ENDGAME SCT Consulting

16/02/2026

Decarbonising Transport

Implications of the Electric Vehicle Transition for Transport Planning and Appraisal

DESCRIBE, UNDERSTAND, MODEL, SOLVE

Contents

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01

Executive Summary

The emergence of electric vehicles will have a profound impact on the energy and transport sectors

Endgame Analytics is undertaking a research series on decarbonising transport, exploring the interactions between policy, technology, and economic strategy.

The transition from Internal Combustion Engines (ICE) to Battery Electric Vehicles (BEVs) creates a nexus between the electricity sector and road transport. This creates a bi-directional relationship: charging behaviours will have implications for the electricity grid, while the costs of driving will depend on electricity market dynamics.

This paper forms the first instalment of our series, focusing on consumer BEV adoption. While the transition is in its early stages, with BEVs representing approximately 8% of new sales in 2025, the structural implications for infrastructure planning, project appraisal, and consumer economics are imminent.

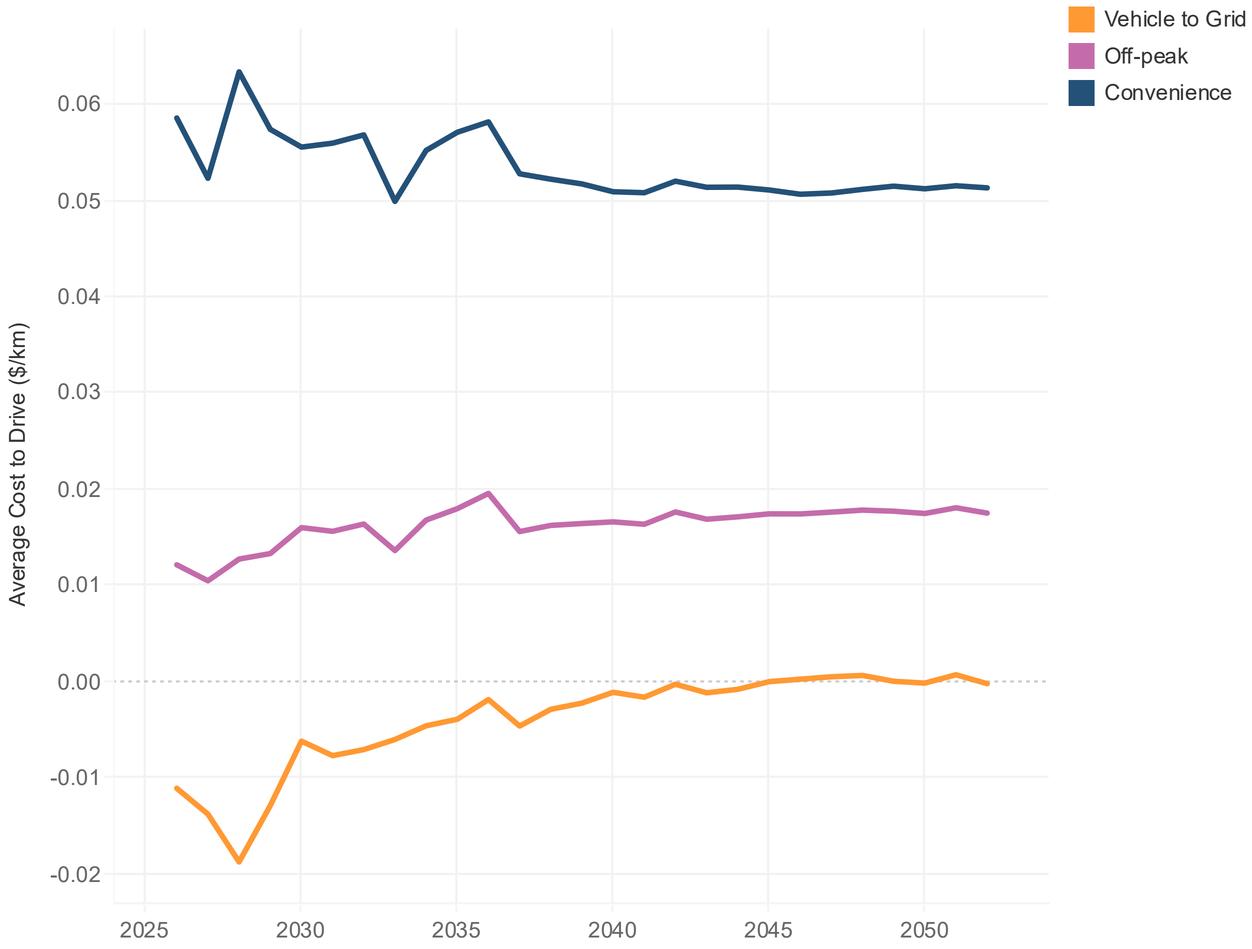
We highlight critical areas for further research, specifically regarding demand elasticities for private travel and the complex opportunity costs of Vehicle-to-Grid (V2G) participation. Furthermore, we outline the necessary evolution of policy frameworks to manage this transition effectively.

We Found:

The wholesale electricity market is undergoing intense transformation. The emerging generation mix will fundamentally reshape daily price cycles, interacting heavily with BEV charging behaviours. Our modelling tests these interactions across convenience, off-peak, and V2G profiles.

On a per-kilometre basis, the combined wholesale and network charging costs are estimated at 5.0 – 6.3 cents for the convenience profile over the next 25 years, compared to -1.9 – 0.1 cents for V2G. This represents a substantial operational saving against the 7.2 – 20 cents per kilometre typical of an ICE vehicle.

Projected network and wholesale driving cost under different use profiles



BEVs offer superior operating economics, though realised savings will increasingly depend on active market participation

As new retail schemes emerge, we see a divergence in consumer costs between "active" users (who leverage wholesale arbitrage) and "passive" users.

BEVs deliver significantly lower vehicle operating costs (VOC) due to reduced fuel and maintenance requirements. For a typical Sydney commute (26 minutes, 18 km), we estimate the generalised cost per kilometre for a BEV is 19% to 27% lower than for an ICE driver. We observe a reduction in fuel costs of 65% to 100% and a ~50% reduction in maintenance costs, attributed to the simpler electric drivetrain.

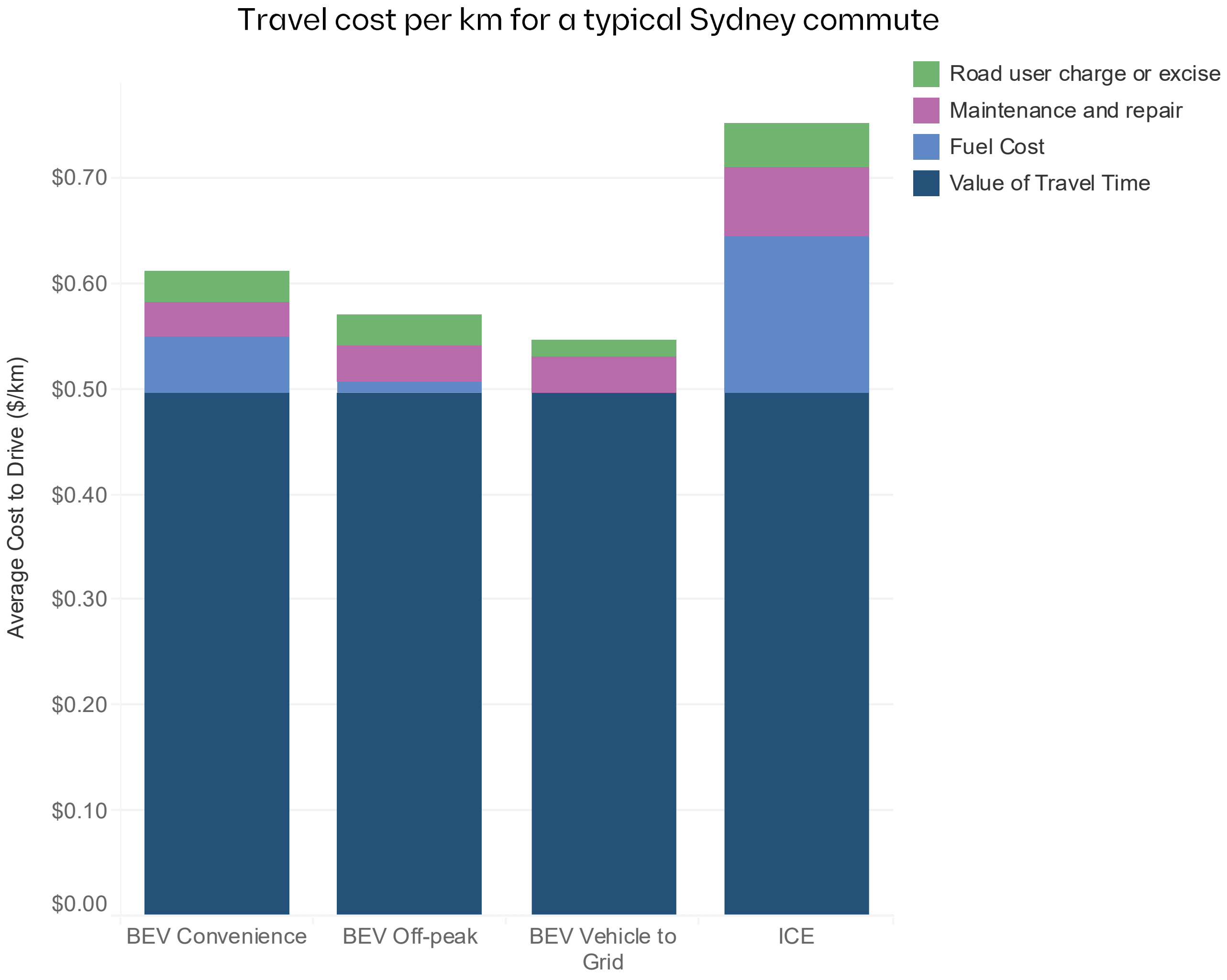
V2G technology introduces a novel opportunity cost, where using the vehicle for mobility forfeits potential revenue from grid support.

The reduction in VOC lowers the generalised cost of travel, which is expected to induce demand. In Cost-Benefit Analysis (CBA), this may direct investment outcomes toward road projects. Consequently, environmental benefits must be carefully weighed against potential congestion externalities.

The decline in fuel excise necessitates a transition to Road User Charges (RUC) to secure revenue and manage the congestion risks of lower-cost mobility. Concurrently, government intervention is required to ensure equitable charging access for renters and to coordinate the grid integration of emerging high-speed charging technologies.

Acknowledgements

We would like to extend our gratitude to Vartguess Markarian (Markarian Economics Pty Ltd) and Aidan McGann (Mountain Vista Advisory Pty Ltd) for their expert review and constructive feedback, which greatly strengthened the analysis presented in this paper.



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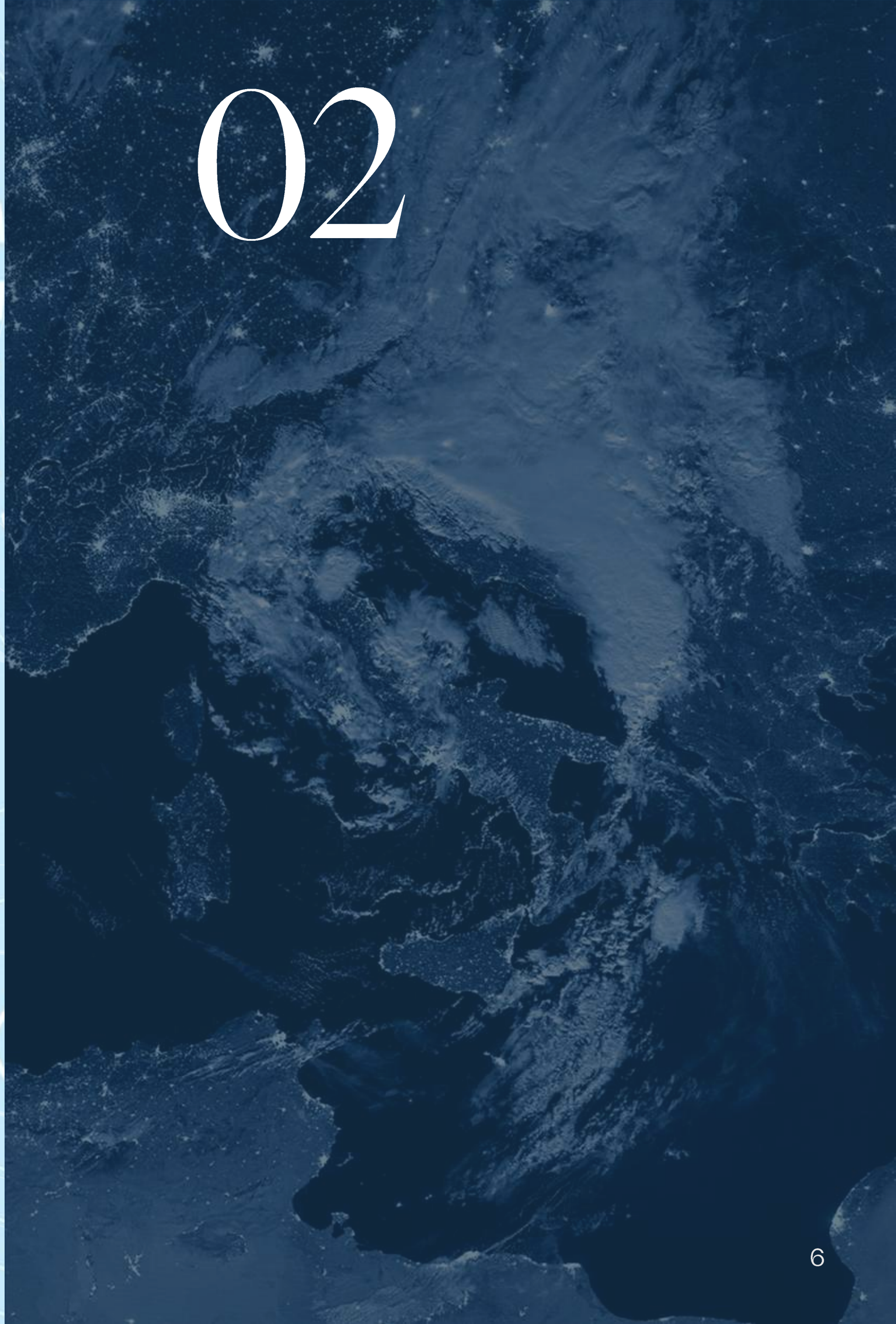


Introduction

Transport appraisal policy is not keeping up with the electric vehicle transition

The transport sector is currently Australia's third-largest emitter, accounting for approximately 22% of national emissions. Passenger cars and light commercial vehicles alone contribute 60% of our transport emissions and over 10% of Australia's total emissions[1].

