Grid Impacts of EVs

Context setting for Spring 2024 ESIG Workshop

TELOS ENERGY

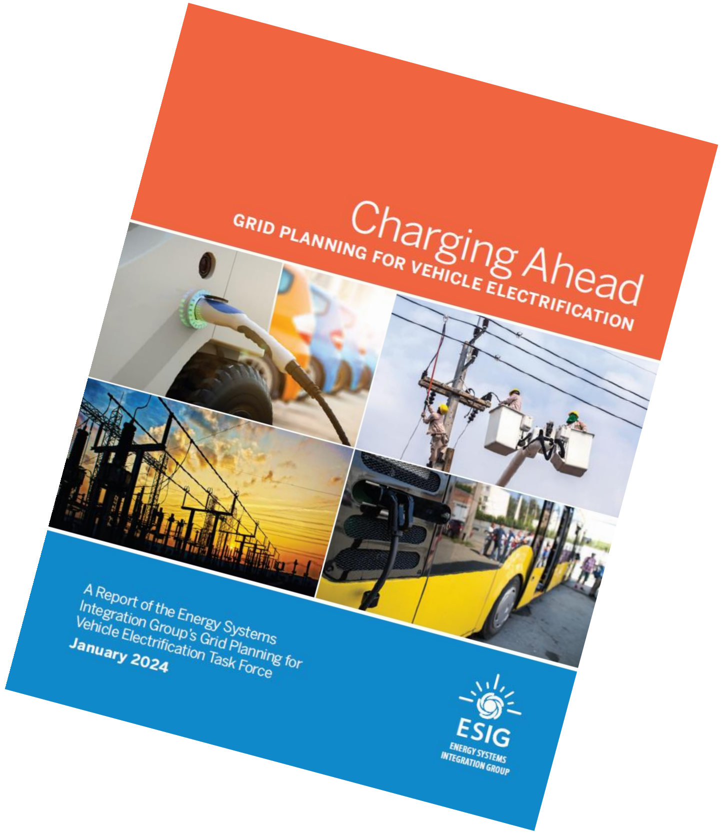
Grid Planning for Vehicle Electrification Task Force

Many Thanks To:

- DOE
- LBNL
- ESIG DER WG
- Task Force Members
  - Utilities
  - Vehicle Manufacturers
  - Aggregators
  - Charging Operators
  - Regulators
  - State Energy Offices

Recent whitepaper and webinar

https://www.esig.energy/grid-planning-for-vehicle-electrification/



Charging Ahead

GRID PLANNING FOR VEHICLE ELECTRIFICATION

A Report of the Energy Systems Integration Group's Grid Planning for Vehicle Electrification Task Force

