RACE for 2030
RELIABLE AFFORDABLE CLEAN ENERGY

29 October 2025

Committee Chair, Georgie Purcell
Parliament of Victoria
Legislative Council Economy and Infrastructure Committee
Parliament House, Spring Street
EAST MELBOURNE VIC 3002

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Dear Committee Chair,

The Reliable Affordable Clean Energy (RACE) for 2030 Cooperative Research Centre submits the following document to the Legislative Assembly Committee on Transport and Infrastructure's inquiry into existing and future infrastructure needed to support electric and alternative energy source vehicles across New South Wales.

The Cooperative Research Centres (CRC) Program is an Australian Government initiative established to fund industry-led collaborations between industry, researchers and end users. RACE is a cooperative research centre for the energy and carbon transformation and is an industry-led research collaborative established in 2020 to drive energy innovation across the supply chain to deliver improved, lower cost and lower emission energy services for energy customers. Projects with RACE leverage industry funding to develop innovative research alongside the best researchers in Australia.

RACE represents a $68.5M investment by government and will deploy $350M of resources into research innovation by 2030. RACE has developed numerous research projects on the transition to electric vehicles since its formation in 2020. Relevant recommendations from project reports against the terms of reference provided by the Legislative Council Economy and Infrastructure Committee have been outlined and a further summary of these completed projects related to the inquiry's terms of reference is provided in Appendix A.

The transition to electric vehicles is fundamental to achieving national and global emissions reduction goals. This transition has the potential to create a wide range of benefits for Australia if managed well, navigating the associated challenges and risks while optimising the benefits requires ongoing cooperation and collaboration between industry, research and end users. The RACE for 2030 CRC thanks the Committee for the invitation to this inquiry and welcomes the opportunity to provide a submission to this Victorian inquiry into electricity supply for electric vehicles

Best regards,

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Australian Government
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AusIndustry
Cooperative Research Centres Program

The RACE for 2030 CRC submits the following response to the Legislative Council Economy and Infrastructure Committee's Inquiry into Electricity Supply for Electric Vehicles.

This response is separated into two sections. The first is intended as a plain language executive summary of recommendations that have been sourced from RACE funded research projects relevant to the inquiry's terms of reference, and relevant context from research proposals currently in development. All research referenced below has been developed within the RACE for EVs research program and further information is available on the program's webpage, and in its annual research prospectus for 2025.

The executive summary outlines key findings from each subject matter area and provides a perspective on the policy implications of this research. The second section is more technical in nature and provides direct excerpts from RACE for 2030 CRC projects, with page number references to reports accessible via links in the Appendix. Where appropriate, background information and context have been provided to explain relevance to the inquiries subject matter without changing the intent or nature of research project recommendations.

Links to all RACE for 2030 CRC projects referenced are provided in Appendix A.

# SECTION 1: EXECUTIVE SUMMARY OF RECOMMENDATONS TO THE INQUIRY BASED ON RELEVANT RACE FUNDED RESEARCH

## (1) strategies to reduce EV charging during periods of peak demand on the grid and increase charging during periods of peak supply.

### Access to Dynamic Tariffs Can Optimise Grid Integration and Peak Management

Dynamic network and energy tariffs provide the greatest opportunity to reduce peak demand and increasing charging during peak supply periods. V2G operating with market-responsive pricing delivers greater wholesale benefits than static time-of-use tariffs, with customers on dynamic pricing able to receive net payments even after transport energy costs. While Dynamic Operating Envelopes for export have been implemented in some jurisdictions in alignment with the National CER Roadmap, limits of dynamic import are yet to be implemented.

Policy implication: Victoria should prioritise the implementation of dynamic consumer electricity tariff options for EV charging, enabling real-time response to grid conditions and renewable energy availability. Government advocacy for tariff innovation can be undertaken through existing energy network working groups and should incorporate the needs and perspectives of a broad range of consumers.

## (2) whether public charging infrastructure is being installed at a sufficient rate in different parts of Victoria, including older suburbs where most people do not have access to off-street parking.

### Equitable Charging Access Requires Solutions for All Housing Types

There are currently significant barriers to charging for apartment dwellers, renters and those reliant on on-street parking who collectively represent over 30% (ABS 2021) of Victoria's population. Multiple technical solutions exist including secured cable management, boom-mounted chargers (Merri-bek Council), portable charge points, workplace charging, and apartment building retrofits, but capital costs and governance barriers prevent testing and deployment. Without intervention, EV adoption benefits will be unevenly distributed across housing types and socioeconomic groups.

Policy implication: Victoria can develop supporting programs & funding that enables charging access across all housing types and remove barriers to innovative charging solutions (such as secured cable crossings & boom mounted chargers). Support for apartments should focus on enabling building retrofits and development of on-street charging solutions where required. Where suitable, support for expansion of charging in the workplace can also move charging load to the middle of the day. Engagement & coordination with ARENA and CRCs such as RACE for 2030 can lower the cost of funding innovative demonstrations and pilots in Victoria.

**(3) the best role for electricity distribution businesses in rolling out EV charging infrastructure, and how distribution network tariffs should be set for EV chargers.**

Recommendations related to this item have been captured against inquiry item 1 with the recommendation "**Access to Dynamic Tariffs Can Optimise Grid Integration and Peak Management**"

**(4) strategies to facilitate the take-up of EV ownership, including the facilitation of bidirectional charging.**

**Bidirectional Charging Delivers Substantial Economic Value**

As with the rollout of smart-meters, Victoria has an opportunity to lead in understanding the impacts of EV loads and bidirectional charging. Vehicle-to-grid (V2G) technology could reduce national energy system costs by $0.7bn to $2.7bn through wholesale market benefits alone, with additional distribution network savings of $0.3bn to $2.4bn. Fast uptake of V2G services could provide up to 16GW of dispatchable capacity by 2050, which is over 30% of the National Electricity Markets 2050 requirements (Step Change scenario).

Policy implication: V2G deployment and understanding of its impacts can be addressed through targeted funding support for commercial fleet demonstrations outside of residential use cases, supportive legislation to enable multi-unite dwellings to participate in smart charging/V2G, and ongoing support for innovative research into application of bidirectional charging services.

