An Online Tool for Future E-Mobility Scenarios and Their Potential Impact on Future NEM Demand

Nargess Nourbakhsh[1,2], Anna Bruce[1,2], Dylan McConnell[1,2] and Iain Macgill[1,2]

[1] School of PV and Renewable Energy Engineering, University of New South Wales, Sydney, Australia
[2] Collaboration on Energy and Environmental Markets, University of New South Wales, Sydney, Australia
n.nourbakhsh@unsw.edu.au

Increasing uptake of DER implies a stronger role for energy users in the sector and increasing interest and engagement. However, to participate effectively in relevant public debates and decision-making processes, customers and those who advocate for them need to be better informed i.e., have access to clearer, engaging, trustworthy and relevant information. The Energy Trends Visualisation (ETV) project, funded by the Race for 2030 CRC, is trialling online and interactive tools to help energy stakeholders better understand the challenges and opportunities presented by the energy transition by making key trends visible.

Within the ETV project, UNSW has developed an online, interactive tool for exploring future e-mobility scenarios and their potential impact on future NEM demand. The tool presents the data traces developed by Katelyn Purnell in her PhD project [1]. Visualising EV charging behaviour under different tariff and infrastructure scenarios can improve understanding of the implications of these policy and investment choices and support engagement from a wide range of stakeholders in relevant decision-making processes. The tool is currently at the pilot phase. It will be pitched at energy stakeholders including customer advocates and highly-engaged customers (e.g., medium-large businesses with high energy costs).

The e-mobility tool has been developed in Python and consists of two visualisation sections. The first part visualises the Demand Forecast and the Impact of EV Charge Profiles on it. The second part displays the EV traces for a typical year.

Data Sources and Preparation

This tool uses a dataset of yearly EV traces developed by Katelyn Purnell in her PhD project [1]. It contains yearly EV traces for passenger vehicles (cars and motorcycles), commercial vehicles (a blended trace containing light commercial vehicles), bicycles, taxis/on-demand ride share vehicles, municipal buses, municipal ferries, and articulated trucks. Details of calculating the EV traces can be found in [1]. The demand data was obtained from the 2022 ISP [2], specifically, the POE10 traces used in the Step Change scenario. The demand dataset included half-hourly data points, and the EV traces were hourly data points. For this tool, we interpolated the EV traces data to become half-hourly.

To implement the percentage bars to be state-based factors, we have used the national vehicle numbers from Australian Bureau of Statistics [3, 4], Transport for NSW [5], and [1], and pro-rated them by each state's population from [3]. No exact data was found for taxis and ferries; the national number of taxies was estimated based on the number of taxis in New York City [1] and population of New York City and Australia, and the number of ferries was estimated based on the number of buses [4] and average daily trips for buses and ferries [5].

Demand Forecast and the Impact of EV Charge Profiles

This part of the tool demonstrates the NEM demand between 2023 and 2051 for various regions of Australia (Figure 1), and, to the extent possible with currently available data, the impact of charging profiles on demand (Figure 2). Four charging regimes are presented in this tool: End of Service, During Service, Sunshine, and Non-peak.

The user can select the region, time span, charging regime, and the percentage of each vehicle type being electrified. Changing the region would load the demand and the number of vehicles for that region. Selected percentage of each vehicle type would be multiplied by the total number of that vehicle type in the selected region and display the result on the right-hand side of the percentage bar. Using the calculated

number of EVs and the typical EV traces for the selected charging regime the tool calculated the demand increase factor and the EV impacted demand is displayed on the graph (Figure 2). It is possible to download any of the plots as an image file.

