QUICK INSIGHTS BRIEF

The Value of Grid Capacity Maps

WHY IS THIS NEEDED?

The development of EPRI's eRoadMAP[1], which provides U.S.-wide yearly EV demand projections to 2030 and beyond, has further highlighted the scale and pace at which EV charging load is likely to materialize on the U.S. electric grid. In certain areas, the projections indicate that medium- and heavy-duty vehicles are likely to make up a significant proportion of the overall future EV energy needs in comparison to light duty vehicles. While fleets can pose certain challenges from a grid connection perspective, owing to their large size and often rapid interconnection timeframes, many fleet developers have a degree of flexibility in both where they connect, as well as the scale of the demand needs over time (i.e., staggering the electrification of a fleet). The capacity of the distribution grid to accommodate these loads is dependent on a number of complex factors including grid characteristics such as existing load, grid topology, and voltage level, as well as the characteristics of the connecting load such as location and size.[2]

Consequently, the available capacity varies significantly by location, both between utilities and within a utility across their substations and feeders. In most areas, fleet developers, and in some cases even groups outside of planners within a utility, do not have any visibility of available capacity at a local level, and, therefore, do not have awareness of locations that may be better suited to support their needs. This can lead to inefficiencies, with both fleet owners and utility companies spending unnecessary time developing and processing interconnection requests for sites that are ultimately not viable. Greater visibility to grid capacity, both internally at the utility and externally for customers, has the potential to benefit both parties by shifting the focus towards areas that have better potential to support loads, expediting the overall interconnection process. It also fosters greater engagement between the utility and their customers and can provide utilities with a better understanding of fleet electrification plans. This in turn provides justification for the need for proactive investment which can expedite the timelines for getting fleets connected to the grid.

"Increased transparency enables Amazon and others in the industry to assess where power is readily available in order to bring more electric vehicles to the road quickly. Publication of the capacity maps from more utilities and participation from more fleets across the country will advance our collective electrification efforts."

- Chris Atkins, Amazon

1 eRoadMAP is an interactive energy map, created as part of EPRI's ongoing EVs2Scale 2030 initiative, that presents the approximate amount of energy needed at a local level to electrify transportation over time for light-, medium- and heavy-duty electric vehicles. https://eroadmap.epri.com/.

2 *EVs2Scale2030™ Grid Primer: An Initial Look at the Impacts of Electric Vehicle Deployment on the Nation's Grid*. EPRI, Palo Alto, CA. 3002028010.

WHAT ARE THE POTENTIAL SOLUTIONS?

There are a number of jurisdictions where efforts to provide greater visibility to customers on grid capabilities are already underway. Certain U.S. states such as California, New York, and Nevada, among others, have mandated the publication of hosting capacity maps, while other U.S. utilities have made the business decision to do so without state mandates.[3]

In Europe, similar efforts have been undertaken by utilities in the UK, Norway, and Portugal, as well as a number of other countries.[4] In addition, there have been a number of recent efforts in the regulatory space to develop frameworks and roadmaps to facilitate, standardize, and provide guidance on future grid data sharing.[5,6]

As part of the EVs2Scale initiative and the eRoadMAP effort, EPRI is currently working to develop a U.S.-wide map that can be used by fleet developers to identify areas that potentially have capacity to support their needs in the near-term. The hosting capacity maps that are already being published by certain utilities will provide the critical starting point for this effort and elements of these maps have started to be integrated into the latest version of eRoadMAP[7]. There are, however, variations between individual utilities in what is included in these maps, in particular:

- The application (i.e., hosting capacity for load or generation)
- The level of granularity (i.e., capacity at substation/feeder/line level)
- The measure of available capacity (i.e., specific MW value, MW ranges, yes/no indicator)
- Access to the underlying data (i.e., API, downloadable file, no download)

As such, representing the data in a consistent way across all utilities can be challenging. Furthermore, the utilities that are already publishing hosting capacity maps only represent a small portion of the U.S. as a whole, therefore, additional utility input is needed to provide a holistic view.

"Even before customers determine the location of a future development, the maps and data on our Distribution Resource Plan External Portal might guide their decision.

If a development location has been selected, they can determine early on in their planning process the state of power capacity for their development. If capacity is not sufficient, they can partner with SCE long before the business needs to be online.

This can eliminate or significantly reduce delays for service access, which could impact a customer's bottom line."

- Southern California Edison

WHAT ARE THE OPPORTUNITIES?

One of the key challenges of this eRoadMAP capacity-side effort is bridging the gap between utilities that already publish detailed hosting capacity maps, and utilities that do not currently share this information, and may not have the resources available to undertake detailed hosting capacity studies on a regular basis, which can be a significant effort. To ensure the level of data captured is of value to developers, EPRI is currently undertaking a capacity mapping effort that assembles all existing hosting capacity maps, but also aims to capture the available substation capacity for utilities that do not currently publish maps. The substation capacity

3 *U.S. Atlas of Electric Distribution System Hosting Capacity Maps, U.S. Department of Energy*, January 2024. https://www.energy.gov/eere/us-atlas-electric-distribution-system-hosting-capacity-maps

4 *Power System of the Future: Keys to Delivering Capacity on the Distribution Grid*, Eurelectric, September 2023. https://www.eurelectric.org/media/6622/report-block-1_part-1-grid-capacity_final-draft_3082023.pdf

