CMC Working Group and NERC Focus on EV Charging

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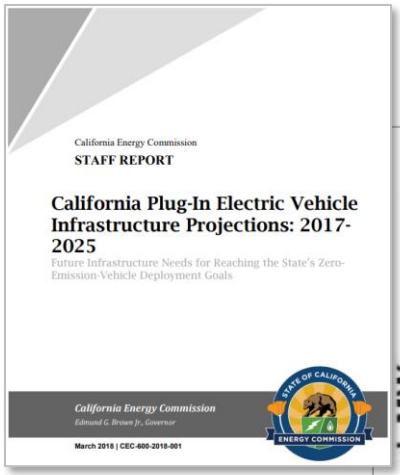
RELIABILITY | RESILIENCE | SECURITY

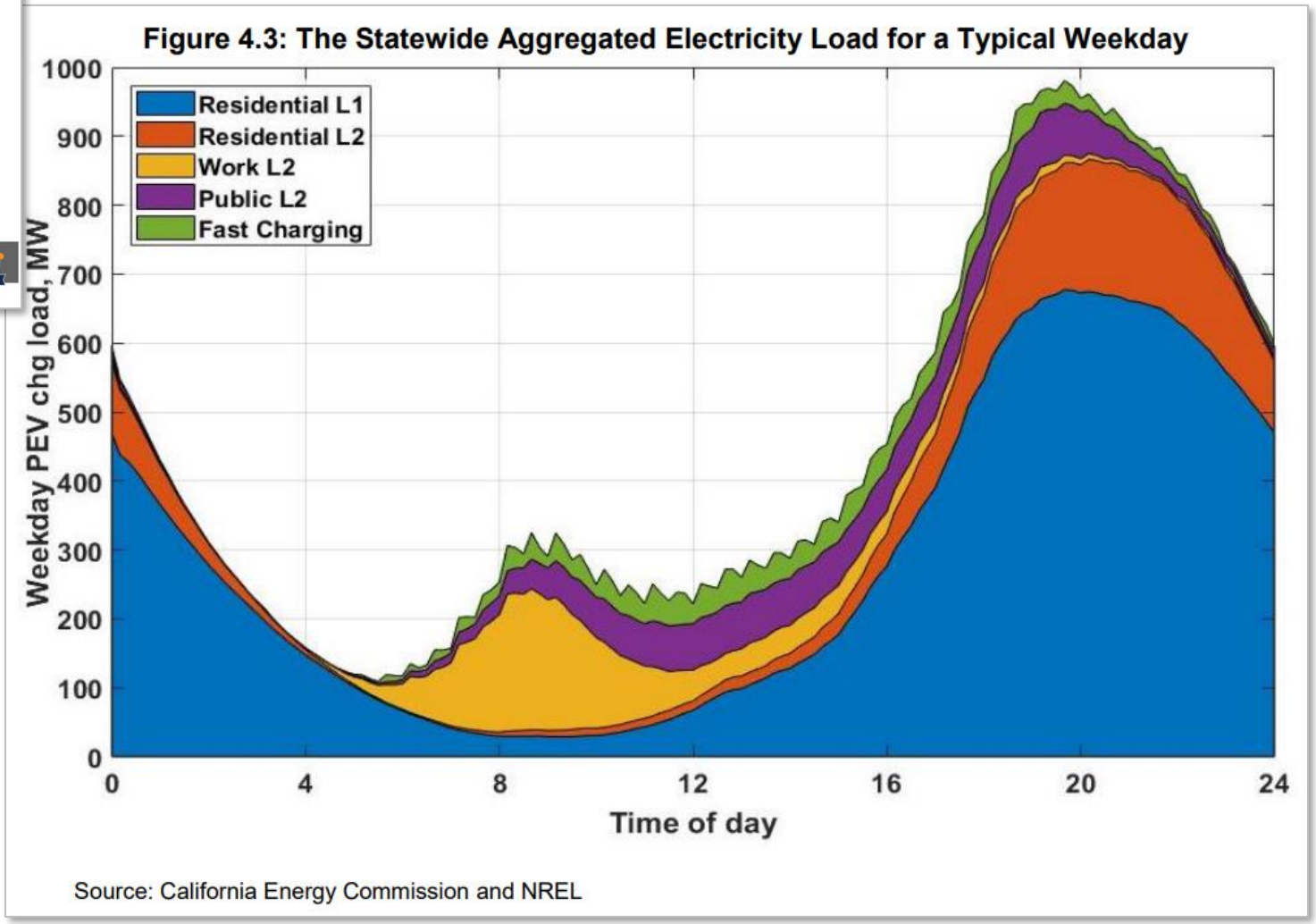



California Mobility Center (CMC)