**Long-Term Policy Certainty Accelerates Market Development and Investment**
The transition to electric vehicles requires sustained government commitment across multiple policy domains including charging infrastructure deployment, grid integration, consumer support, and workforce development. International experience demonstrates that clear, long-term policy signals enable industry to invest confidently in vehicle development, charging infrastructure, and supporting services. Research consistently shows the importance of national policy leadership supported by coordinated state action to achieve market objectives and unlock economic benefits.

Policy implication: Victoria should develop and commit to targets for the electrification of light and heavy vehicles, with supporting long-term strategies and implementation plans for charging infrastructure. Targets & strategies should align with federal decarbonisation targets and national strategy, providing policy certainty across grid integration, infrastructure deployment, consumer access, and equity considerations.

**Real-Time EV Data Infrastructure Is Critical for Evidence-Based Planning**

AEMO's August 2025 review identified critical data challenges as EV adoption accelerates. Current planning lacks real-time visibility of EV charging loads mapped to distribution network assets, creating risks for grid reliability and affordability. Sound evidence on

current infrastructure coverage and future needs across multiple scenarios is critical for optimal investment decisions.

Policy implication: Victoria should support & fund the development of real-time EV data infrastructure that enables proactive grid management and evidence-based infrastructure investment decisions as EV adoption scales. Existing industry consultations through AEMO should be leveraged and supported by state governments rather than designing multiple bespoke solutions for each distribution network area and/or state.

**Consumer Trust and Information Are Essential Enablers**

Trust and misinformation significantly influence EV adoption rates. Research shows consumers seek credible messengers, value lived experiences and expert voices, desire increased knowledge on practical actions and want local community representation in energy conversations. Social and behavioural research has a role to play in improving understanding and engagement with community voices and leaders.

Policy implication: Victoria should provide support for the development of trusted communication channels and community-based education programs on electric vehicles, that address EV misinformation and build public confidence in charging infrastructure reliability and accessibility.

**(5) whether old EV batteries could have a second life as household or community batteries after removal from vehicles.**

The RACE for 2030 CRC does not have recommendations specific to this item.

**(6) the barriers and opportunities to the manufacture, reconditioning and recycling of EV batteries, or other elements of the EV supply chain, in Victoria.**

The RACE for 2030 CRC does not have recommendations specific to this item.

**(7) any other related matters the Committee considers relevant.**

**Innovative Research Collaboration Accelerates EV-Grid Integration Solutions**

Cooperative Research Centres such as the RACE for 2030 CRC mobilise significant resources and expertise by bringing together industry, researchers, and end users to address complex EV integration challenges. RACE research programs are delivering critical research that directly informs policy and industry decision-making. Industry and Government participation and funding is essential to unlocking leveraged funding through CRC's and Victorian State Government involvement has historically lagged other jurisdictions.

Policy implication: Victoria should actively support and participate in cooperative research initiatives that advance EV-grid integration, ensuring Victorian-specific challenges and opportunities are addressed while contributing to national research infrastructure that benefits all stakeholders in the energy transition. This can be done through existing CRC's and future state research, and innovation should engage early with the development of future CRC bids to position Victoria as a leader in innovation.

# SECTION 2: RACE TECHNICAL FINDINGS RELEVANT TO THE INQUIRY INTO ELECTRICITY SUPPLY FOR ELECTRIC VEHICLES.

## INQUIRY ITEM 1) STRATEGIES TO REDUCE EV CHARGING DURING PERIODS OF PEAK DEMAND ON THE GRID AND INCREASE CHARGING DURING PERIODS OF PEAK SUPPLY

### National Roadmap for Bidirectional EV Charging in Australia – 2025

The National Roadmap for Bidirectional EV Charging (Bidi Roadmap) was commissioned by RACE for 2030 CRC in partnership with the Australian Renewable Energy Agency (ARENA). It outlines the critical path to achieving commercial adoption of bidirectional EV charging in Australia and highlights the potential of bidirectional EV charging to reduce electricity costs and accelerate national emissions reduction.

This project also included detailed economic modelling conducted in collaboration with enX Consulting and Endgame Economics to provide an estimate of the wholesale market and distribution network cost savings through V2G in the NEM between FY2027 and FY2050. Different V2G uptake rates were modelled as well as various V2G operating models with different proportions of static time-of-use (ToU) tariff profiles and more wholesale market responsive operations. It was found that in a future high renewable penetration world, V2G reduces firming needs from grid-connected generation and storage assets.

Research during this project identified that bidirectional charging could reduce peak demand. V2G operations can substantially reduce substation critical peak demand while mitigating solar demand troughs. Peak congestion reduction modelling showed load reduction during peak events is 2-3 times smaller in low EV uptake projections compared to high uptake projections across all scenarios (Background Paper, p.37; Market Modelling Report, p.34). It was found that although ToU charging patterns optimise supply/demand balance, Dynamic tariffs are more efficient than ToU tariffs as they fully reward load curtailment and generation when the grid is stressed, and don't encourage battery cycling outside of these times. It was recommended that the transition to dynamic consumer electricity tariffs should be a focus for pricing reform (Background Paper, p.37, p.59).

### My V2X EV: Informing strategic electric vehicle integration – 2023

This project aimed at identifying the barriers and opportunities for vehicle-to-everything technologies (V2X) and developing a path to technology implementation through technical solutions and research partnerships with industry. The project identified the costs, benefits and potential value streams for vehicle-to-grid (V2G) services, regulatory and policy considerations related to V2G, the technical challenges and standards required for V2G implementation and undertook a national consultation with industry to identify opportunities for future research.

It was identified that tariff reform is critical for market signals as current tariff structures can mute high frequency wholesale market signals. Future regulation should focus on tariff reform and how wholesale market signals are better conveyed to end-users to incentivise EV owners to charge optimally for system reliability and affordability (V2X Stage 1 Final Report, p.16). It was noted that at the time of the report the Australian Energy Regulator (AER) had ruled that Victorian households with Level 2 EV chargers must be offered ToU tariffs, with flat rate tariffs prohibited, which in turn would incentivise off-peak charging (V2X Stage 1

Final Report, p.16). Strategic charging was noted as the most valuable stream for demand response to manage exposure to residential tariffs (V2X Stage 1 Final Report, p.12).

**Maximising electric vehicle fast charging by improved thermal management of distribution transformers - 2025**

This project led by Essential Energy and the University of NSW (UNSW) investigated the potential for greater numbers of fast EV charging infrastructure to be connected to the existing distribution network without transformer capacity upgrades or replacements being required.

