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Resilient EV Charging during Emergencies

Additional submitted attachment is included below.

CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

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:

   Ricardo de Castro, rpintodecastro@ucmerced.edu

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

   Ricardo de Castro, University of California, Merced

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?

   As California accelerates the adoption of zero-emission vehicles (ZEVs), it is critical to ensure their operability during emergencies, especially during wildfires, when electric power is often shut off to prevent ignitions. To tackle this challenge, California would benefit from more off-grid mobile charging solutions that can support ZEV emergency evacuations during power outages. It would be useful to California for someone to:

   (1) Develop optimization and artificial-intelligence(AI) -based tools to guide charger placement during emergencies, while accounting for real-time

variables such as EV state of charge, charging demand and charger availability

(2) Perform Techno-economic evaluation of mobile charging technologies (e.g., battery trailers, hybrid units, fuel cells, etc.), focusing on deployment time, energy delivery capacity, cost, and operational constraints.

(3) Execute Pilot testing in wildfire-prone regions, which could help validate mobile charging's technical performance, logistical feasibility, and community impact, generating data to support broader adoption and integration of off-grid mobile charging into emergency response protocols with ZEVs.

EPIC funding could enable partnerships with utilities, technology providers, and local governments to pilot and validate this off-grid charging solution.

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)?

The proposed concept addresses barriers related to ZEV usage during emergency and power outage scenarios. Current EV charging infrastructure is grid-dependent and often unavailable during Public Safety Power Shutoffs (PSPS) or wildfire-related outages, posing risks to safe evacuation. This creates a customer pain point and erodes trust in ZEVs as viable, all-condition transportation solutions—particularly in high-fire-risk communities.

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]

Ratepayer benefits include:

- Improved safety and reliability: off-grid Mobile chargers ensure continuous access to energy during outages, helping communities evacuate safely and reducing reliance on fossil-fueled backup options.
- Environmental sustainability: By enabling broader and more confident adoption of ZEVs, the project contributes to GHG reductions.
- The project supports communities with limited grid infrastructure and few existing chargers, ensuring resilience for all Californians.

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

Quantitative Metrics include:

- Evacuation success rate (% of EVs completing evacuation without running out of charge)
- Charger deployment time
- Energy delivered per charger during emergency events (kWh per deployment)
- Cost per kWh delivered by mobile unit
- Reduction in expected delays compared to baseline without mobile charging
- Population served in high-risk areas (e.g., number of ratepayers reached)

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.

- ZareAfifi, F., de Castro, R., Kurtz, S., (2025), Comparative Analysis of Backup Energy Solutions for Electric Vehicle Evacuations During Grid Failures, *13th IEEE Electrical Energy Storage Applications and Technologies (EESAT)*, USA
- Tang, X., Lin, X., Moura, S., de Castro, R., Markolf, S., Feng, S., Gan, Q. (2024) Enhancing Large-Scale Evacuations of Electric Vehicles through Integration of Mobile Charging Stations, *27th IEEE International*

Conference on Intelligent Transportation Systems (ITSC), Edmonton, Canada.
- Saleem O., Corzine K., Parsa L., de Castro, R. (2024) Development of Zero-Emission Vehicle Evacuation Readiness Score Formulation Methodology, *2024 IEEE 67th International Midwest Symposium on Circuits and Systems (MWSCAS)*, Springfield, MA, USA

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.

The concept enhances the resilience of California's transportation electrification efforts by ensuring that EVs remain viable during emergencies, especially in areas subject to Public Safety Power Shutoffs (PSPS).

Additionally, as wildfire frequency and severity increase due to climate change, communities must adapt by building resilient energy systems. This concept contributes to climate adaptation by ensuring that residents with ZEVs can safely evacuate even when the power grid is offline.

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