- Public-private collaborative whose goal is to accelerate innovation and commercialization of new products, services, and technology in the clean mobility space.
- Focused on creating an ecosystem of entrepreneurs, large and small businesses, investors and academia to build world class companies.
- CMC, NERC, and WECC signed Memorandum of Understanding (MOU) to pursue joint initiatives to ensure grid reliability with growing EV penetrations

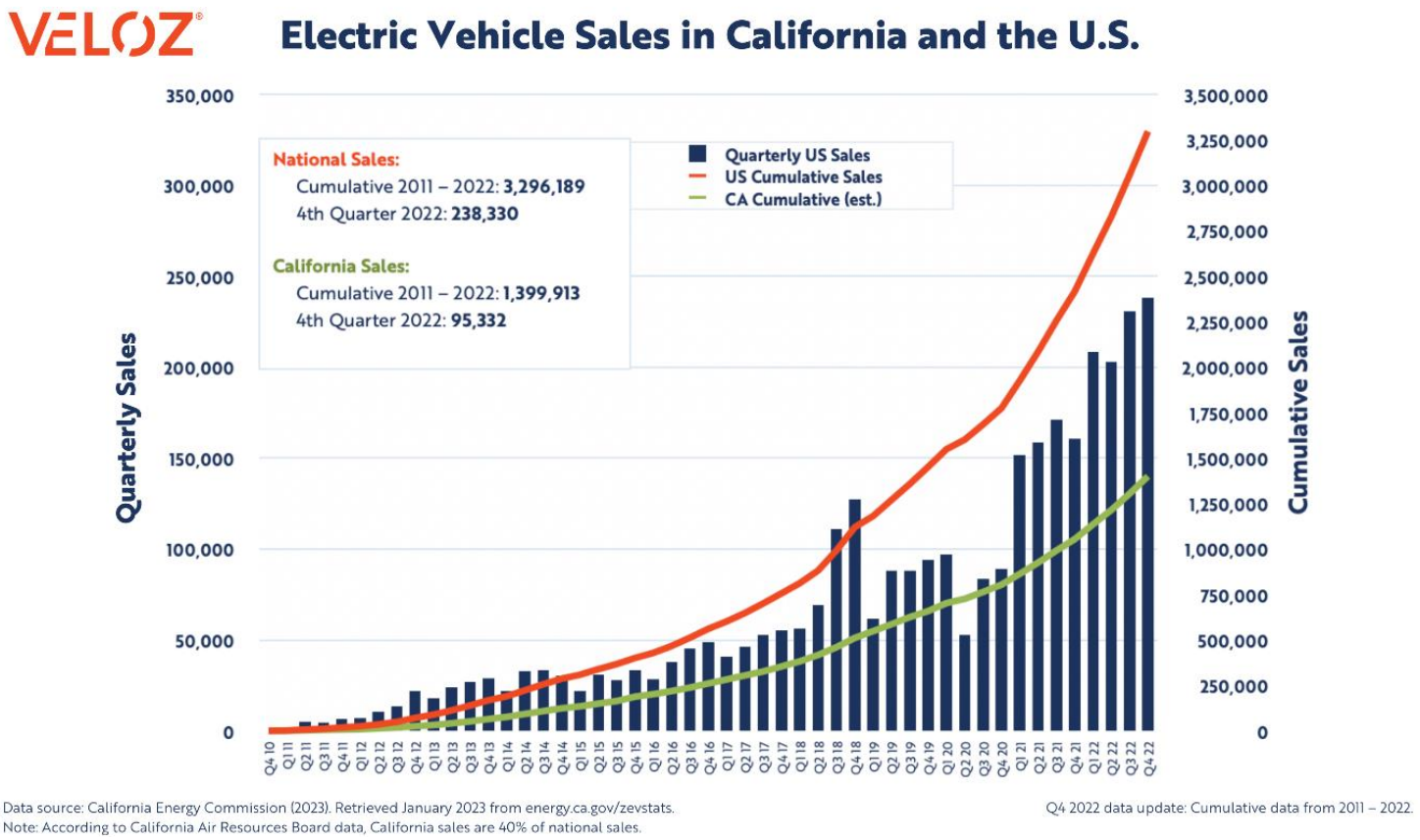
California Energy Commission Projections and Analysis





