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Mr Jonathan Spear
Executive Director and General Counsel
Infrastructure Victoria
Level 16, 530 Collins Street
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Submitted online via: <https://yoursay.infrastructurevictoria.com.au/>

7 March 2018

Dear Mr Spear

AGL Energy (**AGL**) welcomes the opportunity to respond to Infrastructure Victoria's consultation to support its preparation of advice to the Victorian Government on automated and zero emission vehicle infrastructure.

AGL is one of Australia's largest integrated energy companies and the largest ASX-listed owner, operator and developer of renewable generation. AGL is also a significant retailer of energy, providing energy solutions to over 3.5 million customer accounts throughout eastern Australia. In addition, AGL is continually innovating our suite of distributed energy services and solutions for customers of all sizes (residential, business and networks). These 'behind the meter' energy solutions involve new and emerging technologies, including electric vehicles (**EVs**).

We believe that innovative technologies will play a crucial role in improving the efficient use of infrastructure, reducing greenhouse gas emissions, and delivering value for Australian homes and businesses. EVs have the potential to deliver on these objectives based on their use of cost-efficient and clean electricity and will play a pivotal role in Australia's transportation and energy future. Accordingly, AGL wants to improve access to EVs in Australia, by removing the obstacles to ownership and enhancing the ownership experience.

AGL recognises the wide range of societal benefits that vehicle electrification can deliver to Victoria and the broader Australian economy, including the following:

- Increased EVs uptake will stimulate investment in the local economy and provide important opportunities for job creation.
- In the electricity system context, EVs are a flexible resource that have the potential to deliver benefits that will increase with scale.
- A faster shift towards vehicle electrification will increase the benefits from decarbonisation of our electricity system.
- The wider societal benefits resulting from advanced mobility systems will be brought forward through policies that support vehicle electrification.

AGL is invested in the development of the Australian EV market through our Electric Car Plan, which allows customers to charge their electric car, whenever they like and as often as they like for \$1 per day. As part of our Electric Car Plan, we also offset emissions associated with our customers' EVs at home through our



Future Forests Program. AGL is a member of the Electric Vehicle Council, that was launched in May 2017. We have also committed to transitioning 10 per cent of AGL's business vehicle fleet to EVs by mid-2018.

AGL also recognises the important relationship between vehicle electrification, automation and widespread shared mobility. Measures which support these three developments will have a synergistic effect in terms of their anticipated benefits. Indeed, as recent analysis from the Institute for Transportation and Development Policy and UC Davis¹ highlights, coordinated policy action on each of these fronts would ensure the best opportunities to decarbonise energy use, improve road safety and reduce transport costs for households whilst managing the risk of increased transport congestion and urban sprawl. Accordingly, AGL continues to work with the Australian Driverless Vehicle Initiative² and a variety of stakeholders to advance connected electric autonomous vehicle adoption.

As we elaborated in our recent submission to Victorian Parliamentary Inquiry into Electric Vehicles³, AGL considers that public policy settings at both the State and Federal levels can also play a crucial role in accelerating the uptake of EVs in Australia. AGL urges the Victorian Government to consider implementing the following policy measures in particular:

1. A State EV target;
2. A Government fleet EV target;
3. Stamp duty and registration concessions;
4. High Occupancy Vehicle (**HOV**) lane access; and
5. Charging infrastructure planning and support.

We have given careful consideration to Infrastructure Victoria's target outcomes and areas of focus for investigation. In the Attachment to this submission, we elaborate further on the matters of environmental and human health impacts, and energy supply and charging capacity. We consider that charging management and automation will be critical in addressing the risks and realising the benefits of EV uptake. AGL is actively working on business models, products and partnerships to realise these benefits. Planning and support for charging infrastructure will help to ensure an economically efficient approach to EV uptake. Accordingly, we would recommend that the Victorian Government consider designing an EV charging roadmap based on expected uptake scenarios with allocated tasks and responsibilities in partnership with the private sector.

Should you have any questions in relation to this submission, please contact Kristian Handberg, Electric Vehicle Lead, on 0402 955 013, or Kurt Winter, Manager, Policy and Research, on 03 8633 7204.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Stephanie Bashir', written over a light blue horizontal line.