Battery Electric Vehicles (BEVs) are important for Australia's emissions-reduction commitments. While currently accounting for just 1.8% of the car fleet[2] — or roughly 2% when including Plug-in Hybrid Electric Vehicles (PHEVs) — momentum is building. In 2025, BEVs represented approximately 8% of new car sales, with the total Electric Vehicle (EV) sales share reaching 12.1%[3]. This current low fleet share creates a window to plan for significant structural implications before mass adoption occurs.

Simultaneously, the National Electricity Market (NEM) is shifting from thermal generation to renewable energy, increasing the need for system flexibility to ensure supply remains reliable during low renewable generation windows. This will also create the potential for arbitrage, as prices are lower when there is excess solar output, and higher in the evening. Integrating transport into this landscape creates a bi-directional relationship: charging behaviour affects grid stability, while electricity market volatility dictates transport costs. With Vehicle-to-Grid (V2G) technology, driving incurs a new opportunity cost: using the vehicle for mobility forfeits potential revenue from discharging energy during high-price events.

In the transport sector, the switch to BEVs will reduce the cost of driving through lower refuelling and maintenance costs. Lower generalised travel costs have the potential to increase demand for private vehicle travel, shifting users away from public transport and increasing congestion. Existing Australian transport appraisal and demand modelling guidelines provide limited guidance on how to account for BEVs in appraisals and do not capture the dynamic interaction between the developing NEM and transport behaviour.

This paper explores the high-level interactions between the electricity and transport sectors, specifically examining how wholesale market dynamics, network tariffs, and retailer structures affect the cost of driving. Collectively, these elements form the consumer cost stack — the layers of separate charges that build up the final price on an electricity bill.

In doing so, we highlight the need for future research to value the costs, benefits, and externalities of this coupled system and provide guidance for transport appraisal in an electrified future.

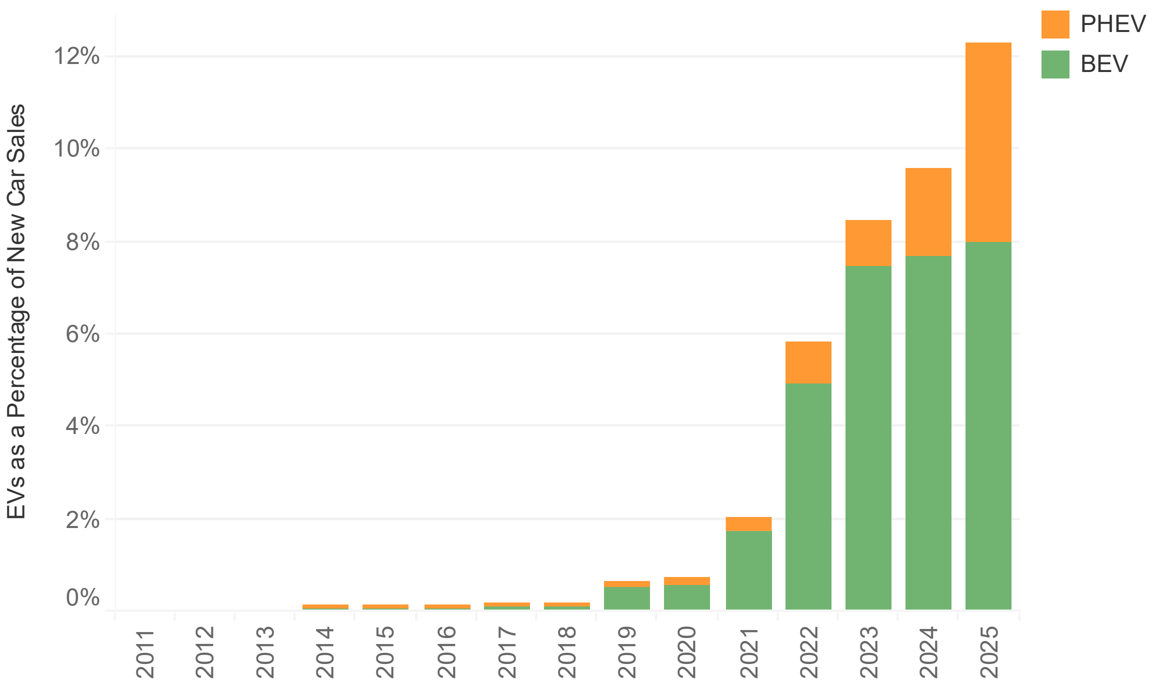
[1] Department of Climate Change, Energy, the Environment and Water 2025. *Reducing transport emissions.* [2] CSIRO 2025. *Electric vehicle projections, page 52.* [3] Electric Vehicle Council 2025. *State of Electric Vehicles, page 16.*

The state of Australia's electric vehicle market in 2025

Australia's electric vehicle uptake remains in its early stages, driven primarily by innovators, early adopters, and corporate fleets. While EVs achieved record market share in 2025, recent growth has been propelled largely by PHEVs rather than pure battery electric vehicles.

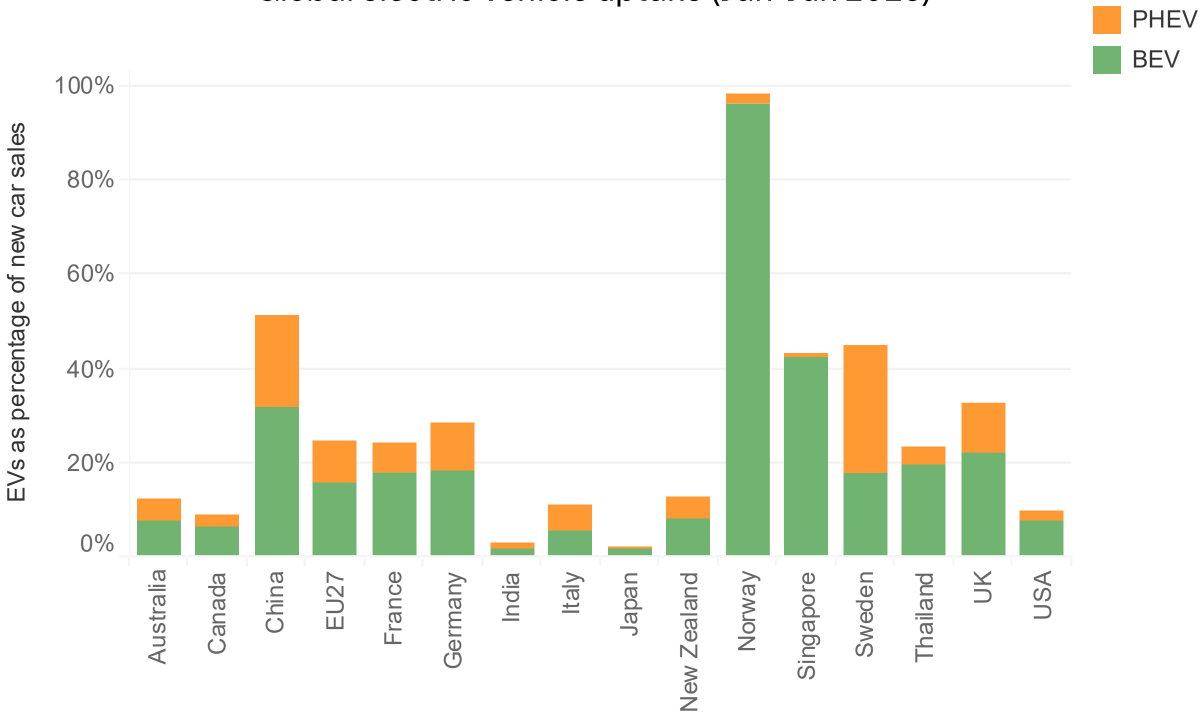
In 2025, electric vehicles captured 12.1% of all new car sales, up from 9.6% the previous year — a 24% year-on-year growth in EV market share. Despite this sales momentum, on-road penetration remains in its early stages, with BEVs comprising just 1.8%[1] of the national fleet (approximately 2% when including PHEVs).

Australian electric vehicle sales[2]



Drivers now have more choice than ever, with more than 150 different EV models currently on sale in Australia with new product launches almost every other month.

Global electric vehicle uptake (Jan-Jun 2025)[3]



Australia's current uptake of BEVs lags behind leading international markets. When considering both BEVs and PHEVs, Australia's combined share of new car sales stands at 12.1%, sitting below the 2025 global average of approximately 25%. Norway continues to lead the transition with around 95% of sales, followed by China at 50%. However, Australia's uptake is higher than several other major markets, including the USA and other major automotive markets, such as Japan and India.

[1] CSIRO 2025. *Electric vehicle projections, page 52.*. [2] Electric Vehicle Council 2025. *State of Electric Vehicles, page 16.* [3] Electric Vehicle Council 2025. *State of Electric Vehicles, page 23.*

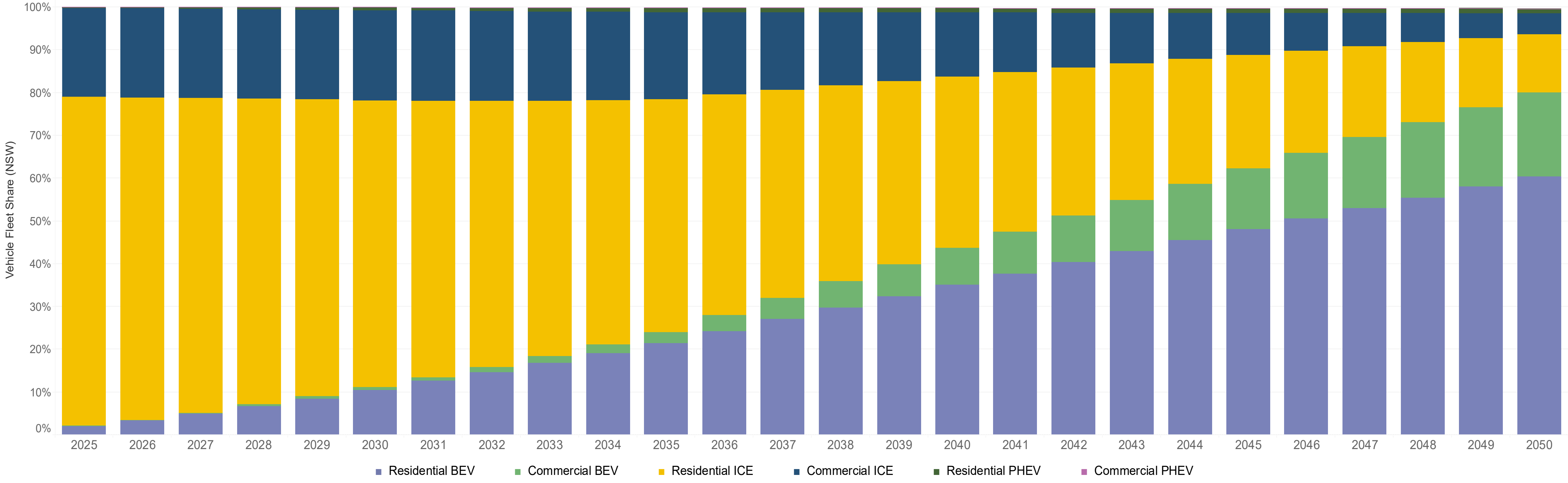
Projections of EV uptake vary widely and will be influenced by available infrastructure and policy incentives

Looking forward, Australian Energy Market Operator's (AEMO) Progressive Change, Step Change, and Green Energy Exports scenarios project a significant shift in fleet composition, estimating the residential BEV fleet share will reach a very ambitious 23–33% by 2035 (71–100% of sales) and 67–99% by 2050 (100% of sales).[1]

This transition implies a corresponding decline in Internal Combustion Engine vehicles. The NSW residential fleet is projected to transition from its current dominance of 5.2 million vehicles to just 1.1 million vehicles by 2050. A similar trajectory is projected for the commercial fleet, though BEV uptake is expected to be slower in the short term.