The uptake of electric vehicles and fast charging facilities across Australia will present challenges and benefits to the distribution network. This requires significant investment in upgrading or installing electrical transformers to supply the growing demand of EV chargers. One way of deferring some of the necessary investments in new network capacity is to unlock existing under-utilised capacity. A complex challenge is understanding the impact on transformer performance, particularly understanding the impacts on the thermal envelope that transformer windings will need to tolerate.

This study demonstrates through numerical modelling, informed by practical experimental heat run tests, the potential to use thermal transformer capacity when considering short duration EV charging profiles that consist of highly peaked loads. The opportunity provided by this potential increased use of thermal transformer capacity is that more vehicles may be able to connect and charge quickly during periods of peak supply. There is currently a second stage to this project being planned by Essential Energy and UNSW to further demonstrate and verify initial findings so outcomes can be generalised and applied to a broader range of conditions.

**RACE for 2030 CRC Projects In progress or Development**

<u>In progress - Managing EV load impact with flexible limits</u>

This ongoing project has and will generate findings related to the use of flexible import limits to manage peak supply. Final recommendations will be available in mid-2026.

This project aims to explore the integration challenges of electric vehicles (EVs) into Australia's electricity grid by developing and evaluating flexible import and export limits as a novel strategy to manage EV loads. Research is focusing on understanding how flexible limits can dynamically adjust network electricity consumption and generation at connection points during periods of high EV uptake. The project will investigate the role of flexible limits in managing peak demand resulting from EV charging, while also exploring their impact on network planning, investment, and operational strategies.

<u>Under development</u>

Projects under development with RACE for 2030 CRC require a certain level of confidentiality be maintained and so only publicly available information has been provided to make the Committee aware that work is progressing on these topics.

There are key challenges to network supply and demand challenges preventing efficient commercial EV adoption across Australian bus depots. RACE is proposing to integrate a Battery-as-a-Service application, with AI-driven decision-making engines with smart charging coordination to optimize fleet operations, reduce costs, and enable energy market participation. Research will be validated through real-world deployment at a major Victorian operations depot with over 900 buses. This research is important because unlike current reactive charging systems it would create real-time autonomous decision-making that responds dynamically to operational needs, energy prices, and grid conditions. The

introduction of Battery-as-a-Service applications specifically for fleet depot charging infrastructure, also reduces capital barriers while enabling energy market participation. Research on this topic is projected to start in early 2026 and run to 2029.

Australia's transition to electric vehicles faces a critical barrier in apartment buildings where high upfront capital costs prevent charging infrastructure deployment. Current charging retrofits require strata buildings to bear costs typically exceeding $1,000 per lot while benefits accrue only to EV-owning residents, creating financial and governance barriers to adoption. Energy authorities also lack fine-grained data on apartment charging patterns, making it difficult to plan grid infrastructure and avoid costly network upgrades. The RACE for 2030 CRC currently has multiple research proposals exploring different avenues to reduce the cost of charging infrastructure in apartment buildings and provide methods to manage peak demand and supply without the impact of costly grid upgrades. Research on this topic is projected to start in early 2026 and run to 2028.

## INQUIRY ITEM 2) WHETHER PUBLIC CHARGING INFRASTRUCTURE IS BEING INSTALLED AT A SUFFICIENT RATE IN DIFFERENT PARTS OF VICTORIA, INCLUDING OLDER SUBURBS WHERE MOST PEOPLE DO NOT HAVE ACCESS TO OFF-STREET PARKING

### National Roadmap for Bidirectional EV Charging in Australia – 2025

It was identified during development of the Bidi Roadmap that off-street parking is one of several infrastructure solutions needed for wide scale deployment of residential bidirectional charging. Particularly with respect apartment dwellers and renters (Background Paper, p.55). Related to this finding was that equity concerns require sustained government action. Industry stakeholders participating in the development of the Bidi Roadmap expressed strong views that bidirectional charging support should be accompanied by sustained government action to address barriers for apartment dwellers, renters, and low-income households who will be unable to access this technology in early years (Background Paper, p.54, p.60).

### Business Fleets and EVs: Taxation changes to support home charging from the grid - 2022

This project investigated how tax changes can accelerate the uptake of battery electric vehicles (BEVs) within business fleets by encouraging home charging and included a review of existing charging practices to understand potential barriers towards EV adoption among fleet managers and residential customers. The final report recommends short-term and long-term tax changes that could improve the accelerated uptake of business fleet BEVs and encourage home charging. It should be noted that this project was undertaken in the period of 2021-2022, and findings should be understood within the context of EV uptake and infrastructure at that time.

The project found that 78% of Victorian households could charge only at home. In urban areas with extensive on-street parking, safety and security of charging cables crossing public footpaths from property-to-vehicle was documented as a significant concern. (BEVs and Fleets Report, p.147). Home charging was considered the primary method for majority of EVs, accounting for around 80% of charging sessions and is the least expensive form of charging, especially when utilising night rates. Public charging infrastructure was perceived as complementary to private charging (BEVs and Fleets Report, p.147).

Multiple alternative solutions were explored for on-street parking, including secured matting/covered ducts for cables, portable charge points, rapid charger stations, creating off-street parking by paving front gardens, utilizing nearby public/commercial parking, wireless charging pads, and encouraging workplace charging (BEVs and Fleets Report, p.147).

With respect to inquiry item 2, the implications of this project suggest that home charging is the primary form of charging in most residential settings, and that a range of solutions are possible for the provision of charging on-street, in addition to encouraging greater workplace charging.

**National Charge Link – 2022**

This project identified that it would be critical to create a national capability and governance framework for electric vehicle charging infrastructure. The objective of the National Charge Link platform was to enable faster-planning capability for national strategies and platforms to ensure the optimisation of deployment and use of charging infrastructure. The project recommended developing a standing database of public and private charging infrastructure and a data aggregation, and a collection layer for private charging data. These assets would then be developed into a national charging infrastructure master planning resource.

Since completion of this project, the Australian Government Department of Climate Change, Energy, the Environment and Water provided initial funding for the development of a national charging infrastructure master planning resource which was launched in August 2024 as the Electric Vehicle Charging Infrastructure (EVCI) mapping tool. This tool delivers on the objectives of the National Electric Vehicle Strategy to guide optimal investment and support improved coordination and planning of charging infrastructure across Australia.