Source: CEC

Driver



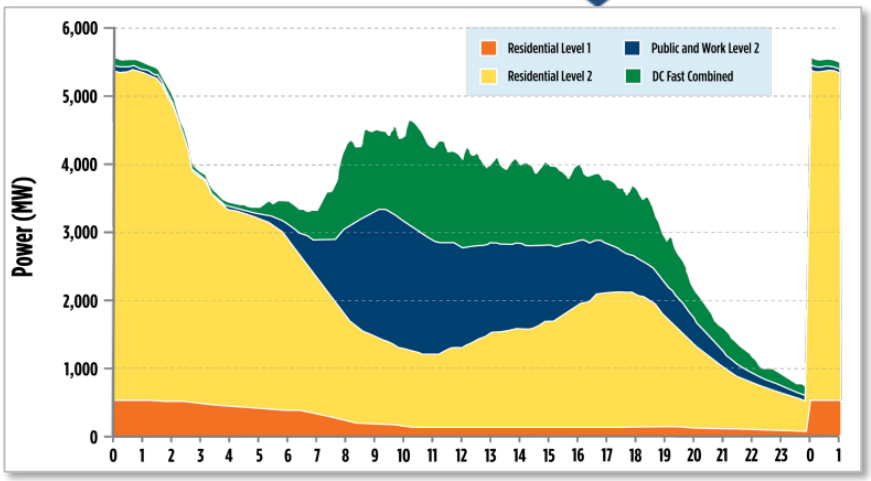
Data source: California Energy Commission (2023). Retrieved January 2023 from energy.ca.gov/zevstats.
Note: According to California Air Resources Board data, California sales are 40% of national sales.

Q4 2022 data update: Cumulative data from 2011 – 2022.

- Wood Mackenzie projects passenger and commercial EVs in the US to grow to:
  - 69.4 million and 3.14 million respectively by 2035
  - 178.3 million and 5.76 million respectively by 2050.

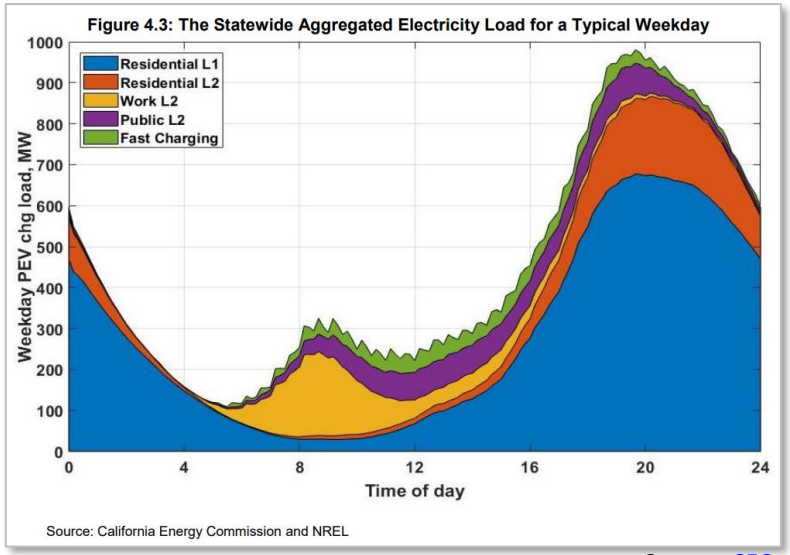
EV Impacts to the Bulk Power System

- Rapid or unexpected changes in load consumption
  - Time of use rates
  - Unplanned “panic charging”
  - Impacts to system frequency and loading patterns



