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Charging around Western Australia
2025 WA EV Network Review

Independent Report to the Tesla Owners Club of Western Australia

February 2025

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Front cover photograph: *Great Northern Highway heading to Newman, Richard Watson (2024)*

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Executive Summary

The Western Australian Government funded WA EV Network has the potential to deliver world-class amenity to WA's rapidly growing EV fleet.

However, three critically significant improvements need to be undertaken to fully achieve its intended goals.

- **Expand** the WA EV Network to include all the Great Northern Highway.
- **Augment** the WA EV Network by reducing the average distance between charger sites from 200km to 100km.
- **Strengthen** the WA EV Network with a fully integrated and responsive operations and maintenance framework which guarantees resilience and reliability.

Background

This independent report was commissioned and part-funded by the Tesla Owners Club of Western Australia (TOCWA) to support the case for further investment in WA EV Network for the benefit of all plug-in EV users; WA regions; businesses; residents and the State's energy utilities. Specifically, three issues are highlighted:

- WA EV Network is a wonderful asset supporting tourism, decarbonisation vehicle fleet transition and economic development, but is urgently in need of an effective maintenance regime.
- There remain insufficient charging site locations to ensure a safe and secure EV journey throughout the State.
- The Great Northern Highway is the major long-distance transport route in WA with no integrated fast DC charging infrastructure.

Recommendations

1. A single accountable body be appointed and resourced to manage all aspects of charging network operation, maintenance, expansion, upgrade and industry/operator collaboration.
2. Key performance metrics be defined, monitored, managed and published for the WA EV Network.
3. Improved network maintenance capabilities, capacity and responsiveness must be funded and implemented immediately.
4. Charging station design and location specifications and standards be reviewed and updated based on emerging trends and stakeholder experience.
5. A further network expansion and in-fill for completion by 2027.
6. An education and stakeholder engagement program in respect of this new technology be developed and delivered to address issues such as safe use, vandalism, charging courtesy and practical trip-planning.
7. The WA Government commit to installing fast DC charging infrastructure as part of an expanded WA EV Network to "electrify" the Great Northern Highway before 2027.

Summary

The Western Australian Government announced in January 2025 that their 'last charger of the WA EV Network' was brought on-line[1]. The WA EV Network is a key infrastructure investment to accelerate the state's shift to electric vehicles for cost savings, decarbonisation, and driver benefits. The network is already experiencing rapid growth in EV adoption and charging usage, with projections indicating EVs will comprise 10% of all vehicles on Western Australian roads within five years, becoming a common sight statewide.

As with all major plant and infrastructure programs, after the commissioning comes the routine of day-to-day operational tasks. Fortunately, electric charging sessions are largely autonomous and do not require local staff to handle the charging process. They also do not require scheduled delivery of energy by road tankers, nor do they involve any cash transactions. They certainly do require maintenance, a reliable power supply and effective communications to make one of the world's longest electric highways resilient and reliable.

Seven recommendations propose urgent governance reforms, performance metrics, maintenance upgrades, and infrastructure expansion, particularly advocating electrification of inland routes by 2027 to support regional EV adoption and tourism. The analysis projects WA's EV fleet will reach 10% penetration by 2030, requiring 4,000+ fast DC charge points across Western Australia.

Scope of this Report

To best align with current vehicle fleet statistics and immediate opportunities (and data), this report:

1. Focusses on battery EVs – almost universally using lithium-based batteries for storage (noting that statistically, almost 50% of the lithium in these batteries was sourced from Western Australia!).
2. Focuses on light vehicles. Typical family vehicles – at present almost exclusively sedans, wagons and smaller SUV types. These vehicles, including those towing trailers/caravans are described as Class 1 and 2

Alternative technology

This report (albeit focussing on light vehicles) does not contemplate any potential infrastructure demand from low-emission road vehicles powered using hydrogen (especially fuel-cells). There is currently no commercial trend nor major vehicle investment strategy from manufacturers that supports any significant expansion in such a road fleet other than (potentially) in niche markets.

The reality is that lithium-ion batteries have demonstrated such extraordinary life spans in operation that million kilometre plus warranties are available (e.g. CATL) on batteries for cars, buses and trucks. As a result, it will be extremely difficult for any alternative to plug-in, lithium-ion based energy-storage technologies to compete commercially.

[1] https://www.wa.gov.au/government/media-statements/Cook%20Labor%20Government/WA-takes-the-wheel-with-EV-network-plugged-in-and-charged-up-20250130

within the Austroads-23 classification scheme. Recent data extracted through Main Roads Western Australia traffic counts has informed this report.

3. Considers specific issues of these vehicles using trailers, camper trailers, caravans.
4. Assumes that 150kW is the minimum power standard for highway chargers – where 20-30 minutes of recharging could add around 200 kilometres of highway range. In practice, these chargers are often dual ported, potentially doubling the charging time required at each port.
5. Ignores any existing or proposed "destination chargers" (7kW to 22kW). These are only suitable for overnight recharging, but are relatively low cost and are suitable for local businesses (especially motels, roadhouses and caravan parks) to install as a customer "incentive".

While out of scope (but noted separately), there are other electric recharging "opportunities" including heavy vehicles and buses. These are considered as being important when developing a network strategy, primarily because:

- Heavy vehicles purchase more energy per trip than light vehicles – we estimate more than 3MWh per 1600 km Perth-North West and return trip (i.e 3200km);
- Manufacturers of such vehicles expect that more than 50% of their sales will be plug-in electric before 2030;
- Charging speed and energy requirements of heavy vehicles is significantly higher than for Class 1 and 2 vehicles and will need suitable supply;
- Commercial level of returns on overall site investment on an EV charging network will be accelerated by the greater usage;
- The need for reliable and resilient electricity supply is ubiquitous for all users; and
- Considering the above brings a higher priority to the whole-of-solution – including for Class 1 and 2 vehicles.

Figure 1: An electric vehicle charging at Minilya, north of Carnarvon on the North West Coastal Highway on the WA EV Network in Western Australia

(Photo credit: Harald Murphy)

Introduction

Two key initiatives in Western Australia have seen the rollout of public electric vehicle (EV) charging infrastructure,

