DOCKETED	
Docket Number:	25-EPIC-01
Project Title:	Electric Program Investment Charge 2026–2030 Investment Plan (EPIC 5)
TN #:	265478
Document Title:	Adil Khurram Comments - Resilient Microgrid based VPPs with distributed coordination
Description:	N/A
Filer:	System
Organization:	Adil Khurram
Submitter Role:	Applicant
Submission Date:	8/8/2025 3:18:32 PM
Docketed Date:	8/8/2025

Comment Received From: Adil Khurram
Submitted On: 8/8/2025
Docket Number: 25-EPIC-01

Resilient Microgrid based VPPs with distributed coordination

Additional submitted attachment is included below.

CALIFORNIA ENERGY COMMISSION

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:

   Jan Kleissl, jkleissl@ucsd.edu, 619-376-3971

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

   University of California, San Diego

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?

   We propose developing virtual power plants (VPPs) via distributed coordination of multiple microgrids for the next EPIC investment plan.

   The purpose of the concept is to leverage microgrids with DERs, flexible loads, onsite generation, etc. to improve grid resiliency to outages and natural hazards such as wildfires, and defer infrastructure upgrades by maximizing the potential of existing resources (DERs, flexible loads, etc.). Microgrids are suitable for this purpose due to the decentralized nature, meaning that microgrids can operate independently (islanded) as well as in on-grid modes. This feature becomes essential during outages during which microgrids can keep the critical infrastructure such as hospitals online while shedding non-essential loads. Introducing coordination between microgrids to form VPPs can further enable microgrids to push power from microgrids with extra/unused energy to constrained microgrids which improves overall grid resiliency. Finally, VPP microgrids can leverage unused energy and/or flexibility for grid services such as demand response, ancillary markets, etc.

EPIC funds are needed to develop communication and data exchange requirements for microgrids to form VPPs, and develop well-defined energy exchange as well as participation mechanisms for coordination between microgrids. This includes kW/kWh committed between microgrids, cost per kWh, etc., and the specific information that needs to be exchanged between microgrids for a resilient coordination. A key outcome of projects under this research concept is the updates to standards and protocols such as OpenADR and IEEE 2030.5 that DER and microgrid controller developers can conform to for widespread adoption. Field demonstration of the proposed concept in a low risk living testbed environment such as DERConnect can de-risk deployment and improve technology developer/customer acceptance. Distributed Energy Resources Connect (DERConnect, https://derconnect.ucsd.edu/) is a new living laboratory at University of California San Diego (UCSD) which is set up for microgrid demonstrations with real loads and DERs on UCSD campus, and is capable of implementing coordination among microgrids to VPPs.

4. In accordance with Senate Bill 96[1], 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)?

[1] 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.

Distributed coordination of microgrids to form VPPs addresses the following technical and market barriers:

I. DERs and microgrid controllers have the capability for communication between multiple microgrids but lack standards for streamlined communication and data flow. The proposed project will result in updates to standards and protocols such as OpenADR and IEEE 2030.5 for widespread adoption by technology developers and vendors.
II. There is no streamlined procedure for energy and data sharing between microgrids and this is a customer pain point for adoption. The project project will result in well-defined mechanisms for coordination between independent microgrid entities to facilitate contracts for energy and data sharing.
III. The amount of data exchange can constrain communication channels between microgrids. This project will set minimum data exchange requirements including frequency of data exchange for a successful VPP implementation.
IV. This project addresses the concerns regarding data security by setting cybersecurity requirements for data exchange that ensures end-user privacy. Distributed coordination algorithms for optimal dispatch of microgrids have inbuilt mechanisms for ensuring privacy; however, these algorithms are not adopted by technology developers due to their complicated nature and long development times. This project can reduce that gap by standardizing dispatch objectives such as cost optimization, minimize load shedding etc. which then allows fixing the data exchange requirements between microgrids.
V. Non-compliance of a microgrid within a VPP is another concern. Leveraging distributed coordination algorithms, we can determine the maximum number of allowed non-compliant microgrids for a successful VPP implementation. We can further determine conservative kW/kWh exchange limits to minimize non-compliance.
VI. Microgrid VPPs can improve grid resiliency by enabling uninterrupted power during short-term outages and minimize load shedding during longer events.
VII. Microgrid VPPs can improve post recovery activities after a natural hazard.

Projects under this concept are expected to implement distributed coordination algorithms that are popular in other fields but not yet adopted by the energy industry due to cybersecurity, cost, and resiliency concerns. In addition to field demonstrations to de-risk deployment, projects are expected to develop power system models using industry standard tools such as PSSE, PSCAD, RTDS, etc. which can further increase adoption.

Projects under this concept are expected to incentivize technology developers and vendors to implement distributed coordination in microgrid controllers and VPP implementation. Utility benefits include integration with grid operations, improved customer adoption, deferred infrastructure investment, and improved response to wildfires. Customers and rate-payers will benefit from increased cost savings, and potentially a large role in negotiating agreements between microgrid operators. The scientific community is incentivized to develop new resilient and energy efficient algorithms for distributed coordination.

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,[2] reliability,[3] affordability,[4] environmental sustainability,[5] and equity?[6]

   This concept directly addresses the ratepayer benefits in terms of reliability, and environmental sustainability by developing coordination between VPPs which encourages zero emission DER adoption, and improves reliability by enabling microgrids to island. Microgrids also

---

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

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

[4] 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.

[5] 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.

[6] 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.

improve affordability by managing grid constraints which allows more EV adoption that otherwise require infrastructure investment, particularly in disadvantaged communities.

Standards developed as a result of this concept will streamline enrollment of microgrids in VPPs and open a path for collaborative microgrids. This concept will also incentivize technology developers to incorporate microgrid VPP standards in optimization algorithms.

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

   Quantitative metrics include:
   - Annual avoided CO2 emissions
   - Reduced customer outage minutes
   - Time to full recovery after wildfire
   - Time to island and reconnect
   - Revenue from sharing energy with neighboring microgrids
   - Flexible kWh available for export
   - Deferred infrastructure costs

   Qualitative metrics include, but are not limited to customer satisfaction with microgrid VPP programs, utility acceptance of coordinated microgrids.

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.

8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:[7]
   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

[7] 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

e. Climate Adaptation

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

The project primarily focuses on b. Distributed Energy Resources Integration since it includes integration and control of DERs in microgrids and VPPs.
The project also addresses Building Decarbonization as well as assisting in Achieving 100 Percent Net-Zero Carbon Emissions since it maximizes the use of DERs and load flexibility by intelligent control mechanisms. Furthermore, coordination between DERs allows constrained microgrids to receive support from microgrids with unused energy. This encourages zero emission DERs adoption and can potentially improve return on investment.

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