Stephanie Bashir

Senior Director, Public Policy

¹ Institute for Transportation and Development Policy and UC Davis Sustainable Transportation Energy Pathways of the Institute of Transportation Studies, (2017) *Three Revolutions in Urban Transportation*. Available at <https://www.itdp.org/publication/3rs-in-urban-transport/>.

² Australian Driverless Vehicle Initiative, *About the Australian Driverless Vehicle Initiative*, Available at <http://advi.org.au/australia/>.

³ See AGL, Submission to the Victorian Parliamentary Inquiry into Electric Vehicles (11 December 2017), Available at <http://aglblog.com.au/2017/12/submission-to-the-victorian-parliamentary-inquiry-into-electric-vehicles-2017/>.



ATTACHMENT

Environmental and human health impacts

The widespread uptake of electric vehicles, when coupled with the decarbonisation of the electricity grid, presents a substantial opportunity to deliver emissions reductions consistent with Australia’s long-term commitments under the Paris Agreement. The increased uptake of electric vehicles also has the potential to contribute towards improved air quality, delivering significant health benefits to communities, particularly in metropolitan areas of Victoria. These benefits stem from the fact that electric vehicles emit zero tailpipe emissions.

Whilst Australia has a range of current climate policies in place which address the electricity sector, there is currently a complete absence of policy to address emissions from the transport sector, underlining the urgent need for policy reform.

We refer Infrastructure Victoria to ClimateWorks Australia’s 2016 report, *The path forward for electric vehicles in Australia*,⁴ of which AGL was a project partner (**Path Forward Report**). As the Path Forward Report underscores, whilst the transport sector is one of the fastest growing sources of emissions in Australia, it also represents the most financially attractive emissions reduction opportunity across the Australian economy. A breakdown of sectoral emissions are set out in Table 1 below.

Table 1. National Greenhouse Gas Inventory, ‘unadjusted’ emissions by sector, year to Dec 2016, sectoral change since 1990⁵

Sector	Emissions (Mt)	% of Australian total	% change since 1990
Electricity	191.5	35.6%	48.4%
Non-electricity stationary energy	92.5	17.2%	44.0%
Transport	95.4	17.7%	55.4%
Fugitive emissions	44.1	8.2%	19.8%
Industrial processes	32.8	6.1%	27.0%
Agriculture	70.0	13.0%	-12.5%
Waste	11.4	2.1%	-42.0%

⁴ ClimateWorks, ‘The path forward for electric vehicles in Australia’ (April 2016), Available at https://climateworksaustralia.org/sites/default/files/documents/publications/the_path_forward_for_electric_vehicles_in_australia_-_submission_to_the_federal_government_vehicle_emissions_discussion_paper_1.pdf

⁵ Australian Government Department of Environment and Energy, *Quarterly Update of Australia’s National Greenhouse Gas Inventory: December 2016*, May 2017.



In AGL's view, all sectors of the Australian economy have an important role to play in meeting Australia's emission reduction targets and its long-term commitments under the Paris Agreement.

AGL accepts the Intergovernmental Panel on Climate Change (**IPCC**) conclusion that the risks associated with climate change are reduced substantially if warming is limited to less than 2 degrees Celsius above pre-industrial levels. Achieving this outcome would require complete decarbonisation of the world economy by 2100 and emission reductions of up to 70 percent by 2050.

As our Greenhouse Gas Policy⁶ elaborates, it is important that governments set both binding and aspirational medium and long-term emission reduction targets. AGL supports the use of both regulatory and market-based policy mechanisms to deliver the required emission reductions. Importantly, a range of policies are likely to be needed.

AGL believes that the costs of decarbonisation should be shared equitably across the Australian economy. Indeed, any failure to address emissions from the transport sector will increase the burden for other sectors, including the energy sector which has already committed to a significant transition program.

The research undertaken by the Victorian Government for its Electric Vehicle Trial in 2012 remains illustrative of the interrelationship between EV energy economy and electricity grid emissions. We refer Infrastructure Victoria to the report, *Victorian Electric Vehicle Trial: Environmental Impacts of Electric Vehicles in Victoria (EV Trial Report)*. Key findings in the EV Trial Report included that:

- the impacts from vehicle operation far outweigh those from vehicle production. That is true even where modelling allows for an EV battery replacement over the vehicle life. Vehicle disposal impacts, including those of the EV battery, were found to be negligible due to the expected high rate of material recycling;
- the dominant influence of vehicle operation during the EV lifecycle highlights the importance of the way in which electricity is made, how efficient energy conversion is, and the way a vehicle is used; and
- the source of the electricity used to power electric vehicles is a key issue in Victoria. Although the breakeven point in terms of carbon emissions from vehicle operation is some years away for vehicles operating on Victoria's current electricity grid, an electric vehicle operating on renewable energy may provide a net benefit in terms of lifecycle carbon emissions within three years of operation.