Achieving substantial uptake will require significant policy action and infrastructure investment. Critical levers to facilitate this transition include more stringent vehicle emissions standards, expanded model availability, purchase incentives, government fleet targets, and the deployment of public charging infrastructure[2].

Projected fleet share of BEV, PHEV, & ICE vehicles in NSW (Step Change)[3]



[1] CSIRO 2025. *Electric vehicle projections, page 52.* [2] Lodhia, S. K. et al. 2024. *Assessment of electric vehicle adoption policies and practices in Australia: Stakeholder perspectives* . [3] AEMO 2024. *Electric Vehicle workbook.*

03

EV Charging and Electricity Market Dynamics

Understanding the electricity supply chain

The cost of charging an electric vehicle over time is subject to the electricity cost stack — the layers of separate charges that make up an electricity bill:

- Wholesale Costs: The cost of generating electricity (e.g., from solar, wind, and coal).
- Network Tariffs: The cost of transporting that electricity through the transmission and distribution network to your home.
- Retailer Costs: Cover the cost of packaging these services into a retail plan, managing accounts, billing and retailer margin etc.
- Environmental Schemes: Levies to fund renewable energy targets and efficiency programs. These currently comprise a small proportion of the total cost stack.

We use NSW as a case study to illustrate how costs will change over time in this paper, yet the core findings are applicable across the NEM. While fundamental structural shifts — such as increased renewable penetration and evolving network tariffs — are consistent nationwide, regional variations in generation mix and climate will influence specific outcomes. Our analysis is done on an ex-GST basis.

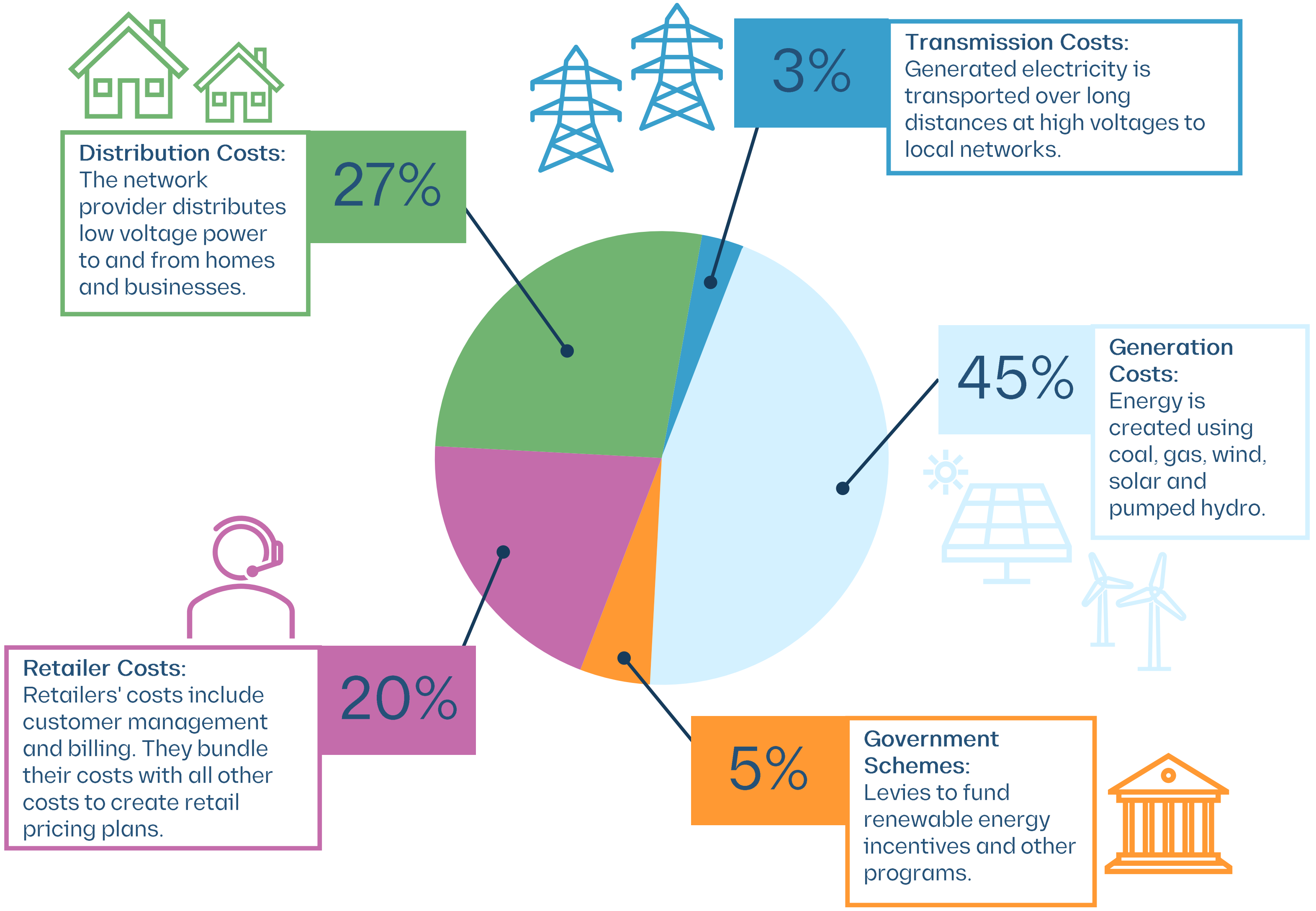


Figure data sourced from Endeavour Energy

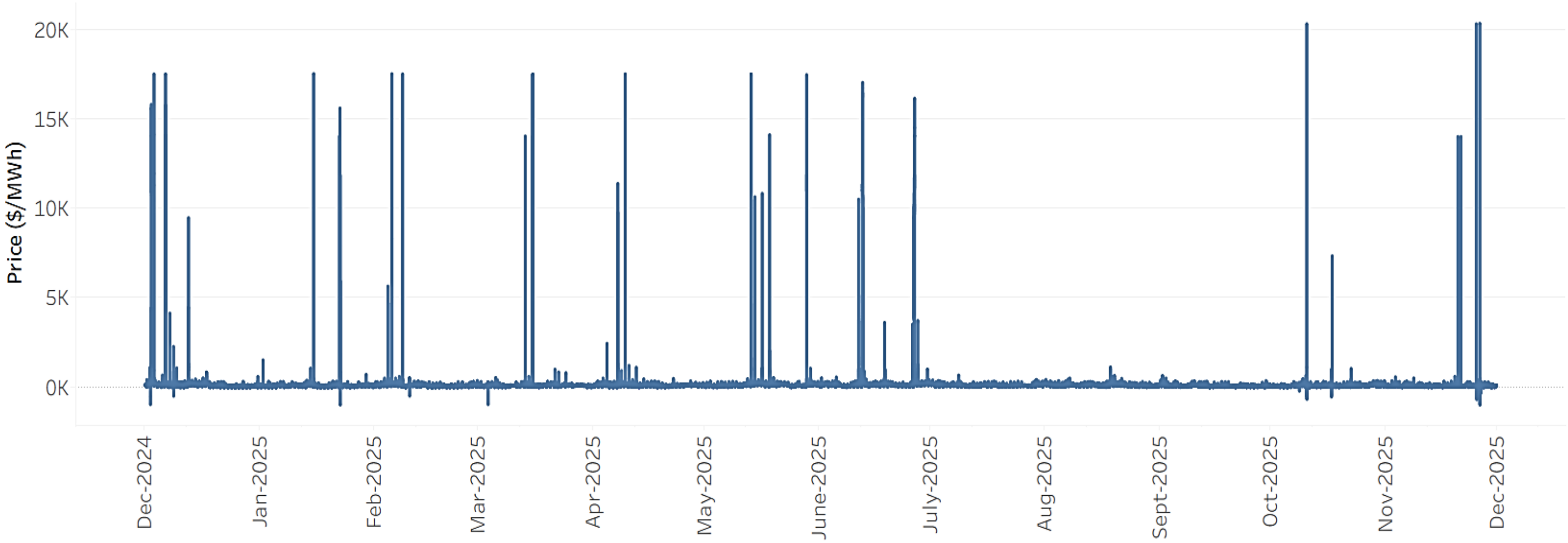
The National Electricity Market and wholesale market dynamics

The adoption of EVs links the transport and electricity sectors, exposing drivers and fleet operators to the NEM. Unlike retail fuel markets, the NEM is a volatile, real-time exchange where electricity is traded between generators and energy users. The AEMO sets prices every 5 minutes based on supply and demand conditions, with wholesale spot prices fluctuating between a Market Price Cap of $20,300/MWh and a Market Price Floor of -$1,000/MWh.

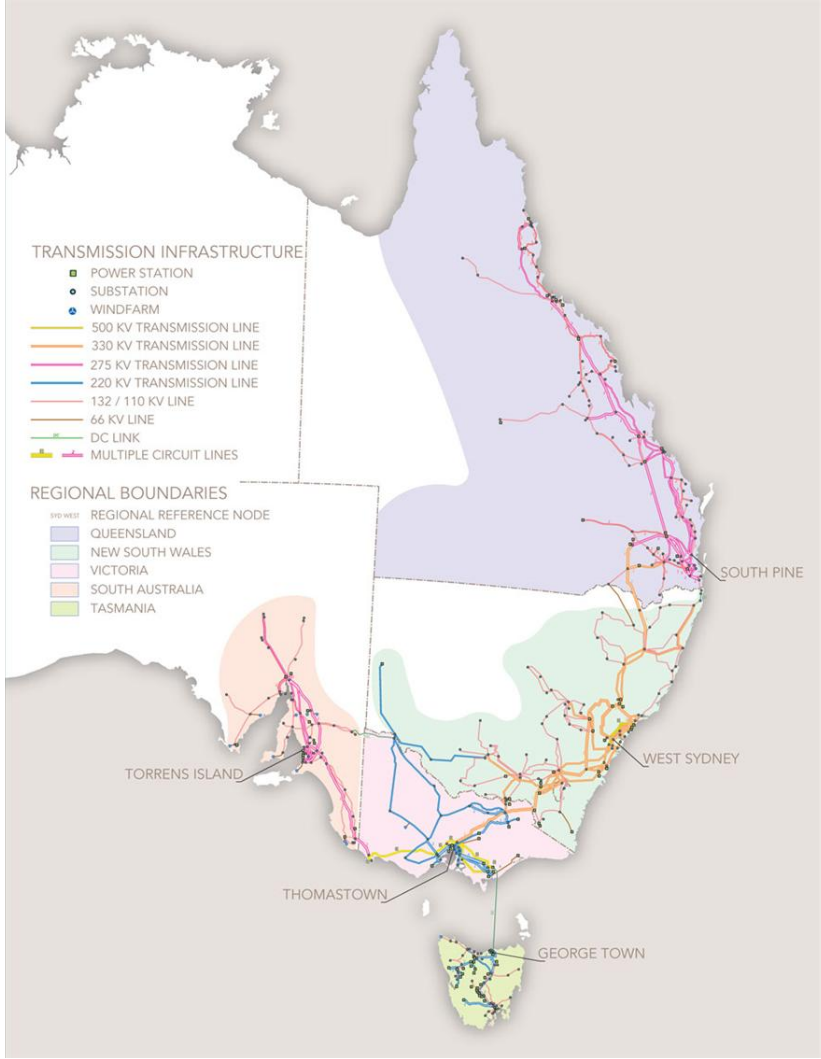
- Peak Price Events: Prices can spike towards the cap during periods of acute system stress. Key drivers include generator outages, low renewable output, or extreme weather events.
- Negative Price Events: Conversely, prices can fall below zero during periods of oversupply. This typically occurs during the middle of the day when output from solar energy resources are high.

The diagram below shows wholesale market spot prices for the New South Wales region between December 2024 and November 2025.

