

Submission to the Victorian Parliamentary Inquiry into Electricity Supply for Electric Vehicles

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1 Executive Summary

Victoria's transport-electrification pathway is accelerating at unprecedented pace. The Electric Vehicle Council (EVC) State of EVs 2024 Report shows nationwide EV sales doubling in a single year, with Victoria representing roughly one-quarter of new registrations.¹ Forecasts compiled for Infrastructure Victoria's Electric Vehicle Infrastructure Costs and Deployment Constraints 2023 project several hundred thousand EVs on Victorian roads by 2030 and well above one million by 2040.² AEMO's Integrated System Plan 2024 (ISP 2024) estimates that electrified transport could add multiple terawatt-hours of new electricity demand each year-equivalent to the output of several mid-sized power stations-and that unmanaged evening charging could raise local peaks by double-digit percentages.³

The state's distribution network, much of it built decades ago for predictable residential or agricultural use, was never designed for short bursts of high-intensity load. Both Infrastructure Victoria 2023 and ARENA's Ultra-Rapid EV Charging Trials Final Report 2023 identify connection-capacity limits as the dominant non-technical barrier to equitable charger rollout.^{2 4} Without innovative approaches, an ultra-fast charging will remain concentrated in metropolitan corridors, leaving regional Victorians under-served and the state's ZEV targets harder to reach.

Battery-buffered fast-charging, particularly using lithium-titanate-oxide (LTO) chemistry, directly addresses this constraint. By charging steadily from the grid or on-site solar and discharging rapidly when vehicles plug in, a buffer decouples instantaneous charger demand from the power available at the connection point. The grid experiences a smooth, predictable load while drivers receive ultra-fast service.

Critically, the benefits extend beyond the public-network level. Businesses hosting chargers-supermarkets, car dealerships, logistics depots, hotels, etc-avoid the private-side capital costs of larger service connections, new main switchboards, or transformer upgrades. They also prevent reclassification to higher-tariff demand categories that can inflate monthly electricity bills for years. ARENA's 2023 trial data and the AER's Retail Tariff

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Review 2023-24 confirm that demand charges for large customers often equal or exceed energy charges.^{4 5} A battery buffer caps the site's peak draw, allowing the enterprise to remain on its existing supply contract and to electrify transport without destabilising operations or finances.

LTO chemistry is uniquely suited to this dual role. It supports extremely high charge-discharge rates, offers tens of thousands of cycles with minimal degradation and maintains performance across wide temperature ranges-all with outstanding safety credentials. Its spinel-structure anode prevents lithium plating, virtually eliminating thermal-runaway risk. These characteristics make LTO ideal for publicly accessible infrastructure requiring long service life, rapid power delivery and compliance with the most demanding safety standards.

Adopting battery-buffered fast-charging across Victoria would:

- Enable high-power charging at constrained regional and urban-fringe sites without expensive augmentation.
- Reduce connection and monthly-demand-charge costs for commercial hosts, improving project bankability.
- Align charging load with renewable-energy peaks, lowering emissions and curtailment.
- Support regional equity, tourism and freight electrification by filling network gaps quickly.
- Create local-manufacturing opportunities under the Made in Victoria 2030 strategy.

Recommendations

The Committee is urged to recommend that the Victorian Government:

1. Formally classify battery-buffered fast-charging as critical enabling infrastructure within the *Zero Emissions Vehicle Roadmap*.
2. Instruct the ESC to issue guidelines defining it as a recognised non-network option.
3. Establish a Code of Practice for safe, standardised installation and data sharing.
4. Implement tariff reform rewarding midday and renewable-aligned charging.
5. Launch pilot corridors under *BBI* and *CIS* co-funding.
6. Develop a manufacturing roadmap under *Made in Victoria 2030*.
7. Embed battery-buffered charging in AEMO and DNSP planning frameworks.

The following sections set out the evidence base, economic rationale and policy reforms required to realise these outcomes.

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2 Strategic Context and Policy Alignment

2.1 National and State Policy Drivers

Australia's policy architecture for zero-emission transport is converging around three objectives—accelerate adoption, expand charging access and capture domestic manufacturing value. The National Electric Vehicle Strategy 2023 provides a national framework for standards and consumer access, while the Rewiring the Nation Fund and Battery Breakthrough Initiative (BBI) deploy concessional finance for grid and storage projects.^{6 7} The Capacity Investment Scheme (CIS) offers long-term revenue certainty for firming assets that support renewable integration.

Victoria's own Zero Emissions Vehicle Roadmap and Climate Change Strategy 2023 Update reinforce these aims, committing the state to 50 per cent ZEV sales by 2030 and net-zero emissions by 2045.⁸ The Made in Victoria 2030 Manufacturing Statement positions advanced batteries and clean-energy components among five priority industries.⁹

Battery-buffered charging sits at the intersection of all these frameworks. It advances ZEV uptake, delivers grid-firming capacity consistent with CIS objectives and establishes a manufacturing platform aligned with BBI Focus Area 2 (Cell Manufacturing) and Focus Area 3 (Pack Assembly and Integration). Policy coherence between Commonwealth and State programs would enable rapid scaling with minimal duplication.

2.2 Market Growth and Load Implications

The EVC's 2024 survey lists more than 3 000 public DC fast-charging connectors nationally, with roughly one-third in Victoria.¹ Yet the spatial distribution remains uneven: two-thirds of regional LGAs still lack a single 350 kW site. AEMO's ISP 2024 projects that unmanaged EV charging could add a load equal to several per cent of NEM summer peak demand by 2035 if uncoordinated.³ Conversely, managed charging aligned with renewable output would turn EVs into a beneficial flexible-demand side resource.

Battery buffers are central to this coordination. They allow charging stations to behave as controllable loads, capable of absorbing power when renewable generation is abundant and releasing it when drivers arrive. In effect, they transform EV infrastructure into dispatchable demand consistent with AEMO's Consumer Energy Resources Integration Roadmap 2024.³

2.3 Regulatory and Tariff Framework

Under the National Electricity Rules 5.17 and the ESC's Distribution Code (V12 2023), DNSPs must evaluate non-network solutions when they provide equivalent reliability at lower cost.¹⁰ Battery-buffered charging clearly meets this test. Yet most regulatory assessments still focus on the public-network side, overlooking the customer-side economics that ultimately determines project viability.

For commercial premises, upgrading supply from 100 kVA to 500 kVA can require new main switchboards, transformers and cabling. Beyond the capital costs, the customer is reclassified to a higher demand tariff, often doubling fixed network charges. ARENA's trial participants reported that these tariffs were a major barrier to regional rollout. ⁴ The AER's Retail Tariff Review 2023-24 similarly noted that for large commercial customers, demand charges regularly constitute 40-60 per cent of monthly bills. ⁵

By limiting the site's instantaneous grid draw, a battery buffer allows the business to remain within its existing contracted capacity and avoid higher demand tariffs. This saves not only upfront connection costs but also recurring expenses over the life of the asset. The economic signal is clear: batteries turn an otherwise sunk network cost into a manageable operating expense with positive cash-flow implications.

2.4 Industrial Development and Supply-Chain Opportunity

The Made in Victoria 2030 strategy and Victorian Industry Participation Policy 2024 set targets for local content in publicly funded projects. Battery-buffered charging provides an ideal application for local value-addition. The Federal Government's BBI grant scheme could assist Victoria to become central to sovereign manufacturing of core components-LTO cells, inverters, battery-management systems and switchgear-can be assembled within existing industrial precincts such as Geelong, Morwell and Lalor. A single assembly line producing gigawatt-hours of high-power modules annually could support dozens of direct jobs and many more indirectly across machining, logistics and testing.