Figure 1 of the EV Trial Report (below) depicts the interrelationship between EV energy economy and electricity grid emissions intensity, which in combination determine the vehicle's full fuel cycle greenhouse gas emissions. Using the first-generation Nissan LEAF as a case study, the EV Trial Report modelled how the vehicle's full fuel cycle emissions (horizontal dashed line) trend away from high emissions (signified by the blue shaded area) towards low emissions (signified by the green shaded area) as the grid decarbonises.

⁶ See AGL, Greenhouse Gas Policy, Available at http://agl2016.sustainability-report.com.au/files/agl_greenhouse_gas_policy.pdf.

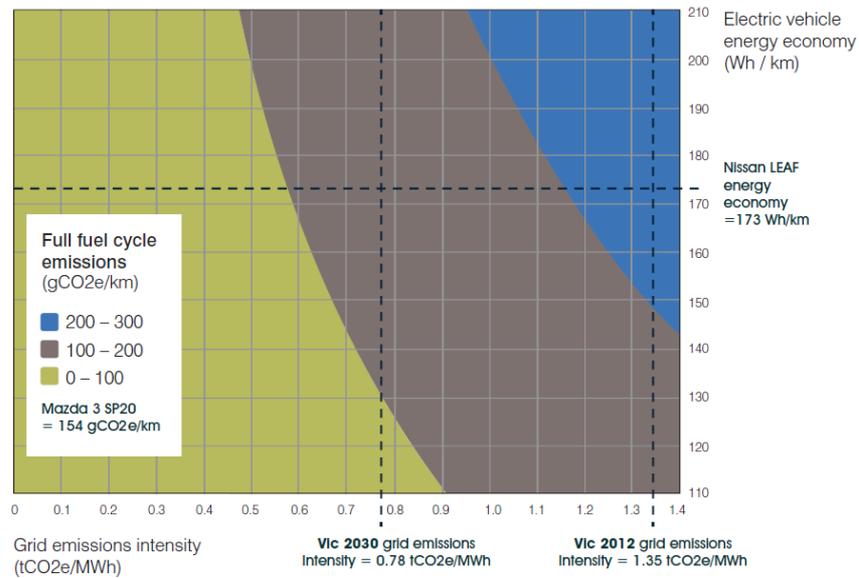


Figure 1. Chart depicting the interrelationship between EV energy economy and electricity grid emissions intensity

Figure 2 of the EV Trial Report (below) depicts the cumulative greenhouse gas emissions calculated over an average vehicle lifetime for an Internal Combustion Engine Vehicle (**ICEV**) and a comparable EV operating on both the Victorian electricity grid mix and renewable energy. The step change in both EV calculations reflects impacts arising from a single battery replacement forecast, however more recent data suggests this may not be required. We also consider that grid emissions impacts will decrease over time, meaning that a vehicle purchased later than 2012 will have lower overall emissions.