- The WA EV Network
- RAC's Electric Highway program

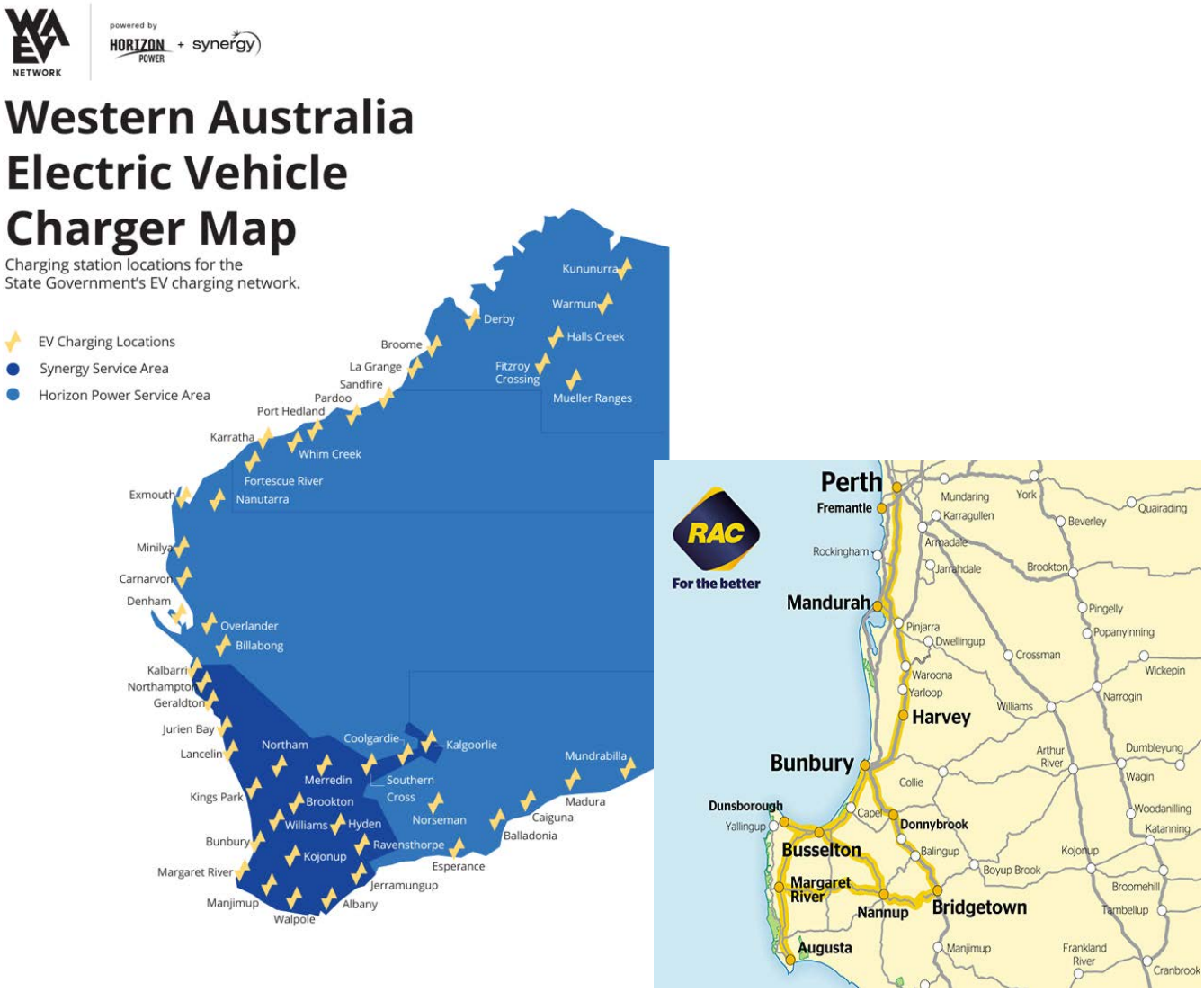

Figure 2: Western Australia's WA EV Network and RAC's Electric Highway.

In 2024, the public WA EV Network and RAC Electric Highway have delivered around 80,000 charging sessions, with each session consuming the equivalent of around 2 days of a regular West Australian house consumption. This is delivering direct revenue to Western Australia's energy generation utilities and network operators while replacing fossil fuel imported for transport.

Enthusiastic and committed WA EV Network users now have the lived experience to have identified ongoing consumer needs for the increasing number of EVs travelling on WA roads. Their learnings highlight critical factors to address for the existing WA EV Network, and for its expansion in the short-medium term - before we can expect commercial investment taking over. In respect of the WA EV Network, they have identified issues including:

- Network communications fragility;
- Poor charger reliability;
- Excessive times to repair sites;
- No consideration for EVs towing trailers – their reduced range and parking requirements;
- Distance between sites often too large;
- 24/7 support services required (on-line and voice);
- Insufficient charger redundancy; and
- Slow (primary and back-up) charging speeds.

It is also the case that, as with any new technology - especially one that is so transformative - standards, costs, capabilities, performance and user demands will very rapidly evolve. This evolution needs to be actively absorbed, while also enhancing the value of public charging infrastructure.

Figure 3: An electric vehicle outback in Western Australia
(Photo credit: Harald Murphy)

The Path Forward in 2025 – Normalise the Network Management

The Western Australian Government reported that their rollout of the WA EV Network was completed earlier this year[2]. The WA EV Network represents an important investment in the plant and infrastructure required for WA to transition our vehicle fleet for decarbonisation, efficiency and user benefits. Already, the growth in the number of electric vehicles – and charging network users - has been dramatic. As our report describes, within the next 5 years EVs will be common on every road in WA and, at that point, we expect to see the expansion of significant private investment in charging infrastructure. For these reasons, well-resourced governance, accountability and responsibility processes and procedures need to be in place to protect these vital public assets and to shepherd the network's growth. This governance body should also establish a single statewide EV charger operations centre to coordinate, engage and/or contract suitably qualified and capable technicians to maintain EV charging network efficiency. These technicians also having local access to decentralised and locally relevant spare parts inventory.

> **Recommendation 1: A single accountable body be appointed and resourced to manage all aspects of charging network operation, maintenance, expansion, upgrade and industry/operator collaboration.**

As with all major plant and infrastructure programs, after the commissioning comes the routine of day-to-day operational tasks. Fortunately, electric charging sessions are largely autonomous and do not require any local staff to handle the charging process. They also do not require scheduled delivery of energy by road tankers, nor do they involve any cash transactions. They certainly do require maintenance, a reliable power supply and effective communications to make the WA EV Network resilient and reliable. However, for various reasons the infrastructure has suffered too many failures, with some taking far too long to resolve. There appear to be many root causes – from electronic communication failure, lack of spare parts, lack of technician skills, vandalism and technical glitches between vehicle, charger and authorisation systems.

Accordingly, for performance tracking, improvement and transparency, the governance body should set and manage network performance standards. Such performance standards could include Network specific metrics such as:

- Network monitoring and communication available more than 99% of the time.
- Mean time to repair
    - remote (software/authorisation) access - 10 minutes
    - on-site - 6 hours SWIS zone; 12 hours non-SWIS.

[2] WA takes the wheel with EV network plugged in and charged up https://www.wa.gov.au/government/media-statements/Cook%20Labor%20Government/WA-takes-the-wheel-with-EV-network-plugged-in-and-charged-up-20250130

- Incident/issue management escalation:
  - First – 24 hours unresolved after first report
  - Second – 48 hours unresolved after first report
- User satisfaction rating >85%
- "Free" charging sessions (due to authorisation/communication failures) < 1%
- Active installed public charging station numbers maintained in the range of 1% of registered EV numbers (i.e. 1 per 100 EVs).

Recommendation 2: Key performance metrics to be defined, monitored, managed and published for the WA EV network.

Network Maintenance was mentioned, but not detailed, costed or described in the 2018 "Electric Vehicle Infrastructure Strategic Planning" report[3]. User experience of the network to date has demonstrated significant issues with network maintenance, particularly in remote areas where any extended breakdown is extremely hazardous. There is evidence of sites being unrepaired for months, with concerns including lack of parts, lack of local skills and repeated vandalism. It is noted that some spare parts issues have improved, and that anti-vandalism measures are also being undertaken (example – Halls Creek[4] as of 14 February 2025). Although there are usually back-up AC chargers available at these sites, their slow charging rate of as little as 7kW significantly increases charging time compared to fast DC charging. A 20-minute fast DC charging session might turn into a 5-hour ordeal if undertaken using an AC charger.

What has been learned on the WA EV Network is that:

- Charging stations are not 100% reliable. They need specialist maintenance and readily available spare parts. They are high-technology pieces of equipment, installed in open areas, relied upon to be operating 24/7, with no continuous monitoring.
- Charging stations have many potential causes of "failure" – from simple communication loss to over-temperature protection cut-off, electronic component breakdown, environmental damage or vandalism. Nothing different to other assets, except that there is currently little economic incentive to avoid, mitigate or remediate such breakdowns.
- There must be skilled resources, especially in remote locations, able to safely diagnose and repair this equipment.
- There must be regional supplies of replacement components to support with prompt repair.