Internationally, Japanese and European manufacturers are seeking partners to diversify supply chains under the Australia-Japan Energy Transition Partnership 2022 and the EU's Global Gateway Strategy. By establishing a credible LTO manufacturing capability in Victoria, the state could capture a share of the Asia-Pacific EV-infrastructure market and export both modules and integrated systems to Southeast Asia and the Pacific. We are currently in discussions with private and public partners in India, Malaysia, Singapore and Sri Lanka to help them unlock renewable energy resources through batteries valuable properties.

2.5 Social and Environmental Co-Benefits

Reliable charging infrastructure directly supports regional tourism and economic diversification. The Victorian Government's Charging the Regions Phase 2 Report 2024 found that towns hosting fast chargers recorded noticeable increases in visitor spending within months of installation. ⁷ Battery-buffered stations extend that benefit to areas where network upgrades are uneconomic. Personally, when I am looking for destinations for a driving getaway, I choose places that have EV charging and it is disappointing how few accommodation providers offer this requisite service.

Environmentally, aligning charging with midday solar production reduces renewable curtailment and lowers marginal emissions intensity. AEMO modelling indicates that if even a fraction of Victoria’s EV fleet were charged during high-renewable periods, statewide emissions could fall by hundreds of thousands of tonnes of CO₂-equivalent per year.³ Battery buffers make such temporal alignment operationally simple, automating charging schedules to respond to price or emissions signals.

2.6 A Comprehensive Policy Alignment Map

Policy Instrument	Relevance to Battery-Buffered Charging	Outcome Alignment
National EV Strategy 2023	Defines standards and access framework	Infrastructure readiness
Rewiring the Nation Fund	Finances grid modernisation	Funding eligibility for storage integration
Battery Breakthrough Initiative	Supports cell and pack manufacturing	Local value-addition
Capacity Investment Scheme	Provides firming contracts	Revenue certainty for storage assets
Zero Emissions Vehicle Roadmap	Targets 50 % ZEV sales by 2030	Charging equity and speed
Made in Victoria 2030	Manufacturing priority areas	Industrial development
ESC Distribution Code 2023	Non-network solution framework	Regulatory pathway
AEMO ISP 2024	Recognises consumer energy resources	Grid integration

Together, these policies provide a coherent mandate for governments to support battery-buffered charging as critical state infrastructure-technically proven, financially efficient and socially equitable.

3 Network Constraints and Evidence Base

3.1 Distribution Network Limitations

Victoria's electricity-distribution system reflects decades of incremental growth rather than deliberate design for high-power EV loads. Rural feeders radiating from zone substations were optimised for steady, predictable consumption from farms, small towns and light industry. A single modern 150 kW charger can draw instantaneous current equivalent to forty households. Two or three such units operating simultaneously can fully consume a feeder's residual capacity.

The Powercor Annual Planning Report 2024 highlights that several rural circuits already operate above 90 per cent of thermal rating during evening peaks.¹ AusNet Services' Distribution Annual Plan 2024 similarly lists voltage excursions exceeding statutory limits on long low-voltage spurs.² When a high-power connection is requested, the DNSP must either augment the line or impose restrictive export/import limits. Each option delays commissioning and inflates cost.

3.2 Evidence from ARENA and Infrastructure Victoria

ARENA's Ultra-Rapid EV Charging Trials Final Report 2023 found that connection works represented the single largest line-item in project budgets and the longest source of schedule delay.³ Infrastructure Victoria's 2023 modelling reached identical conclusions: connection cost variability-not charger technology-was the primary determinant of project economics.⁴ Sites located near highways or regional service centres often lacked the substation headroom needed for even one 350 kW unit, forcing proponents to fund multi-stage upgrades.

These findings show that grid access, not technology maturity, limits equitable rollout. Absent reform, regional Victorians will remain dependent on metropolitan corridors for reliable fast charging, undermining the Zero Emissions Vehicle Roadmap targets.

3.3 Voltage and Power-Quality Issues

Rapid chargers switch current in step-changes that can cause transient voltage dips. The Electricity Distribution Code V12 (ESC 2023) requires voltage at customer terminals to remain within ± 6 per cent of nominal.⁵ On long rural feeders, even modest current spikes can breach this limit. Conventional mitigation involves conductor upgrades or installation of static VAR compensators, both expensive and slow.

Battery buffers inherently mitigate these disturbances. The inverter provides instantaneous reactive-power support, absorbing or injecting vars to stabilise local voltage. ARENA's trial data show that buffered sites recorded significantly fewer protective trips and voltage alarms than unbuffered equivalents.³ This stability improves charger uptime and customer experience while reducing network stress.

3.4 Economic Implications of Traditional Augmentation

AER benchmarking places average rural-feeder reinforcement in the hundreds of thousands of dollars per kilometre, excluding permitting and environmental management.⁶ Procurement of transformers and conductors often requires lead times measured in quarters, not weeks. Once built, the new assets remain underutilised because high-power events are infrequent.

Battery-buffered charging provides the same effective capacity release without sunk augmentation. The buffer absorbs energy at a constant low rate, maintaining feeder load within its existing envelope and releases it in bursts to vehicles. From the DNSP's perspective the connection resembles a moderate constant-power customer rather than a volatile fast-charger site. When traffic patterns shift, the system can be redeployed elsewhere-something fixed copper and steel cannot do.

3.5 Customer-Side Connection and Demand-Charge Costs

More importantly than DNSP augmentation costs (which they recoup from energy users) are the costs borne directly by site hosts, that is Victorian businesses. Commercial premises such as supermarkets, hotels, or car dealerships face major internal upgrades when adding high-power chargers. Upgrading a supply from 100 kVA to 500 kVA typically requires new main switchboards, cabling and protection systems. The business also becomes liable for higher network-access and demand-charge tariffs under large-customer classifications.

ARENA's 2023 trials reported that for metropolitan and regional sites alike, monthly demand charges could exceed energy charges.³ The AER Retail Tariff Review 2023-24 confirmed that for large commercial customers, demand components represent 40-60 per cent of total electricity bills.⁷ A single five-minute peak event can set that charge for the user's entire billing cycle.

Battery buffers cap this exposure by limiting instantaneous grid draw. The charger may deliver several hundred kilowatts to vehicles, but the grid sees only a fraction of that as steady load. The site remains within its existing contracted capacity, avoiding reclassification and protecting other business operations from supply-voltage dips. This is often the deciding factor for small-business participation in public-charging programs.

3.6 Minimum-Demand and Renewable Integration

AEMO's ISP 2024 highlights the challenge of minimum daytime demand caused by widespread rooftop PV.³ During sunny weekends, distributed generation can exceed load, forcing curtailment and negative wholesale prices. Locating charging buffers near renewable generation turns this excess into useful transport energy. When wholesale

prices are low or emissions intensity minimal, the inverter automatically charges the battery; when drivers arrive or prices rise, it discharges. This temporal arbitrage supports renewable utilisation and improves system efficiency.

In my personal view and the view of the Inquiry I chaired, this challenge is understated, is putting grid security at risk and is the product of poor planning. AEMO's insistence on powers to stop the export of clean energy from citizen owned assets highlights this failure. This breaks governments' promises that investing in clean energy was an imperative to reduce emissions, power industry and lower energy bills for all, especially those unable to install or afford PV.²

3.7 Regional and Social Impacts

Reliable highway charging underpins regional mobility and tourism. Charging the Regions Phase 2 Report 2024 found that towns with accessible chargers saw measurable increases in visitor dwell time and expenditure.⁸ Battery-buffered stations can be installed quickly at hotels, service centres, or community hubs without heavy network works, extending these benefits to dozens more localities. Technology thereby advances both decarbonisation and regional-development objectives.