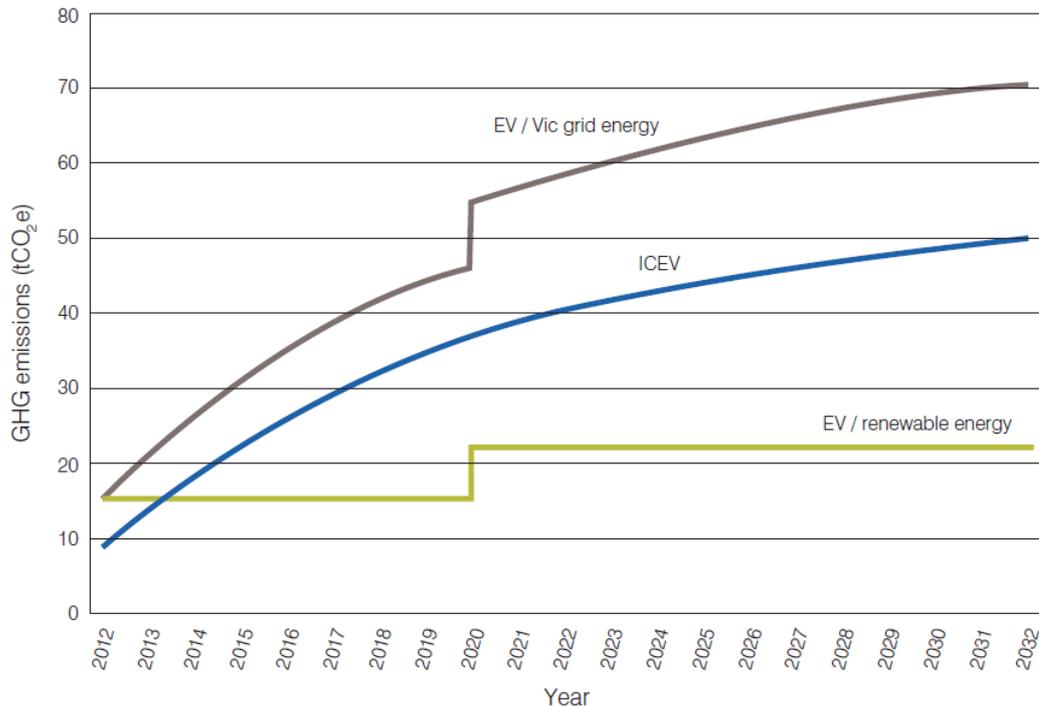


Figure 2. Cumulative GhG emissions calculated over an average vehicle lifetime for an ICEV and a comparable EV operating on both the Victorian electricity grid mix and renewable energy

AGL is acutely aware of the potential for electricity generation to facilitate emissions reductions in the transportation sector, through electrification powered by renewable energy as is illustrated by these figures.

AGL is committed to playing a leading role in developing a pathway to a modern, decarbonised generation sector. As our Greenhouse Gas Policy elaborates, we have made a strong commitment to a range of measures that will drive the decarbonisation of the energy sector, including the closure of all of our existing coal-fired power stations by 2050 and continued investment in new renewable and near-zero emissions technologies. A clear example of the impact of this strategy and as a result of the policy is to place clear time limits on the operation of our fossil fuel plants, providing certainty to communities and the market as to our decarbonisation pathway. Our NSW Generation Plan is a recent example of our continued leadership in driving Australia's clean energy future.⁷

We developed our Electric Car Plan with a strategic focus on its environmental impacts, as the energy grid transitions towards full decarbonisation. AGL's Electric Car Plan for EV charging at home is 100 per cent carbon offset through our Future Forest Program, effectively delivering zero emission charging to our EV customers. Our Future Forests Program enables customers to offset the carbon emissions associated with their electricity usage through Australian forestry carbon credits certified against the Gold Standard. This program is underpinned by robust accounting to ensure its integrity. Whilst retailers currently offer a number of alternative carbon offset programs, in our view, the Gold Standard provides the most robust certification

⁷ See further, AGL NSW Generation Plan, Available at <https://www.agl.com.au/-/media/AGL/About-AGL/Documents/Media-Center/ASX-and-Media-Releases/2017/171209NSWGenerationPlanDecember2017.pdf?la=en&hash=529E1A89370A33DA8F378D761CEE1D919C9C91D>.



standard globally, ensuring that energy efficiency and renewable energy projects actually reduce carbon dioxide emissions, and provide benefits to the local population.

AGL is also committed to ensuring robust product stewardship and recycling of batteries, as their use becomes more widespread in both the electricity and transport sectors. In particular, AGL is a member of the Australian Battery Recycling Initiative (**ABRI**), a not-for-profit association established in 2008 to promote responsible environmental management of batteries at end of life. AGL has been working closely with ABRI and other stakeholders to develop robust product stewardship and recycling processes and standards for the Australian market.

Energy supply and charging capacity

AGL appreciates that the transition towards automated and zero emission technology vehicles will have substantial implications for Victoria's electricity grid with flow-on effects for infrastructure. In particular, we consider that the transition will require careful consideration of charging management and system optimisation in order to address the risks and realise the full benefits of EV uptake.