January 2024

ESIG

ENERGY SYSTEMS INTEGRATION GROUP

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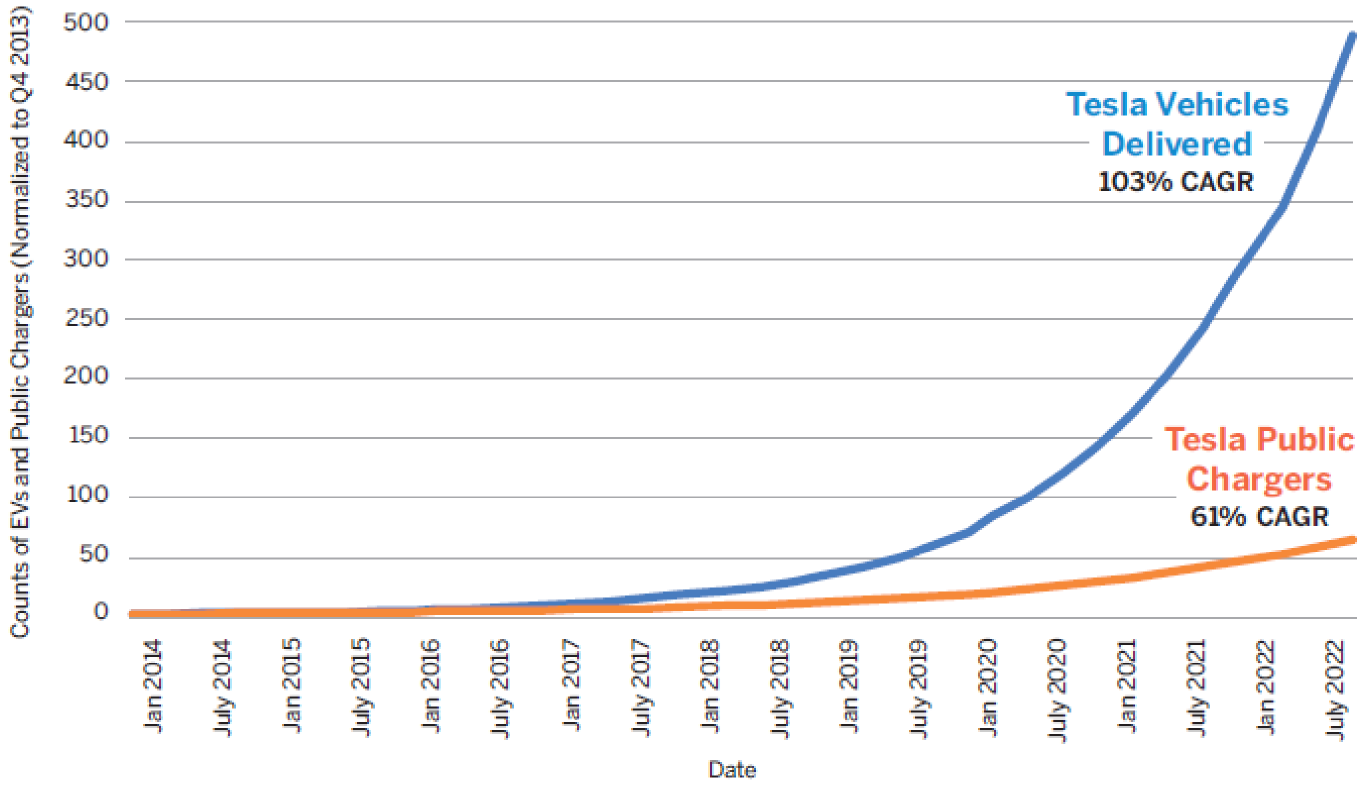
Priorities for effectively integrating vehicle electrification into grid planning

1. **Improve forecasting** by considering multiple vehicle end uses, new vehicle technologies, and more data sources. Use of scenarios to capture the uncertainty of locational and temporal grid impacts.
2. **Embrace smart charging** options at every level of the grid from the premise to the bulk system. Targeted smart charging, operating limits, and strategically located storage can help bridge immediate load growth while long-term solutions are implemented.
3. **Incorporate future-ready equipment** to allow for upsizing of infrastructure or enable future upsizing whenever equipment is being replaced.
4. **Promote proactive upgrades** identified by a multi-stakeholder group because EV adoption and charging needs can grow much faster than utility upgrades can be implemented.

Source: *Charging Ahead: Grid Planning for Vehicle Electrification.* 2024. ESIG. https://www.esig.energy/grid-planning-for-vehicle-electrification/