It is acknowledged that as the transition to EVs continues, there may be other market entrants who deliver tools and web platforms to manage charging infrastructure planning and operation. The benefit of investing in an open-source national resources is that there is an avenue to the continued funding and development of tools and platforms for decision making by customers who may not have resources to access commercially developed products. Developing basic decision-making tools for the benefit of the Australian public supports an equitable and inclusive transition to EVs.

**RACE for 2030 CRC Projects In progress or Development**

<u>Under development</u>

Projects under development with the RACE for 2030 CRC require a certain level of confidentiality be maintained and so only publicly available information has been provided to make the Committee aware that work is progressing on these topics.

Australia's public EV charging deployment faces critical coordination challenges that threaten both market efficiency and equity objectives. Current decision-making lacks systematic analysis of optimal location, operation, and financing strategies, resulting in infrastructure placement that may not maximize benefits for all energy consumers. It is noted that such analysis is ideally ongoing, continually revised work, as EV uptake continues to proliferate. Leveraging unique access to Australia's most comprehensive public charging datasets - 100,000+ sessions from the 3-Council network plus Chargefox's commercial network data covering 2,200+ chargers this project will address three core questions limiting optimal public EV charging deployment in Australia: Where are public chargers best located? How are public chargers best operated? How are public chargers best financed? Research outputs will include public charging data published on an online repository, data analysis reporting, public charging options report with scenario modelling, and a public article on key findings and their policy implications.. This research is aimed to start in 2026 with an end date of 2027.

Local governments across Australia face unprecedented challenges in transitioning their fleets to electric vehicles, complicated by limited resources, technical expertise gaps, and complex planning requirements. As identified in a review of international literature, local authorities may be well suited to accelerate the delivery of charging infrastructure at the

local level, given deep understanding of local community's' needs, experience in delivering major infrastructure projects, and ownership of suitable site locations. However, current approaches towards infrastructure planning and funding remain fragmented and suboptimal. This project will develop region specific EV charging network plans that apply across a cluster of Local Government Areas (LGAs), integrating fleet electrification planning with charging infrastructure deployment in a coordinated regional approach. The project will create evidence-based local charging network strategies that address both technical optimisation and organisational barriers to adoption and validate these planning methodologies through real-world implementation with participating councils in a framework that can be scaled nationally. This research is aimed to start in 2026 with an end date of 2027.

Current EV charging infrastructure planning in Australia faces critical challenges as it scales. First, transport and energy sectors plan infrastructure in isolation, leading to suboptimal investments where charging stations may be deployed without adequate grid capacity or transport accessibility. Second, existing planning tools rely on deterministic approaches that fail to capture the uncertainty inherent in EV adoption rates, charging behaviours, and renewable energy variability, resulting in either over-investment or capacity shortfalls. Third, infrastructure planning lacks integrated performance indicators that can assess the coupled impacts of charging infrastructure on both transport efficiency and energy system stability, making it difficult for stakeholders to evaluate trade-offs and coordinate investments effectively. This research proposal aims to develop an integrated probabilistic planning framework that simultaneously optimises charging infrastructure deployment across coupled transport-energy networks. Through Monte Carlo modelling of Melbourne's networks, dynamic optimization algorithms, and sequential investment strategies, the project will deliver practical tools that enable coordinated infrastructure planning, reducing costs while improving system reliability. This research is aimed to start in 2026 with an end date of 2029.

A review completed by AEMO in August 2025 on Australia's current state of EV and EVSE data identified critical challenges facing Australian energy networks as EV adoption accelerates. This proposal aims to address aspects of AEMO's 2025 EV Data Recommendations Paper and provide a sound evidence base for the forecasting of future EV infrastructure needs. This will be done by developing a continuously updating framework for instantaneous and forecast EV charging load and flexibility mapped to DNSP assets with quantified confidence and actionable demand management potential. The research would develop components of a production-ready system with the capability to provide real-time data pipelines, asset-level EV load estimates, confidence scoring, and flexibility envelopes compatible with DNSP and market operations. Critically, it proposes to leverage market-emergent standards in charging management to provide actionable-in-market capabilities. By developing both the technical infrastructure and governance frameworks for sustainable EV data sharing, this research will support Australia's transition to electrified transport while maintaining grid reliability and affordability. This research is aimed to start in 2026 with an end date of 2028.

**RACE for Electric Vehicles – Research Program Commentary**

The below commentary is general in nature and has not been informed by specific research projects or proposals in development with the RACE for 2030 CRC. It has been written based on the extensive engagement the RACE for Electric Vehicles Program undertakes with the Australian EV and EVSE sector throughout the formation of research projects and is provided not as specific advice but as observations on the current state of market in Australia.

During engagement with the Australian EV and EVSE sector, feedback has been frequently provided that any decision to intervene in the current market settings for deployment of EV charging infrastructure should be made based on sound evidence regarding the level of infrastructure currently available and the needs for infrastructure across multiple future scenarios. Feedback has been provided by industry that there is currently not a sound

evidence base for these decisions, and industry sentiment on this topic was captured extensively by the Australian Energy Regulator (AER) during the CitiPower, Powercor, and United Energy Ring-fencing waiver submission regarding Electric vehicle charging infrastructure commenced December 2024.This industry feedback has informed the development of a research proposal above regarding AEMOs industry consultation on data and decision making in EV uptake and charging allocation. It was also noted in work undertaken for the RACE for 2030 National Charge Link project (2022) that open-source national resources support an equitable and inclusive transition to EVs.

## INQUIRY ITEM 3) THE BEST ROLE FOR ELECTRICITY DISTRIBUTION BUSINESSES IN ROLLING OUT EV CHARGING INFRASTRUCTURE, AND HOW DISTRIBUTION NETWORK TARIFFS SHOULD BE SET FOR EV CHARGERS

### National Roadmap for Bidirectional EV Charging in Australia – 2025

A survey of 8 distribution businesses (covering >90% of Australia's population) during the Bidi Roadmap overwhelmingly ranked peak demand mitigation as main benefit of bidirectional charging, with secondary interest in volt/var reactive power support potentially reducing need for investment in inductors at bulk supply points (Background Paper, p.37). Modelling conducted during the project found dynamic network and energy tariffs most beneficial to both networks and customers. It is also worth noting that this project and related modelling did not examine power quality in this analysis, of which V2G which is also able to provide relevant services and value for customers on dynamic network prices. Customers could receive a net payment of network variable costs even after paying for transport energy, with fastest payback periods for spot passthrough contracts with dynamic pricing (such as Amber Electric and Arcline by RACV).

