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*Comment Received From: Travis Rouillard*
*Submitted On: 8/6/2025*
*Docket Number: 25-EPIC-01*

## Concept proposal for EV Load Balancing

*Additional submitted attachment is included below.*

# Electric Program Investment Charge 2026–2030 (EPIC 5) Research Concept Proposal Form

The California Energy Commission (CEC) is currently soliciting research concept ideas and other input for the Electric Program Investment Charge 2026–2030 (EPIC 5) Investment Plan. For those who would like to submit an idea for consideration, please complete this form and submit it to the CEC by **August 8, 2025**. More information about EPIC 5 is available below.

To submit the form, please visit the e-commenting link: https://efiling.energy.ca.gov/EComment/ECommentSelectProceeding.aspx and select the Docket **25-EPIC-01**. Enter your contact information and then use the "choose file" button at the bottom of the page to upload and submit the completed form. Thank you in advance for your input.

1. Please provide the name, email, and phone number of the best person to contact should the CEC have additional questions regarding the research concept:

Travis Rouillard
travis.rouillard@qualuscorp.com
925-309-9915

2. Please provide the name of the contact person's organization or affiliation:

Qualus, LLC

3. Please provide a brief description of the proposed concept that you would like the CEC to consider as part of the EPIC 5 Investment Plan. What is the purpose of the concept, and what would it seek to do? Why are EPIC funds needed to support the concept?

The proposed research evaluates four strategies to load balance electric vehicle (EV) charging in residential neighborhoods served by the same distribution transformer:
a) **Random staggering** of EV charging start times within a designated time window.
b) **Local collaboration** among EV chargers to adjust charging rates based on detected peer activity.
c) **Centralized coordination** of start times and charging rates to flatten

transformer load profiles.
d) **Centralized optimization** of charging schedules to maximize avoided capacity upgrades by predicting net transformer load.

**Purpose**: The research aims to identify cost-effective, scalable methods to mitigate voltage drops and transformer overloading caused by simultaneous EV charging, ensuring grid reliability and affordability as EV adoption grows. It will assess implementation requirements (e.g., hardware/software upgrades, communication protocols) and quantify benefits (e.g., reduced infrastructure costs, improved grid stability).

**Need for EPIC Funds**: EPIC funds are critical to support modeling, field testing, and data collection across diverse neighborhoods, which are beyond the scope of individual utilities or manufacturers. The research requires collaboration with utilities, charger manufacturers, and communities to validate strategies, analyze costs, and ensure equitable deployment, addressing a gap in current grid management solutions.

4. In accordance with Senate Bill 96[i], please describe how the proposed concept will "lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals." For example, what technical and/or market barriers or customer pain points would the proposed concept address that would lead to increased adoption of clean energy technology or innovation? Where possible, please provide specific cost and performance targets that need to be met for increased industry and consumer acceptance. For scientific analysis and tools, provide more information on what data and information gaps the proposed concept would help fill, and which specific parties or end users would benefit from the results, and for what purpose(s)?

This research addresses **technical barriers** such as transformer overloading, voltage instability, and insufficient grid capacity in residential areas with high EV penetration. It also tackles **market barriers** by reducing the need for costly infrastructure upgrades, which can deter utilities from supporting widespread EV adoption. **Customer pain points** include unreliable power delivery (e.g., dimming lights, appliance disruptions) and high electricity rates due to peak demand charges.

The research will develop and test load balancing strategies to:

- Maintain voltage within ANSI C84.1 standards (e.g., ±5% of 240 V) under high EV loads.

- Reduce transformer upgrade costs by 20-50% through optimized charging schedules.
- Achieve 10-20% peak load reduction via coordinated strategies.

**Data Gaps Filled**: The research will provide:

- Empirical data on transformer load profiles under various EV charging scenarios.
- Cost-benefit analyses of each strategy, including hardware, software, and communication requirements.
- Insights into predictive load modeling accuracy for centralized optimization.

**Beneficiaries**:

- **Utilities**: Informed decisions on grid upgrades and demand response programs.
- **Ratepayers**: Lower electricity costs and improved reliability.
- **Charger Manufacturers**: Guidance on implementing smart charging features.
- **Policymakers**: Data to support equitable EV infrastructure policies.

5. Please describe the anticipated outcomes if this research concept is successful, either fully or partially. For example, to what extent would the research reduce technology or ratepayer costs and/or increase performance to improve the overall value proposition of the technology? What is the potential of the innovation at scale? How will the innovation lead to ratepayer benefits in alignment with EPIC's guiding principles to improve safety,[ii] reliability,[iii] affordability,[iv] environmental sustainability,[v] and equity?[vi]

**Full Success**:

- Identification of the most cost-effective load balancing strategy, reducing transformer upgrade costs by 20-50% (e.g., $10,000-$50,000 per transformer) and peak load by 10-20%.
- Development of scalable protocols for smart chargers and utility systems, enabling widespread adoption.

- Improved grid reliability, maintaining voltage stability within ±5% during peak EV charging.
- Equity benefits by prioritizing solutions for underserved communities with aging grid infrastructure.

**Partial Success**:

- Validation of one or two strategies (e.g., random staggering, local collaboration) as viable with moderate cost savings (10-20% reduction in upgrade costs).
- Identification of implementation barriers (e.g., communication protocol limitations) for future research.