4 Technical Overview of LTO Battery-Buffer Systems

4.1 System Architecture

A complete battery-buffered fast-charging system comprises:

- Grid Interface: Connection hardware with circuit-breakers, metering and protection coordinated to DNSP requirements.
- Bidirectional Inverter: Converts AC power to DC for battery charging and back to AC or DC for discharge; operates in grid-forming or grid-following mode.
- Battery Energy Storage System (BESS): Modular LTO racks with integrated battery-management systems housed in weather-rated enclosures.
- Supervisory Control and Data Acquisition (SCADA): Manages charge scheduling, diagnostics and remote telemetry; interfaces with DNSP and market platforms.

During off-peak or high-renewable periods the inverter draws energy steadily, maintaining grid draw within programmed limits. When a vehicle connects, the battery discharges at many times that rate, supplying the charger instantly. The inverter responds to voltage or frequency deviations in milliseconds, providing local stabilisation.

4.2 Chemistry and Performance Advantages

LTO chemistry, used in Toshiba SCiB and Leclanché TiCell products, employs a spinel-structured anode that eliminates lithium plating, ensuring exceptional safety and longevity.

² The Federal Government's Solar Sharer Scheme has been proposed to help address this failure.

⁹ Public datasheets document tens of thousands of full-depth cycles at high C-rates with minimal capacity loss and operation from sub-zero to above-40 °C ambient temperatures. This makes LTO ideal for outdoor public-charging duty cycles where rapid cycling and temperature extremes are common.

Key benefits:

- High Power Density - Charge/discharge rates several times those of LFP or NMC.
- Long Cycle Life - Order-of-magnitude more cycles before replacement, reducing lifecycle cost.
- Thermal Stability - Negligible risk of thermal runaway; minimal need for active cooling.
- Environmental Profile - No cobalt or nickel; simpler recycling and lower embodied emissions.

4.3 Inverter and Power-Electronics Design

Modern silicon-carbide (SiC) or gallium-nitride (GaN) bidirectional inverters achieve > 97 per cent round-trip efficiency and rapid control response. Firmware enables seamless transition between grid-connected and islanded operation, allowing the buffer to sustain limited charging during outages. This function aligns with the Victorian Emergency Management Resilience Strategy 2024 call for autonomous energy hubs. ¹⁰

4.4 Three-Phase Synthesis from Single-Phase Supply

Half of regional Victoria remains on single-phase feeders. Upgrading them to three-phase supply can cost hundreds of thousands of dollars and take months of design and approval. LTO-buffer inverters can synthesise balanced three-phase output locally: while charging, they draw evenly from the single-phase source; during discharge, they generate a rotating field of three phases feeding standard three-phase chargers. Toshiba supplies SCiB-based stationary systems in both single-phase and three-phase configurations for buildings and social-infrastructure applications in Japan, demonstrating the maturity of the underlying technology platform. The same inverter topologies allow an LTO buffer in Victoria to draw from a modest single- or three-phase supply and present a synthesised three-phase bus to fast-charging equipment where required. ¹¹ Applied in Victoria, it could unlock hundreds of otherwise infeasible sites.

4.5 Renewable Integration and Energy-Market Participation

Co-locating PV generation with LTO storage maximises renewable use. During midday solar peaks the buffer charges at constant power, absorbing surplus energy. When prices or demand rise, it discharges, reducing curtailment. Because LTO tolerates high-rate cycling, it can perform this load-shifting daily for years. Integration with AEMO's emerging DER Market API would allow aggregated buffers to provide ancillary services such as frequency

control or voltage support, creating new revenue streams and improving whole-system efficiency.³

4.6 Control and Communications Architecture

Each installation includes a local controller communicating with DNSP supervisory systems via secure protocols. Algorithms optimise charging schedules using wholesale-price and emissions-intensity signals. Aggregated data contributes to system-planning intelligence while preserving customer privacy. This aligns with AEMO's Distributed Energy Integration Roadmap 2024 recommendation to integrate behind-the-meter storage into operational forecasting.³

4.7 Deployment Practicalities

Prefabricated BESS containers arrive factory-tested, requiring only foundation pads and short cable runs. Commissioning can occur within weeks rather than months. The small, predictable grid connection avoids new high-voltage switchyards or large land acquisitions. Modules are scalable: as traffic grows, capacity can be added incrementally. Decommissioned units can be redeployed to new corridors, supporting asset circularity.

4.8 Compliance and Standards Summary

All systems are designed to meet:

- AS/NZS 5139 - Safety of Battery Systems for Use with Power Conversion Equipment.
- AS/NZS 3000 - Wiring Rules.
- IEC 62619 - Safety Requirements for Secondary Lithium Cells and Batteries.
- UL 1973 - Stationary Battery Safety.
- AS/NZS 4777.2 - Grid Connection of Inverters.

Compliance ensures safety, interoperability and straightforward approval under Energy Safe Victoria procedures.

4.9 Comparison with Alternative Chemistries

Attribute	LTO	LFP	NMC	Na-NiCl ₂	Implication
Energy Density	Moderate	Higher	Highest	Moderate	Acceptable for stationary use
Power Capability	Very High	Medium	Medium	Low	Critical for fast charging
Cycle Life	Extremely High	Good	Moderate	High	Low O&M costs
Temperature Tolerance	Wide	Moderate	Narrower	Limited	All-climate operation
Safety	Excellent	Good	Fair	Excellent	Public infrastructure ready

5 Economic and Grid Benefits

5.1 Dual Benefit Spectrum - Public and Private Savings

Battery-buffered fast-charging delivers value on two fronts.

- First, it avoids or defers DNSP-side augmentation, sparing ratepayers the cost of new feeders, transformers and switchyards.
- Second-and often more decisive for project proponents-it prevents customer-side connection upgrades and the escalation of monthly demand charges that accompany them.

A traditional high-power connection for a supermarket, dealership, or service station might require a jump from 100 kVA to 500 kVA supply. The host must then install larger switchboards and cabling, pay connection-application fees and accept reclassification to a higher tariff class. The AER Retail Tariff Review 2023-24 notes that for large commercial customers, demand-charge components routinely comprise 40 - 60 per cent of total electricity cost. ¹ A single short-lived peak can inflate that bill for the entire month.

By limiting grid draw, a battery buffer keeps the site within its existing contract capacity. The chargers may deliver hundreds of kilowatts to vehicles, yet the grid sees only a controlled, steady load. The enterprise thus avoids new hardware, delays and years of inflated fixed charges. This feature makes the technology attractive not only to utilities and councils but also to small and medium businesses seeking to electrify without jeopardising core operations.

5.2 Avoided Network Augmentation

At the public-network level, DNSPs report reinforcement costs ranging from hundreds of thousands to several million dollars per kilometre depending on terrain and voltage class. ² Such works demand extensive consultation and long-lead procurement. Once complete, they remain under-utilised because high-power charging events are infrequent.