Like Battery Energy Storage Systems, V2G is highly flexible and operates most effectively in response to ToU or dynamic tariffs. The transition to dynamic consumer electricity tariffs should be a focus for electricity pricing reform in Australia, as it is in the US and Europe currently. It was also noted during the project that consumers are diverse, and while early adopters may be able to navigate and achieve optimal benefits from bidirectional charging, future market developments will need to develop appealing and streamlined products, which cater to different levels of technical ability.

Standards compliance is a key role for distribution businesses to play in the rollout of bidirectional charging infrastructure. Updates to AS/NZ 4777.2:2020 were considered to provide a clear but untested pathway to grid connection for AC and DC bidirectional charging technologies (less so for AC due to interoperability limitations implicit in its application) and most DNSPs surveyed for this project (covering >90% of the Australian population) indicated they would be ready to connect a bidirectional EV charging system by mid-2025. Most DNSPs indicated that they would rely on the Clean Energy Council Approved Inverter listing process that requires submission via the CEC's normal product listing process. Product and installation compliance is a concern that the current National CER Roadmap has committed to addressing, however there may still be key issues as these positions evolve.

It was also noted in the Bidi Roadmap that key inconsistencies exist between Australian distribution businesses regarding terminology, current practices and future direction. Greater coordination and national consistency in technical requirements and smart grid management approaches, is not valued in current technical and economic regulatory frameworks for DNSPs and may require legislative reform to achieve (as is being done increasingly in other markets). Closely linked to this is the need provide clear direction on interoperability requirements across e-mobility ecosystems. Industry stakeholders consulted during the project routinely called up minimum interoperability standards as a foundation for streamlining product development and market homologation processes and ensuring baseline protections for consumers as they engage with new products and services.

Distribution businesses have a key leadership role in determining conditions for connection and supporting these requirements as they are developed and implemented.

### Maximising electric vehicle fast charging by improved thermal management of distribution transformers - 2025

The collaboration undertaken in this project led by Essential Energy and the UNSW is a case study of the role electricity distribution businesses can have in leading innovative research and testing that can be applied to other distribution network businesses.

This project found that even with high initial baseload utilisation (0.75 p.u.), transformers may have sufficient thermal capacity to handle additional fast charging load because duration of typical fast-charging session is relatively short compared to thermal time constant of oil. At 25% and 50% utilization, up to four 250kW chargers can operate delivering 1977 MWh annually. (Final Report, p.3-4).

It was found that utilising untapped transformer capacity through improved thermal management can defer installation of larger capacity assets, reducing expenditure on new plant and upgrades while accelerating charger deployment without network augmentation(Final Report, p.3-4). It should be noted that other transformer components are also affected by short transient overload and that this project is currently developing a second stage of research so findings can be applied more broadly. The implications of Essential Energy's innovation and leadership in this area could result in cost savings for all distribution businesses and is a case study in the role electricity distribution businesses can have in leading the rollout of EV charging infrastructure.

### RACE for 2030 CRC Projects In progress or Development

The RACE for 2030 CRC does not have projects in progress or development, as of September 2025, with relevant findings to inquiry item 3.

## INQUIRY ITEM 4) STRATEGIES TO FACILITATE THE TAKE-UP OF EV OWNERSHIP, INCLUDING THE FACILITATION OF BIDIRECTIONAL CHARGING

### National Roadmap for Bidirectional EV Charging in Australia – 2025

The National Roadmap for Bidirectional EV Charging identifies key actions and policy settings needed to support this technology, including consumer value transfer, smart grid maturity, interoperability standards, and national policy commitment. Commissioned by the RACE for 2030 CRC in partnership with the Australian Renewable Energy Agency (ARENA), it was developed by enX Consulting with support from a wide range of industry stakeholders and has since informed several recommendations made in the Federal Governments National CER Roadmap update in August 2025.

Modelling conducted during the project in collaboration with enX Consulting and Endgame Economics provided an estimate of the wholesale market and distribution network cost savings through V2G in the NEM between FY2027 and FY2050. Different V2G uptake rates were modelled as well as various V2G operating models with different proportions of static time-of-use (ToU) tariff profiles and more wholesale market responsive operations. It was found that in a future high renewable penetration world, V2G reduces firming needs from grid-connected generation and storage assets – with a wholesale market benefit, of between $0.7bn to $1.2bn in the slow uptake scenario and between $1.7bn to $2.7bn in the fast uptake scenario. The more aggressive, fast uptake view of V2G uptake would reach 16GW, 90GWh of storage by 2050 NEM-wide, which equates to over 30% of total required dispatchable storage (GW) by 2050, or 14% of total energy storage (GWh) NEM wide.

Key recommendations from the roadmap being progressed in national research and policy development as of September 2025, are summarised below:

- National policy commitment
    - A strong national policy narrative was recommended to signal clear alignment of bidirectional charging with Australia's national interest. With national policy leadership and state/territory support, Australia could bring forward bidirectional product availability to achieve Market Objective: "Bidirectional charging readily available by 2030, with several products available by 2027." (recommendations A1 & A2).
    - The RACE for 2030 CRC is developing several proposals for non-residential commercial V2G pilots, alongside leaders in industry and Government. Any efforts towards large scale commercial deployment of V2G would be greatly supported by significant fleet purchase orders (500+ vehicles), which will likely need to be led by State Government or large commercial fleet managers (recommendation A4 & B3).
- Consumer value transfer
    - Dynamic network tariff rule change request – see above section in relation to inquiry item 3 (recommendation B1)
    - The RACE for 2030 CRC has been engaging with senior government and industry stakeholders on the development of potential V2G installation rebates. It was noted during development of the Bidi roadmap that government support for bidirectional charging should be sustained and highly consider addressing barriers for apartment dwellers, renters, and low-income households who will be unable to access this technology in earlier years (recommendation B2).
- Smart grid maturity
    - The Consumer Energy Resources Information 2030 (CERI 2030) project is currently being led by enX consulting with support from ARENA, the RACE for 2030 CRC is participating as a stakeholder in the project's development (recommendation C1).
    - National consistency among distribution businesses – CER 2030 to contribute, also see above section in relation to inquiry item 3 (recommendation C3).
- Interoperability and standards
    - Several bidirectional roadmap recommendations (D1, D2, D3) are being explored as part of the National CER Roadmaps 2025 update – particularly with regard to CER roadmap actions T1.1 (technical standards for CER interoperability), T2.1 (adoption of standards and regulatory framework), T.0.1.2 (minimum EVSE technical standards) and T.0.1.3 (minimum operating standards for government supported public EV charging infrastructure)
    - The RACE for 2030 CRC is currently the sole Australian representative on the International Energy Agency's (IEA) Electric Vehicles Technology Collaboration Program Task 53 on the Interoperability of Bidirectional Charging. Task 53 is focused on international multi-party bidirectional interoperability testing to deliver system-wide validation across EVs, charging stations, and the grid – with a focus on market readiness and V2G scalability. Currently no commercial Australian organisations are members to Task 53 and Australia is not a partner to the IEAs EV TCP, which would substantially reduce the costs of participation in Task 53 to Australian businesses.
- Supporting consumers