Charging management

We refer Infrastructure Victoria to the Commonwealth Scientific and Industrial Research Organisation's 2012 report, *Spatial Modelling of Electric Vehicle Charging Demand and Impacts on Peak Household Electrical Load in Victoria, Australia (CSIRO Report)*.⁸ The CSIRO Report modelled nine scenarios utilising a novel composite methodology for obtaining special and temporal projections of the charging demand for plug-in EVs and the potential impacts on peak household electricity load.

The CSIRO Report found that:

- the peak daily EV charging load under a demand charging scenario is 0.66kW per EV (average value), peaking at around 7pm in the evening.
- Under an offpeak charging scenario, the expected peak charging demand is higher due to the decreased diversity in the charging behaviour and is projected to be 0.93kW per EV peaking around 2am.
- Under the off-peak+Vehicle to House (V2H) scenario the diversity is further reduced, and the peak load is projected to be 1.50kW peaking around 4am, however this is balanced by the potential for peak shaving of up to 0.4kW during the evening.

⁸ See Paevere, P., Higgins, A., Ren, Z., Grozev, G., Horn, M., McNamara, C., Khoo, Y-B., and Elgindy, T. (2012), *Spatial Modelling of Electric Vehicle Charging Demand and Impacts on Peak Household Electrical Load in Victoria, Australia*. Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Figure 11 of the CSIRO Report (replicated below) illustrates the way in which these different scenarios could operate in Victoria, including the off-peak+V2H scenario:

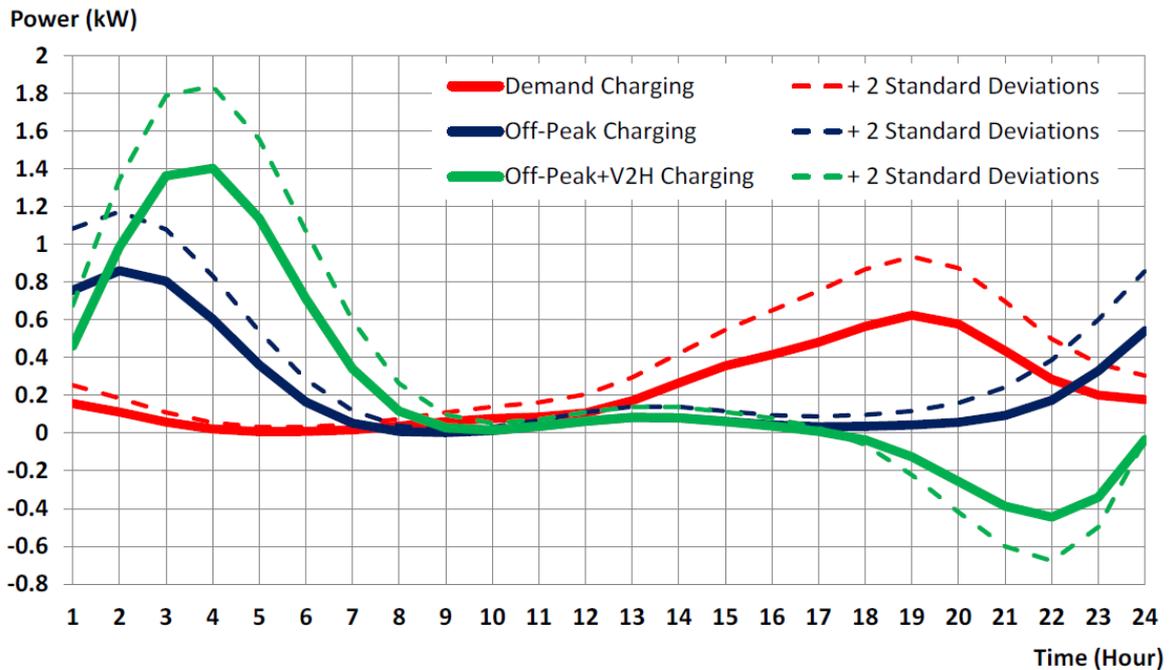


Figure 11. Projected daily charging load profiles per Vehicle in Victoria (Source: CSIRO (2017))

*Note profiles are averaged across all regions in Victoria for all days of the year