NSW electricity spot price 2024 to 2025[1]



Overview of the NEM



[1] AEMO 2025. *Aggregated price and demand data.*

Decarbonisation is transforming the electricity market

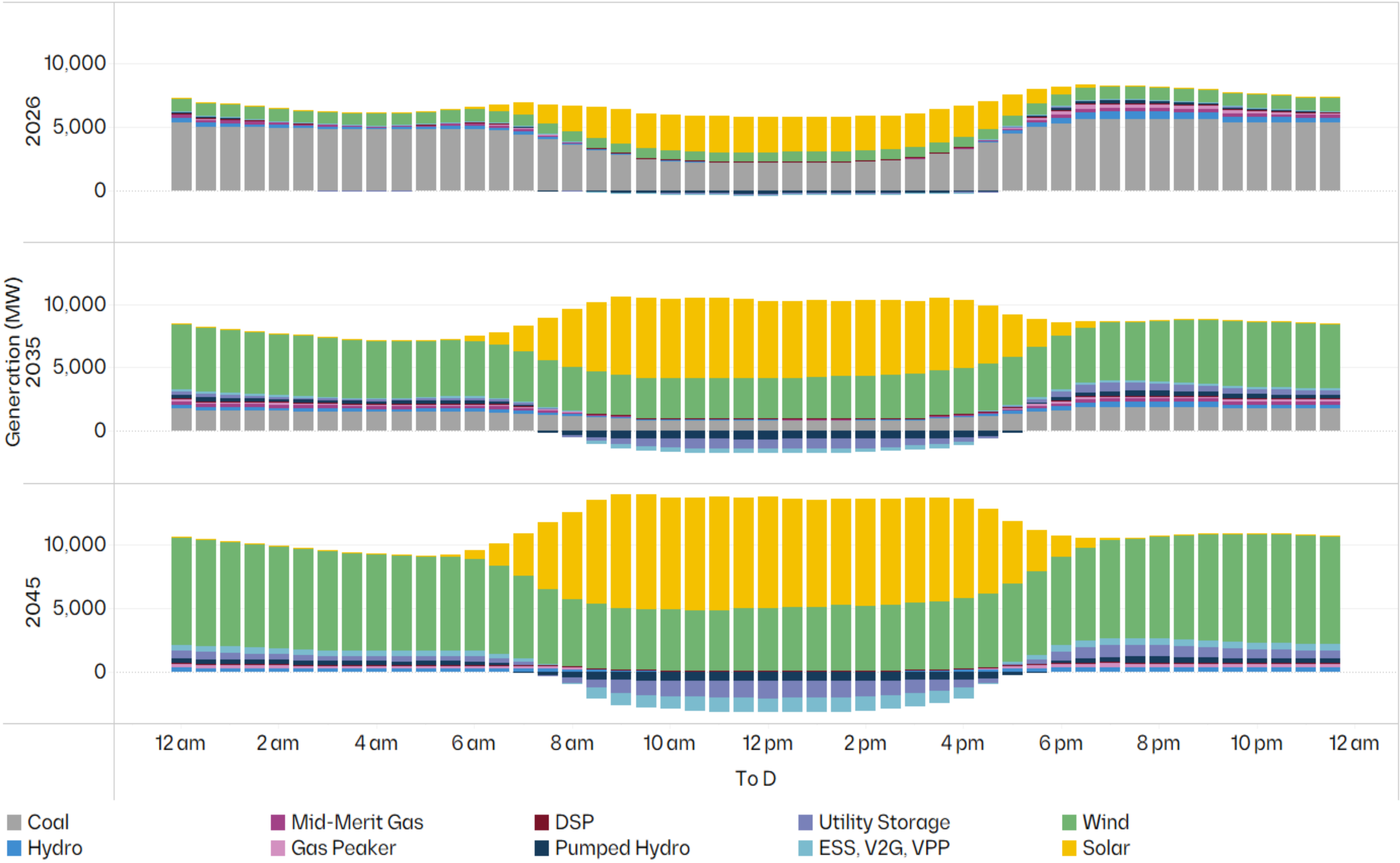
Reliance on current pricing offers an imperfect proxy for future costs, particularly given the structural transformation across generation, networks, and retail as Australia pursues net-zero targets.

Our wholesale electricity market modelling projects the future generation stack for 2026, 2035, and 2045, capturing the progressive retirement of dispatchable fossil-fuel capacity and the rising dominance of variable renewable energy.

As coal and gas plants exit the market, the grid will increasingly rely on wind and solar, necessitating a major expansion in storage capacity. This storage is needed to shift midday solar output to evening peak periods and provide supply during low renewable generation windows.

These evolving generation and demand dynamics, rather than historical averages, will inform projections of the long-term costs and benefits of BEV charging.

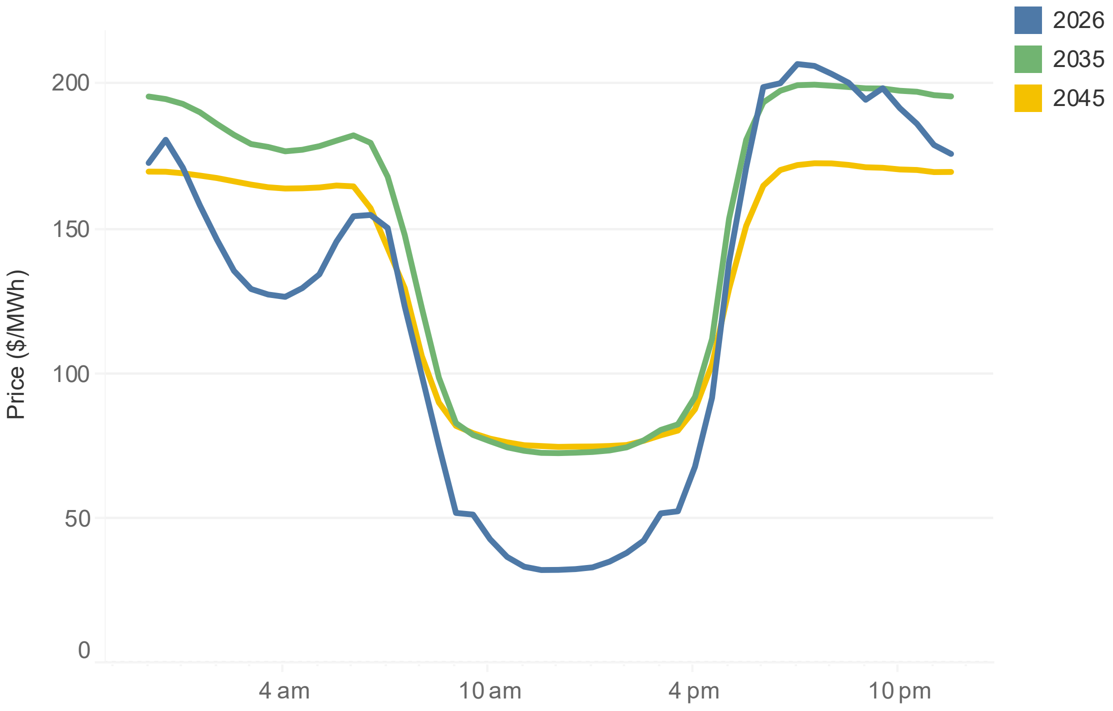
Projected NSW Generation Mix in 2026, 2035, and 2045



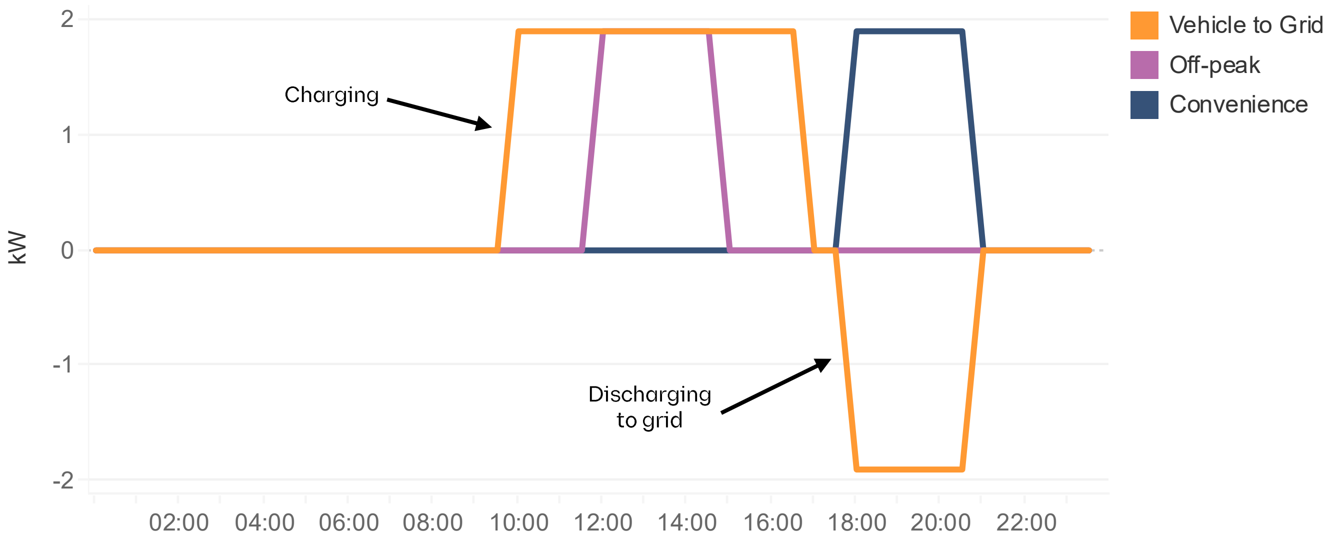
The emerging generation mix will impact daily prices and interact with BEV charging profiles

The average daily wholesale price trace is expected to evolve alongside the changing generation mix. The projected 2026 profile is characterised by higher price peaks and deeper troughs as solar penetration depresses midday prices. In contrast, the forecast 2035 and 2045 traces present smoother curves, driven by the widespread deployment of battery storage acting as both flexible load and dispatchable generation. By engaging in intertemporal arbitrage — charging during low-price periods and discharging during peaks — batteries effectively flatten these price extremes.

Projected NSW daily spot price trace in 2026, 2035, and 2045



Typical BEV charging profiles



Accordingly, we consider three distinct charging profiles that a BEV owner may adopt:

1. **Convenience charging:** Minimal engagement with electricity market signals. The vehicle is charged immediately upon the owner's return home, typically coinciding with evening peak demand periods
2. **Off-peak charging:** Strategically timed to occur during periods of high solar generation and low electricity demand, typically around midday. Charging may occur at either the home or workplace
3. **Vehicle-to-Grid (V2G):** Involves charging during the midday solar peak and discharging stored energy back to the grid during high-demand periods to capture arbitrage value.

We note that V2G does not follow a strict schedule but operates dynamically and would need to consider costs of battery degradation. While these profiles are static and will be heavily influenced by individual travel behaviours, they provide a useful comparative tool.

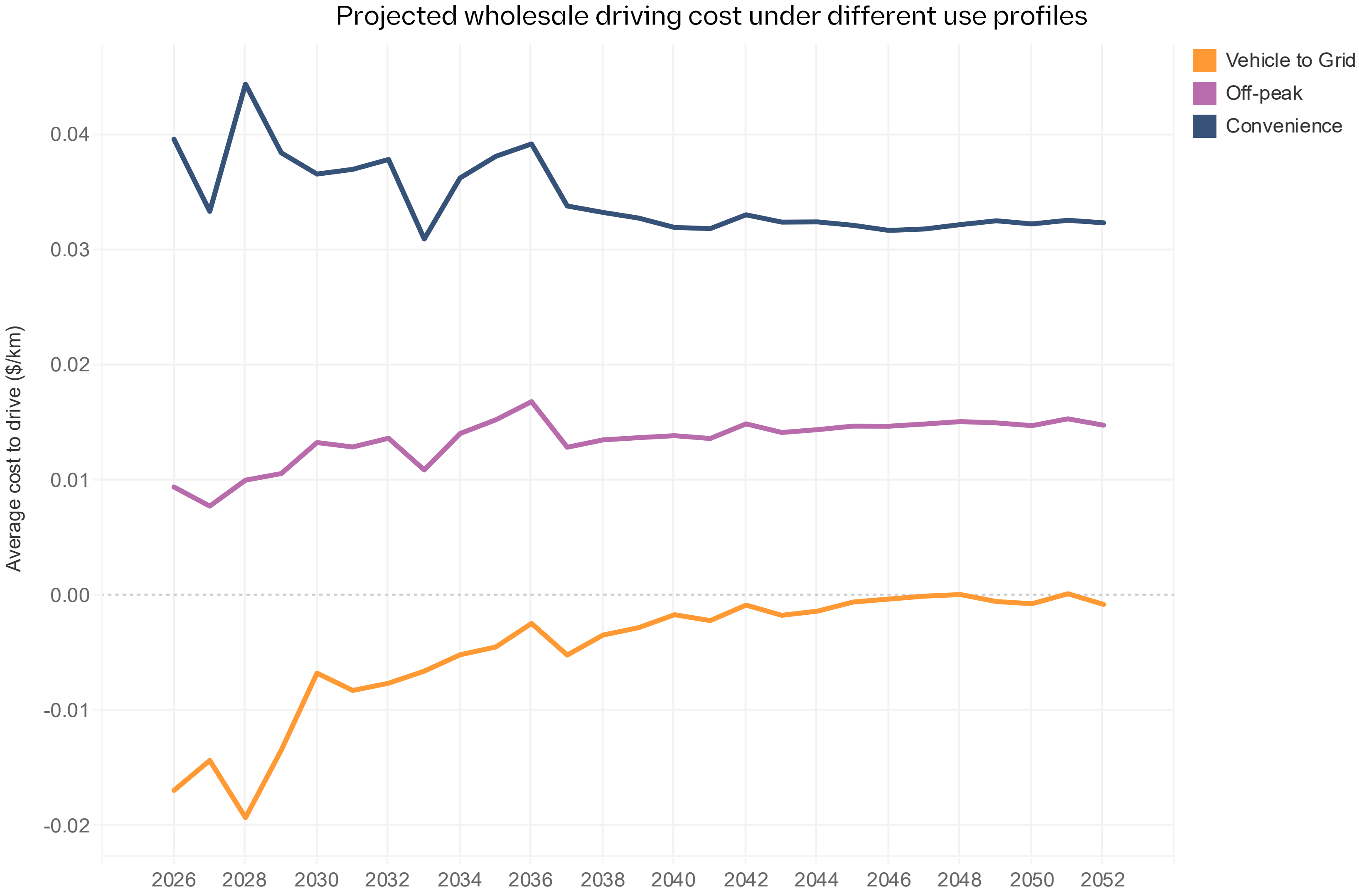
Future wholesale prices and BEV charging profiles will affect the cost of charging

Charging behaviour has a significant effect on wholesale charging costs, with convenience charging representing the most expensive profile and V2G the least. On a per-kilometre basis, wholesale charging costs are estimated at 3.1 – 4.4 cents for the convenience profile over the next 25 years, compared to -1.9 – 0.0 cents for V2G[1]. This represents a substantial saving against the 7.2 – 20 cents per kilometre typical of an ICE vehicle[2].