Typically, plant maintenance would be covered by a service level agreement or undertaking to meet key identified metrics, such as mean time between failure, mean time to repair and repair costs (those defined Key Performance Metrics). There will

[3] Bräunl, T., Harries, D., McHenry, M., & Wager, G. (2018). Electric Vehicle Infrastructure Strategic Planning. The University of Western Australia. https://revproject.com/traffic/report.pdf

[4] *The Halls* Creek *DC charger has (at time of publication) not been working for the last 29 weeks. While the AC charger was replaced about 5 months ago, it has since been re-vandalized.*

also need to be an asset maintenance plan that includes routine, preventative and reactive maintenance standards and procedures. Particularly in the case of decentralised assets like chargers, it would include ongoing system monitoring and analysis to constantly reevaluate the maintenance processes to improve these key metrics over time; compare equipment performance and track support costs. These, for the asset owner, help minimise the whole-of-life asset costs across the network.

From the different perspective of the asset user – the EV driver and passengers – if the WA EV Network is not reliable or resilient due to poor maintenance, the impact is at best severely inconvenient, at worst a hazardous and potentially life threatening stranding.

Remote sites have special needs, they often do not have the resources nor services to support an EV driver and passengers in the event of any network breakdown. Various drivers have reported extended (days, weeks and months – as noted for Halls Creek) of station breakdown at remote locations. This is a clear safety concern for travellers. Whilst these sites appear to be the most difficult to effectively service, they are also often the sites that most need timely service.

Continuous network monitoring and response is required to at least assess and prioritise issues, to interact with users and to activate any remote system diagnoses and resets as appropriate. This requires reliable 24/7 communications, for calls, data and, where possible, video.

> **Recommendation 3: Improved network maintenance capabilities, capacity and responsiveness must be funded and implemented immediately.**

The 2018 “Electric Vehicle Infrastructure Strategic Planning” report envisaged WA would have an EV fleet of 15,800 electric vehicles in the 2025/26 timeframe. In fact, adoption in WA has been much faster, with more than 26,000 already registered in September 2024 and new EV sales continuing to rise. This growth – 50% larger and almost 2 years earlier – reinforces the need to rapidly expand the required infrastructure. In that time also, technology has rapidly evolved for electronic communications, chargers and EVs. EVs have faster peak charge rates, have larger batteries and can tow; better cell coverage and low-cost satellite-based communication provides more reliable communication as more critical EV tools and functions are supported primarily by smart phones.

> **Recommendation 4: Charging station design and location specifications and standards be reviewed and updated based on emerging trends and stakeholder experience.**

To respond to:

- current network gaps;
- prepare for increasing EV traffic;
- open new areas to otherwise unavailable EV-based tourism; and
- further normalise EV use state-wide

will require ongoing high-quality public investment to reassure all current and future EV users that this State's population density and size is not a barrier to decarbonisation, nor will it be that EV drivers are required to accept unreasonable risks when planning trips. Within that financial commitment will be funds for capital asset expansion, future-proof planning and, vitally, effective management, maintenance and support.

These public commitments – especially while most sites are not commercially viable – are vital until there is a 100% guarantee that every charging site on any route is operational. Until then, and as detailed later in this report, 200km gaps between DC charging locations sets up a scenario whereby a failed DC charger means virtually all EVs are incapable of moving on to the next DC charger or back-tracking to the pervious one. At best, if the AC charger is working, about 5 hours is added to the journey. If the AC charger has also failed, the EV is stranded. If an EV is also towing a trailer or a caravan, even a 200km gap between working sites may be beyond the range of many electric cars. Both of these real-world scenarios dictate that a 100 km gap between DC charging sites is the safest and most pragmatic solution.

> **Recommendation 5: A further network expansion and in-fill for completion by 2027.**

What has been experienced so far in Western Australia is that the capabilities and penetration of EVs has grown faster than the infrastructure required to service them. Additionally, for virtually all EV drivers, planning and undertaking trips is a new, and unnecessarily fraught, experience. Differences and incompatibilities between charging networks (do I need a new App? Do I need a new RFID card? Do I need wireless internet access in the outback?), vehicle recharge connections (do I need to carry my own cable?), courtesy (How long should I leave my unattended EV connected?), I cannot disconnect from the charger – what should I do?

In spite of having to deliver upwards of 1000 Volts of high current power, EV charging stations are inherently safer than petrol bowsers. Their multitude of fail-safe features and complex electronics do however mean that attention is also required to address the complex issue of actual and potential vandalism – noting that charging stations will not have nor need constant, in-person surveillance for their operation.

> **Recommendation 6: An education and stakeholder engagement program in respect of this new technology to be developed and delivered to address issues such as safe use, vandalism, charging courtesy and practical trip-planning.**

The Path Forward in 2025 – Act to Fill the Gaps

As an exemplar of a major "gap", the Great Northern Highway is one of Western Australia's most important highways and, as National Highway 95, is the shortest and most direct route between the Perth and the Pilbara region (and by extension the Kimberly). This inland highway offers a resilient alternative North-South route to the coastal highway. However, there is currently no integrated EV charging network along its more than 1000km length. Accordingly, there is virtually no opportunity for neither regional ownership and use of EVs nor for any EV-based tourism.

- Without infrastructure in place, virtually no regular traffic can be expected;
- Lack of local infrastructure also effectively disadvantages regional residents, excluding them from the economic, environmental, and practical advantages of using EVs, as well as travel and tourism business opportunities.

Experience gained during the roll-out and operation of the existing Western Australian EV networks, together with the EV trajectory of vehicle fleet penetration, can help model the potential demand on an expanded charging network. This can allow the network to meet emerging demands and will help transform EV-based tourism and regional usage from a potentially risky adventure to a safe, convenient and commonplace activity. Importantly it will also enable regional residents to access the cost benefits of choosing EVs as a viable option.

It is also apparent that the current demand for, and usage of, the existing charging network infrastructure is not yet sufficient to justify widespread commercial investment in charging infrastructure. Indeed, while the electric vehicle fleet is growing rapidly from a low base, trends indicate that it may be at least 2027 before the proportion of EVs on the road will be sufficient to support a positive return on investment from charging infrastructure for private developers. Consequently, commercial operators are unlikely to invest in regional infrastructure until even later. In their absence, without further government investment in and development of charging infrastructure, the overall transition to low impact/low cost EVs and EV-based tourism will be delayed in the regions, delivering them further disproportionate economic and environmental disadvantage.

Great Northern Highway – The 2025 EV journey plan.

Starting near Midland, Route 95 runs roughly 1,600 kilometres to Port Hedland and has some 250 cars and 347 trucks per day (based on lowest bidirectional numbers at Meekatharra from Main Roads WA data).

A "typical"[5] EV, heading north from the Perth area, could recharge fully at Ellenbrook. From there, and travelling at highway speeds, would travel around 200 kilometres before wanting (or needing!) to recharge. At 200 kms, the EV would be seeking something like 38kWh of energy, which requires the supply of some 41kWh from the charger[6] (and possibly 46kWh from an AC supply to the charger). If using a 50kW charger, this recharge session will take almost 1 hour (we know that, based upon existing statistics from both the RAC Electric Highway and the WA EV network, 35 minutes is the average duration across all journey types). A caveat is that if this 50kW charger has a second charge port being used by another EV, the charging session will take more than twice as long (actual performance is dictated by the recharger's electrical architecture). Slower charge times also cause flow-on queueing delays experienced by other EVs seeking to charge.