- Several bidirectional roadmap recommendations (E1, E2, D4, and D5) are being explored in development of a major research proposal to be led by University of Technology Sydney with support from the RACE for 2030 CRC, ARENA and wider industry. This research proposal will seek to address several of these recommendations including.
    - Developing a Vehicle-Grid Information Network (VGIN) to enable inter-industry collaboration and oversee development of frontline information and education on bidirectional charging.
    - Facilitate collaboration between Government and industry on communication strategies to increase broader CER energy literacy including awareness of bidirectional charging.
    - Engage international stakeholders, scope and seek funding support to develop informal collaborations and events like 'Testivals' as is done in other markets for EV and EVSE vendors to homologate their product(s) for the Australian market.
    - Support industry and Government to engage more proactively with international standards development processes, including boosting representation in relevant groups such IEA Task 53, ISO, IEC, IEEE, CharIN and the Open Charge Alliance.

**Business Fleets and EVs: Taxation changes to support home charging from the grid - 2022**

This project specifically investigated how EV ownership could be encouraged within business fleets through taxation law changes. It's noted in the project that increased fleet electrification commitments have environmental, economic, health and reputational benefits, demonstrate national appetite for EVs to carmakers, support growth of second-hand market and provide motivation for increased charging infrastructure provision (BEVs and Fleets Report, p.145).

The project developed 12 short-term FBT and income tax recommendations to reduce barriers to fleet EV adoption and support home charging from grid, recognizing taxation policy as key lever to facilitate EV ownership transition in fleet sector (BEVs and Fleets Report, p.11).

**My V2X EV: Informing strategic electric vehicle integration – 2023**

This report found at the time of writing in 2023 that there was insufficient hosting capacity for V2G services across some of Australia's existing distribution networks. Existing network infrastructure was not initially designed to embrace high penetrations of EVs and absorb the impacts of charging and discharging of these technologies. However as shown in RACE for 2030 CRC research following the My V2X report, hosting capacity for coincident, unmanaged charging or discharging' such as V2G can be used to balance out load at the transformer. Other solutions to this include improving understanding and transparency of hosting capacity of each distribution network to embrace higher penetrations of EVs differ across different states and distribution network service providers.

Meeting future EV-charging requirements will depend on the modernisation of parts of Australia's energy grid through solutions such as; advanced data-driven algorithms for planning and operation, facilitating the integration of the distribution grid and the Frequency Control Ancillary Services (FCAS) market, and developing non-wire alternative solutions to reduce upgrade costs. While increased demand of EVs will eventually necessitate upgrades of

electricity infrastructure, a V2G scheme could substantially mitigate these new electricity infrastructure costs and international electricity distributors, such as distributors in California, have already started to implement a 'non-wire alternatives' concept in the distribution grid. The predominant objective should be to smartly manage energy generation and storage capacity in active distribution grids to minimise infrastructure upgrades.

**RACE for 2030 CRC Projects In progress or Development**

In progress - Australian Consumers at the Heart of the EV Transition

This ongoing project has and will generate further findings related to EV adoption across different customer demographics. Final recommendations will be available in early 2026.

This study is exploring the issues and challenges that will face all Australian consumers during the EV transition by understanding their lived experience. In-person, qualitative ethnographic interviews with consumers are being conducted alongside quantitative survey research to go beyond existing consumer sentiment surveys to tell us not only the what, but also the how and why concerning EV consumer behaviours in Australia. Outputs, including research insights, policy recommendations, and support in the crafting of customer messaging will be co-designed with consumers and industry over Q4 2025 to put end users at the heart of the process.

Some of the early findings from interviews have found that there is a clear separation of attitudes towards EVs across demographics which will be further defined into potential customer cohorts. It has been seen that interviewees on lower incomes typically face greater barriers in adopting new technologies such as EVs. International research has also found EV charging infrastructure is typically placed in higher income areas, leading to increased perceptions of range anxiety in lower income neighbourhoods.

Under development

Projects under development with the RACE for 2030 CRC require a certain level of confidentiality be maintained and so only publicly available information has been provided to make the Committee aware that work is progressing on these topics.

As indicated in the above recommendations related to the Supporting consumers of the Bidi Roadmap, the Vehicle Grid Information Network will act across several areas related to consumer support and communication of bidirectional charging. Current market conditions for bidirectional charging present both opportunities and challenges. While EV adoption is accelerating and smart charging technologies are advancing, complex challenges span technical domains, regulatory frameworks, commercial models, and social value. Industry consultation has identified fragmented efforts and lack of coordinated dialogue as key barriers to progress. The Vehicle Grid Information Network will be a 3-year (2025-2028), national collaborative platform for accelerating electric vehicle-grid integration through strategic partnerships. It will convene industry leaders across automotive manufacturers, electricity retailers, charging infrastructure providers, and regulatory bodies to address critical coordination gaps limiting Australia's vehicle-grid integration development.

It was explicitly noted by various stakeholders in the Bidi Roadmap additional policy and funding support processes for local market homologation would provide a clear view of Australian market needs to solution vendors, most of whom are based outside Australia. This would help attract vendors to the Australian market ultimately benefiting Australian consumers with greater choice and lower prices. Homologation support could apply to; Allocating funding to support EV and EVE OEMs homologate products for the Australian market, Establishing a formal test scope for international test labs for certification testing against shared and unique national and jurisdictional requirements, supporting informal industry events such as 'Testivals' (typically designed and ran by CharIn) or 'Plugfest's' (typically designed and ran by the Open Charger Alliance) where local and international

technology developers and supply chain stakeholders come together to test end-to-end interoperability within Australia's unique smart grid architectures and BTM energy system contexts. Research on this topic is projected to start in early 2026 and run to 2030.