Source: CEC

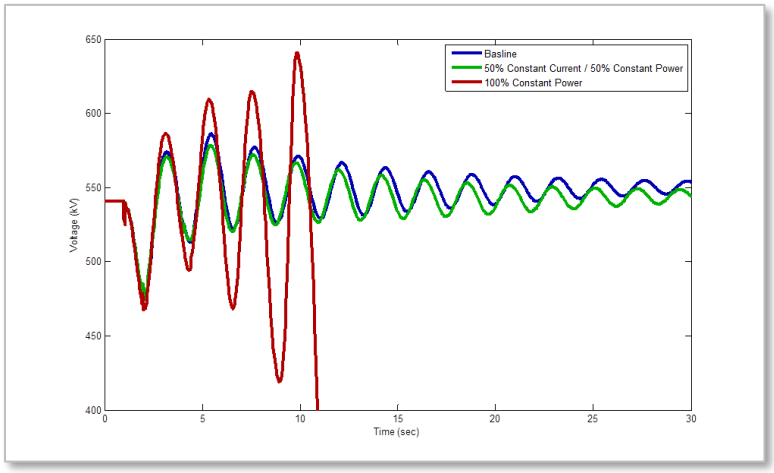
- Ramping needs to manage critical charging hours
  - Charging hours
  - Coupled with daily solar drop-off
  - V2G support for variability



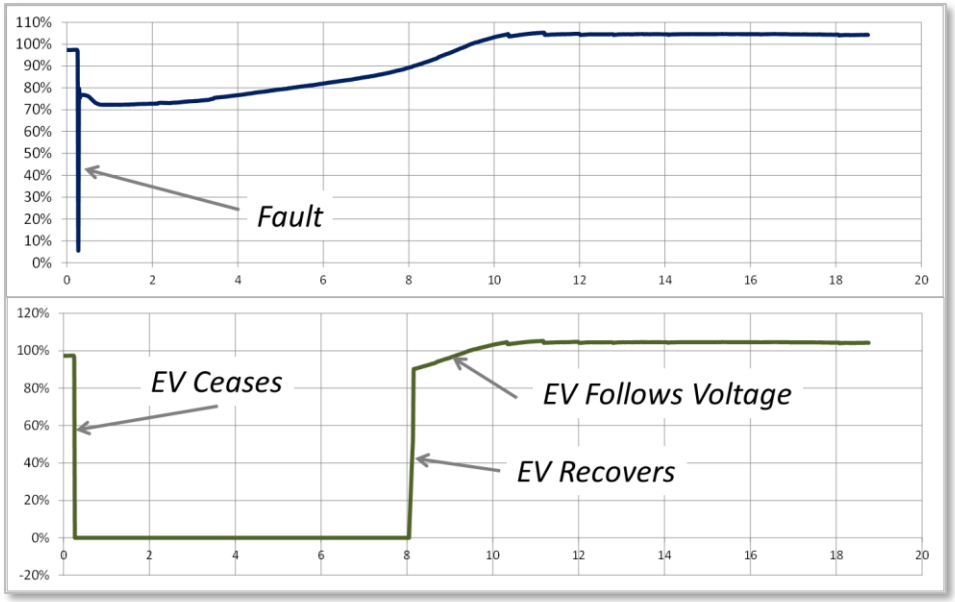
Source: CEC

EV Impacts to the Bulk Power System

- Constant power load characteristics
  - Possible degradation of stability margins
  - Wide-area oscillatory impacts
  - Grid-unfriendly characteristic



- Fault ride-through
  - Responding during faults
  - Planned/studied behavior
  - Recovery characteristic



EV Impacts to the Bulk Power System

- System restoration and blackstart plans
  - Unexpected load steps during blackstart
  - Capabilities during large voltage/frequency swings

Source: History

- Participation in DER Aggregation
  - EV smart charging as DER (FERC definition)
  - V2G as DER (NERC definition)
  - EVs part of DER Aggregators (FERC 2222)
  - Displacement of BPS generation and possible essential reliability services

