Home EV charging and the grid: impact to 2030 in Australia

Prepared by
Ross De Rango

August 2022

ELECTRIC VEHICLE COUNCIL

Executive summary

The potential for EVs to add load to the energy system at times of peak demand is a risk that many parties have interest in, particularly the energy network operators (DNSPs and TNSPs). A simple 'back of the envelope' exercise is sufficient to show that a relatively small level of EV transition has the potential to cause serious problems for networks if the majority of EV charging happens co-incident with people getting home from work in the evening.

Work of this nature has been done by CSIRO and Melbourne University among others, generally based on sample data from EV charging trial programs in non-Australian jurisdictions, leading to an estimated impact on the grid at peak time of up to 2kW per vehicle. The CSIRO work has been used to inform AEMOs energy system planning documents, and is being relied upon in the formation of government policy.

As a contribution to this ongoing discussion, the EVC has drawn together real-world data on consumer EV charging behaviour in Australia.

From multiple independent pieces of work, it is apparent that Australian consumers with EVs are currently choosing to self-manage their EV charging to a significant degree, with the majority of at-home EV charging occurring either in the middle of the night or the middle of the day, and with comparatively little charging occurring during peak time. Contribution per EV to evening grid peak demand appears to be on the order of 250W.

Assuming this behaviour continues, and uptake of EVs aligns with government targets for 50% of new vehicles to be EV by 2030, the contribution of EVs to peak demand out to 2030 is likely to be limited to about 1% of total grid peak demand [1].

These consumer behaviours will deliver an increase in demand during the middle of the day, which will help support the ongoing integration of solar into the grid. They will also see increased network utilisation at night, which will drive down the network component of energy bills for all users.

This is in line with global experience, in particular from the global EV market leader, Norway, where the transition of 20% of on-road passenger vehicles to electric has resulted in negligible increase in peak demand.

The key takeaway is in line with the findings from the recent IEA Global EV outlook report [2]. The Australian grid is relatively robust by global standards and will be augmented over time in line with population growth and increasing electrification outside of the transport sector.

In the near term, our focus needs to be on accelerating uptake of EVs and supporting consumers in making grid-friendly choices, not regulating to manage potential EV-related grid impacts.

The risk of regulating to manage grid impacts at this stage is that many proposed regulatory interventions would have the effect of driving up costs and reducing consumer choice.

https://www.energy.gov.au/sites/default/files/Australian%20Energy%20Statistics%202021%20Energy%20Update%20Report.pdf

www.iea.org/reports/global-ev-outlook-2022

Case Studies

Norway

The period of time from 2011 to 2020 in Norway was characterised by the transition of 20% of their light road vehicle fleet to electric. Norway is now the world leader in terms of percentage of new vehicles sold being EV. They have experienced noticeable increase in electrical energy consumption, but negligible increase in peak demand. From this we can conclude that Norwegian EV drivers don't typically charge their cars at peak times.

Peak demand is shown here:

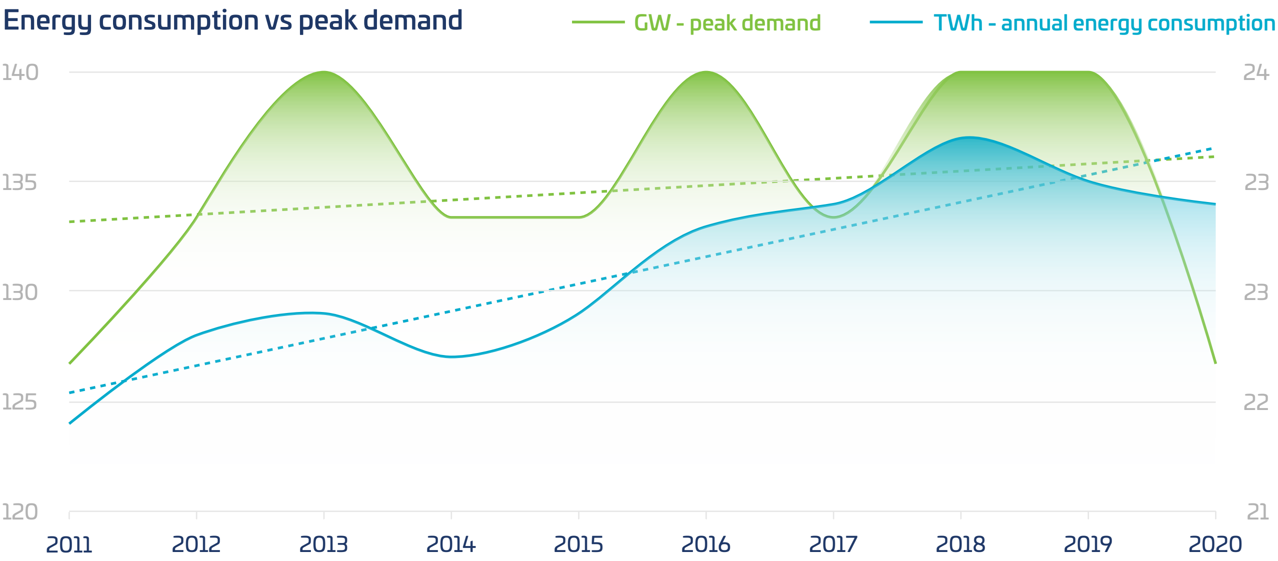
GW		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Peak production	6	6	6	3	3	3	3	3	3	3
NO1	Peak demand	8	8	9	7	7	8	8	8	8	7
	Power balance (GW)	**-2**	**-2**	**-2**	**-4**	**-4**	**-5**	**-5**	**-5**	**-4**	**-4**
	Peak production	9	10	10	10	10	10	10	10	10	10
NO2	Peak demand	5	6	7	6	6	6	6	7	7	6
	Power balance (GW)	**4**	**4**	**3**	**4**	**4**	**3**	**4**	**4**	**4**	**5**
	Peak production	3	3	3	3	3	4	4	4	4	4
NO3	Peak demand	4	4	4	4	3	4	4	4	4	4
	Power balance (GW)	**-1**	**-1**	**-1**	**-1**	**0**	**0**	**0**	**-1**	**0**	**0**
	Peak production	4	4	4	4	4	4	5	5	5	5
NO4	Peak demand	3	3	3	3	3	3	3	3	3	3
	Power balance (GW)	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**
	Peak production	4	3	6	7	7	7	7	7	7	7
NO5	Peak demand	4	3	3	3	3	3	3	3	3	3
	Power balance (GW)	**0**	**0**	**3**	**4**	**4**	**4**	**3**	**4**	**4**	**4**
	Peak production	25	26	26	27	27	27	26	28	27	27
Norge	Peak demand	22	23	24	23	23	24	23	24	24	22
	Power balance (GW)	**3**	**2**	**2**	**4**	**4**	**2**	**3**	**3**	**3**	**5**