While V2G implies a negative or zero financial cost (effectively generating revenue), it introduces distinct opportunity costs, specifically the accelerated degradation of the vehicle's battery and the foregone revenue that could have been earned had the vehicle remained stationary and connected to the grid.

By choosing to drive, the user forfeits the ability to export energy during high-price events, effectively creating a 'shadow price' for mobility. Furthermore, the decision to participate is likely asymmetric: a consumer's Willingness to Accept (WTA) compensation for discharging energy, and thus sacrificing range and battery health, may differ from their Willingness to Pay (WTP) for the travel itself. This suggests that consumers may place a premium on range security, requiring financial incentives that exceed simple arbitrage value to voluntarily discharge their battery.

In the longer term, the cost of convenience charging is projected to decline as increased storage capacity suppresses peak spot prices. Conversely, off-peak charging and V2G costs are expected to rise, as batteries and EVs increasingly absorb excess solar generation, the floor of the price curve lifts.



[1] Efficiency of 0.19kWh/km from CSIRO 2025. *Electric vehicle projections, page 30.* [2] Efficiency of 4.5 to 12.5L/100km and fuel resource cost of $1.60/L from Transport for NSW 2022. *Technical Note on Calculating Road Vehicle Operating Costs, page 21.*

Evolving network tariffs and BEV charging

Networks don't sell electricity to most households and businesses —retailers do. Yet networks design tariffs as if end-consumers were their customers, constrained by regulatory requirements that customers must be able to easily understand the tariff structure.

Network tariffs have historically been flat, not varying by time or network conditions. This disconnect between network tariffs and the true dynamic costs of network use can lead to inefficient charging behaviours that exacerbate peak demand constraints. While retailers manage the misalignment between dynamic prices and flat tariffs, these costs are passed through to consumers through higher charges.

The emergence of consumer energy resources (CER), such as rooftop solar, batteries, and EVs, has driven efforts to introduce more dynamic network prices. For example, Ausgrid is running a pricing trial (Project Edith) to examine the implications of introducing dynamic network pricing. These prices respond to real-time operating envelopes rather than static time-of-use windows. This allows dynamic network prices to signal constraints at specific locations, times, and weather events, rewarding consumers for exporting or importing power when the grid requires support.

Looking forward, the regulatory framework is expected to continue to encourage the introduction of cost reflective network tariffs. The recent Australian Energy Market Commission's Pricing Review draft report suggests refocusing network pricing signals on retailers rather than households, allowing networks to design complex, marginal-cost-based tariffs that retailers can professionally manage.

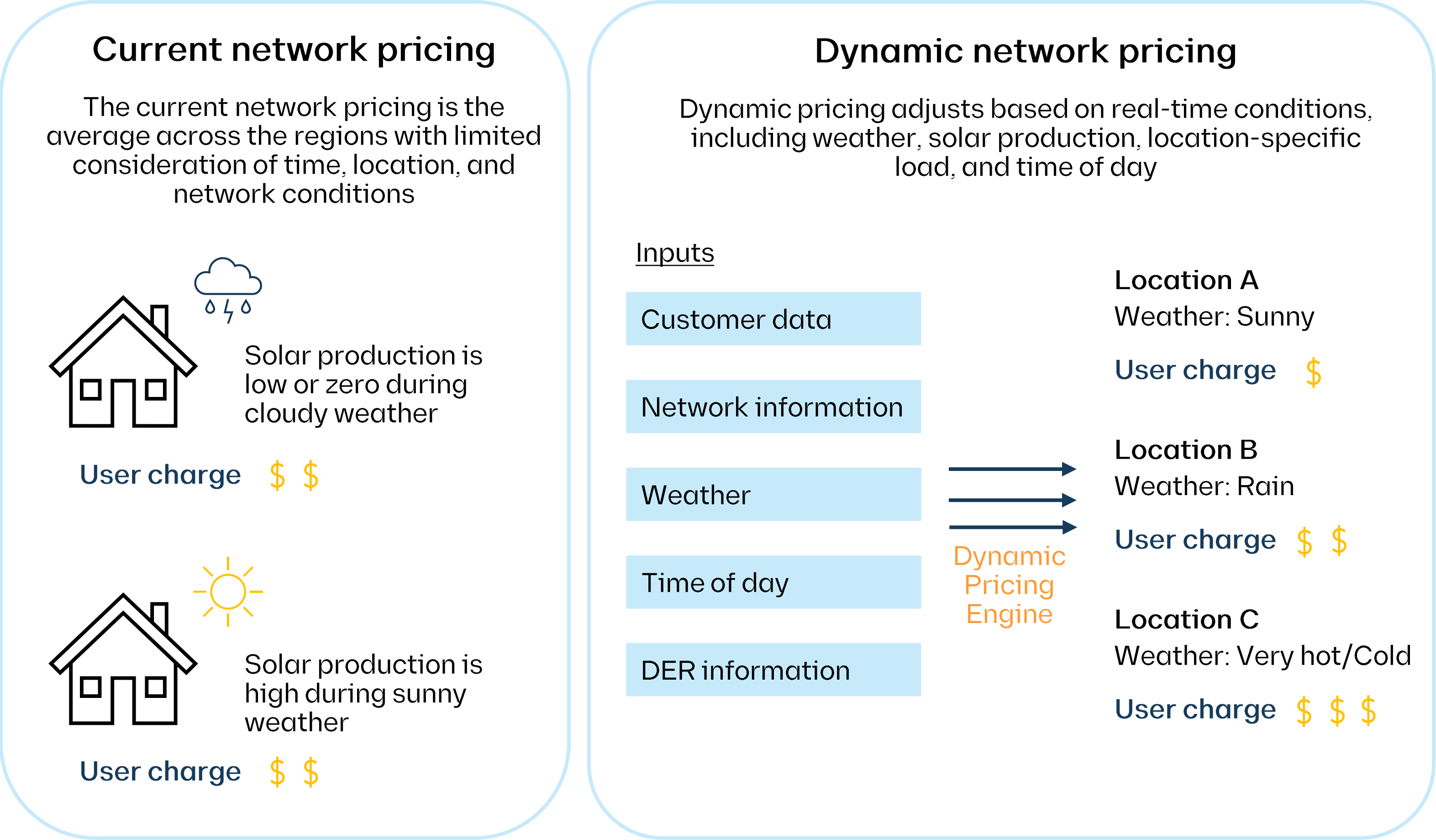


Figure inspired by Project Edith Ausgrid

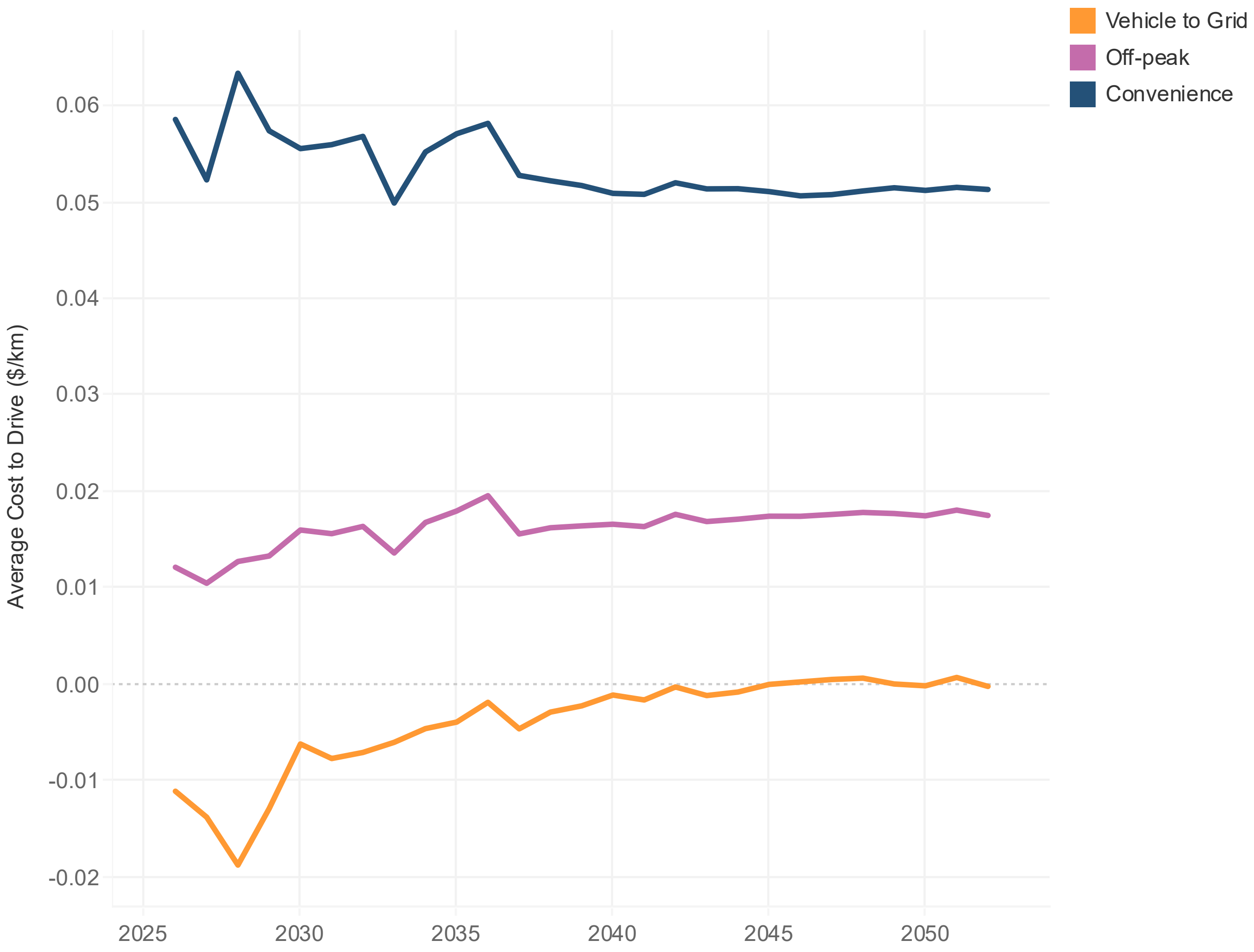
How will network tariffs affect the cost of driving

Network businesses are introducing new tariffs to better accommodate the increasing uptake of price-responsive CER, such as household batteries and EVs. For example, Endeavour Energy is currently trialling the 'Off Peak Plus' tariff, designed for hot water solar soaking and EV charging — see the table below[1]. Under this tariff structure, consumers are encouraged to shift their consumption to periods where there is high solar generation.

	Network Tariff (c/kWh, ex GST)	Description
High-season peak	19.47	Energy consumed between 16:00 to 20:00 on business days. High-season includes the months November to March inclusive.
Low-season peak	11.70	Energy consumed between 16:00 to 20:00 on business days. Low-season includes the months April to October inclusive.
Solar soak	0.00	Charge applied to energy consumed between 10:00 to 14:00 on all days.
Off-peak	3.38	Charge applied to energy consumed at all other times

Similar to wholesale costs, the '*Off Peak Plus*' network tariff penalises the convenience profile. Off-peak charging costs remain largely unchanged as most of the charging occurs during the solar soak period when network prices are zero. The inclusion of network tariffs in the V2G analysis causes the cost curve to shift upwards turning positive sooner, yet the net impacts are minimal.