Battery buffering substitutes intelligent electronics for copper and steel. It provides effective capacity release within existing infrastructure and is redeployable as traffic patterns evolve. Over a 15-year horizon, the avoided regulated asset value translates into lower tariffs for all consumers. The ARENA Ultra-Rapid Trials 2023 concluded that connection works, not charger hardware, dominated total installed cost; buffer integration cut that burden materially by reducing transformer size and simplifying approvals. ³

5.3 Load Shifting and Renewable Utilisation

Victoria's midday solar surplus often drives wholesale prices to near zero. AEMO's ISP 2024 projects further growth in curtailment as distributed PV expands. ⁴ Battery-buffered chargers can be scheduled to absorb energy during these low-price intervals and discharge

when drivers plug in or during evening peaks. The outcome is improved utilisation of renewable generation and reduced system emissions.

The buffers' dispatchability also supports DNSPs during minimum-demand events. By pre-charging when feeder voltage is high and discharging during dips, they act as flexible loads that help maintain operational stability. This functionality aligns precisely with the AEMO Consumer Energy Resources Integration Roadmap 2024 objective of turning customer assets into grid resources.⁴

5.4 Resilience and Continuity of Service

LTO systems' wide temperature range (roughly -20°C to $+60^{\circ}\text{C}$) and rapid-response characteristics make them ideal for resilience applications. During outages, the inverter automatically isolates from the grid and supplies limited local load. Emergency-management agencies identify this "ride-through" capacity as vital for bushfire-prone regions. The Emergency Management Victoria Resilience Strategy 2024 explicitly calls for autonomous power hubs capable of maintaining communications and evacuation support; battery-buffered chargers fulfil that brief while serving transport needs year-round.⁵

5.5 Lifecycle Economics and Cost Comparisons

The CSIRO GenCost 2023-24 Final Report places capital-cost ranges for high-power stationary storage between the mid-hundreds and low-thousands of dollars per kWh depending on chemistry.⁶ LTO sits at the upper end but delivers many-times higher cycle life and charge-rate tolerance. When expressed as cost per kilowatt-hour delivered over lifetime, the result converges with, or undercuts, slower chemistries such as LFP.

Because LTO buffers flatten site demand, they also lower ongoing operational expenses by avoiding network-demand peaks. The combination of deferred capex and reduced opex yields a positive net-present-value outcome even under conservative utilisation assumptions. For public programs seeking cost-neutral decarbonisation, this dual benefit is significant.

5.6 Employment and Industrial Multipliers

Each ten megawatt-hours of annual module-assembly throughput can sustain dozens of direct manufacturing jobs and similar numbers in installation and maintenance. Under Made in Victoria 2030, advanced-manufacturing roles are among the state's highest-productivity occupations.⁷ Regional assembly of battery enclosures, inverter cabinets and switchgear would localise supply chains, reduce import exposure and provide apprenticeships in power-electronics and systems integration.

Local manufacturing also enables export under the Australia-Japan Energy Transition Partnership 2022 and ASEAN Green Mobility programs, capturing value beyond domestic demand.

5.7 Circular Economy and Re-Use Potential

LTO modules retain significant capacity after many years of fast-charge duty. Re-certified packs can be redeployed into community-battery or behind-the-meter applications, extending material life and reducing waste. Their cobalt- and nickel-free chemistry simplifies recycling. Including high-power transport batteries within the Victorian Battery Stewardship Scheme would ensure responsible end-of-life handling and reinforce circular-economy goals.

5.8 Socio-Economic Benefits for Regional Communities

Reliable charging directly affects regional tourism and freight efficiency. Charging the Regions Phase 2 Report 2024 found that towns hosting public fast chargers experienced sustained increases in visitor spending.⁸ Battery-buffered stations extend these benefits to areas lacking grid headroom. For councils and community enterprises, modular systems minimise disruption: installation requires only a small pad, existing single-phase supply and modest approvals. The resulting visibility of EV infrastructure also signals modernisation, encouraging further private investment.

5.9 Indicative Economic Scenario

Using parameters from Infrastructure Victoria 2023 and AER 2024, Arvio modelled a conservative corridor deployment of battery-buffered chargers. Results indicate aggregate avoided network and connection expenditure in the tens-of-millions range over the program life, with proportionate reductions in cumulative emissions through renewable alignment. While indicative, these values illustrate order-of-magnitude benefits consistent with empirical trial data.

6 Policy and Regulatory Recommendations

6.1 Recognition as Critical Enabling Infrastructure

The Committee should recommend that the Zero Emissions Vehicle Roadmap be amended to list battery-buffered fast-charging as critical enabling infrastructure. This would allow funding through existing public-works channels and unlock joint financing with Commonwealth programs such as Rewiring the Nation, BBI and CIS.

6.2 DNSP Planning Reform - Embedding Non-Network Solutions

DNSPs are required under National Electricity Rules 5.17 to consider non-network options. The ESC could strengthen compliance by publishing a formal guideline specifying battery-buffered charging as an eligible category. Transparent cost-benefit templates would assist DNSPs in assessing deferral value relative to augmentation.

6.3 Establish a Victorian Fast-Charging Buffer Code of Practice

Energy Safe Victoria, Standards Australia and industry stakeholders should co-develop a Code of Practice for High-Power EV Charging with Integrated Energy Storage. The Code should:

- Harmonise AS/NZS 5139, AS/NZS 3000 and IEC 62619 requirements.
- Define acceptable designs for single-phase-to-three-phase synthesis.
- Set cybersecurity and data-sharing standards for control systems.
- Provide streamlined certification for compliant modular products.

Such a Code would mirror the successful standardisation of rooftop-solar systems and ensure consistent safety outcomes across jurisdictions.

6.4 Tariff and Market Reform

Current demand-charge structures penalise high-power sites regardless of timing. Time-of-use tariffs that reward midday or high-renewable charging would align private incentives with system needs. The ESC's ongoing Two-Way Pricing Review 2024 and the AEMC's Flexible Export Trials provide clear entry points for this reform.

Complementary market participation should also be enabled. Aggregated buffers could provide voltage-control or frequency-response services through AEMO's Very Fast FCAS markets, as already envisaged for distributed-energy resources.

6.5 Expansion of the Battery Stewardship Scheme

High-power modules used in transport and charging infrastructure should be formally included within the Victorian Battery Stewardship Scheme. Doing so will guarantee traceability, facilitate second-life deployment and signal regulatory maturity to investors and insurers.

6.6 Pilot Corridor Program under BBI and CIS

Victoria should partner with the Commonwealth to deliver demonstration corridors under BBI Focus Area 2 (Cell Manufacturing) and Focus Area 3 (Pack Assembly) linked with the CIS Transport Firming Stream. Candidate routes include the Hume, Western and Princes Highways where feeder limitations are documented in Infrastructure Victoria 2023. The program would validate technical performance, economic outcomes and social benefits within two years.

6.7 Manufacturing Roadmap for High-Power Modules

Under Made in Victoria 2030, government should commission a roadmap detailing the steps from prototype assembly to full-scale production of LTO cells, inverters and control systems. The roadmap should define skills requirements, supply-chain partners and export targets. Collaboration with CSIRO, Deakin University and TAFE Victoria could establish credentialed training in battery assembly and power-electronics testing.

6.8 Integration into Planning Frameworks

Battery-buffered charging should appear in AEMO's Distributed Energy Integration Roadmap 2024 as a formal CER asset class. DNSPs should list planned and potential buffered sites in annual planning reports to capture deferral value in forecasting models. Inclusion in these frameworks legitimises the technology for cost-recovery and incentive-scheme participation.

6.9 Data Transparency and Knowledge Sharing

Early projects must collect and publish anonymised operational data-utilisation profiles, grid impacts, reliability, maintenance-via an open portal like ARENA's. Shared evidence accelerates learning curves and underpins regulatory trust.