www.statnett.no/globalassets/for-aktorer-i-kraftsystemet/planer-og-analyser/nup-2021/analyse-av-transportkanaler-2021-2040.pdf

Total energy used over time, from the same report, is shown here:

TWh		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Vannkraft	122	143	129	137	139	144	143	140	126	142
	Vindkraft	1	2	2	2	3	2	3	4	6	10
	Kjernekraft	0	0	0	0	0	0	0	0	0	0
Norge	Termisk	5	3	3	4	4	3	3	4	3	3
	Samlet produksjon	128	148	134	142	145	150	149	147	135	154
	Total consumption	124	128	129	127	129	133	134	137	135	134
	Kraftbalance	**3**	**20**	**5**	**16**	**16**	**16**	**15**	**10**	**0**	**21**

https://www.statnett.no/globalassets/for-aktorer-i-kraftsystemet/planer-og-analyser/nup-2021/analyse-av-transportkanaler-2021-2040.pdf



Trending the data from this report, we can see that there is a slight trend showing increase in peak demand (GW, right hand side axis, in green), of approximately 2% over 10 years. By comparison, the increase in overall electrical energy use (TWh, left hand side axis, in blue) is a much clearer upward trend, of approximately 10% over 10 years.

Interestingly, population growth was approximately 10% over the period. Not only did peak demand not rise as a result of EV uptake, it did not rise appreciably with population increase.

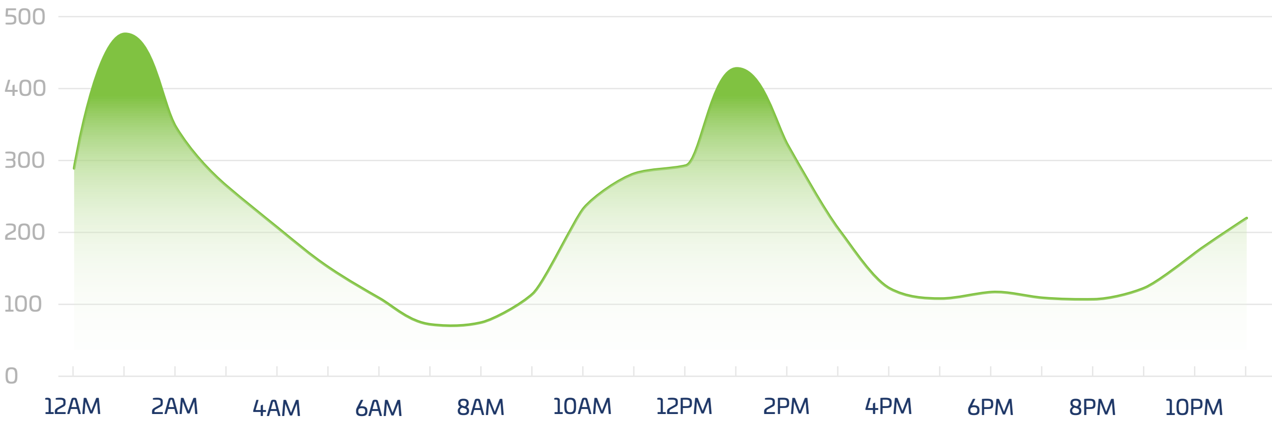
This data is from a very well developed EV market, but it's not Australia, so it's important to collect local data as well in order to validate the viewpoint that Australians will behave similarly to Norwegians, with respect to generally not charging their EVs at peak times. To the extent possible, this data should be as recent as possible, to minimise the differences between early adopters and the mainstream market.

TOCA survey

The EVC and Tesla Owners Club of Australia ran a survey in 2022, addressing many questions relating to EV ownership. One of the questions posed was multiple choice, wherein the 740 respondents were asked to identify up to 12 hours out of 24 in which they most commonly charge their cars.

