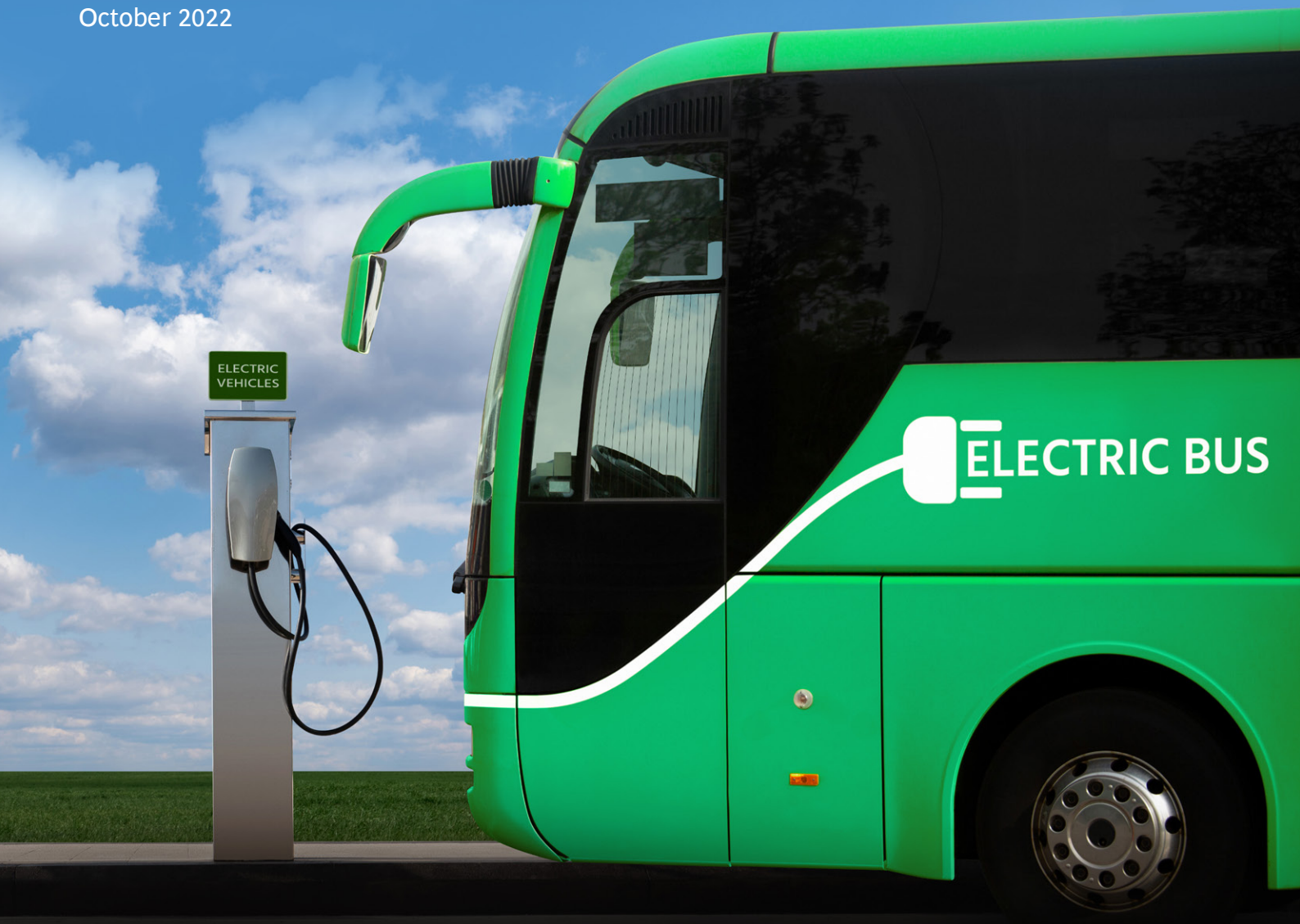

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With more than 1.5 million trucks and buses on the road in Australia alone, commercial road transport is a key driver of greenhouse gas emissions and an important lever to reach net zero as laid out by the Federal Government in its recent National Electric Vehicle Strategy. Although adoption of Electric Vehicle (EV) transport is still nascent outside of passenger vehicles, we expect to see significant growth over the next decade. This will happen in several waves, starting with fleet- and depot-based buses and light commercial vehicles, followed by intra-city and medium distance commercial and passenger freight vehicles.