6.10 Cross-Sector Collaboration

A permanent interdepartmental working group across DEECA, the Department of Transport and Planning and Invest Victoria should oversee coordination between energy, transport and manufacturing policy streams. Annual reporting would track charger coverage, manufacturing jobs created and emissions reductions achieved.

7 Policy Alignment and Comparative Experience

7.1 National Context

Across Australia, state agencies now recognise that charging equity depends as much on local-network constraints as on vehicle cost. Western Australia's EV Network program,

completed in early 2025, shows how difficult it is to deliver reliable fast charging over long, weakly supplied corridors and highlights the role that battery-buffered designs can play in overcoming local capacity limits on constrained feeders.¹ The Commonwealth's Battery Breakthrough Initiative (BBI) meanwhile funds domestic cell and pack manufacturing, while the Capacity Investment Scheme (CIS) supports dispatchable storage assets. Integrating battery-buffered charging into both programs would align national infrastructure, industry and decarbonisation policy.

7.2 International Comparators

European and Asian precedents confirm the practicality of high-power buffers. ABB's *Grid-eMotion Flash* projects in Geneva and Namur show ultra-rapid bus charging supported by stationary lithium-titanate systems to avoid urban-grid stress.² Japan's *SCiB Smart-Community* demonstrations in Iwaki and Yokohama use the same chemistry to sustain three-phase power from single-phase supplies for neighbourhood EV depots.³ These cases provide engineering validation while illustrating commercial models-municipal ownership, concession partnership and service-fee aggregation-that Victoria can adapt.

7.3 Regulatory Alignment

The *ESC Electricity Distribution Code V12 (2023)* already embeds a principle that DNSPs must consider "non-network options" where efficient.⁴ Battery-buffered charging satisfies this definition yet is not explicitly recognised. Formal inclusion would enable DNSPs to recover partial expenditure on third-party installations that defer augmentation. Similarly, the *AEMC Two-Way Pricing Review 2024* advocates tariffs rewarding flexible load; buffers are among the simplest and safest mechanisms to deliver that flexibility.

8 Opportunities for Victoria

8.1 Manufacturing and Supply-Chain Leadership

Victoria possesses the pre-conditions for a domestic high-power-battery industry: existing component manufacturers, skilled labour, research capacity and logistics infrastructure. Deakin University's Battery Research and Innovation Hub, CSIRO's Energy Technology Centre and TAFE Victoria's advanced-manufacturing programs together form a ready pipeline of expertise.

A modest-scale LTO-module assembly facility-supplying tens of megawatt-hours per year-could be established in existing industrial zones such as Geelong, Morwell, or Dandenong South. The state's *Made in Victoria 2030* strategy already lists "batteries and clean-energy components" among priority sectors.⁵ Inclusion of LTO modules would attract supply-chain co-investment from Japanese and European firms seeking diversification away from East-Asian concentration.

Beyond jobs and exports, local manufacturing ensures control over safety standards, certification and after-sales service-factors critical for public confidence in roadside infrastructure.

8.2 Regional Development and Tourism

Battery-buffered chargers can be deployed quickly in small communities using single-phase feeders, providing economic uplift without network expansion. They enable electric-tourism routes across the Grampians, Gippsland and High Country, consistent with the *Tourism 2030 Strategy*. Council-owned hotels, visitor centres and showgrounds can host chargers without breaching existing supply limits. As *Charging the Regions Phase 2 (2024)* observed, each new charging stop increases local visitor dwell time and expenditure.⁶

8.3 Energy System Efficiency

Buffers convert previously wasted midday solar energy into transport fuel, reducing renewable curtailment and stabilising voltage. Aggregated across dozens of sites, this behaviour yields system-wide benefits comparable to a small peaking plant but without new emissions. AEMO's modelling indicates that such flexible demand can lower wholesale-market volatility and defer utility-scale investment.⁷

8.4 Integration with Public and Fleet Charging

Government and corporate fleets face similar connection constraints at depots. Battery-buffered systems allow overnight trickle charging supplemented by daytime fast-charge bursts without exceeding contracted capacity. Integrating this model into the *Fleet Transition Plan 2025-30* would unlock rapid adoption while containing infrastructure budgets.

8.5 Export Potential

South-East Asian nations are pursuing rapid electrification under the *ASEAN Plan of Action for Energy Co-operation 2025-2035*. Victoria can supply modular buffer systems and technical expertise, leveraging trade agreements such as *RCEP* and the *Australia-Singapore Green Economy Agreement*. A well-structured manufacturing base would position Victoria as the region's trusted supplier of safe, high-power charging modules.

9 Hypothetical Projects and Illustrative Scenarios

The following four projects are **hypothetical design studies**, not descriptions of existing installations. Each scenario applies lithium-titanate-oxide (LTO) battery-buffered fast-charging to a specific Victorian corridor or precinct using publicly available data on traffic volumes, freight movements and regional-economic significance. Charger configurations, battery sizes and load profiles are engineering assumptions for illustration only.

9.1 Hypothetical Project A - Hume Freeway Heavy-Vehicle and Coach Hub (Euroa-Benalla)

Corridor and economic context

The Sydney-Melbourne corridor, formed by the Hume Freeway and Hume Highway, is the second most heavily trafficked inter-capital route on the national network, with average non-urban volumes in the order of 16 000-17 000 vehicles per day and the highest heavy-vehicle share of any inter-capital corridor.¹ This road underpins a substantial share of interstate freight and coach travel between Victoria and New South Wales.²

The Euroa-Benalla segment in north-east Victoria includes several major service centres that are natural candidates for early electric heavy-vehicle and coach charging, given their spacing and existing amenities. Local electricity supply is generally via 22 kV three-phase feeders with kiosk transformers sized for current loads; some surrounding rural customers are served by single-phase or SWER systems, but the primary service centres sit on the three-phase network.

Host and existing supply assumption

In this scenario a highway service centre between Euroa and Benalla operates on a **500 kVA three-phase kiosk transformer** supplied from a 22 kV feeder. DNSP planning studies show the upstream zone substation approaching 80-90 per cent utilisation during summer peaks; a conservative **additional import headroom of ≈250 kW** is available without reinforcement.

Objective

Enable credible high-power charging for heavy vehicles and coaches at this critical waypoint while respecting a 250 kW import cap set by the DNSP and avoiding major augmentation.

LTO buffer and power-electronics design

- **Battery:** ≈1.5 MWh LTO in modular, outdoor-rated racks, sized for multi-C discharge and long cycle life
- **Grid-tie inverters:** ≈800 kVA total capacity, but **controls cap net grid import/export at 250 kW RMS** at the point of connection
- **DC charger bus:**
 - two × 350-400 kW truck/coach chargers
 - two × 150 kW light-vehicle chargers
- **PV:** ≈300 kW of roof/ground-mounted PV DC-coupled to the battery/charger bus with export-limiting so that net grid flow never exceeds ±250 kW

Feeder-aware operating envelope

- Under **midday high-solar conditions**, PV and the battery together support one truck charger at full power plus up to one car charger while grid import is kept near 200-250 kW.
- Under **evening peaks**, the battery supplies most of the charger load; grid import is held closer to 100-150 kW to protect feeder loading.
- Overnight, the system throttles to **slow recovery**, drawing perhaps 60-100 kW for several hours to restore state-of-charge before the morning peak.
- Priority and queuing rules ensure coaches with fixed timetables and safety-critical freight receive first access to high-power sessions once SoC and grid-import constraints are taken into account.

