DOCKETED	
Docket Number:	25-EPIC-01
Project Title:	Electric Program Investment Charge 2026–2030 Investment Plan (EPIC 5)
TN #:	265426
Document Title:	Francois Ayello Comments - Quantifying Resilience A Predictive Modeling Tool for California Grid Vulnerability and Recovery
Description:	N/A
Filer:	System
Organization:	Francois Ayello
Submitter Role:	Public
Submission Date:	8/8/2025 10:41:11 AM
Docketed Date:	8/8/2025

Comment Received From: Francois Ayello
Submitted On: 8/8/2025
Docket Number: 25-EPIC-01

Quantifying Resilience A Predictive Modeling Tool for California Grid Vulnerability and Recovery

This concept proposes the development of a predictive modeling and monitoring platform to quantify the vulnerability, response, and recovery of Californiaâ€™s electrical grid under multiple hazard scenariosâ€”including wildfires, earthquakes, landslides, extreme heat, and drought. The tool will help utilities, regulators, and local governments assess where, when, and how the grid is likely to fail, how quickly it can recover, and what investments can most effectively improve resiliency while maintaining affordability and equity.
The model would integrate:
â€¢ Geospatial infrastructure data
â€¢ Climate and land movements and seismic risk projections
â€¢ Energy demand and DER deployment patterns
â€¢ Recovery time, outage impact, and economic loss metrics

Additionally by providing real time or near real time data capture links, the tool can be used as a live â€œrisk monitorâ€ similar to what is used in other energy sectors such nuclear power plants. By simulating both short-term shocks and long-term climate stressors, the tool will support resilience planning, project prioritization, and cost-benefit analysis of mitigation strategies (e.g., microgrids, undergrounding, geothermal integration).

Why is this needed:
â€¢ Although software already exist such as
o https://www.dnv.com/software/electric-grid-reliability-performance/
o https://www.risksciences.ucla.edu/wra-projects-blog/wpra,
there is no state-specific resilience modeling framework available today that integrates technical, social, and environmental risk factors across the grid.
â€¢ Utilities and local planners need accessible, data-driven tools to guide resilience investments, especially under SB 100 and in disadvantaged communities.
â€¢ EPIC support would fund the interdisciplinary R&D needed to combine hazard modeling, grid behavior simulation, and recovery forecasting into a practical decision-support tool tailored to California.

Such a project directly supports EPICâ€™s goals of enhancing reliability, safety, affordability, and equity in a rapidly evolving energy landscape.

See document attached.

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:

   Dr Ali Mosleh
   Professor and Director at UCLA Henry Samueli School of Engineering and Applied Science
   443-413-5775
   mosleh@g.ucla.edu

   Dr Francois Ayello
   AMPP Fellow
   Principal Engineer, DNV USA, Inc.
   614 440 6056
   Francois.Ayello@dnv.com

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

   The B. John Garrick Institute for the Risk Sciences
   University of California, Los Angeles
   Engineering VI 5th Floor, 404 Westwood Plaza
   Los Angeles, CA 90095

   DNV USA, Inc.
   155 Grand Ave, Ste 500,

Oakland, CA 94612, US

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?

Quantifying Resilience: A Predictive Modeling Tool for California Grid Vulnerability and Recovery

This concept proposes the development of a predictive modeling and monitoring platform to quantify the vulnerability, response, and recovery of California's electrical grid under multiple hazard scenarios—including wildfires, earthquakes, landslides, extreme heat, and drought. The tool will help utilities, regulators, and local governments assess where, when, and how the grid is likely to fail, how quickly it can recover, and what investments can most effectively improve resiliency while maintaining affordability and equity.
The model would integrate:

- Geospatial infrastructure data
- Climate and land movements and seismic risk projections
- Energy demand and DER deployment patterns
- Recovery time, outage impact, and economic loss metrics

Additionally by providing real time or near real time data capture links, the tool can be used as a live "risk monitor" similar to what is used in other energy sectors such nuclear power plants. By simulating both short-term shocks and long-term climate stressors, the tool will support resilience planning, project prioritization, and cost-benefit analysis of mitigation strategies (e.g., microgrids, undergrounding, geothermal integration).

Why is this needed:

- Although software already exist such as
    - https://www.dnv.com/software/electric-grid-reliability-performance/
    - https://www.risksciences.ucla.edu/wra-projects-blog/wpra,

  there is no state-specific resilience modeling framework available today that integrates technical, social, and environmental risk factors across the grid.
- Utilities and local planners need accessible, data-driven tools to guide resilience investments, especially under SB 100 and in disadvantaged communities.

- EPIC support would fund the interdisciplinary R&D needed to combine hazard modeling, grid behavior simulation, and recovery forecasting into a practical decision-support tool tailored to California.

Such a project directly supports EPIC's goals of enhancing reliability, safety, affordability, and equity in a rapidly evolving energy landscape.

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 advances California's statutory energy goals by enabling data-driven, risk-informed planning for a cleaner, more resilient electric grid.

   Barriers Addressed:
   - Technical Barrier: Lack of integrated, predictive tools that simulate how California's grid performs and recovers under extreme conditions (e.g., wildfires, earthquakes, heatwaves).
   - Market Barrier: Inability to evaluate and compare resilience-enhancing investments (e.g., DERs, storage, microgrids, undergrounding) on the basis of performance and cost.
   - Customer Barrier: Vulnerable communities experience repeated outages without transparency into resilience planning or equitable infrastructure upgrades.