EV sales and charger deployment: exponential



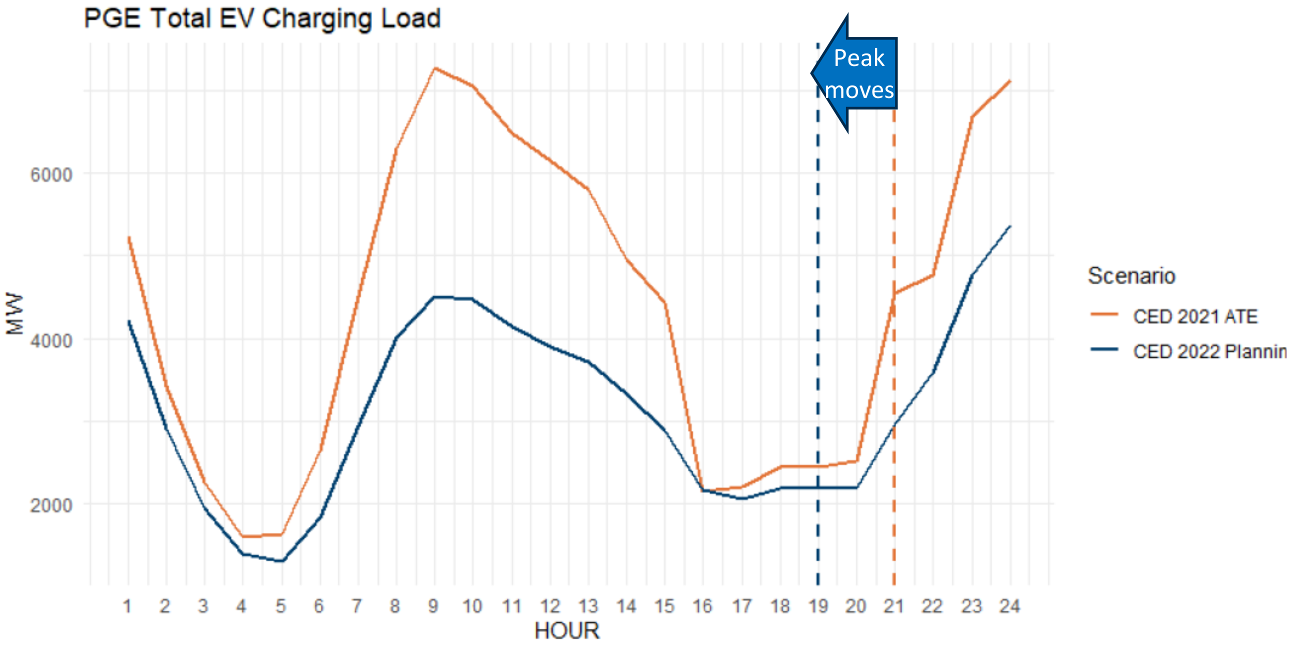
- Long-term goals for EV manufacturers remain intact despite recent changes to near-term plans

- $23.7 billion committed for publicly accessible EV light-duty charging infrastructure
  - 43% -76% of the funding that will be needed for public chargers to support 33M EVs by 2030.

Sources:
Tesla comments to the California Energy Commission, 9/1/2023 (https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-IEPR-03).
The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy23osti/85654.pdf

Bulk System Impacts

CEC’s California Energy Demand (CED) forecast: peak hour charging **moved from 9pm to 7 pm due to change in EV charging** profile with the 2022 iteration and has remained with recent updates.



NERC Key Finding #1: ***EV chargers can negatively impact BPS reliability*** depending on the way they draw current from the BPS (i.e., grid-friendly vs. grid-unfriendly).