Figure 1. Original demand for the selected region and time span (EV Impact is turned off on the graph)

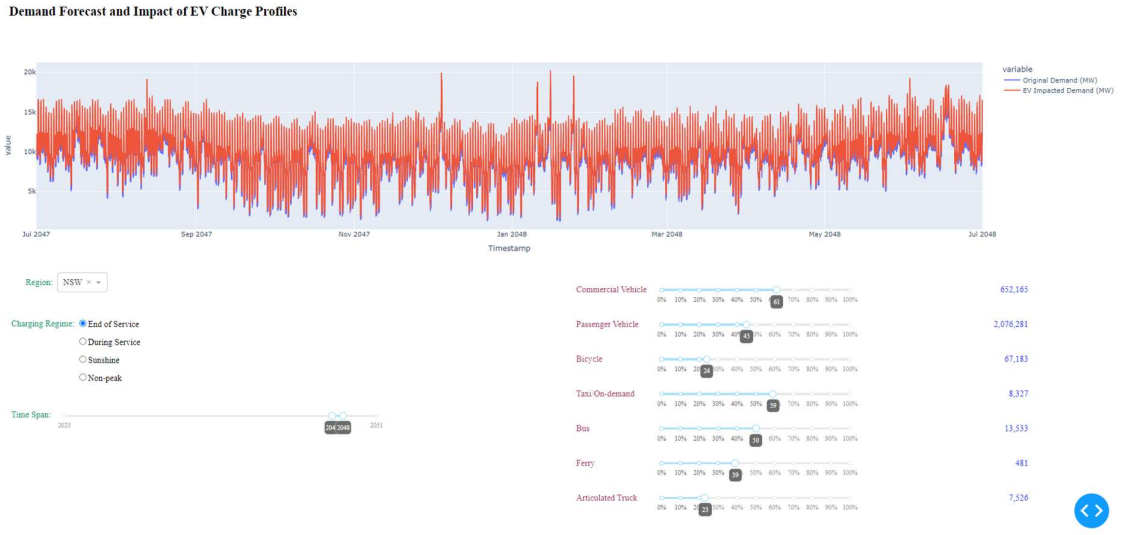

Figure 2. Original and EV-impacted demand

It is also possible to zoom in on the graph to look at the data in narrower time spans, zoom back out on the graph or change the start year and/or end year on the time range slider to observe the data on a different period. At any zoom level, hovering over a data point shows the original or EV-impacted demand at that specific timestamp (Figures 3). We will present the tool and some examples of the effect of changing the region, charging regime, time span, and vehicle electrification percentages on the demand.

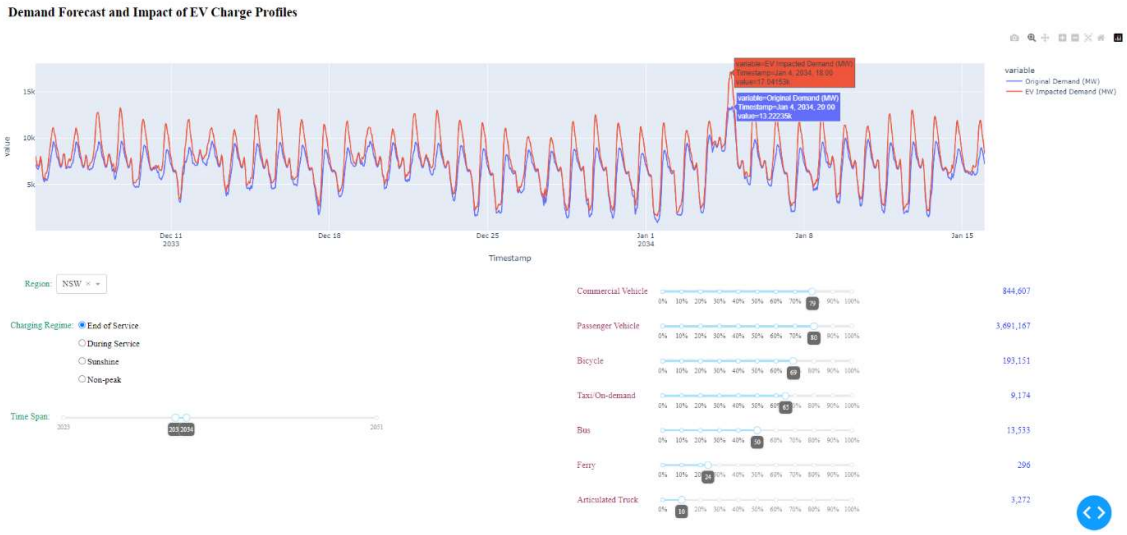

Figure 3. A closer look at the data (6 weeks), original and the EV impacted demand on a specific timestamp

EV Traces for a Typical Year

The second section of the tool visualises the EV traces for a typical year. Details of calculating the EV traces can be found in [1].