Impacts

Compared with a conventional 1-2 MVA connection for the same charger set, the buffered design:

- avoids an immediate requirement for substation and feeder augmentation along a nationally significant corridor
- keeps the host within its existing demand-tariff band or a modestly higher one, rather than stepping into a large industrial tariff with much higher fixed demand charges
- provides a template that can be repeated at several key stops along the Hume, supporting future electric line-haul and coach fleets without overloading the regional network.

9.2 Hypothetical Project B - Western Highway Truck Plaza (Ararat-Stawell, LV Three-Phase Constraint)

Corridor and traffic context

The Western Freeway and Western Highway constitute the main road link between Melbourne and Adelaide and carry substantial interstate freight and tourist traffic. Between Ballarat and Ararat typical daily traffic is around 6 000 vehicles, with roughly one-quarter commercial; between Ararat and Stawell volumes rise to around 6 500 vehicles per day, with around 20 per cent commercial.³ Over two decades traffic and heavy-vehicle shares have grown markedly, prompting the long-running duplication program.⁴

Host and existing LV supply

Assume a truck-stop plaza just off the Western Highway between Ararat and Stawell with:

- a **three-phase LV supply rated \approx 200 kVA** for existing fuel, kitchen and refrigeration loads
- an upstream 22 kV feeder already moderately loaded, with limited spare capacity before voltage and thermal limits are reached at the zone substation.

A traditional high-power connection for even one 350 kW charger would trigger a step change to a 750-1 000 kVA or larger transformer, new HV metering and potentially substantial contribution charges.

Objective

Provide high-power charging for articulated trucks and coaches and moderate-speed charging for light vehicles, all while keeping net site import within ≈ 150 kW to avoid transformer and feeder upgrades.

LTO buffer architecture and envelope

- **Battery:** ≈ 1.5 MWh LTO, engineered for high cycle life under multiple fast sessions per day
- **Inverter:** ≈ 250 kVA inverter, controls enforcing a **150 kW cap** on net grid import/export
- **Chargers:**
 - two \times 350 kW truck/coach chargers
 - two \times 75-100 kW car chargers
- **PV:** ≈ 200 -300 kW roof-mounted, DC-coupled and non-exporting

Operating rules:

- During busy daytime windows, the system allows **one truck charger at or near full power** at a time; if a second truck or a cluster of cars plug in, power-sharing algorithms ramp individual charge rates down to keep the internal DC bus within inverter and thermal limits.
- Over each 15-minute demand window used for tariff calculation, the EMS keeps **average grid import at or under 150 kW**, using the battery to shave peaks and soak up PV output.
- Overnight, the plaza uses spare capacity to slowly recharge the battery at 50-80 kW while supporting lighting and refrigeration, avoiding any sudden load steps seen by the feeder.

Impacts

- The DNSP avoids immediate reinforcement of the rural 22 kV feeder and associated capital cost.
- The plaza operator avoids a reclassification into a larger demand band with significantly higher fixed charges.⁵
- Freight operators gain a reliable high-power stop on the Melbourne-Adelaide route, supporting future zero-emission heavy vehicles.

9.3 Hypothetical Project C - Princes Highway EV Freight and Tourism Hub (Traralgon-Sale, Feeder-Loading Constraint)

Corridor and regional context

Duplication of the Princes Highway between Traralgon and Sale is a long-term project designed to improve safety and efficiency along approximately 43 km of this key corridor.⁶ The route serves Gippsland's diversified regional economy, including forestry, dairy, horticulture and emerging clean-energy industries, and supports significant tourism traffic to the Gippsland Lakes and alpine regions.⁷ Traffic counts indicate daily volumes in the high thousands to tens of thousands of vehicles, with a substantial heavy-vehicle component.⁶

AusNet's distribution planning material for the region identifies several zone substations and feeders in the Traralgon-Sale area operating at relatively high utilisation during evening peaks.

Host and HV feeder assumption

In this hypothetical project a large roadside service hub between Traralgon and Sale sits on a **22 kV feeder and 750 kVA zone transformer**, with DNSP planning indicating that an extra **≈250-300 kW** of firm capacity is available before a more substantial upgrade is required.

Objective

Deliver a mix of high-speed heavy-vehicle charging and passenger-vehicle fast charging while keeping within the available 250-300 kW incremental headroom and avoiding further substation augmentation.

LTO buffer configuration and operation

- **Battery:** ≈1.2 MWh LTO
- **Inverter:** ≈800 kVA total, configured so that **net PCC import does not exceed 300 kW RMS**
- **Chargers:**
 - two × 300 kW heavy-vehicle chargers
 - three × 150 kW chargers for cars and vans
- **PV:** 400-500 kW of ground-mounted PV co-located behind an export-limiting interface

Controls:

- In **midday conditions** the battery and PV can support two heavy vehicles at high charge rates and one or more cars, while grid import is limited to 250-300 kW; in effect the corridor uses daytime solar to fuel freight and tourism.
- In the **evening peak**, charger power is dynamically derated to maintain grid import closer to 150-200 kW, protecting feeder loading and voltage.
- Overnight, the hub recharges the buffer over several hours at 80-120 kW, when both wholesale prices and line loading are lower.

Impacts

- The design avoids or defers substantial reinforcement of feeders serving the Traralgon-Sale duplication, which would otherwise be needed if multiple unbuffered chargers were installed.
- It supports the freight efficiency and tourism benefits that duplication is intended to unlock by ensuring that EVs, including future electric trucks, have a credible, high-power stop along this strategic corridor.^{6 7}

9.4 Hypothetical Project D - Dandenong South Zero-Emission Bus and Freight Depot Cluster (Embedded-Network Cap)

Precinct context

Dandenong South is one of Victoria's most important freight and logistics hubs. It hosts large distribution centres and industrial estates and is the location for a planned rail freight terminal as part of the Port Rail Shuttle Network, which will link the Port of Melbourne to south-east Melbourne by rail.⁸ Developer material describes the Dandenong South intermodal terminal as a 24-hour automated hub designed to handle significant container volumes.⁹

At the same time, Melbourne's zero-emission bus program is expanding: operators such as Kinetic and CDC Victoria are adding electric buses and consolidating depots across the metropolitan network, including in the south-east corridor.^{10 11}

Embedded network and connection constraint

In this scenario several adjacent depots and warehouses participate in a private embedded network with a **shared 11 kV connection agreement capped at 5 MVA**. Existing industrial loads consume roughly 4 MVA at evening peaks, leaving about **1 MVA of headroom** for additional transport electrification and other growth. The DNSP is open to future augmentation but expects proponents to demonstrate efficient use of the existing cap first.

Objective

Provide reliable overnight charging for a fleet of ~80-100 electric buses and daytime charging for medium-duty electric trucks within the 1 MVA headroom, while also improving peak-demand management across the estate.

LTO buffer architecture and operating envelope

- **Battery:** distributed 3-4 MWh LTO across several enclosures located at key depots within the embedded network
- **Inverters:** multiple 1-1.5 MVA inverters, coordinated by an estate-level energy-management system (EMS)
- **Chargers:**
 - bus depot chargers typically 75-150 kW each for overnight use
 - truck chargers up to 150-300 kW for daytime top-ups
- **Grid-import cap:** EMS enforces a strict **1 MVA ceiling on net import** above existing loads, ensuring the 5 MVA overall cap is not breached.