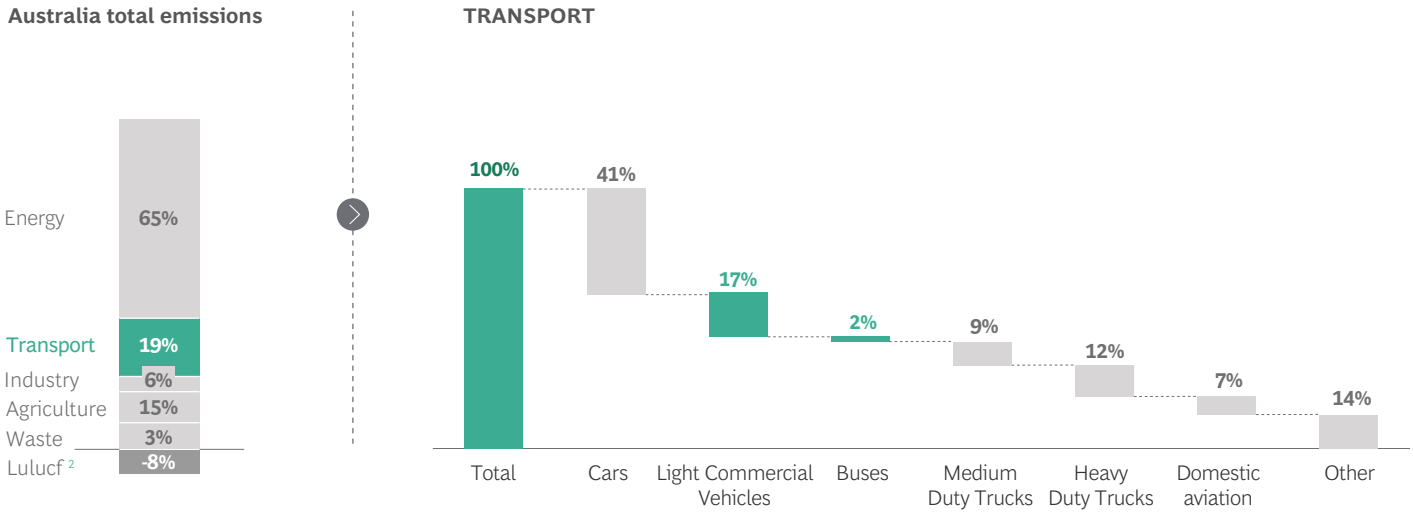
For transit buses, cost parity has already arrived. To accelerate bus and light commercial EV uptake, regulatory support is needed at national, state and city level and an uninterrupted battery supply chain - from raw inputs to material processing and battery cell manufacture. The recent announcement that NSW will phase the electrification of its bus fleet until 2047 (rather than until 2030 as initially planned), shows that this is a challenging transformation.

In the following article, we share some insight into how this transformation will take place, potential accelerating and braking effects, and how businesses and organisations can prepare for an electric future.

Electric cars are not enough — Australia needs to shift gear and start electrifying commercial vehicles to reach net zero

Australia has one of the world's most emission-intensive road transport sectors. Almost 20% of Australia's total greenhouse gas emissions come from cars and trucks compared with 16% globally[1], and more than half of those emissions come from commercial transport (see Exhibit 1). Although electrification of Australia's passenger vehicles has gathered pace in recent years with sales nearly tripling in 2021, a focus on cars alone is not enough; to reach ambitious emissions reduction targets (and net zero by 2050), Australia needs to decarbonise its commercial transport sector as well.

Exhibit 1: Breakdown of greenhouse gas emissions in Australia



Source: Annual reports, Climate Finance Markets and the Real Economy – BCG + GFMA report, Greenhouse and energy information by designated generation facility 2019–20, BCG

Besides reducing emissions, electric vehicles have other notable advantages: from reduced noise pollution and environmental costs for communities, to lower maintenance costs for businesses, to a reduced dependency on fossil fuels for the overall economy. With Australia only holding less than 100 days fuel supply reserve, ongoing global supply chain challenges and rising fuel prices, these other advantages may gain further importance in the near future.