   Key Data and Information Gaps Addressed:
   - No statewide tool currently integrates multi-hazard risks, grid recovery dynamics, and community vulnerability in a usable form for local or utility planning.
   - This tool would provide the first comprehensive, publicly accessible framework to (1) Compare resilience benefits across grid hardening, distributed energy deployment, and clean energy integration and (2) incorporate performance metrics such as outage duration, customer impact, and avoided economic loss.

Who Benefits and How:

- Utilities and grid planners: Identify high-risk assets, optimize infrastructure investments, and inform wildfire mitigation plans.
- State agencies (CEC, CPUC): Use for regulatory guidance, program funding prioritization, and climate adaptation policy.
- Local governments and Community-Based Organizations: Target resilience upgrades in disadvantaged and high-risk communities.
- Developers and technology providers: Understand where clean technologies (like geothermal or storage) provide the most resilience value.

The tool will accelerate California's progress toward 100% clean energy by ensuring the grid is not only clean, but also resilient, affordable, and equitable under the growing pressures of climate and infrastructure stress.

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]

   Anticipated Outcomes Include:

Safety	Helps prevent and shorten outages that pose risks to health, emergency response, and infrastructure.
Reliability	Enhances planning for firm clean power and rapid recovery during grid stress events.
Affordability	Guides investment toward the most cost-effective resilience measures, avoiding overbuilding and waste.
Sustainability	Prioritizes clean energy technologies (e.g., geothermal, storage, microgrids) that reduce emissions and improve resilience.
Equity	Identifies vulnerable, underserved areas for targeted resilience upgrades, ensuring inclusive benefits.

6. 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.

6.1 - Grid Vulnerability and the Need for Resilience Planning

- **SB 350** mentions doubling Energy Efficiency by 2030 https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/clean-energy-and-pollution-reduction-act-sb-350

- **California Energy Commission (CEC).** *Electric Program Investment Charge 2021–2025 Investment Plan* Emphasizes the importance of tools that improve grid resiliency, particularly for disadvantaged communities and during wildfire and climate-driven events. https://www.energy.ca.gov/publications/2021/electric-program-investment-charge-2021-2025-investment-plan-epic-4-investment

- **California Public Utilities Commission (CPUC).** *Guidance for Public Safety Power Shutoff (PSPS) Mitigation Plans*
  Highlights the growing frequency of PSPS events and the need for proactive investment in grid hardening and local resilience. https://www.cpuc.ca.gov/psps/

6.2 - Need for Assessing the Effects of Climate Risk on Resilience

- *California's Fourth Climate Change Assessment (2018)* shows increasing threats from wildfire, extreme heat, and drought, which create new operational challenges for the electric grid. It supports the need for forward-looking, hazard-based planning tools. https://www.climateassessment.ca.gov/

- **NREL**. *Resilience in Energy Planning (2020)* identifies metrics and modeling frameworks to evaluate power system resilience and the co-benefits of distributed energy resources. https://www.nrel.gov/security-resilience/energy-resilience

6.3 - Need for Equity and Community Resilience

- **CEC** *EPIC Program Equity Indicators Report (2023)* reinforces the need for inclusive resilience strategies and highlights data gaps in assessing grid vulnerability in disadvantaged communities.

https://www.energy.ca.gov/rules-and-regulations/energy-suppliers-reporting/clean-energy-and-pollution-reduction-act-sb-350-3

7. 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.

    7.a Transportation Electrification
    While not focused on EV infrastructure, this project directly supports transportation electrification by improving the resilience of the grid that will be increasingly burdened by vehicle charging demand.

    7.b Distributed Energy Resource (DER) Integration
    The proposed tool will evaluate how distributed energy resources—like rooftop solar, battery storage, and microgrids—contribute to resilience in different parts of the grid. It will help identify where DERs provide the greatest benefit during outages or grid stress, guiding investment in DER deployment not just for decarbonization, but also for emergency support and local recovery. This supports more strategic, resilient, and equitable DER integration.

    (c) Building Decarbonization
    As buildings shift to all-electric systems, their resilience during outages becomes more critical. This tool will help planners understand how building electrification intersects with grid vulnerability, and where to prioritize upgrades or backup systems to maintain continuity of service. It enables safer and more reliable decarbonization of the building sector.

    (d) Achieving 100 Percent Net-Zero Carbon Emissions
    Grid resilience is essential to phasing out natural gas without compromising reliability. By identifying cost-effective clean energy investments that also deliver resilience benefits this project helps California achieve net-zero emissions goals without falling back on fossil

backup. It supports planning that ensures clean power is not just abundant, but also available when and where it's needed most.

(e) Climate Adaptation

This project directly supports climate adaptation by modeling how the grid performs under California-specific climate stressors (wildfires, extreme heat, drought, and earthquakes). It enables state and local agencies to prepare for, withstand, and recover from climate-driven disruptions, and prioritize investments in the most vulnerable and disadvantaged communities. The tool is a critical enabler of evidence-based climate resilience planning.

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

---

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