Projected network and wholesale driving cost under different use profiles



[1] Endeavour Energy 2025. *Sub-threshold Tariff Notice, page 9.*

Retailers will set the end price that most consumers face

The retailer acts as the aggregator of the cost stack, presenting the end-consumer with a price to recover wholesale costs, network charges, retailer operating costs and margins, and renewable/energy efficiency scheme costs.

Historically, retailers have provided consumers with flat tariffs, thereby managing end customers' exposure to wholesale market volatility. The increased rollout of smart meters allows retailers to offer more innovative pricing structures, such as time-of-use tariffs, demand tariffs, or direct exposure to NEM wholesale spot prices. Amber is an example of an energy retailer that currently passes through wholesale and network costs directly to consumers for a flat fee of $25 per month.

Having access to tariffs that are more cost-reflective allows customers to save money on electricity bills by shifting consumption to lower-cost periods. However, some customers may prefer tariffs with less cost-reflectivity, thereby minimising exposure to wholesale market volatility.

Looking forward, we anticipate the emergence of two distinct consumer pathways:

1. "**active**" users who respond to wholesale and network prices to minimise costs, and
2. "**passive**" users who prefer more predictable billing without exposure to wholesale market prices.

For 'passive' users, we expect retailers to charge a premium (compensating for the risk of managing their wholesale market exposure) or impose constraints such as limiting charging to off-peak periods when wholesale costs are lower.

Heavy vehicle operators will likely be 'active' users by necessity rather than preference – given the high energy throughput of delivery fleets and traditionally thin operating margins, they will be compelled to actively respond to electricity prices to maintain competitiveness.

Retailers are already introducing products tailored to EV charging. The table below sets out a selection of plans currently offered by retailers. These plans typically place conditions on when charging can occur but, in turn, offer low charging rates.

Provider	Plan Name	Charging Rate	Condition
AGL	Night Saver EV Plan	8c/kWh	12am-6am
Engie	EV Night Saver	10c/kWh credit	12am-6am
Origin	EV Power Up	8c/kWh	Scheduled charging session
OVO Energy	The EV Plan	6c/kWh	12am-6am
Powershop	EV Day plan	Free *	12pm-2pm. *Control load prices still apply
Red Energy	Red EV Saver	Free **	12pm-2pm weekends. ** GreenPower charge of $3.3 c/kWh applies

For comparison, our combined wholesale and network charge analysis estimates an average off-peak charging cost of 6c/kWh (or 1.2c/km), which is comparable to these retailer offers during specific times.

In addition to these private offers, the Australian Government's new Solar Sharer Offer (commencing July 2026) will require retailers in NSW, SA, and South-East Queensland to provide households with a three-hour window of free electricity during the middle of the day. This initiative is designed to absorb excess solar generation and provides a significant opportunity for EV owners to access zero-cost charging without needing a specific EV-only plan.

[1] AEMC 2025. *Residential Electricity Price Trends 2025, page 33.*

Charging costs will be increasingly seasonal and peak during winter

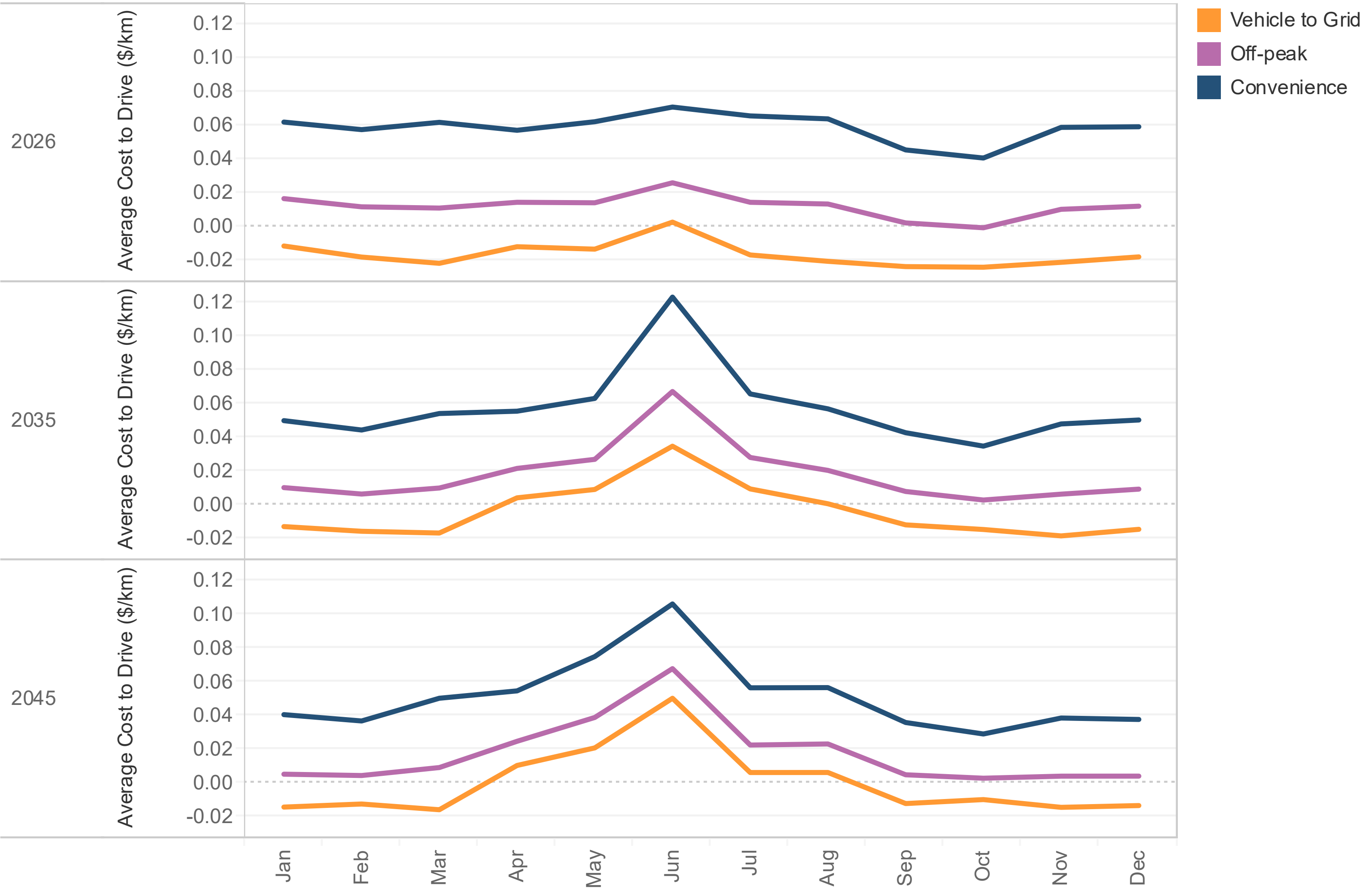
The analysis presented on slide 17 shows the incremental costs of charging a BEV for an active user using a retailer similar to Amber (which passes through wholesale and network costs, plus a fixed monthly fee).[1]

We estimate that the costs of charging an EV range from 5 – 6.3 c/km for the convenience profile over the next 25 years, compared to -1.86 – 0.0 c/km for V2G.

Notably, the cost of charging exhibits distinct seasonal patterns, peaking in winter due to reduced output from weather-dependent renewables like solar and wind. Further, there is a divergence in price signals: Endeavour Energy's trial EV tariffs applies a high peak during summer (November–March), whereas wholesale prices peak in winter.

Our modelling indicates that wholesale supply dynamics dominate this interaction, resulting in higher overall costs during the colder months. In 2026, the cost of driving is approximately 0.8–1.4 cents per km higher in June compared to January. By 2045, this seasonal variability intensifies dramatically as grid reliance on variable renewables grows, with June driving costs becoming approximately 6.5 cents per km higher than January across the charging profiles.

Projected wholesale and network driving cost over a year



[1] We note that our analysis has not factored in the costs of efficiency schemes. However, these costs are minor and would have a negligible effect on our analysis. For further details about these costs, see AEMC 2025. *Residential Electricity Price Trends 2025, page 33.*

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04

Economic and Planning Implications

Cost Benefit Analysis guidelines will need to be updated to reflect Vehicle Operating Costs of EVs

Existing cost benefit analysis (CBA) guidelines are focused on ICE vehicles. As BEVs become a higher proportion of the fleet, there will be a need to update these guidelines to reflect the fleet mix on our road networks

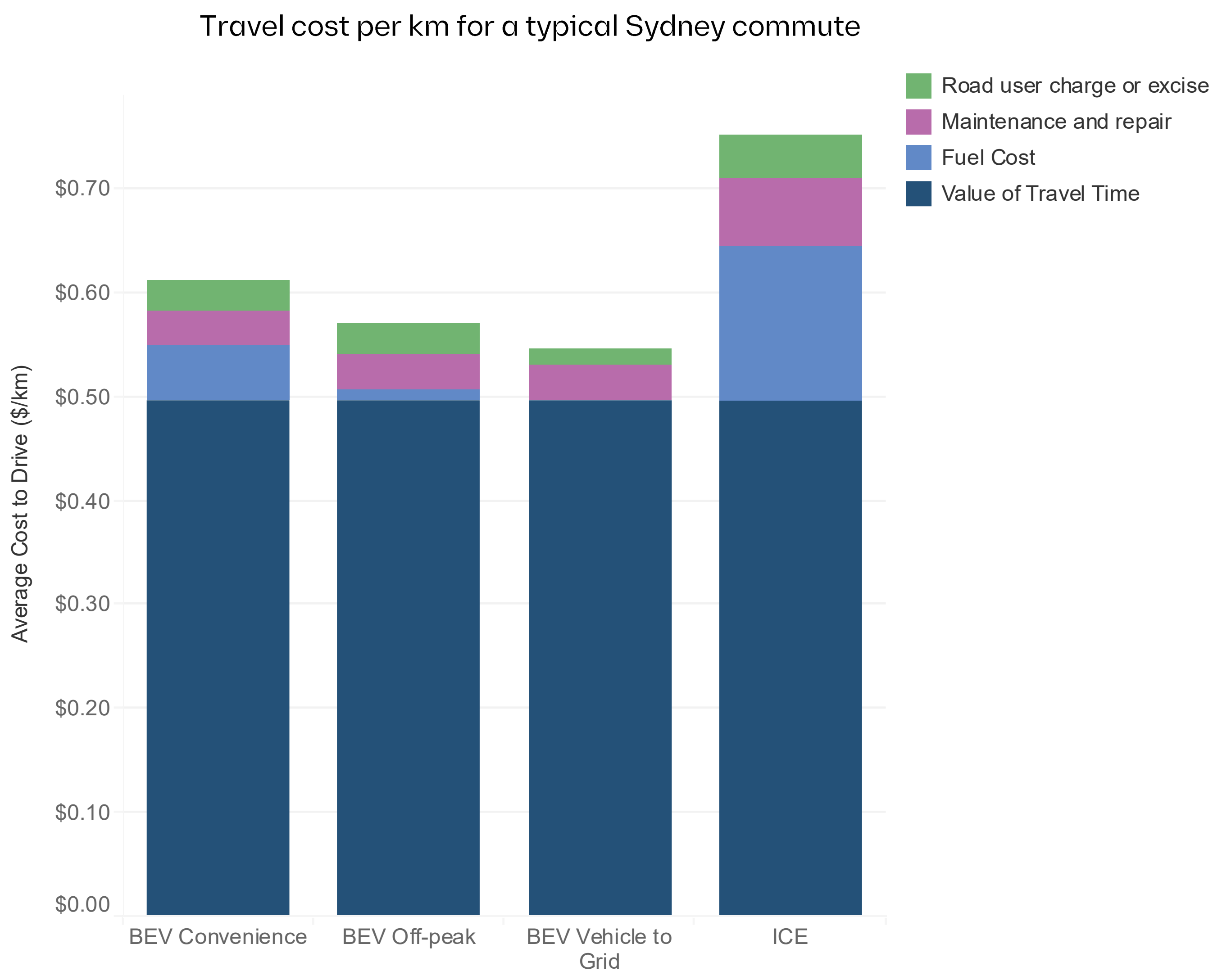
Vehicle Operating Costs (VOC) are an example parameter value that will need updating – BEVs have significantly lower VOC due to lower fuel and maintenance requirements when compared to equivalents.

The figure to the right considers the generalised travel costs for a typical Sydney commute of 26 minutes and 18 kilometres[1]. We estimate that the generalised cost per kilometre for a BEV is 19% to 27% lower than for an ICE driver. We have also included the Road User Charges (RUC) announced by the NSW government that will apply from 1 July 2027 onwards.[2]

In terms of specific components, we observe a substantial reduction in fuel costs for BEVs, ranging from 65% to 100% lower than their counterparts. Maintenance and repair costs are also approximately 50% lower, attributed to the simpler electric drivetrain and fewer moving parts.