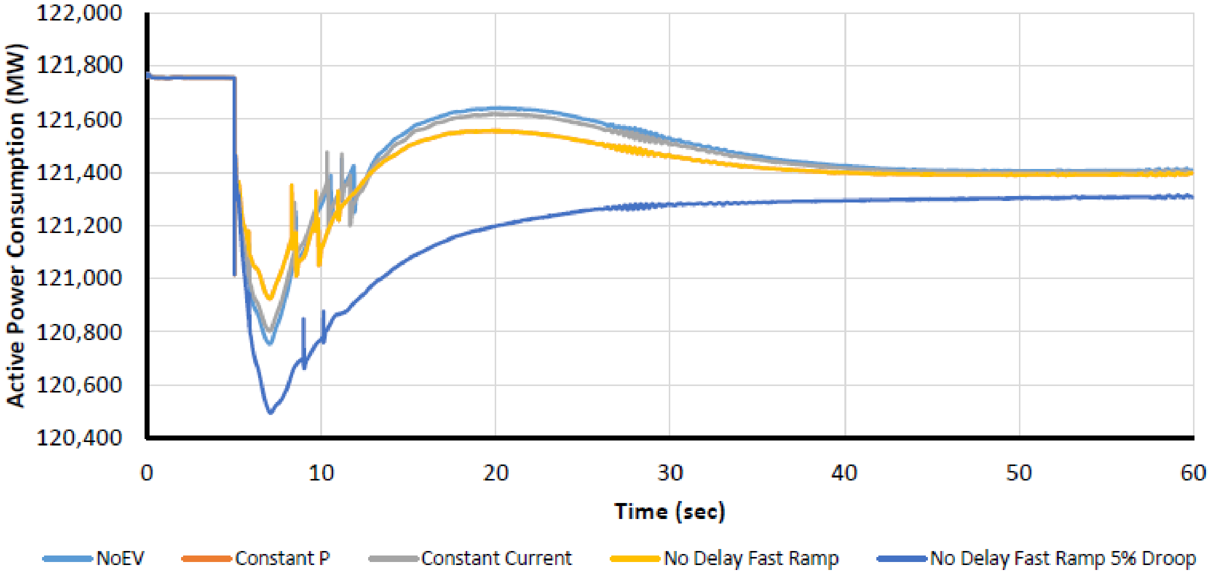


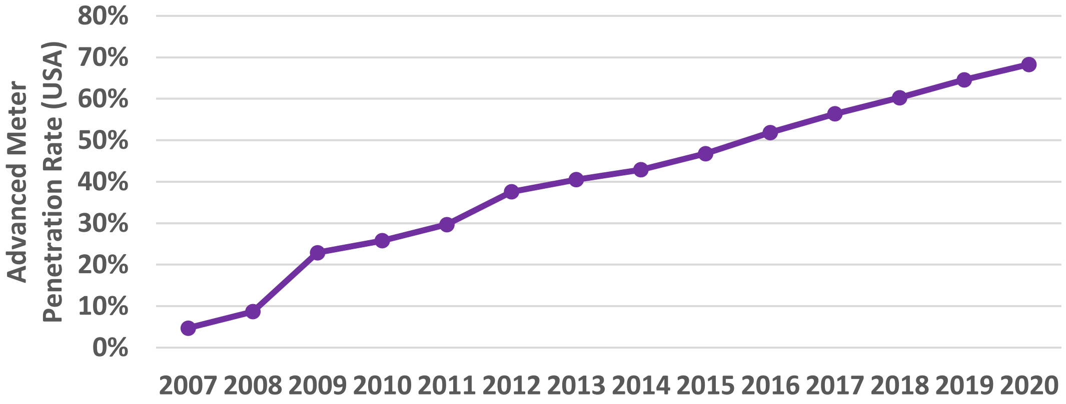
Figure 3.14: Interconnection-Wide Load during Conventional Generation Loss—Light Load

Sources:
Peak Electricity Demand Update to the California Energy Demand Forecast, 2021- 2035 CEC (Nick Fugate, Energy Assessments). 2022
Potential Bulk Power System Impact of Electric Vehicle Chargers. 2024. NERC.

Distribution Infrastructure Landscape

Advanced Metering

- 68% of meters across the country are "advanced"
  - "Advanced" is defined as capable of tracking hourly usage and reporting at least daily
- Modern meters can record far more information and report it in near-real time.