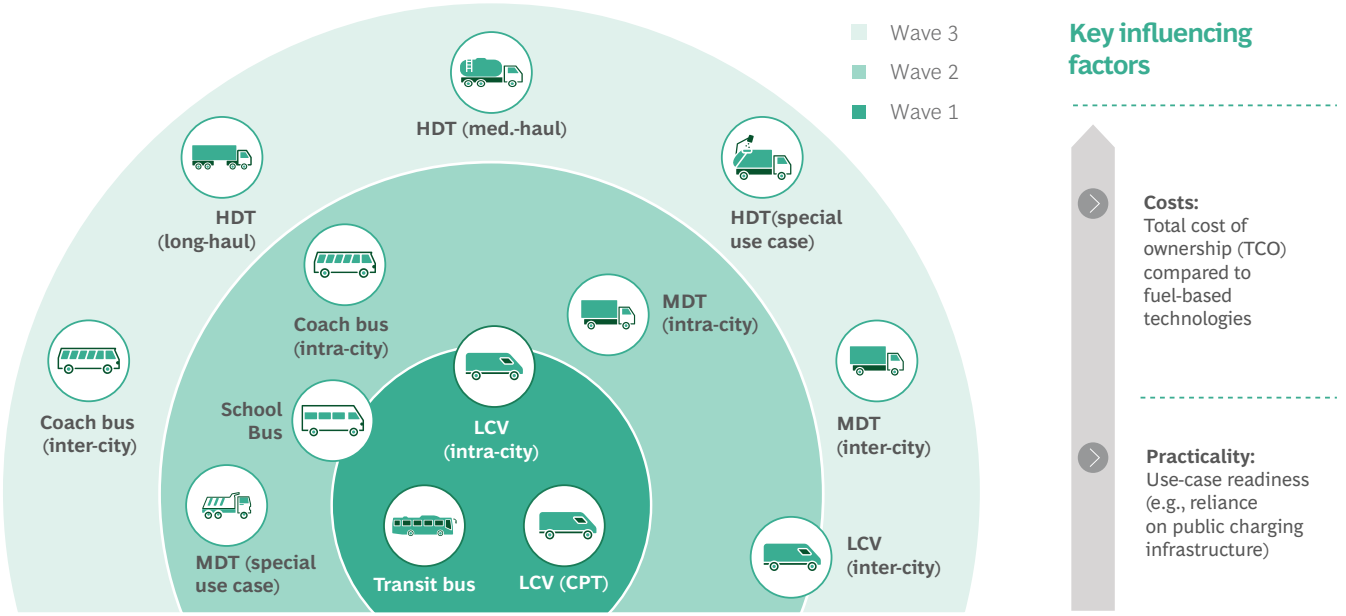
1. How to Avoid a Climate Disaster, by Bill Gates
2. Land-use, land-use change and forestry

The first wave of commercial vehicle electrification is underway, with two more waves to follow

Rather than a uniform transition, electrification of light and heavy commercial vehicles will follow three discrete waves (see Exhibit 2):

- **Wave 1:** Transit buses and intra-city light-commercial vehicles (LCV)
- **Wave 2:** School buses, intra-city coach buses, inter-city light-commercial vehicles, and selected uses cases for medium-duty trucks (MDT)
- **Wave 3:** Inter-city buses, inter-city medium-duty trucks, and heavy-duty trucks (HDT)

Exhibit 2: Electrification of commercial road transport is expected to follow three waves



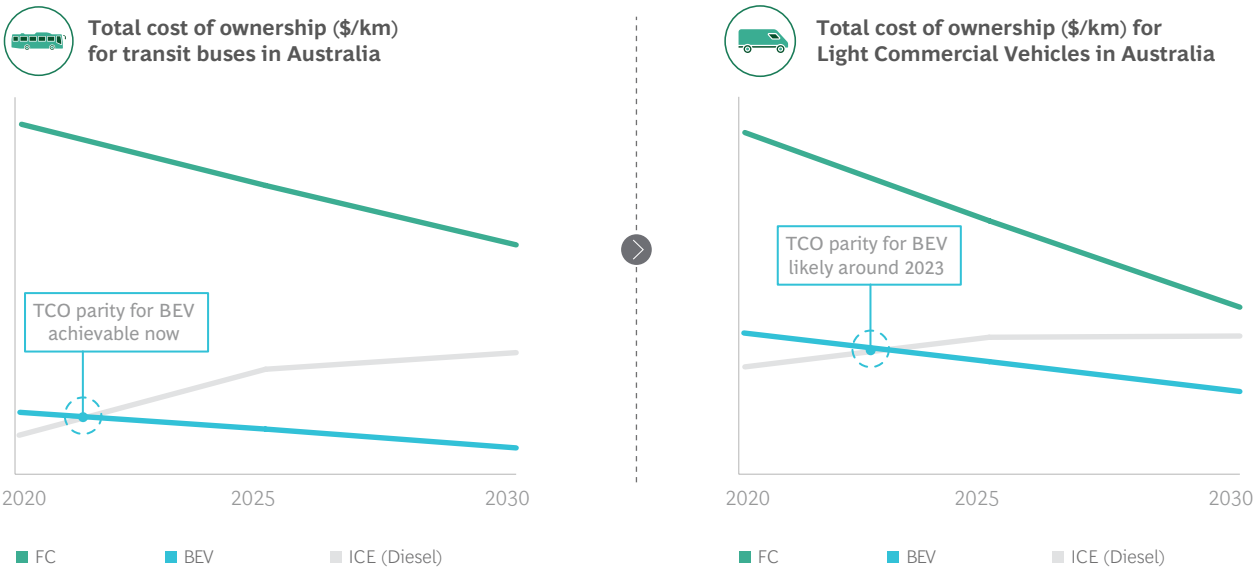
LCV: Light Commercial Vehicles; MDT: Medium-Duty Vehicles; HDT: Heavy-Duty Vehicles; CPT: Courier Parcel Transport