Fortunately, there is a 50kW, dual port charger in Dalwallinu, some 220 kms from Ellenbrook. But, once beyond the South West Interconnected System (SWIS), Great Northern Highway has very little power infrastructure, presenting a significant challenge for establishing EV charging stations along the route. Only three Horizon Power towns (Mount Magnet, Cue, and Meekatharra) are present along the route, and they are relatively close together (approximately 100km apart). This leaves large gaps in the network that need to be addressed. After this stop, there is no high-speed charger on the highway until we arrive at the Spoil Bank Recreation Reserve in Port Hedland. Accordingly, of the tourist destinations along the route including: Karijini, Kalgan Pool, Cathedral Gorge, Three Pools, Eagle Rock Falls and Eagle Rock Pool and New Norcia, only New Norcia is within range. As a result, this EV driver will probably turn around and head back South.

Decarbonisation
When using a fully renewables-based energy supply, a single one-way EV journey on this highway can replace an ICE journey consuming at least 100 litres of fossil fuel, avoiding more than 250kg of CO2 emissions.

If a fast-charging network was installed, all tourist destinations would be in range, and EV recharging could repeat seven more times before Port Hedland. Currently, any EV venturing north will rely on long-stay (i.e. extended parking or overnight) sessions at caravan parks or similar, where extremely slow AC charging is available. (Noting that

[5] Based upon normalised 110 km/h at 25°C ambient across the range of 205 EV makes and models, road tested in Europe. Updated December 2024.

[6] Trentadue, G., Lucas, A., Otura, M., Pliakostathis, K., Zanni, M., & Scholz, H. (2018). Evaluation of fast charging efficiency under extreme temperatures. *Energies*, 11(7), 1801. European Commission, Joint Research Centre Directorate C Energy, Transport and Climate.

charging at a single phase 10A power point requires about 16 hours charge for 200km of range.)

In “electrifying” the inland Great Northern Highway – the shorter route between the South-West and the Pilbara - EV transformation benefits will be also extended to an entire new regional population, and create an ‘electric loop’ between the North West and the South West**.**

This expansion would deliver an estimated 20 new charging sessions per day (around 1.2MWh) supplied by Horizon Power based upon EV fleet size in WA and the current measured light vehicle traffic on the Great Northern Highway. This demand expected to double before 2027 for this highway alone.

Expansion will also enhance tourism with existing popular destinations opened to EVs. Additional tourism, especially from the increasing “grey nomad” travellers, will also add significant local benefits – commercially (estimates are more than $100 per day) and socio-economic (part-time/casual work, volunteering, etc) due to their intentionally slow travel schedule.

- Enhanced road safety – EVs (with or without trailers) able to maintain normal highway speeds without range anxiety. (As opposed to driving significantly slower than the speed limit in order to stretch range.)
- Support WA drivers and tourists as the local vehicle fleet transforms to electric.
- Economic and climate resilience with this alternative north-south highway route.
- Benefits to regional residents with lower cost, reliable transport options.
- Benefits to regional residents

Recommendation 7: The WA Government commit to installing fast DC charging infrastructure as part of an expanded WA EV Network to “electrify” the Great Northern Highway before 2027.

Great Northern Highway – EV Based Considerations

The successful implementation of a Great Northern Highway EV Network will represent an approach that will be globally relevant as an example of how to truly deliver a seamless EV travelling experience under extreme circumstances. It would also demonstrate the forerunner of future electric heavy vehicle freight.

For now, though, the tested “real world” range of 214 battery electric vehicle models available in Europe (as of December 2024) was some 398 kms, normalised at 25°C and 110km/h (note that the claimed WLTP range claimed was 478 kms). These tests applied the extreme condition of driving from 100% capacity to zero – something that EV drivers would never intentionally do. This does indicate that a planned 200km distances between chargers is reasonable – only if every charger is operating and that communications between the car, the charger and the charging network provider are

all able to recognise and authorise the particular EV to charge. However, if that EV is towing a trailer (Figure 4), or has a roof-rack and bulky items attached, its range will be reduced by up to 70%, primarily through increased aerodynamic drag and rolling resistance, potentially causing half of all towing EVs to be effectively stranded within 200km.

Figure 4: Recharging with a caravan in outback Nanutarra, Western Australia (Photo credit: Harald Murphy)

Particularly for this route (and a significant proportion of the remainder of the WA EV Network):

- There is the clear potential for drivers and passengers spending excessive time recharging EVs in inhospitable and isolated environments, if chargers are widely spaced.
- There is a clear potential for unsafe road incidents between heavy vehicles travelling at 100 km/h, and EVs driving at 80 km/h (or less) forced to conserve energy consumption due to charger failure.
- Based on a maximum of 200km between fast DC charging stations, when any single site is inoperable, there is (for most EVs at highway speed), virtually no alternative recharging solution within range (either forward or backward). Accordingly, charging stations will need to be located closer together, at 100km intervals. Any less redundancy will result in (effectively) stranded vehicles and their occupants. The Tesla Owners Club of Western Australia,

based upon their experience, have suggested site locations for the Great Northern Highway, and across the existing WA EV Network (Figure 5).

Under current circumstances, most EV owners will not use this highway at all, and regional residents will not be encouraged to choose an EV. Those few that do will be treating it as a very well-planned, and well-run, adventure rather than a routine trip.

Fast DC stations will support more vehicle sessions, generating more revenue for the energy utilities – all directly linked to the continuously increasing EV fleet size.

Ideally, from an investment and operating cost perspective, installing a charger into an existing townsite grid or micro-grid is the most effective and resilient option. Where there is no existing grid infrastructure, there will need to be a high reliance on new, expensive, standalone power systems (SPS) to support EV charging stations. These systems would need to be installed at locations that may have very little or no existing amenities for EV drivers, which could impact the overall user experience and potentially discourage EV adoption in the region.

Transport Synergies

Soon there will be the incentive for transport operators to roll out their own recharging infrastructure to support long-distance haulage while also delivering on their decarbonisation objectives. This would be most efficient in this State's perspective if it was part of network and able to offer synergies by also supporting other users, "roadhouses" or regional centres. Given that every heavy-vehicle round-trip between (say) Welshpool and the Pilbara will consume some 3MWh of electricity, the planning and management of these charging stations will have an impact on energy management, industry economics, transport emissions, safety and regional economic activity. This could offer an efficient approach that helps meet WA (and Australia's) particular issues of long distances; low population density and limited electrical grid capability.

Based upon WA local and international experience, several other critical success factors have been identified with reference to the architecture, layout and infrastructure of charging stations:

- EV queueing and queue management.
  While not currently a significant issue in Western Australia, queuing has been problematic elsewhere as EV numbers have increased – with few systems in place to manage them. They are caused by a range of factors – limited ports, limited site access, slow charge rates…
  Considerations include:
  - Charger layout – to accommodate larger vehicles; pull-through bays; left/right/front/rear vehicle charge port location;
  - Multiple chargers/Multiple ports (but maintaining at-least 50kW supply power to each EV when more than one is charging). EV charging speeds are increasing as design architecture evolves, but time spent on chargers will remain near the (current) 30-35 minute average for the near term;
  - Parking zones away from charging stations – for trailers if unhitching is required.

- Planning for larger/towing vehicles for site construction will avoid issues of blocked access, unhitched trailers and inconsistent EV charge port locations.

- Charger reliability and repair.

  This remains a significant concern for EV charging stations, particularly in remote and regional areas with failures experienced due to:

  - Excessive temperature
  - Communication failures (for access approval or between charger and EV – see below)
  - Physical damage/vandalism
  - Electronic or sensor failures
  - Power supply failure

  Some issues can be resolved remotely (if communications are operating), others may be "self-repairing" such as overheating. Others will require on-site intervention, including options of drop-in portable chargers to replace units with longer repair times. In any event, the journey is impacted. There is evidence that overall, such failures are becoming less frequent, with shorter repair times, but there are extreme outliers with unacceptably long outages.