- Other possible impacts
  - Power quality, harmonic, control interactions

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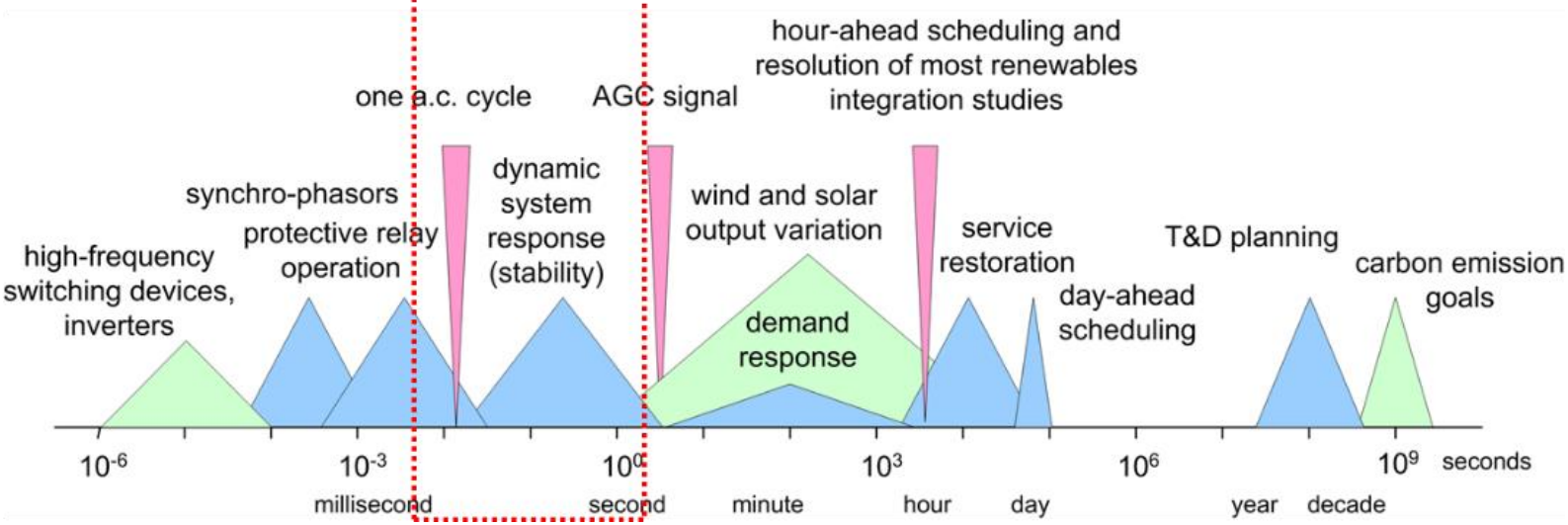
Open Questions on EV Impacts to the Bulk Power System

- How will EVs affect resource and energy adequacy in at-risk areas?
- How will time of use rates affect charging patterns?
- How will EVs affect grid dynamics and stability?
- How will EV projections get into load forecasts?
- How will unmanaged versus managed charging affect load patterns?
- How will V2G technology affect system operations and planning?
- How will/could V2G affect essential reliability services?
- How will EVs participate in DER aggregation?
- How will we model and study all of these concerns?

- How can we work in partnership with the EV industry to encourage "grid-friendly" EVs?

Timeframes of Reliability

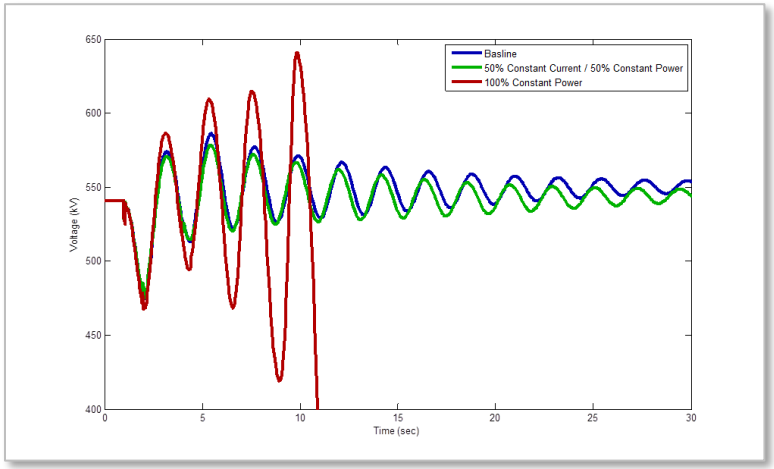
	Protection	Automatic Controls	Operator Actions	Generation Dispatch	Investment
Operations					
Planning Tools	Short-circuit, Electromagnetic Transient	Steady-State and Dynamic Power Flow	Real-time Contingency Analysis, Short-term Forecasting	Optimal Power Flow, Production Cost Simulation	Generation and Transmission Expansion