Source: BCG analysis

The key driver of electrification of commercial vehicles is when their TCO reaches parity with internal combustion engine (ICE) options, which is largely a function of upfront cost and utilisation. Lighter vehicles with short trip distances and low idle time will reach upfront cost parity before heavier vehicles that need to travel longer distances. This is because the largest cost component in an electric vehicle is the battery, and the size of the battery required is determined by the distance able to be travelled between charges and the average energy demand across that distance. Utilisation is also important because electric vehicles typically have significantly lower running costs than ICE vehicles, so the more an EV is used, the faster it will pay back the increased upfront cost and the more likely it will be to achieve TCO parity.

TCO parity has already been reached for transit buses (see Exhibit 3) due to the high utilisation and modest energy requirements, and light commercial vehicles is only one year away. Other bus types will come on board in wave 2, including school buses and particular types of coaches (e.g., employee transport buses, and day tour buses), which will reach ~80% and ~55% electrification by 2030 respectively (see Exhibit 4). Compared to transit buses, their longer replacement cycle and less intensive usage will result in slower adoption. Wave 3 includes heavy vehicles with high payloads and power requirements, which hydrogen FCEV powertrains may be able to service more economically.

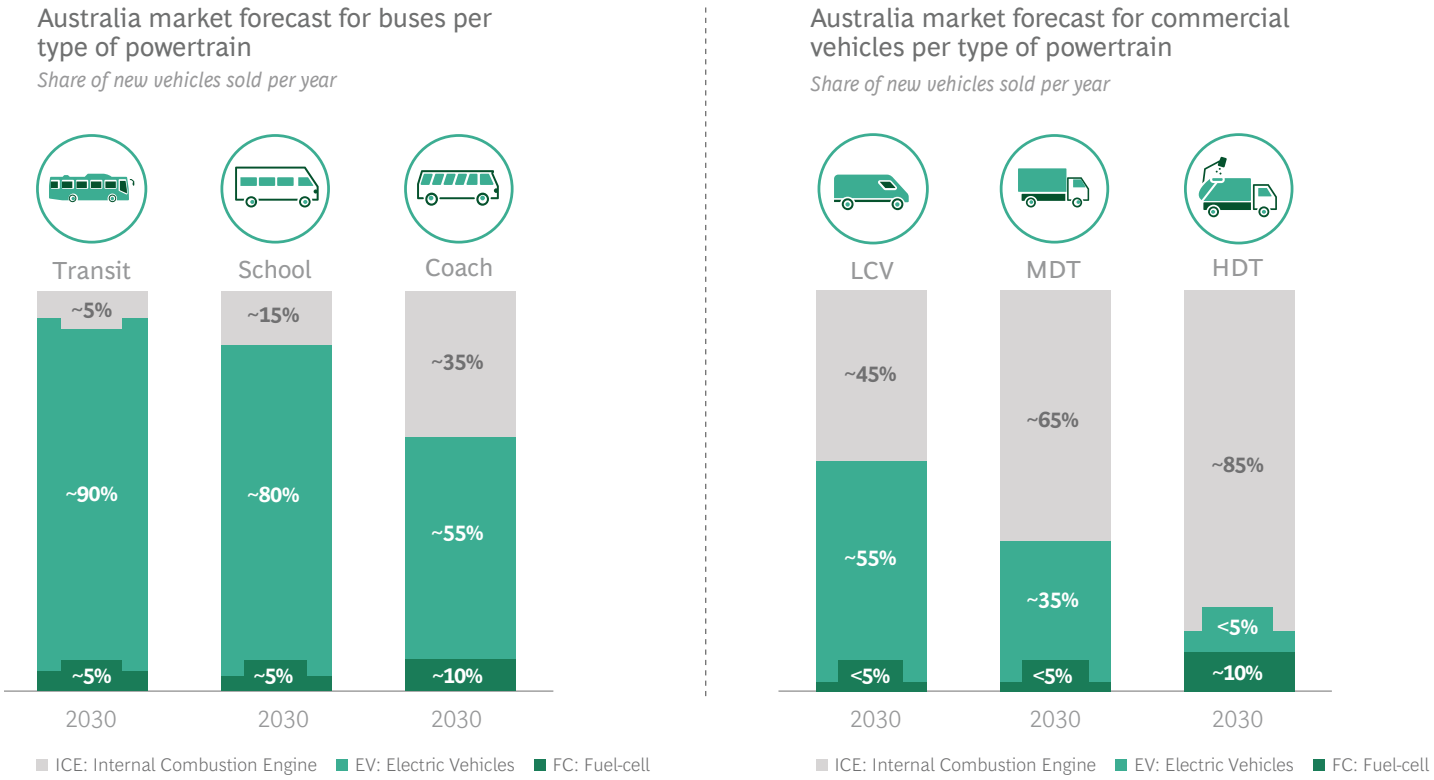
Exhibit 3: already achievable now, TCO parity for LCVs likely around 2023