## INQUIRY ITEM 5) WHETHER OLD EV BATTERIES COULD HAVE A SECOND LIFE AS HOUSEHOLD OR COMMUNITY BATTERIES AFTER REMOVAL FROM VEHICLES

RACE has yet to conduct research specific to this topic and therefore does not have a formal response to this matter.

RACE does note that through discussions with industry and research partners we have observed an interest in application of old EV batteries for second life applications and there has been an observable uptick in sales of second hand EVs through auction sites with the primary purpose to reuse batteries for home energy storage systems. There is likely safety implications associated with the reuse of batteries that have been involved in an impact or collision. Current auction providers do appear to undertake battery testing but there are further opportunities for best practice through use of battery passport frameworks being explored in international contexts.

An unintended consequence of facilitating greater use of old EV batteries for second life in other applications is that second hand EVs may have a lower price floor than internal combustion vehicles prior to scrapping. The consequences of this are an area of research currently under exploration at the RACE for 2030 CRC as there are indications that erosion of adequate supply of very low-cost second-hand vehicles may have perverse impacts on certain demographics that rely on these vehicles for regular transport.

## INQUIRY ITEM 6) THE BARRIERS AND OPPORTUNITIES TO THE MANUFACTURE, RECONDITIONING AND RECYCLING OF EV BATTERIES, OR OTHER ELEMENTS OF THE EV SUPPLY CHAIN, IN VICTORIA; AND

RACE has yet to conduct research specific to this topic and therefore does not have a formal response to this matter.

## INQUIRY ITEM 7) ANY OTHER RELATED MATTERS THE COMMITTEE CONSIDERS RELEVANT

### Accelerating EV adoption through commercial radio – ongoing (to be completed 2027)

This project has and will generate further findings related to consumer trust and misinformation in relation to EVs and EV charging infrastructure.

Trust and misinformation are key influencers in the adoption of EVs and use of EV charging infrastructure. The aim of this ongoing project is to identify and analyse commercial radio's role in Australia's response to issues such as EV misinformation, climate change and net zero targets.

Researchers are working with radio content directors to develop content that resonates with commercial radio audiences and people who are vulnerable to misinformation and resistant to the renewables roll out and shift to EVs. The efficacy and impact of the content is being evaluated through a rigorous research program using content analysis, surveys, focus groups and interviews with audience members, producers and presenters.

The following are some of the early findings from focus group interviews. To date the project has found focus groups participants

- Believe the messenger is important, like to hear lived experiences and experts, and trust what radio hosts have to say
- Express a desire to increase their knowledge on climate and energy topics and seek education about actions they can take
- Express a desire to bring climate/energy into everyday conversation and increase public engagement with these topics
- Want local voices to represent their community

These findings are relevant to the terms of the inquiry as consumer trust in EV and EV charging product is key to its effective use and integration within communities

**RACE Project: Strategic Electric Vehicle Integration – ongoing (to be completed 2026)**

This project has and will generate further findings related to EV charging infrastructure needs in holiday parks/regional tourism destination areas

The Strategic EV Integration (SEVI) project is a three-year, industry-led research initiative focused on exploring promising use cases for the integration of electric vehicles (EVs), associated technologies, and business models across Australia. Research has focused on select demonstration projects in New South Wales, Western Australia and South Australia.

The South Australian research focus has centred on the context of Holiday parks, particularly those in regional areas of destination tourism. Preliminary research has included an investigation into the EV related market landscape and baseline for Holiday Parks in the South Australian region. From review of the literature and consultation with stakeholders on this topic, researchers have considered the drivers for EV infrastructure installation in parks and their approaches to EVs and identified early movers of EV infrastructure installations. Preliminary research to date has suggested.

- EVs are increasing in popularity and holiday parks will naturally be a point of charging as people park their vehicles for periods of time.
- EV charging in holiday parks could also help plug a gap in the EV charging infrastructure network in regional areas, while offering an opportunity to support the electricity network in weaker, less resilient parts of the grid.
- Unmanaged charging could exacerbate network issues in regional and remote areas with large swings in seasonal demand. It could also add to the operating costs of many tourism businesses which are already experiencing increasing electricity costs due to the growing energy demands of holiday makers

**RACE Project: Electric vehicles and the grid: Opportunity Assessment – 2021**

This project had findings relevant to customer equity in the transition to EVs

Customer equity is an important consideration which has been raised by multiple stakeholders during research projects and partner engagement. While still nascent, it is vital to understand the potential equity issues that can arise as networks reach hosting capacity limits and access to network resources is limited. When transitioning to an electrified future, it is critical that all consumers can participate and benefit from Australia's transition to EVs – this is particularly an issue for First Nations and low-income Australians those living in regional and remote areas, apartment dwellers, renters, and those who don't and can't drive.

# APPENDIX A: RACE FOR 2030 CRC PROJECTS RELEVANT TO THE INQUIRY'S TERMS OF REFERENCE

### Electric vehicles and the grid: Opportunity Assessment – 2021

This project was compiled with the expertise of multiple experts across a broad range of disciplines relating to EVs, including vehicle and charging infrastructure, distribution and transmission networks, as well as social science areas of human interactions with technology and urban planning and design. It provides a comprehensive literature review on the subject matter of EVs and the grid, a detailed barrier analysis, and list of research opportunities and recommendations.

Available at: https://www.racefor2030.com.au/content/uploads/N1-EV-Opportunity-Assessement-Report-FINAL_05112021.pdf

### E3: Developing the future energy workforce – 2021

This project, Developing the future energy workforce, addresses several fundamental questions about Australia's energy sector, including how to measure the workforce, how training and skills can be fit for the future, and how to strengthen Australia's innovation pathways. The work is separated into three work packages addressing: 1. Market size, workforce and employment; 2. New skills development; and 3. Innovation pathways.

The project describes a pathway to understanding the present and future energy workforce in Australia. Developing the workforce is crucial to enabling the clean energy transition and realising the RACE for 2030 CRC vision of a customer-centred clean energy system, and to the successful translation of RACE for 2030 CRC research outcomes to industry impact.