A. von Meier, "Challenges to the Integration of Renewable Resources at High System Penetration," California Energy Commission, May 2014: https://www.energy.ca.gov/

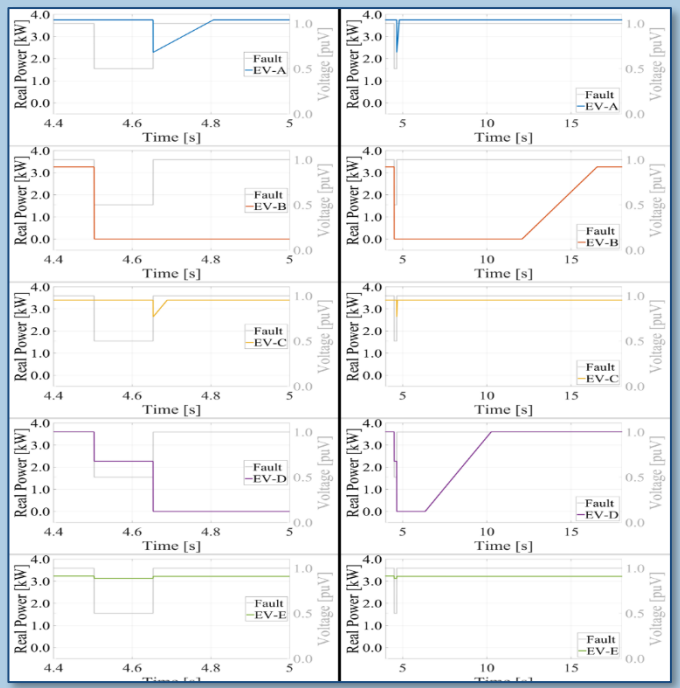
Draft Guideline

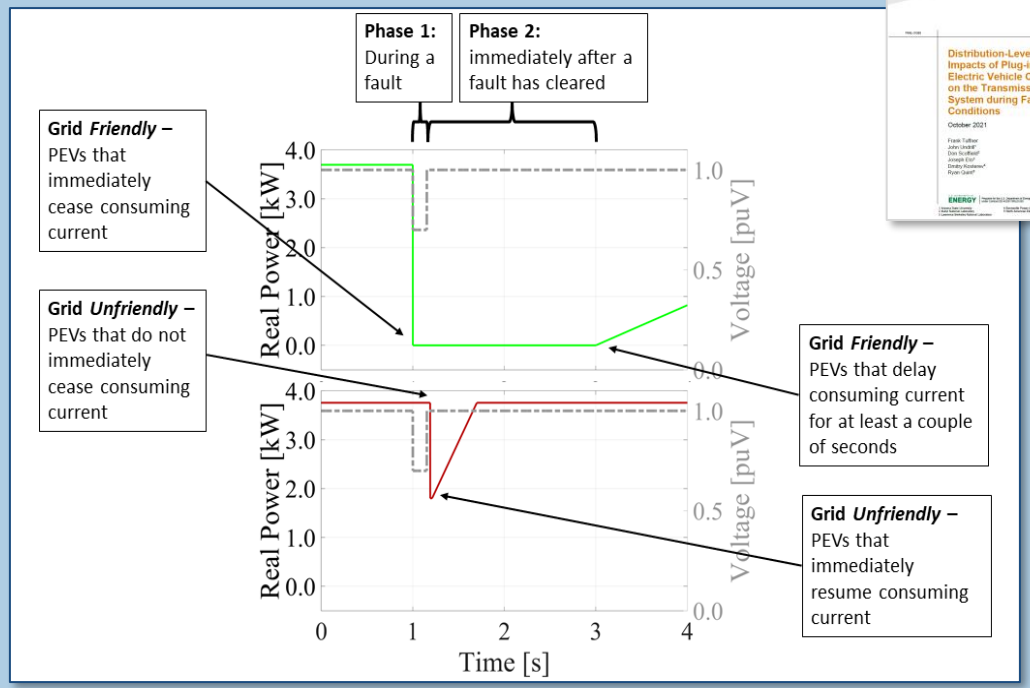
- **"Electric Vehicle Dynamic Charging Performance Characteristics During Bulk Power System Disturbances"**
  - Fundamental "grid-friendly" EV charging dynamic behavior
  - Steady-state current consumption – constant current
  - Power factor
  - Active power-frequency control (frequency response support)
  - Ride-through performance
    - Dynamic response times
    - Voltage ride-through ranges