- Communications systems.

  These key 24/7 communication networks need to be considered

  - Charger to Vehicle:
    Although covered by international standards (e.g., ISO 15118), occasional glitches can still occur (e.g., battery full, battery faulty, over-temperature) where a particular EV model/charger type are not properly matched
  - Customer to Charger Network Accounting System:
    There are various access mechanisms (credit/network cards, direct vehicle ID, smartphone apps) available – some requiring prior set-up, registration, card receipt, and so on. The multiple charging network operators all only support their own accounting access – which then authorises and monitors the charging session. Accordingly, any issue with any of the EV or driver's access options – due to network failure, card reader failure, smart app failure – will block a recharge session.
  - Customer to Network "Help Desk":
    24/7 support is ideal through redundant communication channels (phone, VOIP, cellular network, satellite) to resolve access issues, remote diagnosis and remote system reset, charging cable disconnect or maintenance call-out.
  - Site Monitoring:
    Vandalism should be considered as part of overall security planning.
    Customer safety and security
    Incident/emergency alarms

  Communications infrastructure is currently very limited along the route. This will pose challenges for:

  1. Remote monitoring and management of charging stations
  2. Payment processing for charging services
  3. Real-time information updates for EV drivers about charger availability and status

Also, strategic placement of charging stations is needed to ensure driver safety.

Given the vast distances involved, it's crucial to have a reliable network of chargers to prevent EV drivers from becoming stranded.

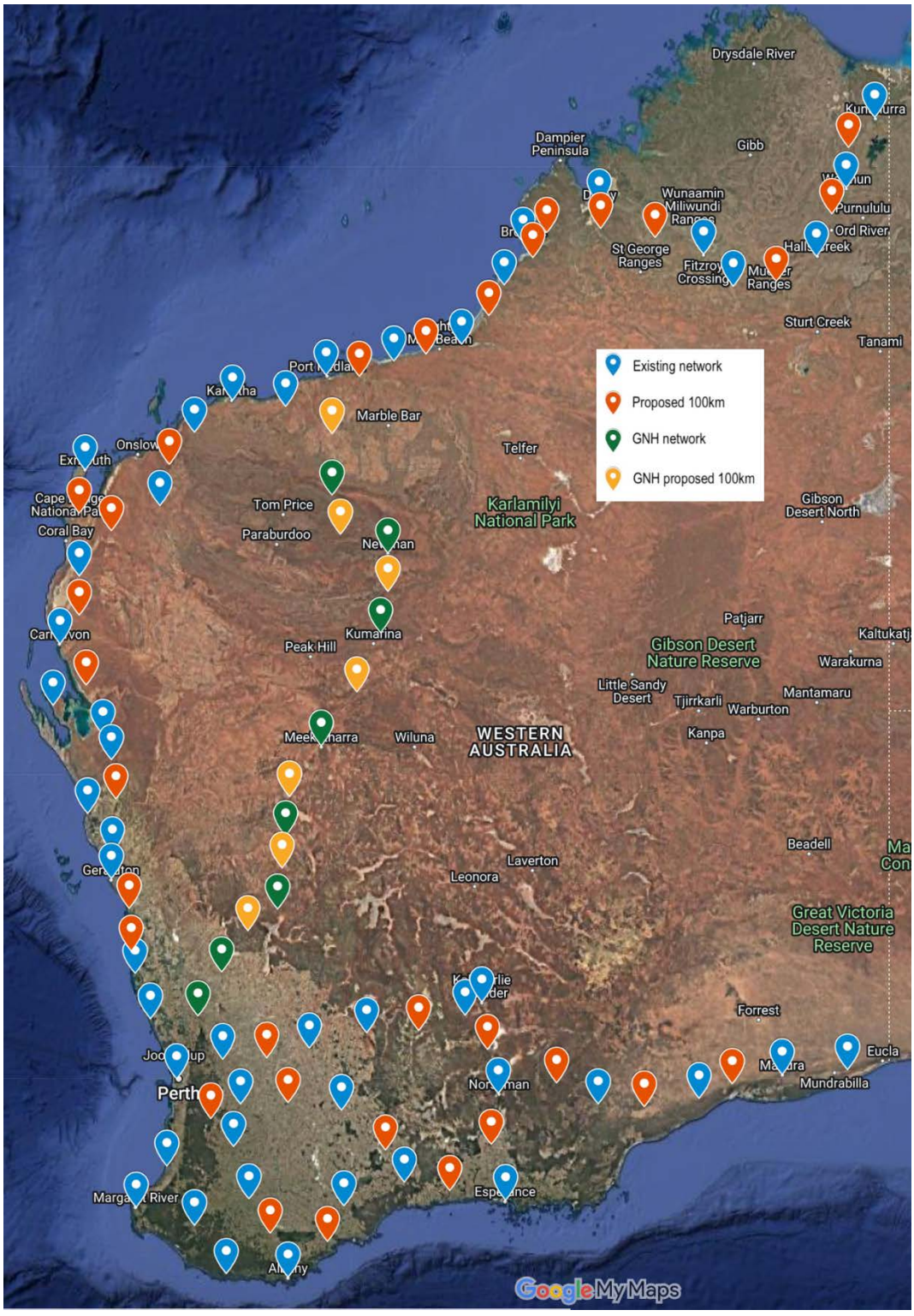

Figure 5: TOCWA Map of existing Western Australian charger locations, TOCWA propose amelioration of additional charger locations of the existing network to reach 100km spacing, and

also propose the Great Northern Highway route, at 200km spacing with mid-point supplementary charger locations to support towing and charger failures.

Is the need really pressing?

Global vehicle manufacturers are clearly shifting their production focus from CO2 emitting vehicles to zero emission vehicles. In moving away from this technology, the overwhelming technology choice is for vehicles using battery based, electrical energy storage. This change is noticeably accelerating, so much so that the vast majority of new vehicles sold before the end of this decade will be electric. While there will continue to be a very large fleet of aging ICE vehicles, their increasing operating cost, decreasing reliability and increasing functional disadvantage will see them being used less and less, and in primarily niche roles.

It is clear that carbon emissions must be rapidly reduced and eventually eliminated. Today, wherever such emissions are both affordably and practically avoidable, there is no rational reason for delaying their elimination. If presented with an opportunity to both support economic growth and eliminate carbon emissions, such a win-win argument is compelling.

This imperative has been reflected in the extraordinary growth in sustainable energy developments and the rapidly accelerating growth in EV sales, both resulting in significant planning challenges.

The automotive industry is undergoing a significant transformation with the continued growth of EV sales in contrast to the decline in ICE vehicle sales:

- EV sales continue their upward trajectory, with final global sales of electric vehicles around 17.4 million units in 2024 (Figure 6), up 20% over 2023 and comprising almost 20% of total car sales.
- Global ICE car sales around 43 million units in 2024, the lowest level in four years, and down 2.3 million units (5% decline) compared to 2023.

By the end of 2027, about one half of all new global vehicle sales (some 48 million) will be described as “New Energy”, and two thirds of these will be zero emission battery electric (Figure 6).