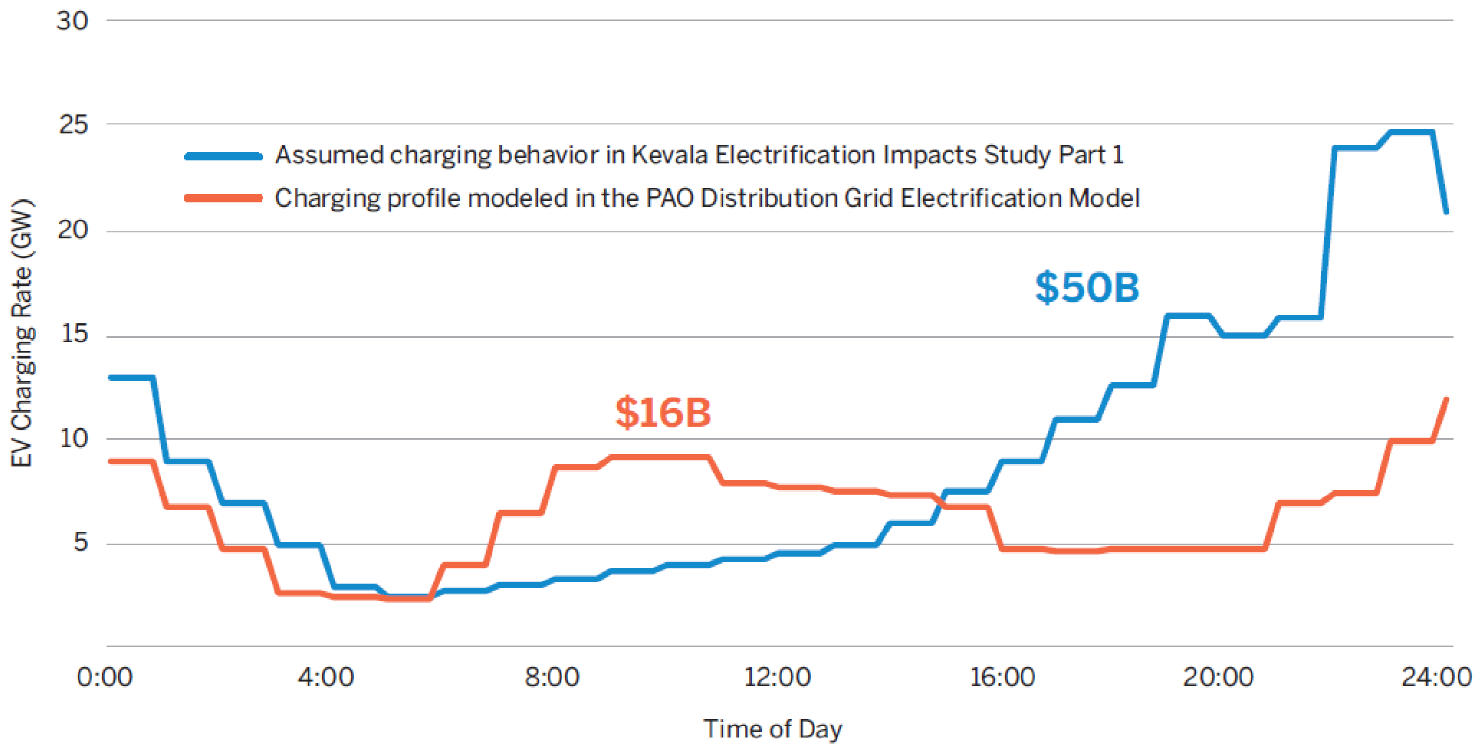


Distribution Transformers

- 1994 estimate of 50 million transformers with 2.3+ TW of utility-owned installed capacity
- Initial NREL estimates today: **60-80 million transformers = 3+ TW installed capacity**
- Capacity of distribution transformers **expected to increase 160%–260%** to support the Electricity Futures Study Moderate electrification scenario.
- There is a broad consensus among utility engineers that the majority of the transformer stock is reaching the **end of designed life**. However, little data are available on actual transformer age.

Sources:
Assessment of Demand Response and Advanced Metering 2023. FERC.
Major Drivers of Long-Term Distribution Transformer Demand. NREL (Killian McKenna). 2024.
https://www.nrel.gov/news/program/2024/how-many-transformers-will-the-us-distribution-grid-need-by-2050.html?trk=feed_main-feed-card_feed-article-content

Electrification -> Distribution upgrades (California)



