National Center for Sustainable Transportation

POLICY BRIEF

Future Electric Vehicle Charging Demand at Highway Rest Areas and Implications for Renewable Energy Penetration in California

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Issue

California has goals to rapidly expand electric vehicle adoption, with executive orders calling for 1.5 million electric vehicles on the roads by 2025 and 5 million by 2030. Significant charging infrastructure will be needed to support these new vehicles. While many urban areas in California have prioritized construction of charging stations, most rural areas lack charging infrastructure. This deficit hinders electric vehicle adoption in rural areas and makes long distance electric vehicle travel difficult.

To address this issue, Caltrans has begun investing in charging infrastructure in rural and underserved areas around the state, particularly at highway rest areas. However, an understanding of potential future intercity charging demand will be needed to inform continued investments in support of a growing electric vehicle fleet.

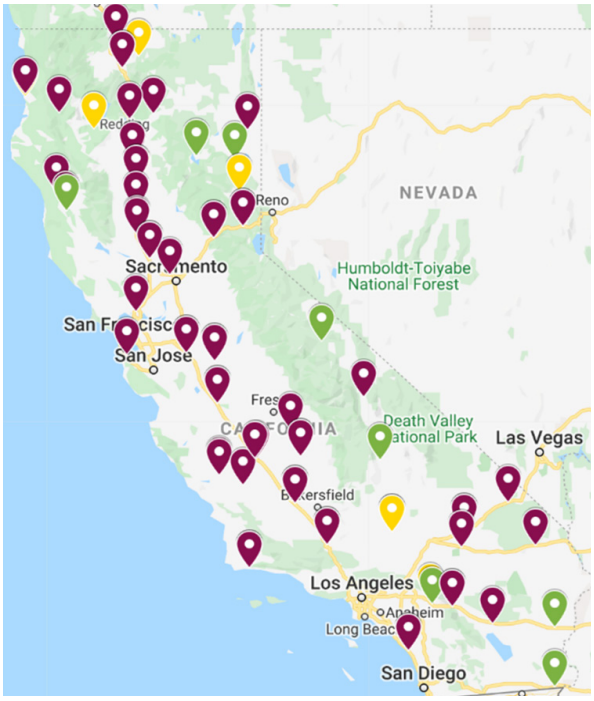

Figure 1. Projected rest area charging demand in 2050. Maroon rest areas are projected to see lots of traffic with high charging demand. Yellow rest areas will see relatively low traffic, but those vehicles will have high charging demand. Green rest areas will see more traffic, but vehicles will have less charging demand.

Researchers at the University of California, Davis collected state travel data and electricity demand data to run a model that identified optimal highway rest areas for electric vehicle charger installation and calculated how an increase in charging demand would affect the California electricity grid at selected highway locations. The project aimed to maximize the use and generation of solar and wind energy, while also increasing electric vehicle adoption and mobility in the state.

Key Research Findings

Researchers identified 52 key rest areas that are anticipated to have high future charging demand. These rest areas (maroon dots in Figure 1) will serve high traffic volumes and vehicles that will tend to have depleted batteries requiring substantial charging. These rest areas and their vicinities should be high priorities for charging infrastructure investment, as the current lack of infrastructure will likely inhibit intercity electric vehicle travel in these areas. While Caltrans is planning to install chargers at several of these locations, the analysis shows that additional chargers will be needed in the future.

Some rest areas are anticipated to have less charging demand out to 2050. These rest areas generally will see less traffic (yellow dots in Figure 1), or higher traffic volumes with less charging demand (green dots). These demand projections can inform decisions on the number and capacity of chargers installed at or near each rest area. The rest areas with little charging demand

stay relatively constant out to 2050, providing more certainty as to where to prioritize investment.

Charging demand at rest areas is anticipated to grow rapidly between 2030 and 2050. If California's entire vehicle fleet is electrified, the state will need about 7 gigawatts of charging capacity for intercity travel by 2050. While this will require substantial investment, the vast majority (87%) of charging demand would continue to be for relatively short distance (less than 100 miles) or intracity trips.

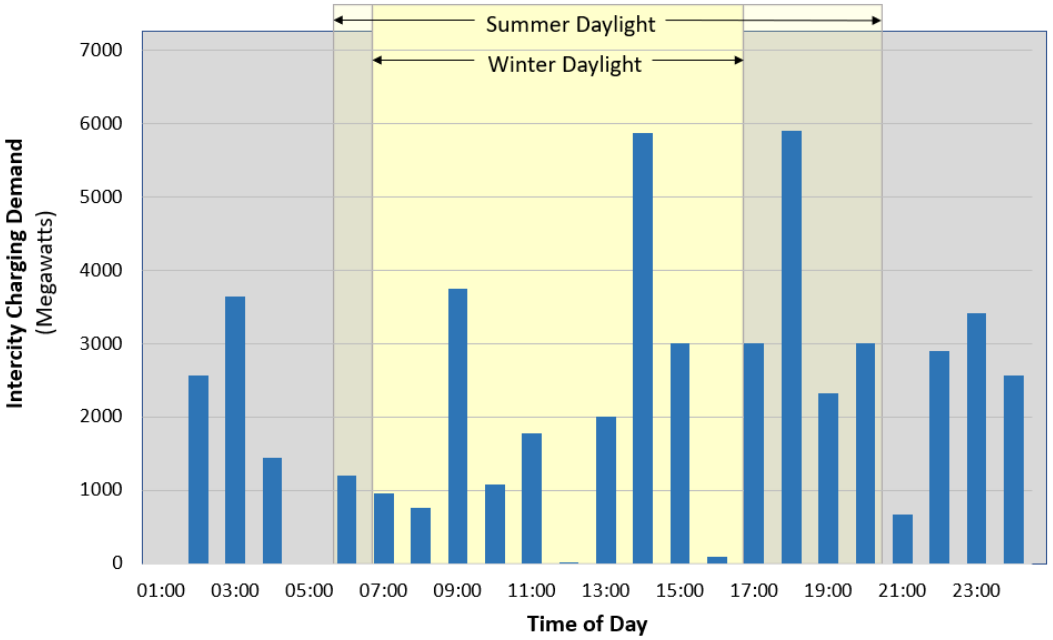

Figure 2. Projected intercity vehicle charging demand in 2050, with incentives to encourage daytime charging when renewable energy is most abundant.

Projected intercity charging demand will not significantly detract from, and could even support, grid reliability as California continues shifting to renewable electricity sources. Projected electric vehicle market growth will occur while California increasingly relies on variable renewable electricity sources. Matching the timing of electric vehicle charging with peak renewable energy generation during the daylight hours can take advantage of plentiful solar energy and support grid reliability. While peak intercity charging demand is projected to occur in the evening hours when renewable energy resources are less available, significant demand is also projected to occur during daylight hours. This charging profile at least partially aligns with peak renewable energy generation. Policies such as price incentives to encourage daytime charging, while likely to be most effective in shifting intracity charging behavior, could also shift intercity charging to better support future grid reliability and the use of renewable energy (Figure 2).

More Information

This policy brief is drawn from "Utilizing Highway Rest Areas for Electric Vehicle Charging: Economics and Impacts on Renewable Energy Penetration in California," a report from the National Center for Sustainable Transportation, authored by Behdad Kiani, Joan Ogden, F. Alex Sheldon, and Lauren Cordano, of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/utilizing-highway-rest-stops-electric-vehicle-charging-economics-and-impacts-renewable.

For more information about the findings presented in this brief, please contact Behdad Kiani at bkiani@ucdavis.edu.

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