Source: IHS Markit Automotive (2022); ABS; AEMO; World Bank, Expert interviews; BCG analysis

However, TCO parity is not enough; charging infrastructure also needs to be available for each specific use-case. The shorter range and nightly return-to-depot usage patterns of transit buses and light commercial vehicles for last-mile delivery are suitable for EVs because their fleet-based operations mean they are not dependent on public charging, and private infrastructure can be installed at existing depot.

Exhibit 4: Electrification of buses expected to be faster than electrification of commercial vehicles



Source: IHS Markit Automotive (2022); ABS; AEMO; Expert interviews; BCG analysis

Waves 2 and 3 of electrification will see non-depot use-cases and longer distance transportation which will be dependent on public or on-route charging infrastructure. This will include light commercial vehicles used in inter-city transport, intra-city medium-duty trucks engaged in short regional distribution and hub-to-hub traffic, and some selected and special heavy-duty truck use-cases.

Electrification is not the answer for all commercial vehicles

While electrification is winning the race to zero in selected light and medium commercial vehicles, the jury is still out on the optimal decarbonisation technology for heavy vehicles, both due to longer distances travelled and the trade-off between payload and battery size. Some use-cases, such as long-distance inter-city coach transportation, and long-distance trucking routes, are not likely not to see electrification by 2030 due to their reliance on high- voltage highway charging infrastructure. Instead, hydrogen fuel cell technology will play an increasingly important role in decarbonizing these vehicles and driving towards net zero. Especially for heavy-duty off-road vehicles (e.g., dump trucks) there is currently no clear winning technology expected for the next decade. Only low load and range vehicles of selected use-cases (e.g., underground mining) are suited to battery electrification.

Commercial electric vehicle adoption in Australia will be subject to major accelerators and brakes

While the waves of commercial vehicle electrification are dictated by cost (total cost of ownership compared to fuel-based technologies) and practicality (use-case readiness,e.g., reliance on public charging infrastructure), three additional factors can accelerate or slow down those waves. Organisations will need to keep an eye on these signposts as they could indicate a need to move plans forward or develop contingencies.