Available at: https://www.racefor2030.com.au/content/uploads/RACE-E3-Opportunity-Assessment-FINAL-REPORT-October-2021.pdf

### National Charge Link – 2022

The National Charge Link (NCL) platform emerged from work funded by both the Australian Renewable Energy Agency and NSW Government related to electric vehicle charging infrastructure. This work recognised that it would be critical to create a national capability and governance framework for electric vehicle charging infrastructure. The objective of the NCL platform was to enable faster-planning capability for national strategies and platforms to ensure the optimisation of deployment and use of charging infrastructure. This project centred on the design of this platform with the aim of firming the project's design, exploring funding and governance opportunities, and considering how to incorporate input from new and emerging datasets.

Available at: https://www.racefor2030.com.au/content/uploads/National-Charge-Link.pdf

### Business Fleets and EVs: Taxation changes to support home charging from the grid - 2022

This project investigated how tax changes can accelerate the uptake of battery electric vehicles (BEVs) within business fleets by encouraging home charging. The project recommends 17 short-term and long-term tax changes that can accelerate the uptake of business fleet BEVs and encourage home charging

Available at: https://www.racefor2030.com.au/project/business-fleets-and-bevs-taxation-changes-to-support-home-charging-from-the-grid-and-affordability/

**My V2X EV: Informing strategic electric vehicle integration – 2023**

This project aimed at identifying the barriers and opportunities for vehicle-to-everything technologies (V2X) and developing a path to technology implementation through technical solutions and research partnerships with industry. The project identified the costs, benefits and potential value streams for vehicle-to-grid (V2G) services, regulatory and policy considerations related to V2G, the technical challenges and standards required for V2G implementation and undertook a national consultation with industry to identify opportunities for future research.

Available at: https://www.racefor2030.com.au/content/uploads/V2X-Stage_1_Final-Report.pdf

**National Roadmap for Bidirectional EV Charging in Australia – 2025**

The National Roadmap for Bidirectional EV Charging was commissioned by the RACE for 2030 CRC in partnership with the Australian Renewable Energy Agency (ARENA). It outlines the critical path to achieving commercial adoption of bidirectional EV charging in Australia and highlights the potential of bidirectional EV charging to reduce electricity costs and accelerate national emissions reduction. The report identifies key actions and policy settings needed to support this technology, including consumer value transfer, smart grid maturity, interoperability standards, and national policy commitment. It also directly contributes to the Australian Government's National Consumer Energy Resources Roadmap , and informed several recommendations made in the National CER Roadmap update in August 2025.

Available at: https://online.fliphtml5.com/jczqfe/ihiw/

**Maximising electric vehicle fast charging by improved thermal management of distribution transformers - 2025**

This project focuses on an area of emerging stress that is very likely to become a huge issue for the electrical grid. It seeks to investigate whether transformers can be momentarily loaded higher than their initial nameplate rating to allow for greater EV charging without substantially increasing transformer temperature. It was hypothesised through this research that this could allow for greater deployment of electric vehicles at existing transformers, which would indicate large potential cost savings in infrastructure deployment and reduction in embodied emissions through achieving much more throughput of EVs charging using the same original product. This coupled with dynamic connection agreements holds the potential to release significant capacity from existing infrastructure. The projects final report goes some way to demonstrating the additional capacity available. A caveat is that many of the simulated scenarios in this report are specific and numerical hence the outcomes cannot be generalised. Further work is under development to test and verify outcomes from the first part of this project.

Available at: https://www.racefor2030.com.au/content/uploads/Final-report-0571-FINAL-FINAL.pdf

**Australian consumers at the heart of the EV transition – ongoing (to be completed 2026)**

This project aims to explore the issues and challenges that will face all Australian consumers during the EV transition by understanding their lived experience. Research will focus on all consumer behavioural aspects of EVs – including but not limited to purchase, charging, servicing, service use, battery management, energy management technologies, driving and use patterns, and energy consumption. In-person, qualitative ethnographic interviews with consumers will be conducted alongside quantitative survey research to go beyond existing consumer sentiment surveys to tell us not only the what, but also the how and why concerning EV consumer behaviours in Australia. Outputs, including research insights, policy recommendations, and support in the crafting of customer messaging will be co-designed with consumers and industry to put end users at the heart of the process.

Project page and updates will be published at:
https://www.racefor2030.com.au/project/australian-consumers-at-the-heart-of-the-ev-transition/

**Accelerating EV adoption through commercial radio – ongoing (to be completed 2027)**

This project will identify and analyse commercial radio's role in Australia's response to climate change and its net zero targets. Working with content directors, producers and presenters across states and regional areas, we will develop content that resonates with commercial radio audiences and with people who are vulnerable to misinformation and resistant to the renewables roll out and shift to EVs. The efficacy and impact of the content will be evaluated through a rigorous research program using content analysis, surveys, focus groups and interviews with audience members, producers and presenters.

Project page and updates will be published at:
https://www.racefor2030.com.au/project/accelerating-ev-adoption-through-commercial-radio/

**Strategic Electric Vehicle Integration (SEVI) – ongoing (to be completed 2026)**

The Strategic EV Integration (SEVI) project is a three-year, industry-led research initiative focused on exploring promising use cases for the integration of electric vehicles (EVs), associated technologies, and business models across Australia. Central to this project is the emphasis on co-design and collaborative implementation with partners and stakeholders, guided by research plans co-designed with industry. These plans lay the groundwork for the implementation and assessment of research within select demonstration projects in New South Wales, Western Australia and South Australia.

Project page and updates will be published at:
https://www.racefor2030.com.au/project/strategic-electric-vehicle-integration/

**Managing EV load impact with flexible limits – ongoing (to be completed 2026)**

This project aims to explore the integration challenges of electric vehicles (EVs) into Australia's electricity grid by developing and evaluating flexible import and export limits as a novel strategy to manage EV loads. Research is focusing on understanding how flexible limits can dynamically adjust network electricity consumption and generation at connection points during periods of high EV uptake. The project will investigate the role of flexible limits in managing peak demand resulting from EV charging, while also exploring their impact on network planning, investment, and operational strategies.

Project page and updates will be published at:
https://www.racefor2030.com.au/project/managing-ev-load-impact-with-flexible-limits/