The results were:

Preferred at home charging times



There are two characteristic peaks in the data, in the middle of the night (corresponding with off-peak tariffs) and the middle of the day (corresponding with domestic solar production).

The hours between 4pm and 9pm, which is when the presentation of EV charging load to the network is most likely to be problematic, are some of the least common preferred charging times, second only to 7-8am.

For the purposes of estimating grid impact of EVs, we can treat this survey response as an average charging profile. Further, we can assume that each vehicle is consuming on average approximately 10kWh/day at home, based on other data collected in the survey with respect to kilometres driven each year, and typical efficiency of EVs.

This would lead us to conclude that each EV will contribute approximately 960W in the middle of the night, 870W in the middle of the day, and on the order of 215-250W during the traditional peak demand period of 4pm to 9pm.

We note that this is survey data, rather than actual recorded data. This means that there is room for doubt as to the difference between reported behaviour and actual consumer behaviour. The next two case studies address this.

The University of Queensland

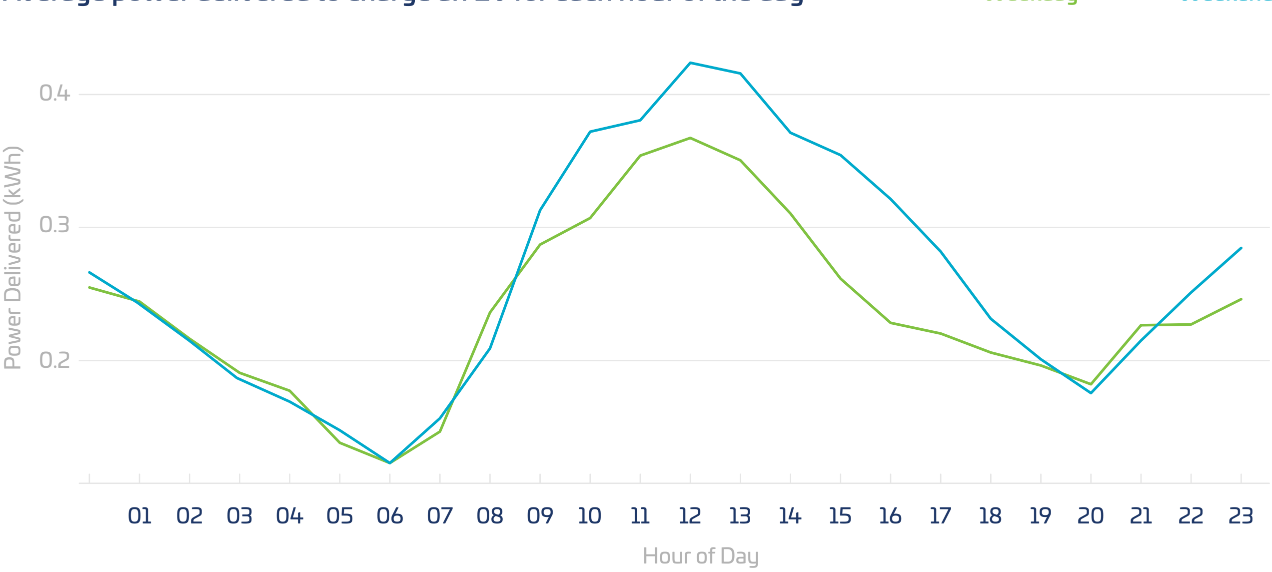
Researchers at the University of Queensland undertook a study in which they were provided access to minute-by-minute driving and charging data logged by 239 Tesla vehicles in Australia over a six-month period.

The pre-print of their paper is available here:

https://arxiv.org/ftp/arxiv/papers/2206/2206.03277.pdf

The average at-home consumption of EVs in that sample was per the chart below:

Average power delivered to charge an EV for each hour of the day



Similarly to the TOCA survey work, we see the characteristic peaks in the middle of the night and the middle of the day, and a relatively low level of charging at peak times. In this data set, the impact per EV at peak time is in the 150W-300W range, with a minima at 8pm.