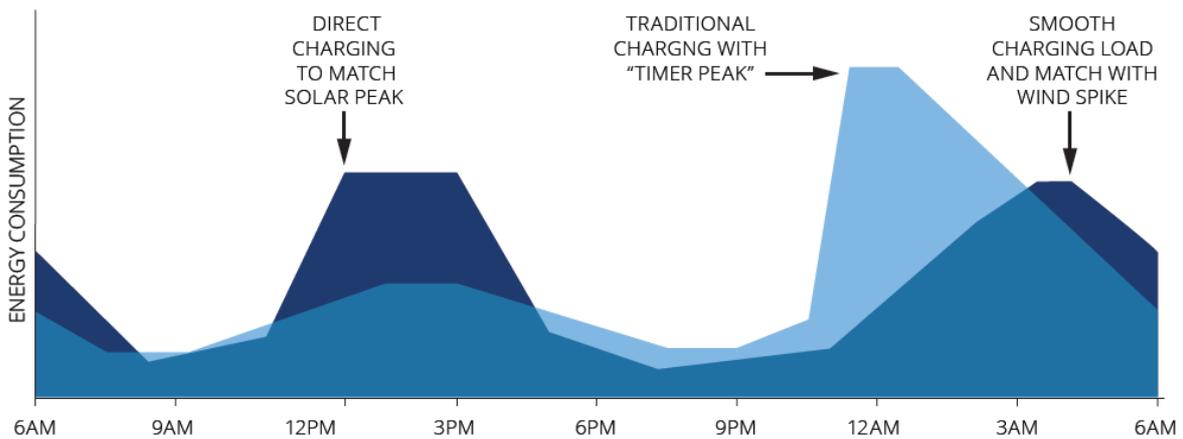
Much like electricity, demand in the transport system is likely to remain peaky due to the way in which demand reflects human activity, especially work and sleep patterns. Nevertheless, AGL considers that with managed charging, the increased penetration of EVs could play an important role in improving the reliability of the grid. We refer Infrastructure Victoria to Smart Electric Power Alliance’s 2017 report, *Utilities and Vehicles: The Case for Managed Charging (SEPA Report)*⁹. As the SEPA Report highlights, managed charging could deliver a range of benefits, including:

- Improving grid economics by achieving higher utilization rates, and therefore capacity factor, of generation assets;
- Reducing emissions by aligning charging with surplus renewable generation;
- Reducing grid stress and maintain grid stability by minimizing charging ramp rates and reducing the strain on distribution transformers; and
- Reducing the need for new peak generation and distribution capacity resulting from EVs charging during peak hours.

⁹ Erika Myers, (2017) *Utilities and Vehicles: The Case for Managed Charging*. Smart Electric Power Alliance.

As the following chart from the SEPA Report illustrates, through managed charging, EVs could be used to support the grid during the middle of the day, taking full advantage of any excess in solar generation, and at night so as to draw upon increased wind generation at that time:

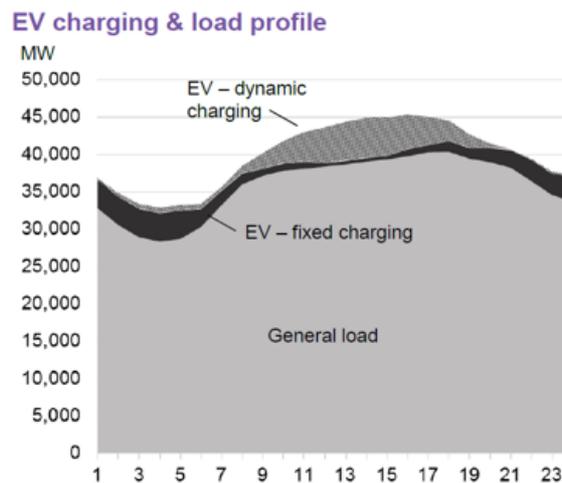
FIGURE 2: OPPORTUNITIES FOR EV MANAGED CHARGING TO MEET GRID NEEDS (ILLUSTRATIVE)



Source: BMW of North America (2016) with edits by Smart Electric Power Alliance (2017)

Note: The light blue area illustrates the impacts of a hypothetical time of use residential charging rate with the lowest rate period beginning at 11 pm. The dark blue area shows how managed charging could distribute charging loads with peaks in renewable energy generation.