Regarding Total Cost of Ownership (TCO), BEVs are delivering significant operational savings and are now approaching capital cost parity thanks to the introduction of competitive lower cost brands like BYD.

Looking forward, the capital expenditure component for BEVs is projected to decrease further as battery costs fall, economies of scale are realised, and market competition intensifies. Consequently, the paradigm that BEVs are "too expensive" is being dismantled; they are now cost-competitive at the point of purchase and significantly cheaper to run.



[1] BITRE 2016. *Five facts about commuting in Australia, page 2* [2] In the V2G case, the negative driving cost (revenue generated from arbitrage) is subtracted from the RUC, effectively acting as a rebate in the cost stack — though this may also be treated as an opportunity cost.

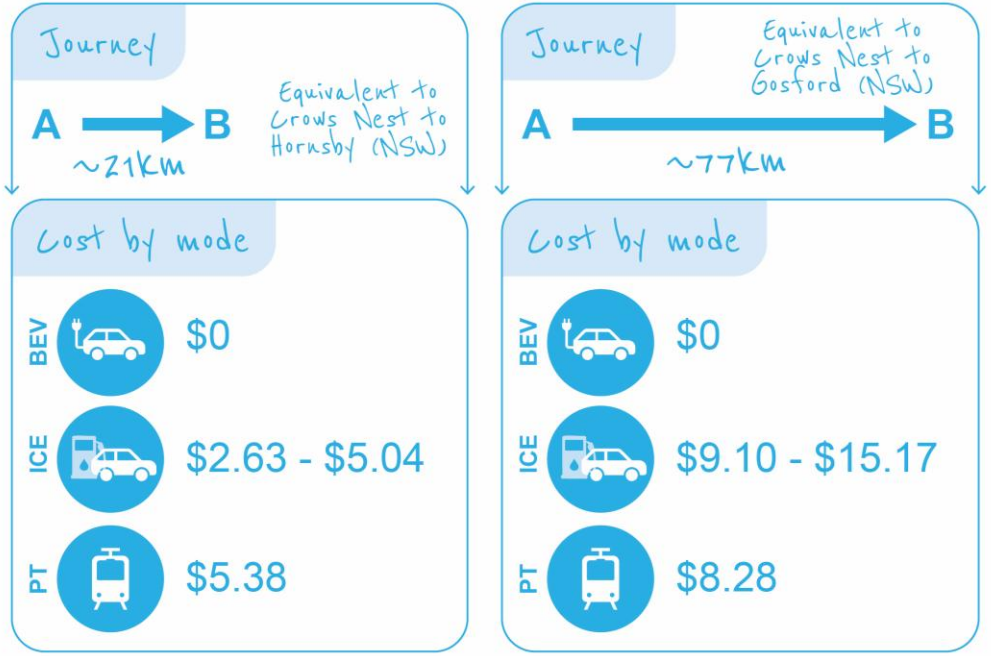
BEVs may increase the short and long run demand for private travel

The lower generalised travel cost offered by BEVs is expected to induce an increase in road use. However, published elasticities in the literature vary widely; for instance, short-run fuel price elasticities range between -0.026 to -0.37, while one study suggests that generalised travel cost elasticities range from -0.5 to -1.0 in the short run, extending to -1.0 to -2.0 over the long run.[1]

The implication for short-run and long-run induced BEV demand remains ambiguous. Evidence from Norway, the global leader in EV uptake, suggests that BEV ownership leads to an overall increase in car trip demand in the order of 10–20%[2]. However, other emerging research indicates that these additional EV-induced kilometres are largely to specific travel purposes, being mainly longer weekend trips by urban households[3]. Periods of low or high wholesale and network prices may affect demand, potentially resulting in substitution to other modes as commuters seek to avoid peak charging costs. Emerging studies are exploring charging demand responsiveness to electricity prices, though elasticity results remain variable.[4][5]

A novel dimension in this decision-making process is the opportunity cost of V2G participation. Beyond the traditional valuation of travel time, driving a BEV now technically incurs an additional cost: the foregone revenue that the vehicle could have earned by discharging to the grid. While the primary use of a vehicle is for mobility, meaning essential trips will likely proceed regardless of market signals, this dynamic raises the 'shadow price' of travel. Consequently, during extreme price cap events, the forfeiture of significant arbitrage revenue may act as a deterrent for discretionary trips, setting a higher value threshold for the decision to drive.

From an appraisal perspective, the reduction in VOCs alters the relative cost of road transport compared to other transport modes. While immediate impacts are limited by current fleet penetration, the long-term economic signal of cheaper driving improves the competitiveness of private vehicles, potentially placing pressure on public transport mode share as adoption scales. The increase in number of road users relative to other transport modes may direct future appraisals in favour of road infrastructure and may encourage sprawl as the financial penalty for longer commutes diminishes.

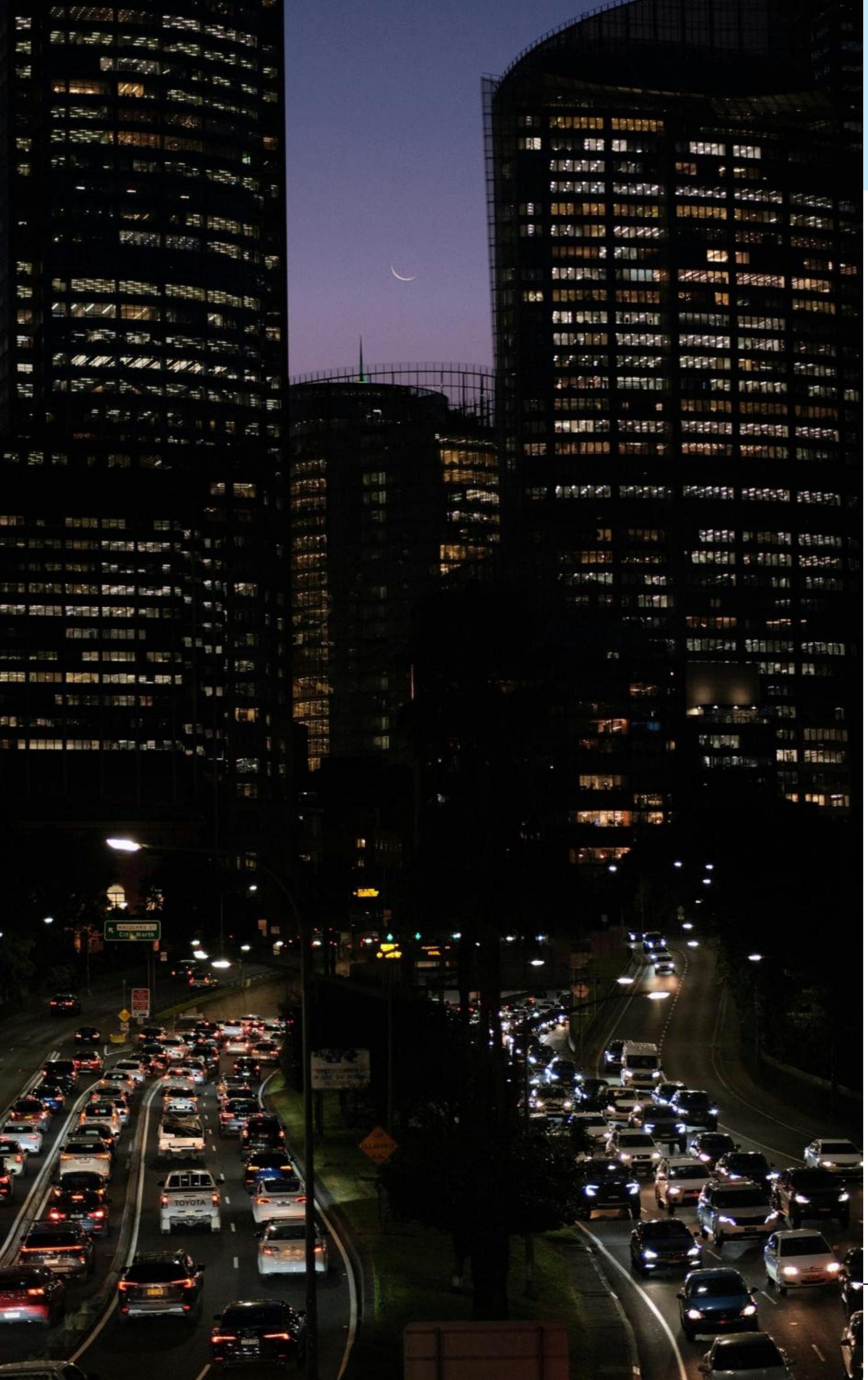


This assessment assumes that a BEV is recharged at zero direct cost (e.g., via a solar share scheme), noting there may be an opportunity cost of forfeited revenue from V2G or solar export. Fuel costs for an ICE vehicle are based on the fuel consumption of a Ford Ranger using E10 unleaded petrol. Public transport fares are from Transport for NSW.

Key impacts

- Induced Demand: Lower travel costs may stimulate private vehicle use, shifting mode share away from public transport and increasing congestion
- Opportunity Cost: Driving decisions now incur a new economic cost being the foregone revenue from not discharging to the grid (V2G)
- Appraisal: Increase in number of road users may direct future appraisals toward road projects

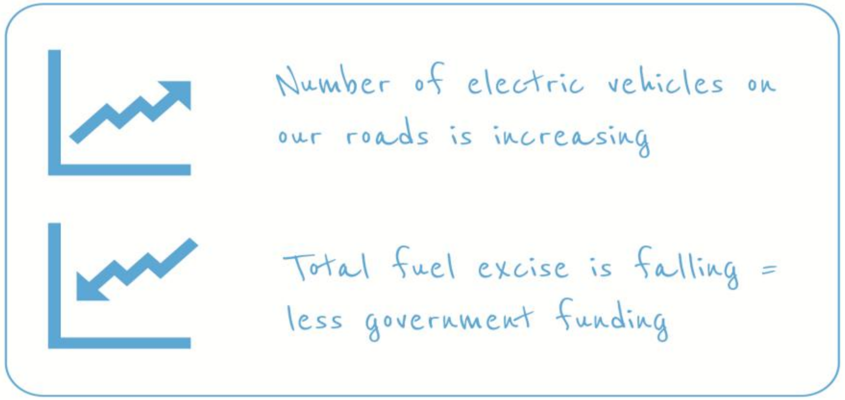
[1] Victoria Transport Policy Institute 2025,*Understanding Transport Demands and Elasticities, page 50.* [2] Green, C. P. & Østli, V. 2025. *The effect of battery-electric vehicle ownership on transport demand and substitution between modes.* [3] Liu, Z. et al. 2025.*The impact of electric vehicle adoption on travel mode choices.* [4] Kuang, H. et al. 2025. *Unraveling the effect of electricity price on electric vehicle charging behavior: A case study in Shenzhen, China.* [5] Bernard, L. et al. 2025. *The Impact of Dynamic Prices on Electric Vehicle Public Charging Demand: Evidence from a Nationwide Natural Field Experiment.*



Declining excise revenue and the case for road user charging

Fuel excise revenue generated $15.7 billion in the 2023/2024 financial year[1]. However, this revenue is becoming increasingly unsustainable.

As the fleet transitions to electric vehicles, the volume of excise collected is projected to fall. Without intervention, such as the transition to a road user charge, this decline creates a funding gap.



From a localised perspective, parking policy could be used to mitigate low-cost BEV-induced travel. For example, increasing parking costs or limiting parking availability could reduce demand for parking and associated private vehicle use. This is only considered appropriate in areas with strong active or public transport linkages, ensuring connectivity from alternate modes of travel.

Looking forward, autonomous electric vehicles could limit the effectiveness of parking policies by enabling owners to be dropped off without parking. While currently available in limited locations (such as paid services in select US cities, including San Francisco and Phoenix), this capability represents a future congestion risk. To address this, future RUC schemes may need to incorporate dynamic pricing mechanisms to manage road network demand.

Continued and enhanced investment in public and active transport allows for a reduction in road network demand, and therefore reducing the need for road network upgrades. Further benefits include improved accessibility and equity outcomes, enhanced social interaction and inclusion, as well as positive health benefits, such as reduced stress, reductions in obesity and sedentary-based health conditions.

[1] Australian Automobile Association (AAA). What is fuel excise?