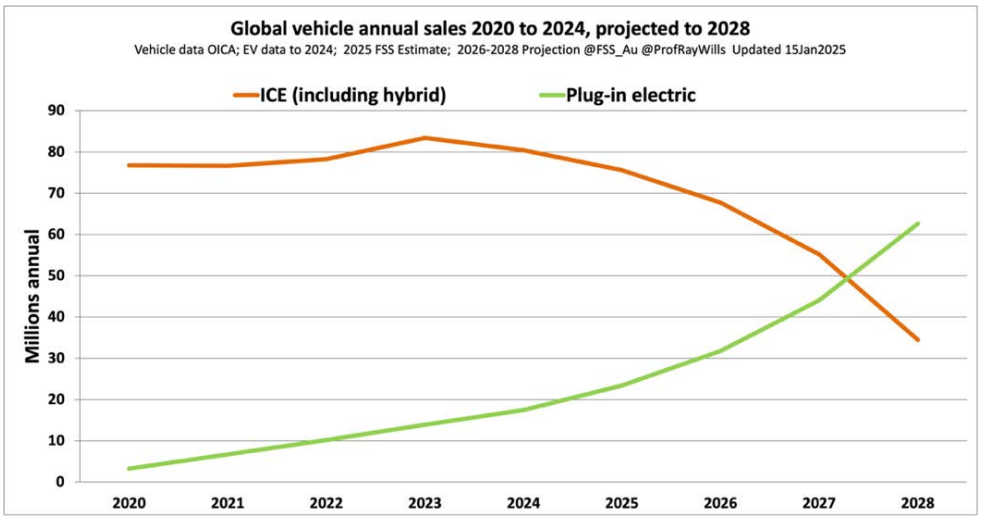

Figure 6: Global transition to electric vehicles – data to 2024, projection to 2028

Australia follows this global trend in EV adoption – albeit with a slight time lag. In 2024, EVs were more than 9% of Australian new car sales. This was a 13.5% increase year on year. As vehicle manufacturers increasingly change their own production focus from ICE to EV, Australian new-car buyers will experience fewer options for new ICE vehicles, but will have vastly more options for EVs. In Europe, in December 2024 there were more than 200 models of EV from more than 40 manufacturers on sale.

Currently, Australian EV purchasing is primarily driven by private buyers (Figure 7).

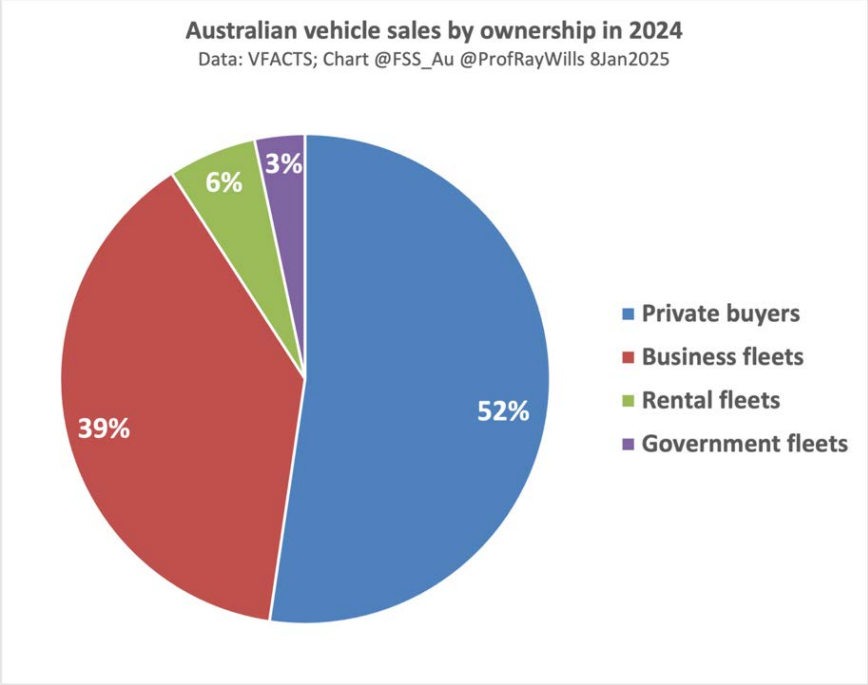

Figure 7: Australian vehicle sales by ownership in 2024

In Western Australia, a slightly higher uptake rate of new EV sales[7] was achieved, with particular concentration in the Perth region (Figure 8). This heat map also clearly highlights the disadvantage experienced by regional residents by effective exclusion from EV use options.

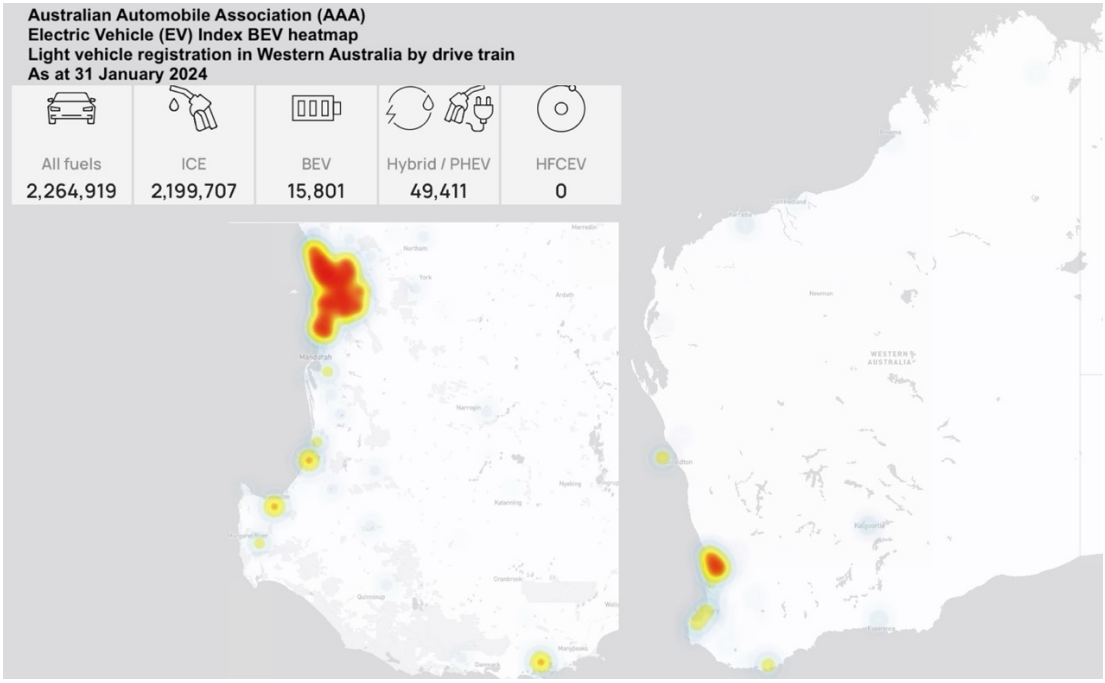

Figure 8: Western Australian heatmap of electric vehicles - regional data as of January 2024 - EV Index https://www.aaa.asn.au/research-data/electric-vehicle/)

As we can now clearly see these vehicle fleet changes globally and locally, we can apply these trends to the Great Northern Highway[8] and can project the number of EVs expected on that highway in future (Figure 9).

We expect that EV numbers would be higher when suitable charging infrastructure is in place. The novelty of EV tourism; the reduced cost of driving an EV long distance; the fact that an EV tourist can "drive the inland-coastal loop" between the South-West and North and the novelty and quality that EVs can deliver will all encourage new road-trips. Even so, this chart indicates that a charging station in Meekatharra could expect 5 charging sessions per day in 2027 consuming around 250kWh of energy daily – and based on knowledge of current usage of other route chargers, most likely between 9AM and 4PM (coinciding with significant solar energy production).

[7] . Regional data to Q3 of 2024, EV Index https://www.aaa.asn.au/research-data/electric-vehicle/

[8] using recent traffic counts near Meekatharra - half-way between Perth and Port Hedland and chosen because it measured the fewest vehicle movements on the highway.