Origin Energy smart charging trial

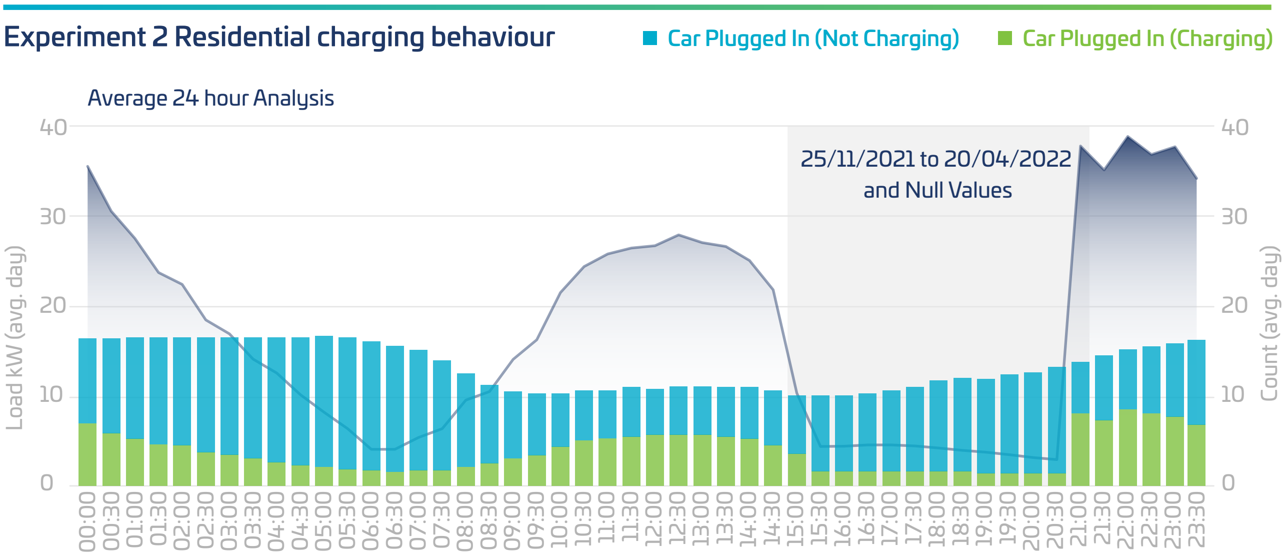
Supported by ARENA funding, Origin Energy ran a trial involving 150 EV driving consumers and tested their behaviour under various experimental conditions.

arena.gov.au/assets/2022/05/origin-energy-electric-vehicles-smart-charging-trial-lessons-learnt-2.pdf

The baseline condition was 'no incentive on EV charging time', which resulted in ~30% of energy being consumed by the vehicle being delivered between the hours of 3pm and 9pm. This equates to an average load per EV in the six hour peak demand window of around 400W, under conditions where incentives for the consumer to avoid charging at peak time have been deliberately removed

The first experiment was a price-based incentive, where the user was 10c/kWh better off if they avoided charging their vehicle during the 3pm to 9pm window. This reduced the amount of energy consumed during the 3pm to 9pm peak window to 10% of total energy consumed, equating to a peak demand impact per EV of around 167W. This level of pricing incentive is comparable to existing retail offers in the Australian market, such as the Powershop Electric Vehicle tariff product.

The second experiment was external orchestration via the smart charging equipment, with a daily 25c payment in place to financially reward the consumer for accepting external control, in addition to the 10c/kWh benefit from the first experiment. In the experimental design, the consumer retained the ability to override the external scheduling. Origin found that participants valued the override feature as it provided flexibility and control when needed. Under this condition, 6% of energy consumed by the EV was consumed during the 3pm to 9pm window, equating to a peak demand impact per EV of around 100W.



		Early Morning 5am to 10 am	Solar Sponge 10am to 3pm	Peak 3pm to 9pm	Overnight 9pm to 5am
Baseline	No incentives	7%	25%	30%	38%
Experiment 1	Incentives	4%	31%	10%	55%
Experiment 2	Incentives with control	9%	30%	6%	55%

One of the interesting takeaways here is that both experimental conditions aimed at shifting charging away from peak times yield very similar results. Whether or not the charging is externally controlled, the presence of a price signal is highly effective at delivering the same type of usage profile observed in the other case studies presented, characterised by low demand during the evening peak, and relatively high demand during the middle of the day and the middle of the night.

Other data streams known to exist, but not analysed in this summary report.

Australia is at the start of the transition to EVs, with approximately 50,000 EVs on the road so far, out of approximately 15 million passenger vehicles on the road – on the order of 1 vehicle in 300. As more EVs enter the market, and we shift from the average EV owner being an early adopter, to the average EV owner being a mainstream consumer, it's reasonable to assume that average at home charging behaviour may change.

If average charging behaviour shifts from consumers following the price incentives and doing their charging out of peak times, in the direction of consumers accepting higher prices and doing their charging at peak times, then the negative impacts on the grid will be higher, and the positive impacts lower.

If consumers increasingly adopt retail offers that reward them for charging their EVs outside of peak time, then the negative impacts on the grid will be lower, and the positive impacts higher.

For this reason, it's crucial that data continues to be collected and analysed on domestic EV charging behaviour so that emerging behaviour trends can be identified in a timely fashion, and incorporated into strategic planning.

If we start seeing a behavioural trend towards EV charging happening at peak times, effort will need to be made to swing average consumer behaviour back towards the usage patterns seen in the case studies here.

Multiple pathways exist for the collection and analysis of this data.

Several additional potential data streams that could be reviewed to further build out this work are:

Vehicle OEMs

Tesla record charging data of all of their vehicles, in relatively small time intervals. This data is not typically publicly released, but could in principle provide a sample set of charging data from the majority of EVs presently on Australian roads. As demonstrated through the research project being conducted at The University of Queensland, there is also the opportunity for Tesla owners to provide access to this data through third-party platforms.

Other vehicle OEMs could be approached for similar information as the market develops, and manufacturer market share spreads out.

Solar Victoria / C4NET

In Victoria, smart meters are ubiquitous, and 30 minute household interval data is stored for 2 years. In principle, the usage data of households receiving grants for the purchase of EVs could be analysed, comparing historical energy usage profiles prior to the acquisition of the EV, with energy usage profiles post-acquisition of the EV.

Care would be needed around data cleansing, the establishment of a control group, elimination of confounding variables, and so forth, but in principle a similar average EV-usage profile could be derived from analysis of smart meter data.