5 *NARUC Grid Data Sharing Framework*, NARUC, November 2023. https://www.naruc.org/core-sectors/energy-resources-and-the-environment/electric-vehicles/grid-data-sharing/

6 *A Roadmap to an Energy Data Sharing Infrastructure by 2028*, Ofgem, October 2023. https://www.ofgem.gov.uk/sites/default/files/2023-10/FSNR%20workstream%205%20consultant%20recommendations.pdf

7 *EPRI Updates Interactive EV Planning Tool to Identify Grid Capacity Availability*, EPRI, Palo Alto, CA., June 2024. https://www.epri.com/about/media-resources/press-release/aXVrpVo2NSzkyIEZOk6DGrkMSBwmsRQc

approach does not necessitate a detailed study and represents data that should be readily accessible for most utilities. The goal is for utilities to be able to share this data in a streamlined format, and update the data as frequently as is feasible for them. The data would then be added and/or updated on the nationwide map which would provide directional guidance to fleet operators and charging developers regarding where there is potential grid capacity to support electrification needs without necessitating infrastructure upgrades.

Figure 1 shows a mock-up of how this substation data could be visualized using a synthetic data source. In the graphic on the left, each dot represents a distribution substation, the color of the dot represents the available capacity of that substation. Each substation has an associated radius depending on its voltage level that represents the "reach" of that substation's capacity. The resulting heatmap represents the density of substations weighted by the available capacity of each substation in that area. Darker blue areas represent areas with a higher number of substations with higher available capacity, yellow areas represent fewer substations with lower available capacity. A hexagon (hex) version of the heatmap can also be created, as shown in the figure on the right. The hex map representation facilitates the sharing of capacity information in a way that provides directional guidance to developers while being mindful of security concerns associated with sharing asset-specific information. The maps can also provide significant value internally at utilities to inform groups that may not currently have visibility to or understanding of this kind of information, in particular customer facing groups, for the purposes of developing effective customer programs and business development strategies. EPRI is currently consulting with members of the EVs2Scale project to refine the approach further and capture their input and feedback.

"Con Edison is thinking more boldly about ways to accelerate the adoption of electric vehicles in our service territory, while simultaneously strengthening the sustainability of our energy grid to prepare for the increase in demand. We are proud to participate in the expansion of EPRI's eRoadMAP™, which will help our customers identify available grid capacity that can accommodate new charging sites and support our goal of transitioning more New Yorkers away from fossil fuels and toward a cleaner transportation future."

- Britt Reichborn-Kjennerud, Con Edison

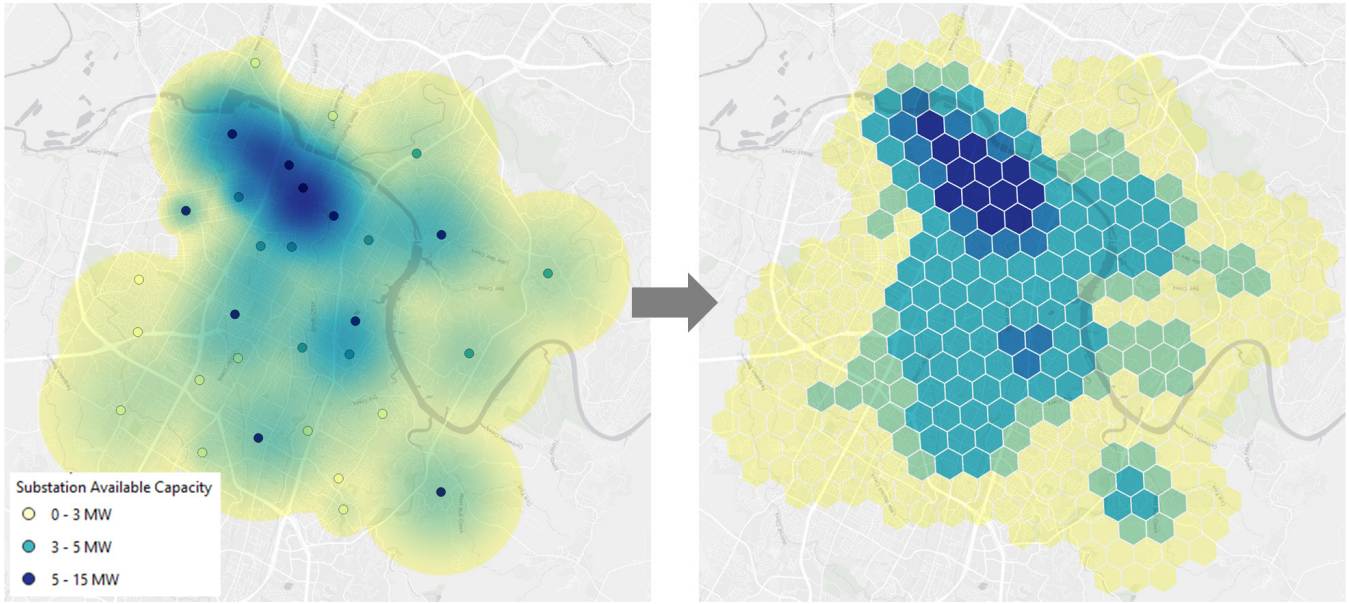

Figure 1. *Mock-up of available substation capacity visualization*

About EPRI

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Together, we are shaping the future of energy.

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