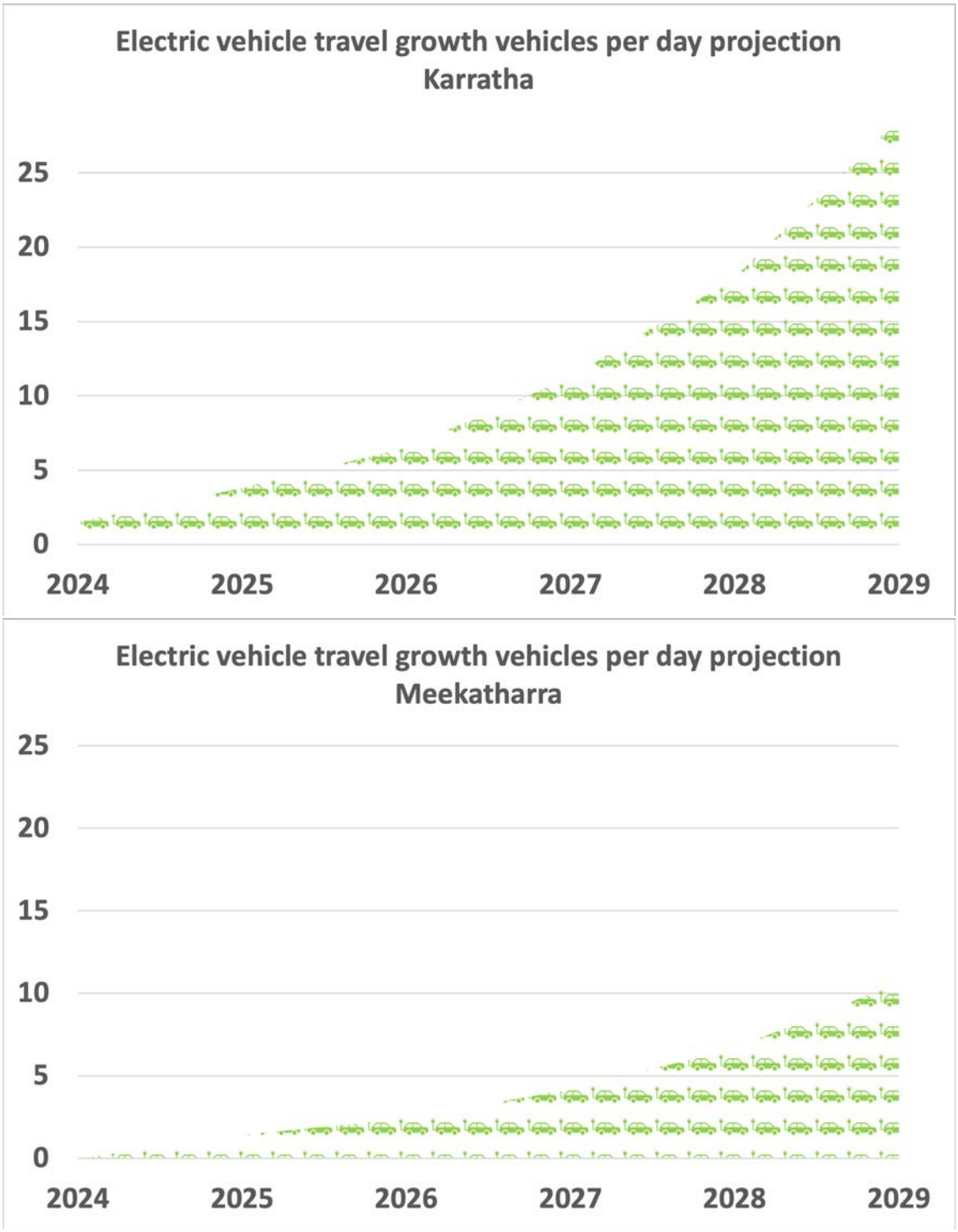

Figure 9: Western Australian electric vehicles fleet bi-directional movements at Meekatharra and Karratha based on 2024 Main Roads Western Australia traffic counts, with FSS projection to 2029

NB: Meekatharra assumes completed electrification of route; Main Roads locations: South of Meekatharra (SLK 754.00) Great Northern Hwy (H006); Karratha South of Madigan Rd (SLK 1084.65) North West Coastal Hwy (H007)

By way of comparison, this projection shows that the Karratha site is likely to have 12 sessions per day in 2027 – consuming around 600kWh.

Western Australia, especially through its WA EV Network and RAC's Electric Highway program, has begun its transition towards transport decarbonisation through the rollout of more than 120 charging stations across the state. This forward-looking approach, which considered tourism and existing traffic patterns, has already delivered social, environmental and regional economic benefits, albeit none yet offering commercial returns for the network operators' overall investment. Reflective of this, the Western Australian Government has extended electricity distribution licence and retail licence exemptions for electric vehicle charging stations to 30 June 2027.[9]

From a WA-centric perspective, this overarching transition has a very direct economic impact, beyond tourism, safety, decarbonisation and transport resilience. WA does not produce or refine oil, every drop of liquid fuel pumped into vehicles is imported, is expensive and security of supply is subject to various global challenges. In contrast, an ICE vehicle can be expected to import the equivalent of its own weight in petrol (or diesel) every 18-24 months. Furthermore, only about one third of the energy available in that fuel is converted into usefully moving the vehicle – overcoming rolling and wind resistance. Two thirds is converted into heat, noise and vibration - none of which bring productivity or benefit. Meanwhile 100% of Western Australia's sunlight arrives for free. When solar energy is converted into electrical energy and loaded into batteries, around 90% of that energy goes into motion.

From an export perspective, Western Australia is the world's largest producer of lithium – key to the batteries in EVs. WA is also fourth on the list of rare earth mineral suppliers - as essential for efficient EV motors.

Further, multiple WA companies have also locally developed technology and processing to directly support this energy transition.

Further, as of January 2025, the WA government continues to support EV adoption through initiatives such as:

- The Charge Up EV Charging Grants program, which co-funds up to half the cost of purchasing and installing EV chargers for businesses and local governments.[10]
- A target of at least 25% of eligible government fleet vehicles being electric by 2025-26.[11]

These efforts, combined with the ongoing expansion of charging infrastructure, position Western Australia well for a continued transition towards electric transportation, bringing economic, environmental, and social benefits to the state.

However, we note this view from TOCWA:

> *"An unintended consequence of a reliance of the Charge Up EV Charging Grants program to deliver further EV charging infrastructure along crucial routes (such as the Great Northern Highway) is that it fractures the continuity of what*

[9] https://www.wa.gov.au/government/document-collections/extension-of-licence-exemptions-electric-vehicle-charging-stations

[10] https://www.wa.gov.au/organisation/energy-policy-wa/charge-ev-charging-grants?t

[11] https://www.wa.gov.au/system/files/2023-09/a-guide-to-electric-vehicles.pdf

critically needs to be a uniformly designed, installed and maintained system. Experience gained through the RAC gifting their regional fast DC chargers to each respective LGA highlights the pitfalls of localized ownership and responsibility whereby the LGA KPIs were discordant with that of the entire network. (What may have locally been seen as an isolated outage of low priority often led to a significant breaking of an entire route comprised of several other distant chargers which were useless unless they all worked.)"

There are further "fast charging stations" from, for example Ampol, BP, Tesla and others – but at relatively small numbers and concentrated at high-traffic sites. There is a currently stark lack of any suitable coverage along the Great Northern Highway (Figure 10).