Accelerator: Regulatory support

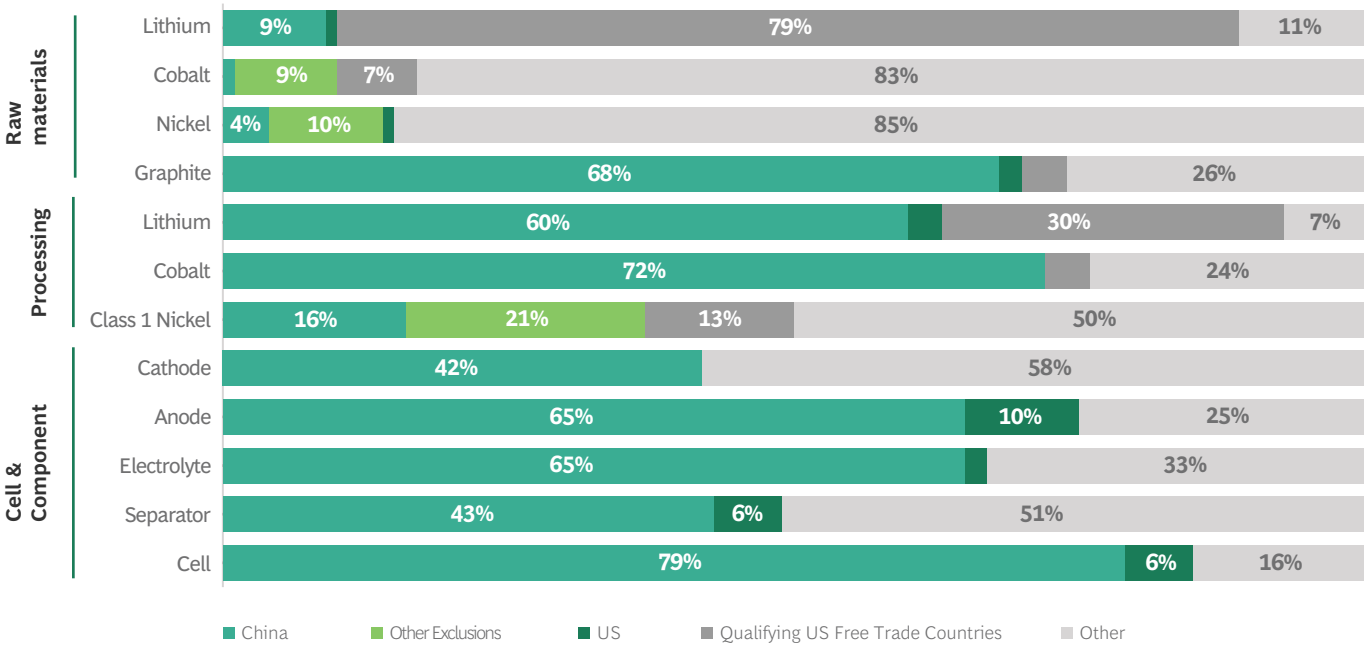
Regulatory support is likely to be an accelerator for adoption through, for example, ICE bans or incentives to switch to EVs. In the US, the Inflation Reduction Act (August 2022) has multiple tax credits and incentives, including USD 40,000 for purchases of new electric or hydrogen trucks and buses including off highway vehicles. BCG estimates that, as a result, close to half (47%) of all light vehicle sales, excluding vans, in the US will be electric by 2030. While Australia is lagging international peers in terms of regulatory support, this is expected to change following the recent federal election. The recently published National Electric Vehicle Strategy is a first sign of a stronger federal support for greater adoption of electric vehicles. In addition to a more robust federal climate agenda, Australian state governments have also focused on emissions reduction and other interventions, particularly in the transport sector. Targeted interventions can speed up the adoption of specific types of commercial vehicles. This is particularly the case for the bus sector, where operators are contracted by the state government. In Victoria, all transit buses purchased from 2025 are targeted to be zero

emissions and in the ACT, the entire bus fleet targeted to be full electrified by 2040. Although NSW recently delayed its initial goal to electrify 100% of the state's transit buses from 2030 to 2047, half of its fleet (~4,000 vehicles in Sydney) are still planned for replacement by electric buses by 2035. With pressure on other states to adopt similar targets, electric bus adoption is likely to accelerate further.

While regulation in Australia is now generally very supportive of legislation, one policy on the table could slow down adoption: road user levies. Presently, electric vehicles receive an inadvertent subsidy by not paying the federal fuel excise (because they don't purchase any fuel). But Victoria has implemented a per kilometre levy for EVs, and other states may follow suite. While a necessary change in the long term, such policies may have a detrimental impact on EV impact in the short term.

Exhibit 5: High concentration of raw materials produced in China used for processing and for cells/components of electric vehicle (EV) batteries

Share of global production, 2021 (%)



Source: H.R. 5376 – Inflation Reduction Act (congress.gov), BCG analysis

Brake: Supply chain constraints

Several global challenges across the entire battery supply chain will need to be overcome to meet future demand. With demand for lithium and other rare earth minerals (e.g., nickel and cobalt) growing at >25% CAGR per year through to 2030, supply constraints and cost increases may delay the tipping point for EV adoption and slow the build-out of battery capacity. Additionally, global supply chains for EV batteries rely heavily on China especially for raw materials processing and cells/components (see Exhibit 5). Alleviating this bottleneck and reliance will require building resilience in the mining of rare earth elements, material processing, cell component production and various stages of cell manufacturing. For a more detailed view on what action is needed to boost supply in a sustainable way and keep the transition to electric vehicles on course, see BCG's latest publication, The Lithium Supply Crunch Doesn't Have to Stall Electric Cars.