Proactively Studying EV Impacts on BPS Reliability

Understanding → **Models** → **Studies**





https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-31558.pdf

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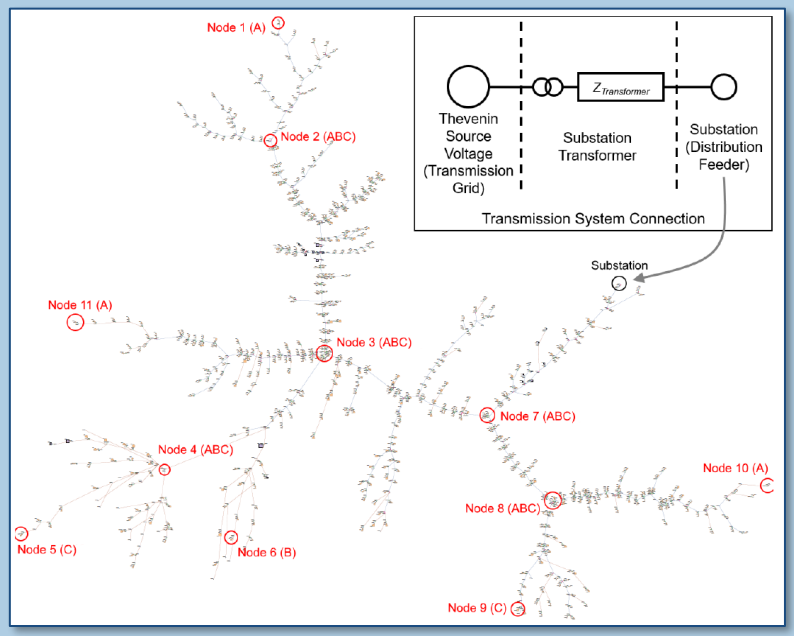