Operational logic:

- Overnight, buses are scheduled so that only a subset charge at any one time, with the battery supplying much of the incremental load; grid import remains a flat, predictable profile within the 1 MVA headroom.
- During the day, PV across estate rooftops (assumed ~1 MW aggregate) and the LTO buffer serve truck chargers, with EMS curtailing charging during rare periods where both industrial loads and charging coincide at very high levels.
- The EMS can also provide ancillary services and demand-response, discharging the battery to keep net import under the cap during extreme peaks or market price events, while ensuring buses remain ready for the next service run.

Impacts

- The DNSP gains a highly predictable load profile and can defer upgrade of several 11 kV feeders and zone equipment feeding the precinct.

- Bus and freight operators gain a practical pathway to deep electrification without individually negotiating costly new connections.
- The model is directly relevant to the Port Rail Shuttle Network and similar freight precincts, providing a worked example of how high-power LTO storage can support both zero-emission buses and rail-linked freight hubs in one of Victoria's most important industrial regions.^{8 9 10 11}

10 Indicative Scenarios and Long-Term Outlook

10.1 Scaling Trajectory

If only a modest share of Victoria's future public chargers incorporated storage buffers, cumulative avoided network expenditure could reach many tens of millions of dollars over the next decade. Parallel adoption by commercial premises would multiply private savings and create a self-reinforcing market for locally produced modules. Such uptake would complement grid-scale storage by distributing firming capacity closer to load.

10.2 Research and Development Opportunities

Partnerships between Arvio, CSIRO and Victorian universities could refine inverter control algorithms, thermal-management designs and recycling pathways. ARENA's open-data model should guide knowledge-sharing so that each deployment contributes to broader technical maturity. R&D investment in power-electronics manufacturing could also bridge into defence and heavy-vehicle sectors, diversifying revenue.

10.3 Contribution to Net-Zero Targets

Integrating battery-buffered charging across transport corridors could deliver measurable emissions reductions through renewable utilisation and efficiency gains. While precise totals depend on grid mix, even conservative modelling indicates material contributions toward the 2045 net-zero goal. By complementing rather than competing with centralised infrastructure, this technology embodies practical decarbonisation-deployable now with proven components and established standards.

11 Conclusion and Recommendations

Victoria's energy transition hinges on solving two interlinked challenges: providing equitable access to ultra-fast EV charging and doing so without unsustainable grid expansion. Battery-buffered fast-charging-particularly using safe, durable LTO chemistry-addresses both.

It replaces augmentation with intelligence, transforms cost centres into flexible assets and aligns transport electrification with renewable integration. For business hosts, it avoids expensive connection upgrades and volatile demand charges; for DNSPs, it defers reinforcement; for communities, it delivers reliable service and local jobs. All technical evidence-from ARENA trials, Infrastructure Victoria analysis and AEMO modelling-supports these conclusions.

The Committee is therefore urged to recommend that the Victorian Government:

8. Formally classify battery-buffered fast-charging as critical enabling infrastructure within the *Zero Emissions Vehicle Roadmap*.
9. Instruct the ESC to issue guidelines defining it as a recognised non-network option.
10. Establish a Code of Practice for safe, standardised installation and data sharing.
11. Implement tariff reform rewarding midday and renewable-aligned charging.
12. Launch pilot corridors under *BBI* and *CIS* co-funding.
13. Develop a manufacturing roadmap under *Made in Victoria 2030*.
14. Embed battery-buffered charging in AEMO and DNSP planning frameworks.

Taken together, these steps would deliver immediate, measurable and enduring benefits-technical, economic and environmental. They would also demonstrate Victoria's leadership in pragmatic, evidence-based energy transition.

References

1. Electric Vehicle Council. *State of EVs 2024 Report*. Sydney: Electric Vehicle Council, 2024.
2. Infrastructure Victoria. *Electric Vehicle Infrastructure Costs and Deployment Constraints*. Melbourne: Infrastructure Victoria, 2023.
3. Australian Energy Market Operator (AEMO). *Integrated System Plan 2024–26 and Consumer Energy Resources Integration Roadmap*. Sydney: AEMO, 2024.
4. Australian Renewable Energy Agency (ARENA). *Ultra-Rapid EV Charging Trials – Final Report*. Canberra: ARENA, 2023.
5. Australian Energy Regulator (AER). *Retail Tariff Review 2023–24*. Canberra: AER, 2024.
6. Department of Climate Change, Energy, the Environment and Water (DCCEEW). *Rewiring the Nation Fund Guidelines*. Canberra: DCCEEW, 2023.
7. Department of Transport and Planning (Victoria). *Charging the Regions – Phase 2 Report*. Melbourne: State of Victoria, 2024.
8. Department of Energy, Environment and Climate Action (Victoria). *Zero Emissions Vehicle Roadmap*. Melbourne: DEECA, 2023.
9. Department of Jobs, Skills, Industry and Regions (Victoria). *Made in Victoria 2030 – Manufacturing Statement*. Melbourne: State of Victoria, 2023.
10. Essential Services Commission (Victoria). *Electricity Distribution Code Version 12*. Melbourne: ESC, 2023.
11. Powercor Australia. *Annual Planning Report 2024*. Melbourne: Powercor, 2024.
12. AusNet Services. *Distribution Annual Plan 2024*. Melbourne: AusNet Services, 2024.
13. Australian Energy Regulator (AER). *Distribution Performance Report 2024*. Canberra: AER, 2024.
14. Toshiba Corporation and Leclanché SA. *SCiB and TiCell Technical Datasheets and Safety Certifications (2024 Edition)*. Tokyo and Yverdon-les-Bains: Toshiba and Leclanché, 2024.
15. Emergency Management Victoria. *Resilience Strategy 2024*. Melbourne: State of Victoria, 2024.
16. Commonwealth Scientific and Industrial Research Organisation (CSIRO). *GenCost 2023–24 Final Report*. Canberra: CSIRO, 2024.
17. Government of Western Australia. “WA Takes the Wheel with EV Network Plugged In and Charged Up.” Media statement, January 2025.
18. ABB Group. *Grid-eMotion Flash and Opportunity Charging Case Studies – Geneva, Namur, Nantes*. Zurich: ABB, 2016–2020.
19. Toshiba Corporation. *SCiB Smart-Community Projects Summary*. Tokyo: Toshiba, 2021.
20. Australian Energy Market Commission (AEMC). *Two-Way Pricing Review 2024*. Sydney: AEMC, 2024.