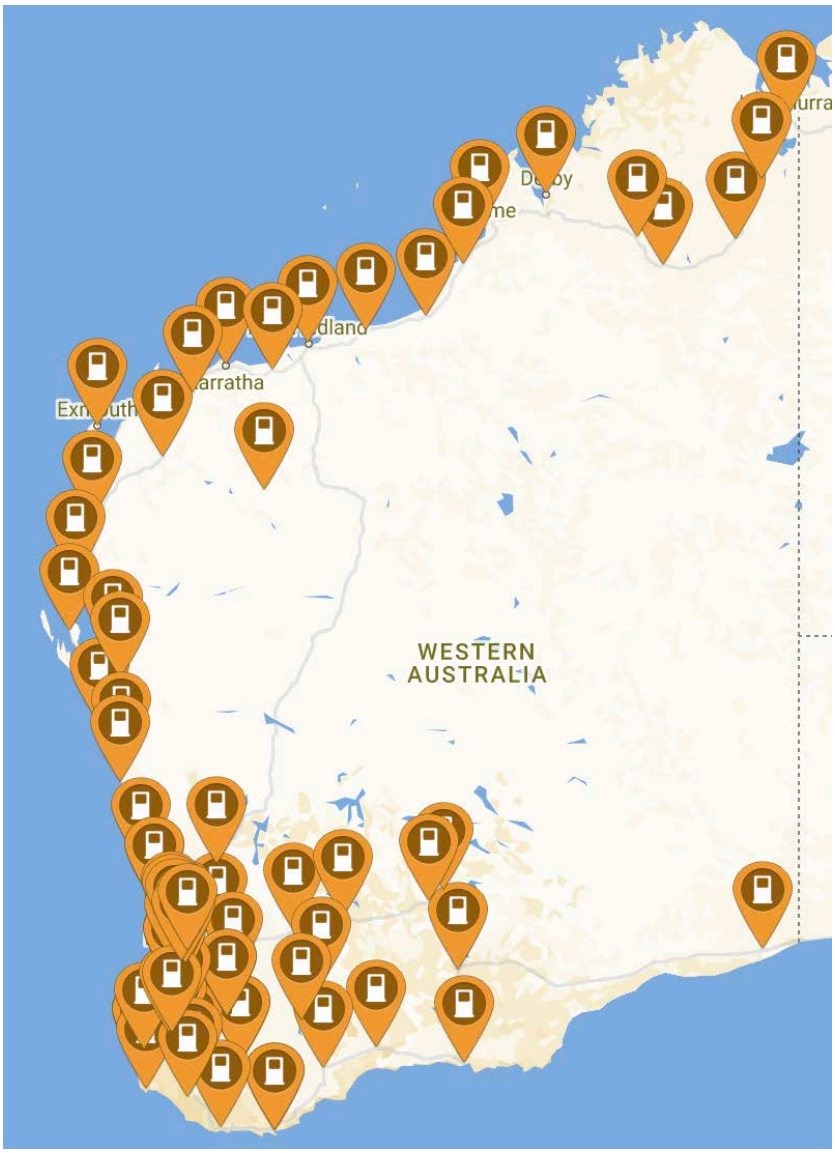

Figure 10: Western Australian electric vehicle charger map from Plugshare including publicly accessible private chargers (Only chargers of 50kW or greater shown)[12]

[12] https://www.plugshare.com – accessed 10 Feb 2025

Since 2022, EV sales have lifted, and the EV fleet growth is accelerating. This expansion will contribute to a range of other economic, social and environmental gains:

- An ICE vehicle will import its own weight in fossil fuels every 18 months to 2 years. With Western Australia's climate, that energy can be essentially replaced by sunlight and wind using plug-in EVs.
- An overwhelming majority of EVs in our vehicle fleet contains very significant values of minerals originally sourced from Western Australia – especially iron (38%), lithium (almost 50%), aluminium (11%) and-rare earths (4th largest global supplier).
- Supported EV infrastructure enables the WA Government to directly impact decarbonisation by managing the source of energy.
- Growth of the EV fleet will be matched by demand – and need – for more EV chargers (Figure 11) – with as many as 4000 charge points required by 2030.

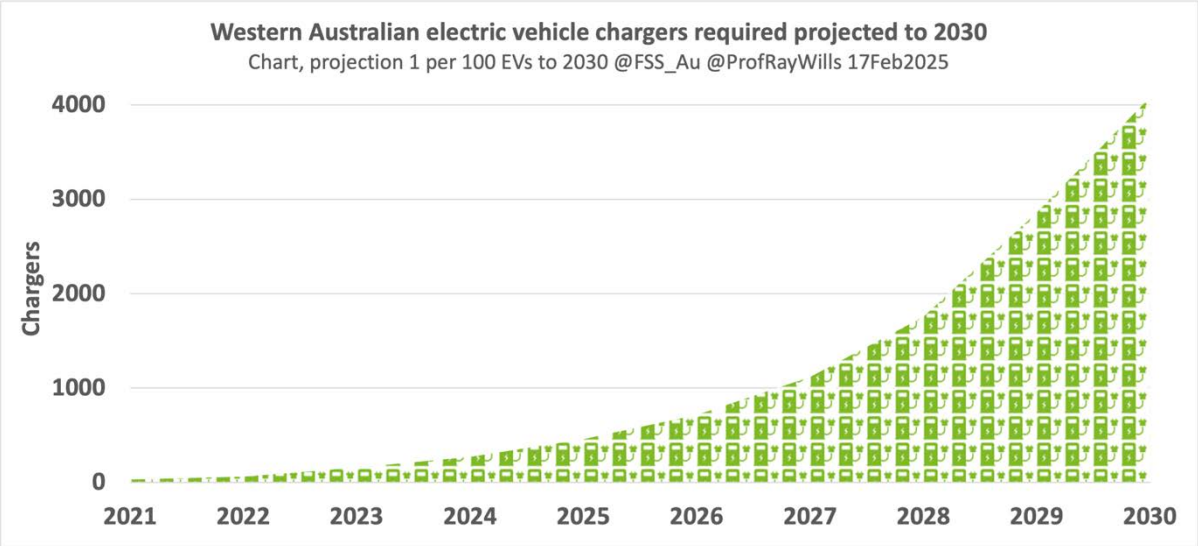

Figure 11: Western Australian electric vehicle charger fleet required over time based on one charger per 100 electric vehicles

Conclusions

This report notes the significant progress made in Western Australia's EV infrastructure development, notably through the completion of the construction phase of the government-committed WA EV Network. These initiatives have been instrumental in supporting EV adoption and regional tourism along coastal and south-western routes.

What we have seen is that there have been, and continue to be, issues with timely site maintenance, communications, site access and site distribution.

This study also highlights a critical gap in the existing infrastructure: the Great Northern Highway. As one of Western Australia's most important inland routes, its lack of EV charging infrastructure represents a significant barrier to EV adoption, regional development, and tourism in the state's northern areas. The report's findings underscore the need for strategic investment in charging infrastructure along this route to:

1. Enable safe and convenient EV travel between Perth and Port Hedland – and beyond.
2. Support regional residents in accessing the economic and environmental benefits of EVs.
3. Boost tourism and economic development in towns along the route
4. Contribute to the state's decarbonization objectives.

The recommendations provided align with the state's demonstrated commitment to EV infrastructure and offer a roadmap for extending these benefits to a crucial inland corridor. By addressing this infrastructure gap, Western Australia can improve its trajectory in EV adoption and sustainable transportation.

As the global and local automotive markets continue their rapid shift towards electric vehicles, the timely implementation of these recommendations will ensure that Western Australia's inland regions, and all EV users, are not left behind in this transformative transition. This proactive approach will yield long-term economic, environmental, and social benefits for the state and its residents, while also enhancing Western Australia's resilience and connectivity.

The road less travelled, outback in Western Australia
(Photo credit: Harald Murphy)