BEVs reduce environmental externalities but may impose others

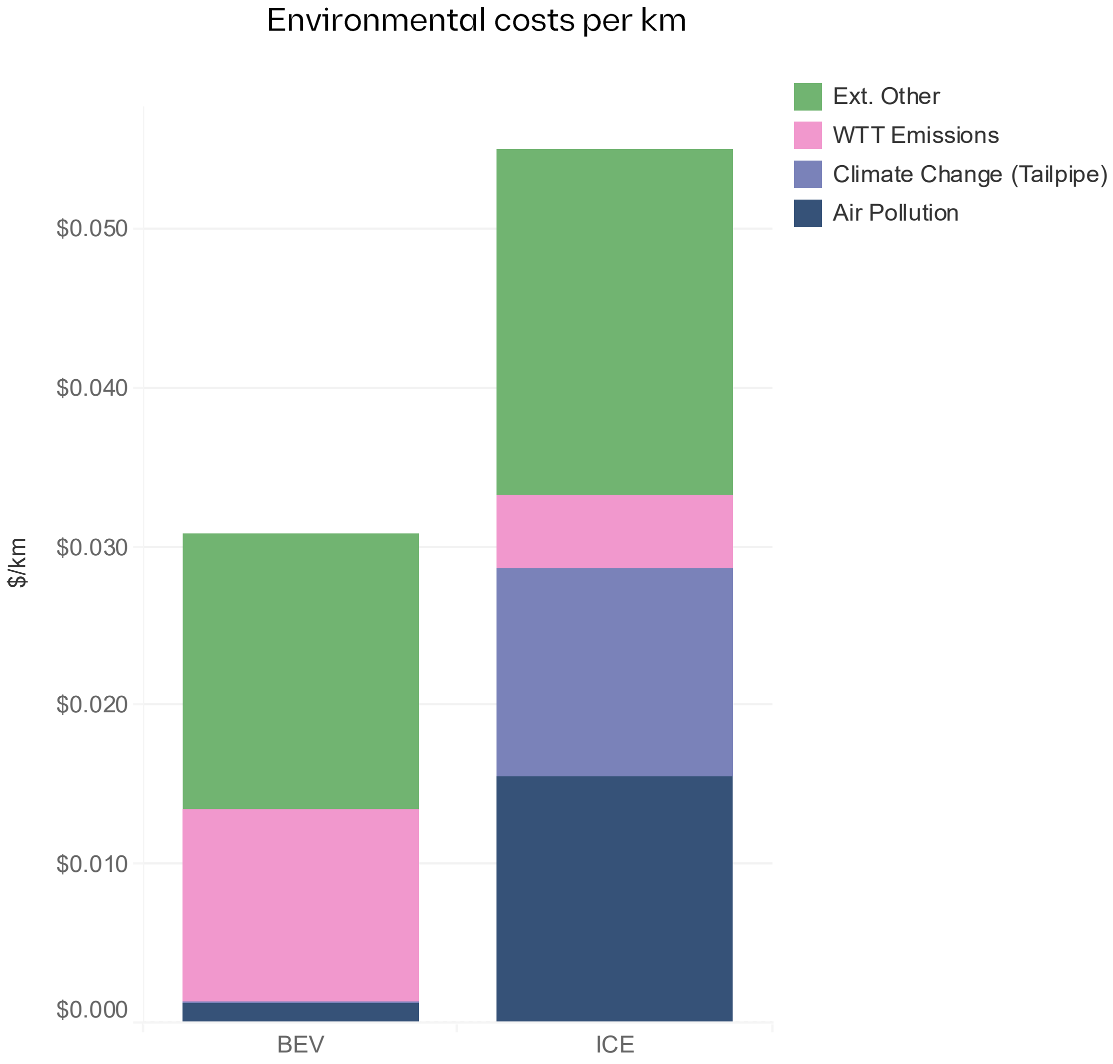
In a CBA, emissions and other environmental impacts are treated as externalities – costs that are not directly perceived by the user but are borne by society. For the transition to BEVs, we categorise these externalities into four primary domains:

1. Air Pollution: Costs associated with local pollutants (NOx, PM10, etc.), including adverse health outcomes and damage to building materials.
2. Climate Change (Tailpipe): The costs of Greenhouse Gas (GHG) emissions from vehicle operation.
3. Well-to-Tank (WTT): Indirect environmental costs associated with the extraction, production, and distribution of energy (fuel or electricity).
4. Other Environmental Costs: A grouping of broader impacts including noise, soil and water contamination, biodiversity loss, and urban separation. Due to data limitations, we have held these constant between BEV and ICE vehicles in this model, though it is anticipated that BEVs will reduce many of these.

Using parameter values from ATAP PV5, we find a total externality reduction of approximately 44% for BEVs compared to ICE vehicles for a typical commute. This figure is conservative, given that we have held the Other Environmental Costs category constant.

Further, a significant proportion of these externalities are GHG-related. BEVs eliminate direct tailpipe emissions, though WTT emissions are currently higher due to the emission intensity of the grid. This will reduce as the grid decarbonises – our modelling suggests NEM emissions intensity will fall from 0.54 tCO_2/MWh in 2026 to 0.04 tCO_2/MWh by 2045. This will also vary with time of charging, with midday charging yielding lower emissions.

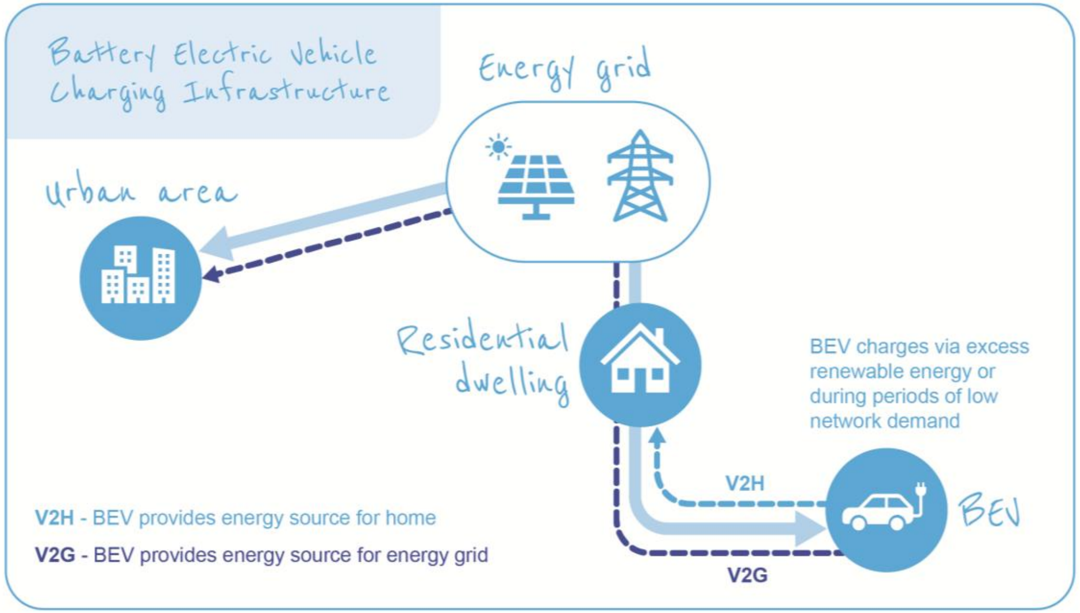
However, there are potential disbenefits to consider. BEVs may contribute to increased congestion externalities if lower operating costs induce higher vehicle kilometres travelled. Furthermore, due to their battery mass, BEVs are heavier than equivalent ICE vehicles, which may contribute to accelerated pavement deterioration, although this is generally considered a greater issue for heavy vehicles rather than passenger cars. Further research is required to improve the understanding of externalities of BEVs.



Unlocking Australia's existing dwellings for EV charging requires targeted policy support

The expansion of BEVs necessitates robust charging infrastructure, with V2G and Vehicle-to-Home (V2H) connectivity offering potential to lower electricity prices. While single dwellings generally require minimal approval for installation, the landscape for multi-unit and commercial buildings is more complex.

As of October 2023, the National Construction Code 2022 mandates that 100% of parking spaces in new apartment buildings and 10–20% in commercial buildings be 'EV ready'. However, this only ensures supporting cabling and capacity, not the actual chargers. Retrofitting existing apartments remains a major hurdle due to high costs, capacity constraints, and complex strata laws. In many jurisdictions, approval often requires a special resolution (75% support), creating conflict where non-EV owners or those with limited funds must share installation costs or common area power upgrades.



Electric vehicle charging levels and range chart	Power	Range added per hour	Typical application
Level 1 Single phase (domestic)	1.4 - 3.7kW	10 - 20km range/hour	Home
Level 2 slow Single phase (domestic or public)	7kW	30 - 45km range/hour	Home, work, shopping centres, car parks
Level 2 fast Three-phase (public)	11 - 22kW	50 - 130km range/hour	Urban roadside
Level 3 Fast charge (public)	25 - 350kW	150 - 300km range/hour	Highways, motorways and key routes
Emerging Fast charge (public)	1000kW	~4,500km range/hour	Highways, motorways and key routes

To address these barriers, government grants and legislative reform are essential. Some states have already lowered strata approval thresholds from 75% to 50% to facilitate upgrades. Equity is also a concern; renters without home charging access face higher costs compared to homeowners with solar and battery setups.

On the retail front, high-speed charging technology is rapidly advancing. BYD recently revealed 1MW infrastructure capable of adding 400km of range in just five minutes, comparable to refuelling an ICE vehicle, though this requires significant grid investment. Ultimately, while Australia has ample parking capacity, a swift transition for existing dwellings depends on targeted government policy and funding, whereas retail charging is expected to follow a market-led approach.

Where to from here and how we can help

This report initiates Endgame Analytics' series on decarbonising transport. We demonstrate that while the EV transition is still in its early stages, its interaction with a transforming NEM creates imminent structural implications for consumer economics, infrastructure planning, and project appraisal.

The convergence of electricity and transport sectors establishes a new, bi-directional relationship where wholesale dynamics, network tariffs, and retail structures directly dictate the cost of driving. While BEVs offer substantial operational savings and eliminate tailpipe emissions, these lower travel costs risk inducing demand and increasing congestion. V2G technology introduces a novel opportunity cost beyond travel time savings, where driving forfeits potential revenue from grid support.

To navigate this transition, knowledge gaps must be addressed, such as demand elasticities, V2G behaviours, and the net impact of emerging externalities. Policy frameworks will need to evolve in parallel; consideration should be given to modernising CBA guidelines to reflect the different cost structures of the emerging fleet, while broader transport settings may need adjustment to maintain public transport competitiveness against the falling cost of private driving.

Our Next Focus

Our next instalment will focus on the decarbonisation of road freight. We will assess the prevailing narrative that long-haul freight is unsuited for electrification, exploring the operational and financial viability of battery electric trucks within this low-margin sector.

Get in Touch

Endgame Analytics and SCT Consulting are helping clients navigate these interactions between policy, technology, and economic strategy.

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ENDGAME SCT Consulting

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Appendix 1: Wholesale Model Overview

We model various scenario outlooks using industry best practice

Electricity market modelling is a multi-stage process from least-cost capacity expansion to economic dispatch.

Inputs

- Participants
- Entry dates
- Availability
- Retirement dates
- Operating characteristics
- Fuel costs
- Investment options
- Build costs
- Lead time
- Resource availability
- Gas supply
- Demand
- Network topology
- Peak demand
- Distributed energy resources (DER) uptake
- Electrification
- Transmission
- Maximum/minimum flow
- Loss equations
- Transmission constraints
- Policies
- Federal and state targets
- Carbon budget

Process

Long term capacity expansion (LT)
What investment do we need to meet demand, satisfy our constraints and at least cost?

Short term dispatch (ST)
What are the future price, USE and generation outcomes when we represent the market at high granularity?

Outputs

- System LRMC
- Build path
- Price and dispatch outcomes

Endgame scenarios capture credible and realistic assumptions to assess risk

In addition to AEMO scenarios, our wholesale market model also assesses several in-house scenarios. We have used our Sunny Side Up scenario to model the BEV charging wholesale prices in this paper.

High level input assumptions

Detailed assumptions for each category are provided in the Appendix

	Gold Rush	Headwinds	Sunny Side Up
	Investment is dominated by solar and storage, underpinned by CIS delivery subject to build limits.	**Economic coal retirements slow the transition with difficult headwinds in developing wind generation.**	**Significant barriers of wind entry drive prices upwards with a system built on solar and storage alone.**
Demand	ESOO 2025 Step Change with Endgame house adjustments	ESOO 2025 Step Change with Endgame house adjustments	ESOO 2025 Step Change with bearish data centre growth and industrial load closures
Supply	2 GW/p.a. ramping wind limit, 5 GW/p.a. solar limit	2 GW/p.a. ramping wind limit, 3 GW/p.a. solar limit	1 GW/p.a. wind limit, 5 GW/p.a. solar limit
Coal exit	Explicitly modelled coal exit (NSW and VIC near end of technical life)	Explicitly modelled coal exit (NSW and VIC near end of technical life)	Explicitly modelled coal exit (NSW and VIC near end of technical life), further delays in QLD coal exit
Policies	CIS enforced by FY32 subject to entry limits, NSW Roadmap enforced by FY30	No explicit generation targets enforced	No explicit generation targets enforced
Transmission	Endgame house delays to transmission projects	Endgame house delays to transmission projects	Endgame house delays to transmission projects