21. Department of Transport and Planning (Victoria). *Fleet Transition Plan 2025–30 (Draft)*. Melbourne: State of Victoria, 2025.
22. Department of Jobs, Skills, Industry and Regions (Victoria). *Victorian Industry Participation Policy 2024*. Melbourne: State of Victoria, 2024.
23. Australian Trade and Investment Commission (Austrade). *Australia–Japan Energy Transition Partnership 2022 – Overview Brief*. Canberra: Austrade, 2022.
24. ASEAN Centre for Energy. *ASEAN Plan of Action for Energy Co-operation (APAEC) 2025–2035*. Jakarta: ASEAN, 2023.
25. Visit Victoria / Department of Jobs, Precincts and Regions (Victoria). *Victoria’s Tourism 2030 Strategy*. Melbourne: State of Victoria, 2023.
26. Commonwealth of Australia. *Battery Breakthrough Initiative – Program Guidelines (2023 Release)*. Canberra: DCCEEW, 2023.
27. Commonwealth of Australia. *Capacity Investment Scheme – Design Paper*. Canberra: DCCEEW, 2024.
28. Australian Energy Market Operator (AEMO). *Consumer Energy Resources Integration Roadmap – Technical Appendix*. Sydney: AEMO, 2024.
29. Infrastructure Victoria. *Network Investment and Augmentation Costs – Data Tables*. Melbourne: Infrastructure Victoria, 2023.
30. Department of Transport and Planning (Victoria). *Electric Fleets – Opportunities and Challenges Discussion Paper 2025*. Melbourne: State of Victoria, 2025.
31. Bureau of Infrastructure and Transport Research Economics (BITRE). *Inter-capital Corridor Performance and Characteristics*. Canberra: BITRE, 2013 (with later statistical updates).
32. Bureau of Infrastructure and Transport Research Economics (BITRE). *Freightline 1: Australian Freight Transport Overview*. Canberra: BITRE, 2014.
33. VicRoads / Department of Transport and Planning (Victoria). *Traffic Volume Data Portal – Hume, Western and Princes Highway Corridors (2019–2023 extracts)*. Melbourne: State of Victoria, accessed 2025.
34. Major Road Projects Victoria. *Western Highway Upgrade – Project Benefits Fact Sheet*. Melbourne: State of Victoria, 2019.
35. Victorian Government. “One Step Closer to Completing Princes Highway Duplication Between Traralgon and Sale.” Media release, 28 April 2021.
36. One Gippsland. “One Gippsland Seeks Government Backing for Four Key Road Projects.” Media release, 20 December 2024.
37. Victorian Government, Department of Transport and Planning. *Port Rail Shuttle Network – Project Overview*. Melbourne: State of Victoria, 2023.
38. Salta Properties. “Dandenong South Intermodal Terminal – Project Overview.” Project information sheet, accessed 2025.
39. Kinetic Group. “Electric Bus Fleet Expansion in Melbourne.” Media release, 2024.
40. CDC Victoria. “Zero-Emission Bus Expansion Program.” Press statement, 2024.

Appendix A – Glossary

AEMC – Australian Energy Market Commission – Independent rule maker and market development body for the National Electricity Market, including the Two-Way Pricing Review

AEMO – Australian Energy Market Operator – Organisation that plans and operates the National Electricity Market and gas markets, and publishes the Integrated System Plan and Consumer Energy Resources Integration Roadmap

AER – Australian Energy Regulator – National regulator that sets network revenues, monitors performance and reviews retail tariffs for electricity and gas

ARENA – Australian Renewable Energy Agency – Federal funding agency that supports renewable and enabling-technology projects, including ultra-rapid EV charging trials

BBI – Battery Breakthrough Initiative – Commonwealth program that supports battery cell manufacturing, pack assembly and related sovereign capability in Australia

BESS – Battery Energy Storage System – Integrated battery, power-conversion and control system used for stationary energy storage and grid support

BITRE – Bureau of Infrastructure and Transport Research Economics – Commonwealth body that provides data and analysis on road, freight and inter-capital transport corridors

CER – Consumer Energy Resources – Distributed energy resources owned by customers, such as rooftop solar, batteries and electric vehicles, that AEMO and DNSPs are progressively integrating into planning and operations

CIS – Capacity Investment Scheme – Commonwealth revenue-support mechanism designed to underwrite investment in firming and dispatchable capacity to complement renewable generation

CSIRO – Commonwealth Scientific and Industrial Research Organisation – National science agency; in this context the publisher of the GenCost report on technology cost projections

DEECA – Department of Energy, Environment and Climate Action (Victoria) – Victorian department responsible for climate, energy and environment policy, including the Zero Emissions Vehicle Roadmap

DNSP – Distribution Network Service Provider – Company that owns and operates the local electricity distribution network (poles and wires) and manages customer connections and augmentations

DSO – Distribution System Operator – Emerging role where a distribution business actively operates its network, procures local flexibility and integrates consumer energy resources, rather than only providing passive network capacity

EMS – Energy Management System – Control platform that monitors and optimises energy flows, demand and storage within a site or embedded network to meet technical and tariff constraints

ESC – Essential Services Commission (Victoria) – Economic regulator for Victorian electricity and gas networks and retail licences, and the author of the Electricity Distribution Code

EV – Electric Vehicle – Road vehicle powered by one or more electric motors drawing energy from a rechargeable battery

FCAS – Frequency Control Ancillary Services – Market services procured by AEMO to maintain power-system frequency within prescribed limits

GenCost – GenCost report – Annual CSIRO publication that estimates current and projected costs for generation and storage technologies used in planning and policy analysis

HPFV – High Productivity Freight Vehicle – Higher-capacity or longer-combination heavy vehicle that can operate on approved routes under access permits

HV – High Voltage – Higher-voltage levels in the distribution and sub-transmission system (typically 11 kV and above) used to move power over longer distances and supply larger customers

kVA – Kilovolt-ampere – Unit of apparent electrical power used to rate transformers and customer connections, related to but distinct from kilowatts

kW / kWh – Kilowatt / kilowatt-hour – Units of electrical power and electrical energy; kW measures instantaneous rate, kWh measures energy over time

Kinetic – Kinetic Group – Major Melbourne bus operator that is rolling out zero-emission buses under Victorian government contracts

LFP – Lithium iron phosphate – Lithium-ion battery chemistry with good cycle life and thermal stability, widely used in stationary storage and some EV applications

LTO – Lithium titanate oxide – Lithium-ion battery chemistry using a titanate anode, characterised by very high charge and discharge power, long cycle life and strong safety performance, used here for high-power charging buffers

LV – Low Voltage – Low-voltage part of the distribution network (for example 230/400 V three-phase) that directly supplies homes, small businesses and many commercial premises

NEM – National Electricity Market – Wholesale electricity market and physical power system linking the eastern and southern states and territories of Australia

PCC – Point of Common Coupling – Electrical point where a customer installation connects to the public network and at which power-quality and capacity limits are defined

Port Rail Shuttle Network – Port Rail Shuttle Network – Victorian program to develop intermodal terminals, including Dandenong South, to move containers between the Port of Melbourne and key freight precincts by rail

PV – Photovoltaic – Solar panels and associated equipment that convert sunlight into electricity, usually installed on rooftops or ground-mounted arrays

Rewiring the Nation – Rewiring the Nation Fund – Commonwealth financing facility that supports major transmission, interconnection and related enabling infrastructure

SCADA – Supervisory Control and Data Acquisition – System used by networks and asset owners to monitor and control substations, batteries and other field equipment in real time

SCiB – Super Charge ion Battery – Toshiba’s lithium-titanate battery product family, used in vehicles and stationary storage and referenced as a leading LTO implementation

SoC – State of Charge – Percentage of usable battery capacity that is currently stored, analogous to a fuel-gauge reading

SWER – Single Wire Earth Return – Rural distribution configuration that uses a single high-voltage conductor with earth return, generally with relatively low capacity compared with three-phase feeders

Tariff (demand) – Demand charge tariff – Electricity tariff structure that includes a charge based on the maximum power drawn over a defined interval in the billing period

Two-way pricing – Two-way pricing framework – AEMC initiative to design network tariffs that reflect both consumption and export and encourage flexible demand and the integration of consumer energy resources

WA EV Network – Western Australian EV Network – State-backed network of DC fast-charging sites rolled out along major highway corridors in Western Australia

ZEB – Zero-Emission Bus – Bus powered by electricity or hydrogen fuel cells that produces no exhaust emissions and is being deployed in Melbourne’s bus network

ZEV – Zero-emissions Vehicle – Vehicle that produces no greenhouse-gas or pollutant emissions from the exhaust in operation, typically a battery-electric or fuel-cell electric vehicle