Brake: Vehicle availability

Australia, as an isolated market without end-to-end original equipment manufacturer (OEM) production, is particularly vulnerable to the availability of vehicle inputs. OEMs are currently not incentivised to export EVs to Australia, which may result in a supply gap and increased costs. Given limited bus and commercial vehicle manufacturing in Australia, uptake of EVs continues to be highly dependent on imports from Europe (e.g., Volvo, Daimler, MAN, Scania) and China (e.g., Yutong, BYD). Similar to the situation for passenger vehicles, there some risk that Australia becomes the 'dumping ground' for ICE commercial vehicles while OEMs are not incentivized to prioritise the Australian market over other regions (e.g., Europe) that have stricter emission regulations. However, this also presents an opportunity for Australia's local bus assembly capabilities to ramp up (e.g., knock-down manufacturing) – a sector that has experienced surging demand and an increase in lead times.

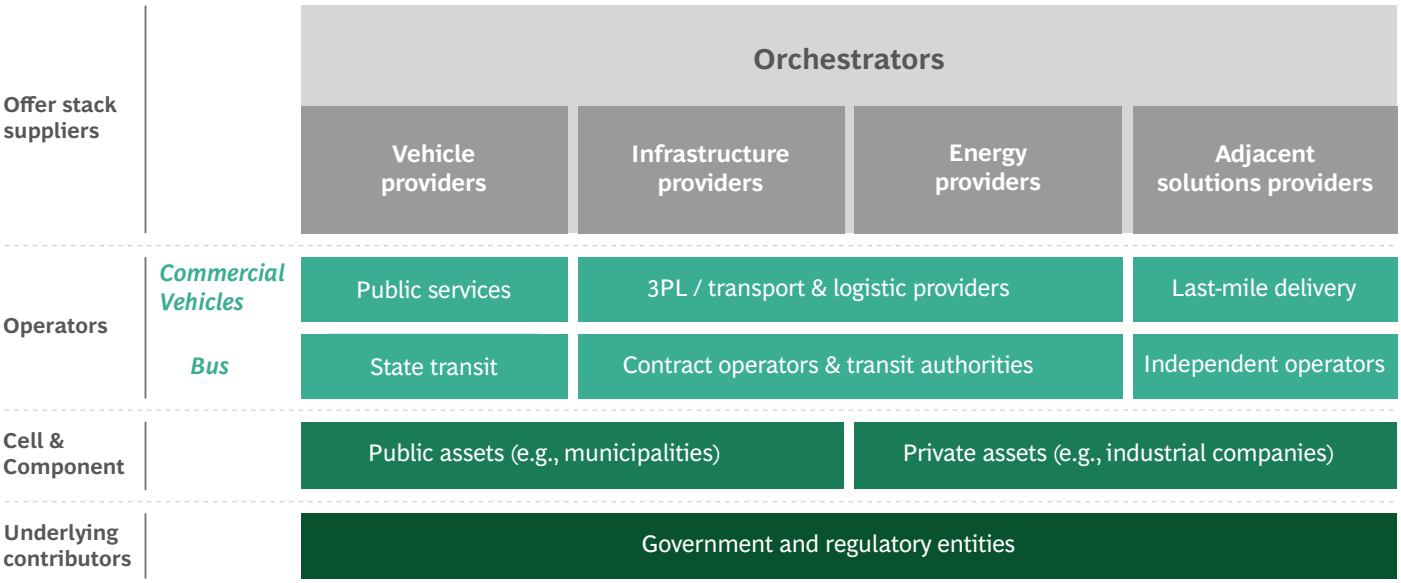
Players in the commercial transport ecosystem need to act now to be prepared for an electric future

It is already clear that most buses and light commercial vehicles will be electric rather than hydrogen fuel-cell powered. That's why key players in the commercial transport ecosystem need to start preparing now to not be left behind (see Exhibit 6).