It's our understanding that Solar Victoria and C4NET are undertaking an analysis of this type.

AGL smart charging trial

One of the components of the ARENA-funded AGL smart charging trial is a cohort of drivers acting as a control group. This group is not subject to external orchestration of their chargers but are on a time of use tariff. They are therefore incentivised to charge their cars at non-peak times.

Similarly to the Origin Energy smart charging trial, we can expect to see a published report covering the learnings from this AGL trial.

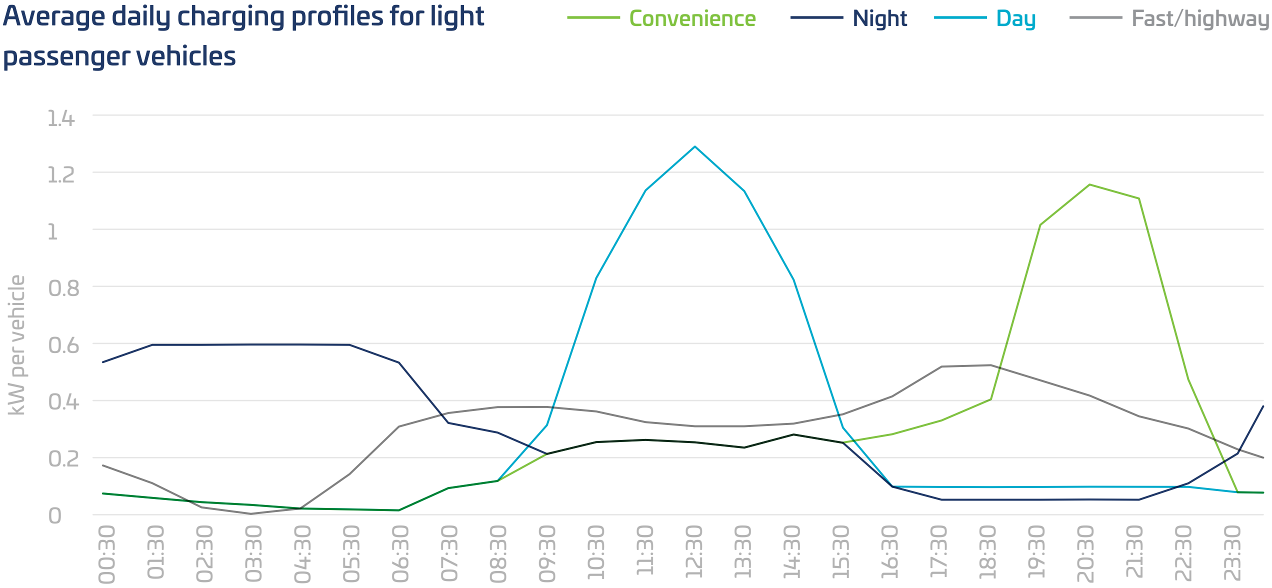
Comparison to other work in the field

Based on the case studies, the impact of EV charging at times of the peak evening demand in the grid under BAU conditions appears to centre around a value of approximately 250W per EV.

CSIRO

250W per EV is around one fifth of the impact forecast under the convenience charging model from the most recent CSIRO work on this matter. The convenience charging profile from CSIRO is assumed to be a dominant behaviour in AEMO forecasting work, which informs AEMOs ESOO and ISP. This is not necessarily the fault of the CSIRO work, which calls out specifically that "If there is no time of day tariff controlling or incentivising when to charge, then vehicle owners charge whenever it is convenient". In the Australian context, the majority of consumers with solar on their roof are incentivised to charge during the day by low feed-in-tariffs, and there is wide availability of incentives to the consumer to charge off peak at night.

Average daily charging profiles for light passenger vehicles



https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2021/csiro-ev-forecast-report.pdf

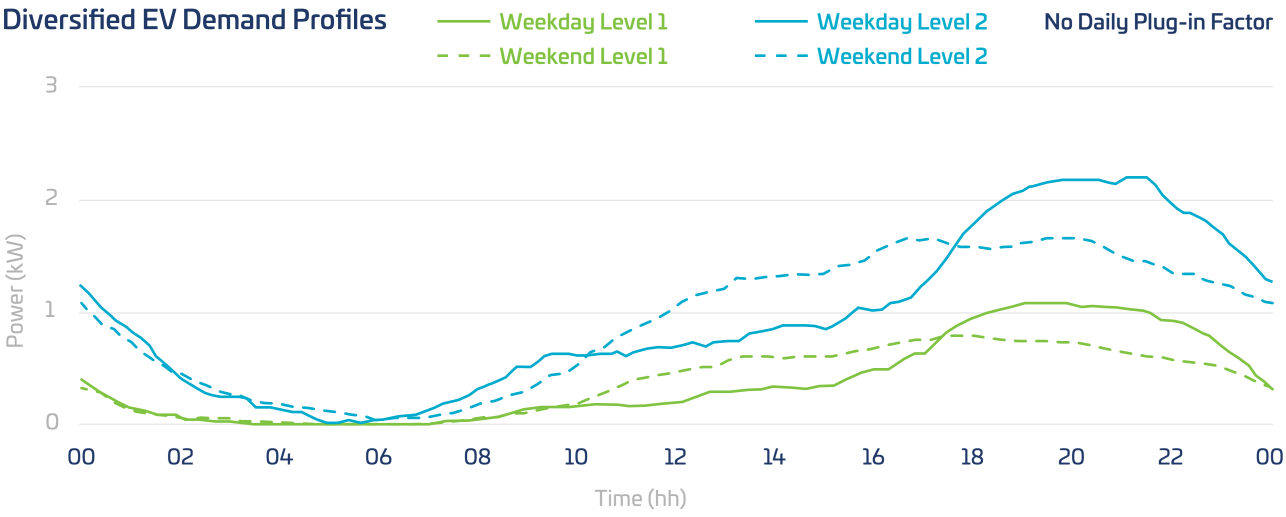
Actual behaviour observed in the case studies presented here show that a blend of the 'night' and 'day' profiles presented in the CSIRO work are the dominant behaviour, and that the 'convenience' charging profile is not representative of actual consumer behaviour.