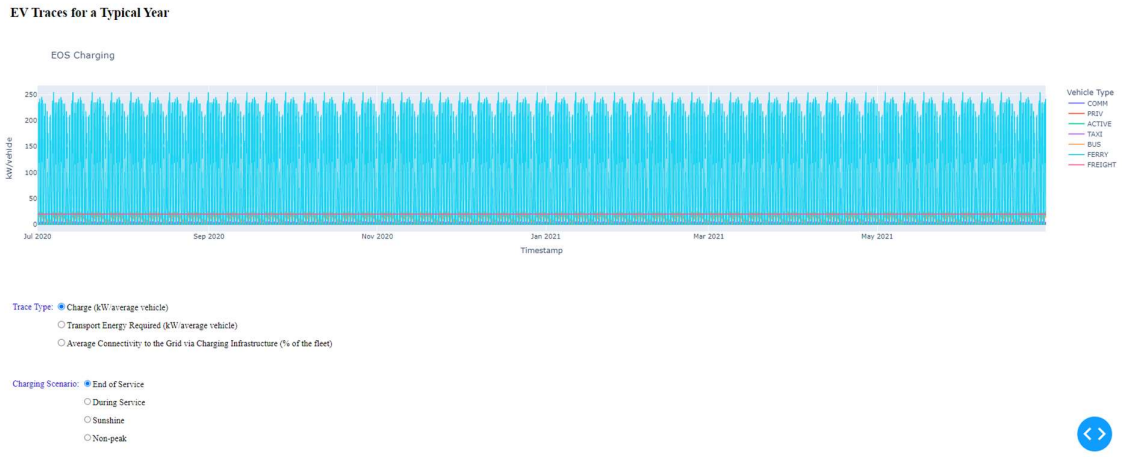

Figure 4. EV Traces for a Typical Year, Charge Traces, End of Service Charging

There are three possible trace types: charge, transport energy required, or average connectivity to the grid via charging infrastructure. Like the first section, the charging scenarios include: End of Service, During Service, Sunshine, and Non-peak. Selecting any trace type or charging scenario results in displaying the relevant data on the graph and updates the unit and title accordingly. It is also possible to zoom in to observe the data in a narrower time span, turn off one or some of the vehicle types from the graph, or look at the exact values by hovering over any of the traces. We plan to present combinations of traces and charging scenarios in the session.