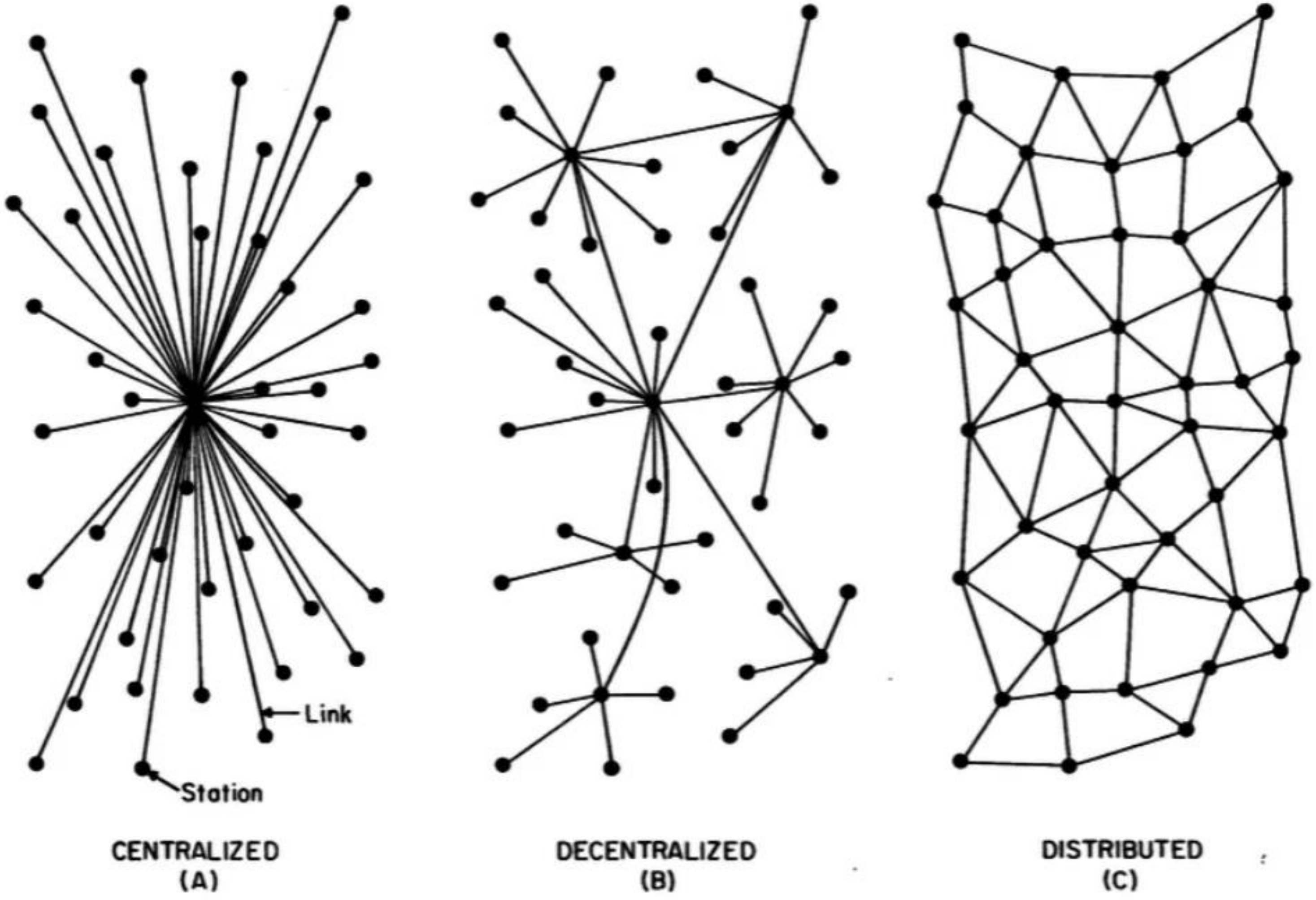
Differences in charging assumptions can have a large impact on the cost of distribution upgrades. Smart charging can adjust the charging profile.

- Differences in the shape and magnitude or EV charging can lead to very different needs in distribution upgrades.
- Costs of upgrades can be spread across more energy sold, potentially decreasing rates for everyone.
- Opportunities for innovation given such a large need. How does V2X fit in?

Source: *Charging Ahead: Grid Planning for Vehicle Electrification.* 2024. ESIG. https://www.esig.energy/grid-planning-for-vehicle-electrification/

Control Paradigms in Distribution

- Is there a one size fits all?
- Should multiple solutions be used to address different needs?



Baran, P. (1964). On Distributed Communications, Memorandum RM-3420-PR.