This discussion paper focusses on at-home charging rather than public charging, but we'd note here that the Fast/highway profile presented in the chart above is also mis-aligned with actual behaviour. Fast/highway charging is concentrated in the middle of the day in Australia, with relatively little contribution in the mornings and late afternoons, and virtually none in the middle of the night.

Australian drivers aren't typically stopping at fast chargers on the way home from work – they're using them in the middle of the day while out and about. Intelligent design of tariffs to lower the cost to the consumer of public fast charging in the middle of the day, in order to promote consumption of excess solar generation, could reasonably be expected to accentuate this.

Melbourne University

250W per EV is approximately one eighth of the impact forecast by Melbourne University work in this space, which assumes 80% of drivers will use 7kW chargers at home, with typical 2kW imposition on the grid during peak times on weekdays:



www.researchgate.net/publication/360887067_Milestone_8_EV_Management_and_Time-of-Use_Tariff_Profiles

Interestingly, other work undertaken by the team at Melbourne university effectively predicts the behaviours we've seen in the case studies, as opposed to the behaviours predicted in the report referenced above.

In this earlier piece of work, drivers of both EVs and ICEVs were surveyed to establish the degree to which they'd be willing to self-manage their EV charging away from peak times, in exchange for reduced cost.

Discount Level	Change to 11pm	Change to between 10am and 2pm
No discount	13.6%	16.5%
10% discount	19.8%	24.2%
20% discount	27.2%	40.7%
50% discount	66.7%	53.8%

www.researchgate.net/publication/355444278_Electric_Vehicle_Charging_Consumer_Survey_Insights_Report

In this earlier piece of work, we see that a significant majority of drivers state a willingness to avoid peak time charging, in exchange for discounts at a level that are already available today for the majority of consumers. This is consistent with the TOCA survey work and the data from the case studies presented in this paper.

Probable grid impact based on case studies

If we use 250W per EV as the average demand at peak time and assume 1.5 million passenger EVs on the road at 2030 (in line with announced state government targets for 50% of new vehicle sales being EV by 2030), we will have an increase in peak demand of approximately 375MW, across the country.

This is on the close order of 1% of the combined peak demand across the NEM and the SWIS. For context, we note that weather driven year-to-year variations in system peak demand are routinely on the order of 10%.

In terms of probable future behaviour, we note that:

1. Australian retailers are already developing and promoting retail energy products specifically targeting EV drivers, offering very lower cost charging for EV charging at off peak times – for example: www.powershop.com.au/electric-vehicle-tariff/
2. Car manufacturers globally are making it easier and easier for consumers to take advantage of this type of pricing model: youtu.be/UjenHNz-MRI
3. Based on a 20c/kWh difference between typical flat rate retail pricing, and super-off-peak or solar feed-in-tariff pricing, a typical EV driver can save $600/annum with no loss of amenity through making a general adjustment to their EV charging time. The available annual saving is higher in markets such as SA and WA, where there is a wider gap between typical flat rate pricing and off-peak pricing.

Based on these factors, adequate education of consumers in this regard, without any change to existing market mechanisms, could reasonably be expected to drive the 250W per EV contribution to network peak demand further down.

In terms of impact on energy requirement, 1.5 million passenger EVs on the road in 2030, consuming 10kWh/day, will add on the order of 5.5TWh/annum. This is approximately a 2% increase on the 265TWh[3] generated and consumed annually.

https://www.energy.gov.au/sites/default/files/Australian%20Energy%20Statistics%202021%20Energy%20Update%20Report.pdf

The possibility that orchestration of EV charging in the home may be commercially viable in future underpins the final recommendation of this paper around setting requirements for EV charging equipment to capable of participating in orchestration in future. It is clear from the case studies that there is no need to attempt to compel consumers to join in orchestration solutions today.

As has already been noted, monitoring behaviour over time will be important. The 50,000 EV drivers on Australian roads today are early adopters, whose behaviour might not accurately reflect the behaviour of mainstream consumers over the coming decades, so effort should be made to track aggregate EV charging behaviour over time.

Recommendations

Tariffs and pricing:

We should encourage EV charging at home, during the day, where practicable for the driver. This can be done through a combination of the ongoing reduction in the solar Feed-In Tariff rate, and access to retail products that offer low cost energy during the middle of the day, particularly on weekends.

As a secondary preference to middle-of-the-day charging, we should encourage EV charging at night, after peak time. This can be best achieved through ensuring consumers have access to retail electricity products that incorporate very low overnight energy rates. As an example, the Powershop EV tariff offers ~9c/kWh pricing overnight in many jurisdictions, and many EV drivers use it.