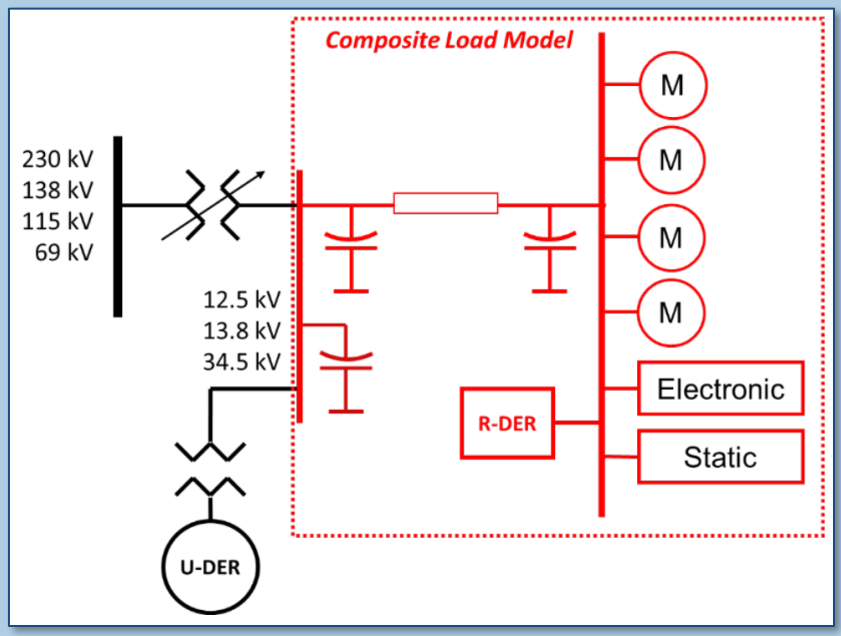

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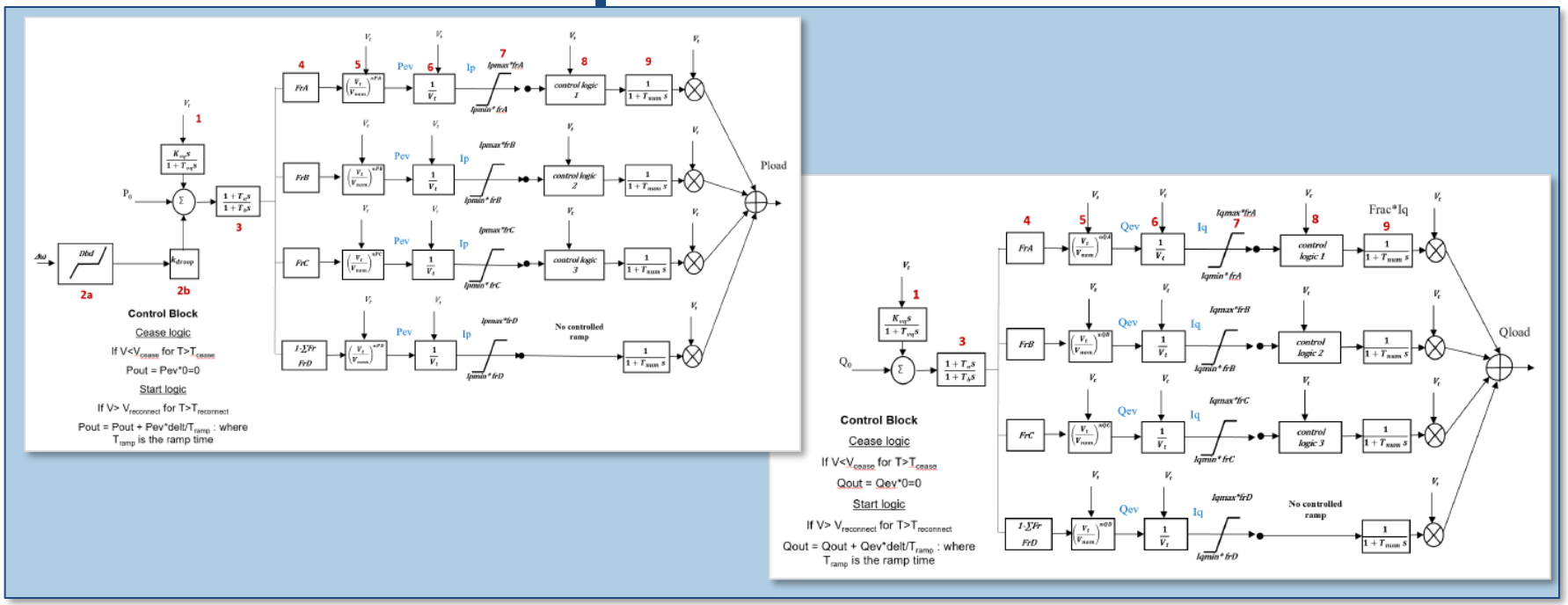

"Positive Sequence Model for Aggregated Representation Electric Vehicle Chargers: EPCL Model Description," EPRI Project 1-116982

Proactively Studying EV Impacts on BPS Reliability

Understanding → Models → Studies

Planned Activities:

- Model Development
- Beta Testing
  - Local Reliability Impacts
  - Wide-Area Reliability Impacts
- Industry Roll-Out of EV Model

Key Focus Areas Moving Forward

- Data collection for assessments – resource and energy adequacy
  - *Understanding what is installed today and into the future*
- Dynamic model development for planning and operational reliability studies
  - *Understanding how EVs will perform electrically and how that either supports or adversely affects grid reliability*
- Collaboration between energy and transportation sector
  - *Outreach, information sharing, and encouragement for grid-friendly performance of EVs as a team – leveraging shared goals and outcomes*
- Engagement and involvement from grid planners and operators
  - *Advocating the importance of engagement from energy sector entities*

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Questions and Answers

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