Bloomberg New Energy Finance similarly projects that dynamic EV charging would enable a rich source of demand side flexibility, as is illustrated in the following chart:

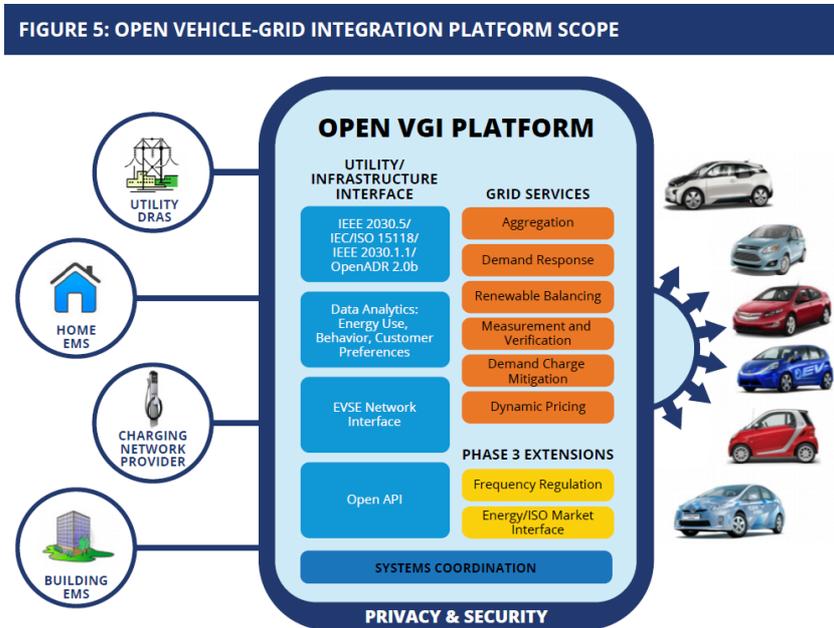


Source: Bloomberg New Energy Finance, New Energy Outlook (2017)

AGL will be trialling remote EV management during peak events for a number of AGL EVs in New South Wales (**NSW**) through our Managed for You program.¹⁰ Our Managed for You program is part of a nationwide initiative administered by the Australian Renewable Energy Agency (**ARENA**) and the Australian Energy Market Operator (**AEMO**) to deliver a three-year demand response pilot project. The NSW Government has provided additional funding to the initiative for projects that are based in NSW, such as AGL’s EV trial. Demand response contributes to the stability for the electricity system by reducing discretionary energy use at times when demand spikes, such as during summer heatwaves. AGL anticipates further opportunities to develop demand response in the Victorian context, including through projects that test EV charging management.

Automation and system-wide optimisation

AGL also considers that automation and the ability to integrate of EVs into the grid will enable further opportunities for system-wide optimisation. This could be enabled through technology platforms that enable EVs and EV supply equipment to connect to various nodes allowing energy service providers to proactively manage charging activity to assist with a variety of grid services. An example of this is the Electric Power Institute’s (**EPRI**) Open Vehicle-Grid Integration Platform (**OVGIP**) which aims to allow equipment manufacturers to use existing on-vehicle communication technologies and energy service providers’ standard interface protocols. The figure below illustrates the range of grid services that could be enabled through software that provides for system optimisation:



Source: Electric Power Research Institute (2016)

¹⁰ See further AGL’s Managed for You program at <https://aglsolar.com.au/managedforyou/>. For further information about the national initiative see Dan Silkstone, ‘Keeping the lights on in NSW, one smart meter at a time’ (16 October 2017), Available at <https://arena.gov.au/blog/demand-response-agl/>.



AGL envisages particular opportunities for system-wide optimisation in the context of public transport fleets. In our view, the economic profile of EVs in public transport fleets continues to improve and will be optimised when deployed at network scale based on the ‘opportunity charging’ model. In early 2017, AGL’s Electric Vehicle Lead supervised a Master of Energy Systems student project which compared electric and diesel buses in the Australian context. The findings of that study revealed that the extra cost of an electric bus would be paid back within 3 years (based on current price points and forecasts). Moreover, as battery prices continue to fall, the electric bus advantage will continue to grow.

Further analysis and consultation with tech vendors and bus operators suggests that the electric bus advantage will be greatest when deployed at the network scale based on the “opportunity charging” model. Opportunity charging nominally uses battery-buffered high-powered fast-charging stations to regularly charge the vehicles along their service route during passenger on/off-boarding. The advantages of the opportunity charging model include that it:

- allows downsizing of the bus batteries and conservation of the bus payload for passengers;
- enables more efficient asset utilisation by avoiding over-capitalizing on the bus battery, shifting investment to better utilized charging infrastructure; and
- provides a distributed network of batteries that could potentially be used to support the grid.