An ideal tariff from the point of view of securing grid-friendly consumer behaviour would be characterised by:

- Very low solar FiT, to maximally encourage self-consumption of solar.
- Very low pricing from the grid from ~9am to ~3pm, to encourage day-time charging wherever feasible, in order to 'solar-soak' excess generation from neighbouring properties and limit the need for solar curtailment.
- Low pricing from the grid from ~midnight to ~6am, to encourage overnight charging where day-time charging isn't feasible
- Moderate pricing at all other times, to discourage EV charging at home between ~6am and ~9am (the morning peak), and ~3pm and ~midnight (the evening peak).

Actions required:

DNSP tariff reform in some jurisdictions to support retailers creating residential retail offers aligned with above.

Retailer engagement to develop and promote products designed to reward consumers who charge at grid-friendly times.

DNSPs and retailers will need to collaborate on this - it is a shared responsiblity, for collective benefit.

Harmonisation of SIRs to permit 32A EV charger installations

Given that the majority of domestic EV charging under consumer control happens at times that support the grid, better outcomes will result from consumers having appropriately sized charging hardware. A consumer limited to a 20A single phase charger, with a 12 hour window at home to undertake a 300km range recharge, will need to charge for the whole twelve hours – meaning, they're more likely to start charging during peak times in that circumstance. If the consumer has access to a 32A single phase charger, they will only need 8 hours for a 300km range recharge, which will increase the likelihood that they'll follow the price signals and avoid peak times.

Currently, various Service and Installation Rules (SIRs) around the country limit the installation of EV charging to 20A or 25A, while others allow 32A. There would be merit in harmonising these requirements, such that a consumer anywhere in Australia can install a 32A single phase EV charger in a domestic setting.

Action required:

DNSPs and State/Territory Electrical Regulators to update SIRs to support EV charging.

Education around maximum demand requirements

AS/NZS3000:2018 cover maximum demand determination in section 2.2.2, with four permissible methods. Electrical system designers typically use method (a), calculation. In the context of standalone domestic homes, this method requires an assumption that the EV charger will contribute to maximum demand at full load. Where the consumer is installing a 32A charger, this often leads to a determination that the electrical connection to the network requires an upgrade, which creates cost for the consumer, and leads to the possibility of higher grid impacts.

AS/NZS3000:2018 section 2.2.2 also includes methods (b) and (d), assessment and limitation, which can be used to apply local load management approaches at the dwelling level, and thereby avoid the need for upgrading the connection, while retaining the ability to deploy a 32A charger.

Method (d) in particular is very simple. The replacement of the main switch in the switchboard with a circuit breaker, coupled with ensuring the driver understands that they won't be able to charge their car at the same time as they're running both aircon and electric oven, will suffice for many installations.

The standard as written supports good outcomes, but knowledge amongst the people applying the standard at time of installation design and those utilising the standard from a regulatory approval standpoint needs to improve, so that the optimal approaches are used.

Action required:

Development of education materials for electrical contractors, electrical system designers, and those regulating/approving connections, and delivery of this material.

Education for importers on electrical safety

Regulations apply to electrical products for reasons of electrical safety (EESS and NSW fair trading) and interference with communications equipment (ACMA). The requirements around EV charging equipment include the industry standard RCM mark, which is common to many different types of electrical product.

We do not see any requirement for changes to this scheme, but there will be merit in ensuring that new entrants to the electrical equipment supply space are aware of their obligations with respect to compliance.

Action required:

Education for new entrants into the electrical equipment importing space, to ensure that they are aware of their compliance obligations.

Visibility for network planning

While the overall impact of EVs on network peak demand can reasonably be expected to be limited in the medium term, clustering will occur, where EV uptake in some regions moves faster than EV uptake on average. We're already seeing this in certain suburbs in Sydney.

If a particular region acquires EVs faster than average, and the consumers in that region tend to charge their cars at peak times more than average, it's possible that networks will see localised issues of transformer overload, which carries the risk of outages to consumers.

This problem can be mitigated through improved visibility. Part of the answer is likely to be data sharing between vehicle registration bodies and energy networks, to identify potential clustering areas before problems occur. This is already in place to a degree in Queensland.

In addition to this measure, there will be merit in exploring mechanisms whereby the installation of EV charging equipment is captured in a register that DNSPs have appropriate access to. These are not perfect solutions, however, as they will not distinguish between 'well-behaved' charging and 'poorly-behaved' charging. Monitoring of the LV network will be needed as well.

Actions required:

Vehicle registration bodies to work with DNSPs to share data facilitating early detection of EV clustering. Relevant bodies to explore appropriate mechanisms to capture EV charging equipment installation locations, in a similar manner to DER registers.

DNSPs to improve LV network visibility for internal use. As an example, this could include monitoring hardware and software for transformers.

Requirements around demand response / DER capability

The case studies presented here indicate that provided consumers have access to ToU tariffs, contribution to network peak demand by EVs out to 2030 can be expected to be relatively minor. Network augmentation will of course continued in this timeframe, driven by the usual factors. Over longer timescales, orchestration of EV charging may prove to be more economically efficient than augmentation of the distribution networks.