Bus operators need to start preparing to transition to electric fleets now. The economic advantage of electric buses is clear, with all bus types either at TCO parity with diesel, or reaching TCO parity within the next three years. Operators will need to continue considering infrastructure and use-case readiness in decisions on when and how to electrify: from self-procurement to integrated turnkey solutions and vehicle-as-a-service solutions. A self-procured solution may be less costly in aggregate, but an integrated turnkey or subscription-based solution may de-risk the transition and reduce the capital required to rapidly electrify.

In the transit and school bus sector, where buses operate in urban environments and largely under a return-to-depot model, the transition to electric is already underway—particularly in NSW and the ACT.

Exhibit 6: Overview of key players in the commercial road transport ecosystem



Source: BCG experience

In the coach segment, operators will need to consider the specific use-cases and whether the current infrastructure supports electrification. For short and medium-haul usage (e.g., employee transport coaches, and day tour coaches), the case for electrification is strong, and around ~50% of new coach sales are expected to be electric by 2030.

Bus operators need to start securing supply today to avoid potential supply chain challenges emerging from the rapid electrification of vehicles. As recently seen in NSW – setting ambitious targets is not enough. Bus operators and transit authorities need to start preparing the broader infrastructure ecosystem to enable transport electrification. With constraints on lithium and rare earth minerals, batteries may become increasingly difficult to procure. And with increased demand on international and local bus manufacturers, the lead time for bus OEMs may draw out replacement cycles.

Commercial vehicle operators will see increasing benefits to electrification over the coming years, particularly in the light commercial vehicle segment that primarily services shorter intra-city last-mile delivery. TCO parity is expected to be achieved by 2023 for light commercial vehicles, with depot-based fleet operators in the first wave to electrify given they are least reliant on public infrastructure. We expect that yearly sales of electric light commercial vehicles will reach around ~55% of new sales by 2030, primarily driven by demand in New South Wales, Victoria, and Queensland, where policies and infrastructure are most in favour of electrification.

With the shift to electrification, operators of light commercial fleet vehicles need to transition their existing fuel-based fleets to EVs in the near to mid-term, requiring both significant upfront investments and also the operating expertise to run the business in a new paradigm of mobility. EV fleets have unique operational and optimisation constraints compared to traditional fuel-based fleets and the required operating expertise is distinctly different. While software solutions are coming to the market to support operators through this transition, the arrival of EV fleets will require a fundamental shift in the operation of commercial fleets. Therefore, operators of commercial fleet vehicles need to start building these capabilities to be prepared for the disruptive transition to electric vehicles.

Governments, regulatory authorities and route concessionaries will need to create a regulatory environment that supports and incentivises EV adoption, and ensures supply and infrastructure will meet demand. This will include investing in public infrastructure and grid networks to support building of new depots, and to expand the use-case readiness of electric vehicles. With the National Electric Vehicle Strategy, the Australian Federal Government laid out first actions to establish the right systems and infrastructure to enable greater and a more rapid adoption of EVs. As electric vehicles make up a larger proportion of vehicles on the road, governments will also need to switch from fuel-based to road-based levies to fund road infrastructure.

Commercial road transport **offer stack suppliers** will also have an increasingly important role to play in the electrification transition. Vehicle OEMs will play a central part in accelerating the launch of new electric vehicles, with smaller new and local manufacturers having the opportunity to break into a challenging market. In particular, the more regulated bus market, with import restrictions on

larger buses, presents an opportunity for local OEMs and assemblers to inform operators of potential TCO benefits of electrification and negotiate early contracts. Infrastructure providers can act by accelerating the ramp-up of required infrastructure, focusing particularly on early adoption use-cases. Examples include developing the hardware and software required for mass-scale depot charging, and management of battery assets. Additionally, energy providers can also support the ramp-up of grid networks, and explore potential adjacent business models, particularly in charging, where expertise in energy networks will allow for a competitive advantage.
The rapid electrification of bus and commercial fleets will also open opportunities for orchestrators to build new business models around electric vehicles and address some of the critical challenges in adoption. For example, usage-based models and new financing models to alleviate the capital constraints operators may face in the adoption of electric vehicles.

Conclusion

While electrification of cars is typically the focus of transport decarbonisation, it's important not to lose sight of the remaining half of the challenge. Light commercial vehicles, buses and even some trucks are ripe for electrification. The recent energy market context with higher fossil fuel commodity prices and the stronger global decarbonisation agenda further accelerates an already rapidly emerging trend in commercial vehicle electrification, creating risks and opportunities for companies along the commercial vehicle value chain.