Indeed, the uptake of EVs in public transport fleets would provide benefits not only to the transport sector but also to the electricity sector as transport system asset owners are empowered to participate in the electricity distribution market.

The electricity grid is undergoing a rapid transformation, driven in part by customers’ increasing desire to exert more control over their energy supply arrangements. Smart appliances, smart inverters and intelligent control systems are also entering the market. In combination with solar PV and battery systems, these technologies enable the creation of small-scale electricity ecosystems ‘behind-the-meter’ - that is, on the customer side of the meter, with a single connection to the grid. These systems and their interaction with the electricity distribution network can be closely monitored and intelligently controlled. They can be dispatched individually or as a fleet to respond to changing network conditions or conditions in the wholesale market.

Opportunities for Government

AGL considers that the Victorian Government could play an integral role in addressing charging options outside of the home through the planning and deployment of charging infrastructure. We note that the Federal Chamber of Automotive Industries has recently clarified the choice of EV plug standards and committed to harmonised EV charging standards.¹¹ Moreover, the anticipated introduction of longer-range EVs over the next 18 months makes planning and deployment a timely focus for the Victorian Government.

Concerted State policy on EV infrastructure planning and deployment would greatly assist in addressing (perceived) EV range limitations and extended zero emissions vehicle operation. Although Victoria has the highest number of charging stations in Australia, we note that these stations are currently concentrated in metropolitan areas. We consider that there is scope for the Victorian Government to develop more robust planning frameworks than extend EV range across the entire State. We note with interest initiatives such as

¹¹ See Federal Chamber of Automotive Industries, ‘FCAI Technical Statement on EV Charging Standards for Public Recharging Infrastructure’ (18 September 2017), Available at <https://www.fcai.com.au/news/publication/index/year/all/month/all/publication/99>



the Queensland Government's work with Energy Queensland to roll out a network of fast chargers that will allow EVs to travel 1800 km between Cairns and the Gold Coast.¹²

AGL recognises that at the early stages of the EV market in Australia, fast charging infrastructure is likely to present a challenging business model for private sector investment. This is because fast charging infrastructure addresses only an occasional need for EV owners, without necessarily capturing the indirect value of EV charging services. Accordingly, we would urge the Infrastructure Victoria to consider way in which to facilitate private sector infrastructure investment.

We refer Infrastructure Victoria to the Centre for Climate and Energy Solutions' 2015 report, *Business Models for Financially Sustainable EV Charging Networks (C2ES Report)*.¹³ The Washington State Legislature's Joint Transportation Committee commissioned the C2ES Report in 2014 to develop new business models that would foster private sector commercialisation of publicly available EV charging services and expand the role of private sector investment in EV charging throughout Washington State. As the final report concluded, charging station business models that rely solely on direct revenue from EV charging services are not currently financially feasible. The C2ES Report presents a range of potential business models that could be applied to improve the financial performance of charging stations projects. Given that these findings were focused on Washington State, we consider that further analysis would assist in understanding how private sector investment could be best facilitated in the Victorian context.

Planning and support for charging infrastructure will help to ensure an economically efficient approach to EV uptake. We refer Infrastructure Victoria to AECOM's 2011 report, *Forecast Uptake and Economic Evaluation of Electric Vehicles in Victoria (AECOM Report)*, that was commissioned by the Victorian Government Department of Transport. The AECOM Report forecast that EVs are likely to reach cost parity with ICEVs in 2025. Accordingly, the economic benefit to Victoria would be maximised through an approach that encourages rapid adoption of EVs by that time. EV adoption still relies upon the provision of charging infrastructure. Infrastructure planning and support should begin now, in recognition of the lead time for deployment and the approaching EV cost parity.

Having regard to the matters discussed above, we would recommend that the Victorian Government consider designing an EV charging roadmap based on expected uptake scenarios with allocated tasks and responsibilities in partnership with the private sector.

¹² See Queensland Government, 'Queensland Electric Super Highway', Available at <https://www.qld.gov.au/transport/projects/electricvehicles/super-highway>

¹³ Climate and Energy Solutions, *Business Models for Financially Sustainable EV Charging Networks (2015)*, Available at <https://www.c2es.org/site/assets/uploads/2015/03/business-models-ev-charging-infrastructure-03-15.pdf>.