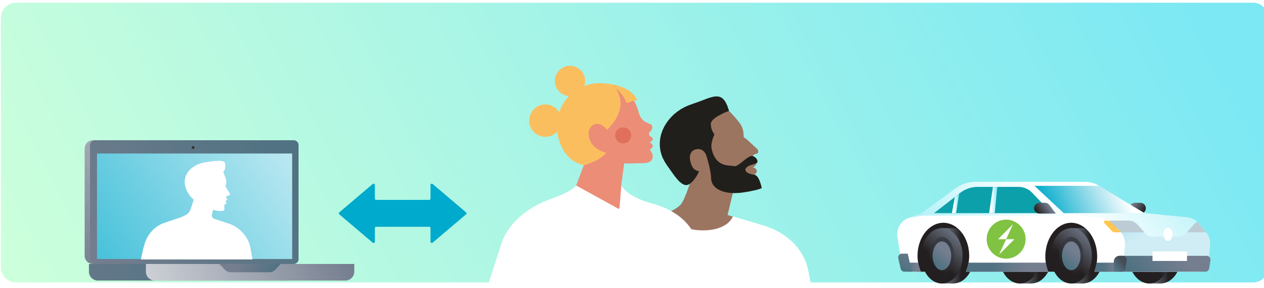
Under the Distributed Energy Integration Program the Electric Vehicles Grid Integration taskforce gave consideration to various orchestration pathways:

Interoperability pathways to mobile devices

Interoperable EVSE relays messages between electricity system and the vehicle

Interoperable vehicle communicates directly with electricity system, and optionally with EVSE to identify site-specific data

Market incentives or other signals influence consumers' charging decisions



aemo.com.au/-/media/files/stakeholder_consultation/working_groups/der-program/deip-ev/2021/deip-vgi-standards-report.pdf?la=en

It is probable that the future will involve a mixture of the approaches outlined above. Market incentives are already in place, and are already having a significant effect per the data presented in the case studies. These can be expected to remain in place, because consumers like them, and they work.

Orchestration by way of EV charging equipment (EVSE) has been the subject of multiple ARENA trials, and demonstrably works at a technical level:

- arena.gov.au/projects/agl-electric-vehicle-orchestration-trial/
- arena.gov.au/projects/origin-energy-electric-vehicles-smart-charging-trial/
- arena.gov.au/projects/jemena-dynamic-electric-vehicle-charging-trial/
- arena.gov.au/projects/realising-electric-vehicle-to-grid-services/

One of the key open questions is around whether the benefits associated with orchestration in this manner can exceed the costs associated with implementation and operation, by comparison to simpler approaches such as ToU tariffs.

Based on the Origin data, it appears that the vast bulk of the available network benefit in the medium term can be achieved through ToU tariffs, which can be assumed to have zero incremental cost as smart meters become ubiquitous. From the Origin data, the annualised difference between the
'incentive only' approach and the 'incentive + control' approach would be approximately 150kWh per annum per vehicle, shifted out of peak time and into off-peak time.

The annualised incentive paid to the participants in the 'incentive + control' experiment, over and above the 'incentives only' experiment that is closely aligned with a ToU tariff approach, was ~$90. If we assume that the cost of operating an orchestration solution is $100 per annum per charger on top of the $90 per annum additional incentive payment, the value of each kWh shifted away from peak and into off peak would need to be around $1.30 – equivalent to an average price differential of $1300/MWh. This won't stack up commercially in the near term, but if the cost of secure external orchestration falls significantly, or the differential between cost of electricity at peak time and off-peak time rises significantly, or consumers become willing to accept external control with substantially less compensation, it may stack up commercially in future.

Orchestration by way of the Electric Vehicle itself is also possible, and may represent a lower total cost solution, because it removes the need to duplicate a secure communications pathway between the party undertaking the orchestration and the home. It also does not require any specific dedicated electrical equipment in the home.

Against the possibility that orchestration by way of the EVSE may prove to be economically efficient in future, there is merit in considering requirements (either regulatory or subsidy-driven in nature) for all installed EV chargers to have communications capability on board. Assuming the incremental cost per EV charger is minimal, and offset by an appropriate government rebate, this could be taken as a no-regrets measure almost immediately.

If taking this step, direct alignment with international standards and approaches will be crucial. Adopting unique Australian standards of this nature will drive up cost to consumers, reduce competition in the marketplace, and reduce the likelihood that global best practice solutions will be able to be adopted in future. Further, the approach should be nationally consistent in scope, rather than individual state-based jurisdictions setting different requirements around hardware compliance or installation practices.

Close consideration will need to be given to probable consumer response to measures of this nature. If the measure increases the cost or complexity of an EVSE installation, it can be expected that more consumers will opt to use the existing powerpoint on their garage wall instead.

Action required:

Federal government to investigate methods for incentivising and/or requiring EV charging equipment installed in the Australian market to have OCPP 1.6J communications capability (or approved equivalent), over at least one of Ethernet, Cellular modem, or Wifi. This measure is intended to future-proof EV charging equipment installations to support future participation in EV charging orchestration schemes, in the event that EV charging orchestration becomes commercially viable in a manner that requires communications capability in the EV charging equipment.

Home EV charging and the grid: impact to 2030 in Australia

Prepared by
Ross De Rango

August 2022

ELECTRIC
VEHICLE
COUNCIL