**Value Proposition**: Reduced infrastructure costs lower ratepayer bills, while reliable power delivery enhances customer satisfaction. At scale, the innovation could save California utilities $100M-$500M annually by 2035, assuming 50% EV penetration in residential areas.

**Ratepayer Benefits**:

- **Safety**: Reduced risk of transformer failures or fires due to overloading.
- **Reliability**: Fewer voltage drops and outages.
- **Affordability**: Lower grid upgrade costs passed to consumers.
- **Environmental Sustainability**: Supports higher EV adoption, reducing greenhouse gas emissions.
- **Equity**: Prioritizes solutions for low-income neighborhoods with constrained grid infrastructure.

6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.

**Quantitative Metrics**:

- **Peak Load Reduction**: Percentage reduction in transformer peak load (target: 10-20%).
- **Voltage Stability**: Percentage of time voltage remains within ±5% of nominal (target: 95%+).
- **Cost Savings**: Reduction in transformer upgrade costs (target: $10,000-$50,000 per transformer).

- **Implementation Costs**: Hardware/software costs for each strategy (e.g., $50-$200 per charger for smart features).
- **Adoption Rate**: Percentage of chargers or households adopting load balancing features post-research (target: 30% within 5 years).

**Qualitative Indicators**:

- **Customer Satisfaction**: Surveys on power reliability and charging experience.
- **Utility Feedback**: Ease of integrating strategies into existing grid management systems.
- **Equity Impact**: Deployment success in underserved communities, measured via case studies.

7. Please provide references to any information provided in the form that supports the research concept's merits. This can include references to cost targets, technical potential, market barriers, equity benefits, etc.

- **Cost Targets**: EPRI (2021). "Electric Vehicle Infrastructure Cost Analysis." Estimates transformer upgrade costs at $20,000-$100,000 per unit.
- **Technical Potential**: NREL (2023). "Impacts of Residential EV Charging on Distribution Transformers." Reports 10-30% peak load increases with uncoordinated charging.
- **Market Barriers**: CPUC (2022). "California's Electric Vehicle Infrastructure Plan." Highlights grid capacity constraints as a barrier to EV adoption.
- **Equity Benefits**: CEC (2024). "EPIC Equity Framework." Emphasizes prioritizing underserved communities for grid upgrades.
- **Load Balancing Studies**: IEEE (2023). "Smart Charging Strategies for EV Load Management." Demonstrates 15-25% peak load reduction with coordinated charging.

8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:[vii]
   a. Transportation Electrification

b. Distributed Energy Resource Integration
c. Building Decarbonization
d. Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas
e. Climate Adaptation

Please describe in as much detail as possible how your proposed concept would support these goals.

This research primarily supports **Transportation Electrification** by enabling scalable, cost-effective EV charging infrastructure in residential areas, critical for achieving California's goal of 5 million EVs by 2030. It addresses grid reliability and cost barriers, ensuring equitable access to EV charging.

**Secondary Contributions**:

- **Distributed Energy Resource Integration**: Load balancing strategies align EV charging with distributed energy resources (e.g., solar) to optimize grid performance.
- **Climate Adaptation**: By reducing the need for transformer upgrades, the research enhances grid resilience against increased demand from climate-driven EV adoption.

The research will provide actionable data and protocols to utilities, manufacturers, and policymakers, accelerating EV adoption while maintaining grid stability and affordability.

## About EPIC

The CEC is one of four EPIC administrators, funding research, development, and demonstrations of clean energy technologies and approaches that will benefit electricity ratepayers of California's three largest investor-owned electric utilities.

EPIC is funded by California utility customers under the auspices of the California Public Utilities Commission.

To learn more about EPIC, visit: https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program

EPIC 5 documents and event notices will be posted to: https://www.energy.ca.gov/proceeding/electric-program-investment-charge-2026-2030-investment-plan-epic-5

Subscribe to the EPIC mailing list to stay informed about future opportunities to inform the development of EPIC 5: https://public.govdelivery.com/accounts/CNRA/signup/31897

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i See section (a) (1) of Public Resources Code 25711.5 at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC&sectionNum=25711.5.

ii EPIC innovations should improve the safety of operation of California's electric system in the face of climate change, wildfire, and emerging challenges.

iii EPIC innovations should increase the reliability of California's electric system while continuing to decarbonize California's electric power supply.

iv EPIC innovations should fund electric sector technologies and approaches that lower California electric rates and ratepayer costs and help enable the equitable adoption of clean energy technologies.

v EPIC innovations should continue to reduce greenhouse house gas emissions, criteria pollutant emissions, and the overall environmental impacts of California's electric system, including land and water use.

vi EPIC innovations should increasingly support, benefit, and engage disadvantaged vulnerable California communities (DVC). (D.20-08-046, Ordering Paragraph 1.) DVCs consist of communities in the 25 percent highest scoring census tracts according to the most recent version of the California Communities Environmental Health Screening Tool (CalEnviroScreen), as well as all California tribal lands, census tracts with median household incomes less than 60 percent of state median income, and census tracts that score in the highest 5 percent of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

vii In 2024 the CPUC adopted five Strategic Goals to guide development of the EPIC 5 Investment Plan. A description of the goals can be seen in Appendix A of CPUC Decision 24-03-007 available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M527/K228/527228647.PDF