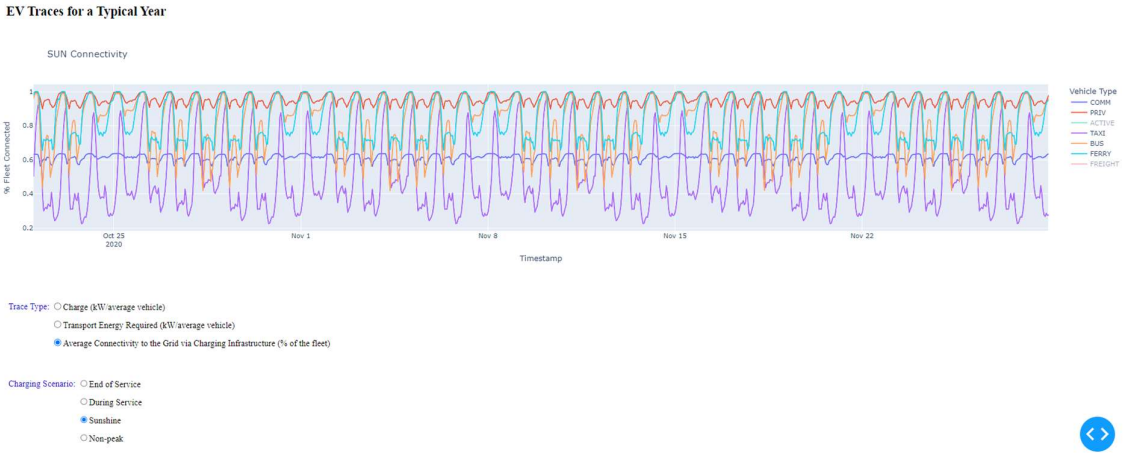

Figure 5. EV Traces: 22 Oct to 29 Nov, Average Connectivity to the Grid via Charging Infrastructure, Sunshine Charging

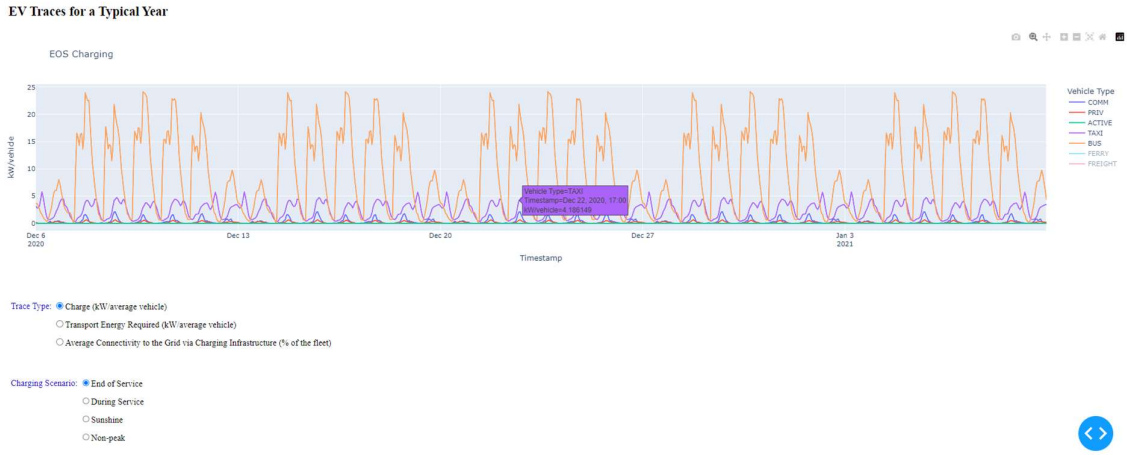

Figure 6. EV traces: 6 Dec to 10 Jan, EOS charging, the Charge value for Taxis on 22 December at 17:00

Conclusion and Future Work

This work presents a trial version of an online, interactive tool that visualises the EV traces, future NEM demand and the potential impact of EVs on demand. We will monitor how these visualisations get picked up and used by stakeholders including consumer representatives and media. We invite feedback from interested stakeholders and based on this feedback, we may make improvements to usability of the tool, and add functionality such as solar and wind traces and the ability to compare them against the demand traces both with and without the impact of EVs.

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References

[1] Purnell, K., Bruce, A.G., MacGill, I., 2022, 'Impacts of electrifying public transit on the electricity grid, from regional to state level analysis', *Applied Energy*, 307, https://doi.org/10.1016/j.apenergy.2021.118272.

[2] Australian Energy Market Operator, 2022, '2022 Integrated System Plan (ISP)', https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp.

[3] Australian Bureau of Statistics, 2023, 'National, State and Territory Population March 2023', https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/mar-2023#states-and-territories.

[4] Australian Bureau of Statistics, 2020, 'Survey of Motor Vehicle Use, Australia, 12 Months Ended 30 June 2020', https://www.abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/latest-release.

[5] Transport NSW, 2023, 'Public Transport Trips - All Modes', https://www.transport.nsw.gov.au/data-and-research/data-and-insights/public-transport-trips-all-modes.