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Accelerate adoption of clean technologies in California cities

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:

   Chris Jones
   cmjones@berkeley.edu
   530-650-9493

   Kaihui Song
   kaihuis@berkeley.edu
   734-353-2248

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

   CoolClimate Network, UC Berkeley

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?

Local governments are critical to achieving state decarbonization goals. Effective and equitable transportation electrification, building decarbonization, distributed energy resources and climate adaptation will require a combination of state, local and regional policy, combined with active engagement of community-based organizations, residents and businesses.

Climate action planning is the process by which local governments identify and prioritize local interventions to meet greenhouse gas reduction targets. The California Air Resources Board (Scoping Plan Appendix D) encourages local governments to develop climate action plans (CAPs) while the California Environmental Quality Act provides streamlining of projects identified in CAPs that meet statewide emission reduction criteria. As a result, most California local governments have developed at least one CAP (Boswell, 2025), but their development has been sporadic, inconsistent, and costly to local governments, especially those with limited resources.

A recent UC Berkeley project has developed greenhouse gas inventories along with hundreds of data indicators, and a policy tool intended to dramatically reduce costs of local governments to develop climate action plans. Rather than each local government individually collecting data, usually hiring consultants, this project streamlined the process by providing standardized methods for tracking sector-specific GHG emissions, assessing key indicators, and estimating the mitigation potential of various policies. These tools have garnered strong interest from local governments and are helping to scale climate planning efforts more efficiently and equitably.

While improved GHG inventories have helped cities better understand their emissions profiles, many still face challenges in identifying cost-effective decarbonization strategies, particularly given financial and social constraints. This proposed project aims to pinpoint high-impact, low-cost opportunities ("low-hanging fruit") to accelerate the adoption of clean technologies such as electric vehicles, solar rooftops, and heat pumps. To achieve this, the project will undertake the following tasks:

Task 1. Building a spatially and temporally resolved dataset to track the historical deployment of clean technologies at the census tract level across selected cities.

- **Solar + Battery**: Data will be sourced from the *California Distributed Generation Statistics (DG Stats)* database, covering installation size, location, and adoption date.

- **Heat Pumps**: We will use the *TECH Clean California Public Reporting Portal* to extract installation records by location and year.

- **Electric Vehicles**: EV fleet data will be collected from the *California EMFAC model*, disaggregated by census tract using registration records and vehicle type.

This dataset will provide insights into adoption patterns, temporal trends, and geographic disparities across technologies and communities.

Task 2. Modeling Clean Technology Deployment Potential Under Constraints.

We will develop spatially explicit models and metrics to assess the technical and feasible potential for scaling clean technologies, integrating economic, infrastructural, and social dimensions. The approach will vary by technology:

- Rooftop Solar + Storage:
    - Use machine learning–based regression to estimate rooftop area from parcel-level building footprints and remote sensing data.
    - Apply hourly PV generation modeling using climate data (e.g., solar irradiance, temperature).
    - Simulate hourly electricity demand for building archetypes to evaluate grid-aligned feasibility.
    - Perform techno-economic optimization to determine deployable capacity by building type, incorporating cost, payback period, and grid constraints.
- Electric Vehicles:
    - Identify tipping points for EV adoption by analyzing local infrastructure (e.g., public charging availability), income levels, and policy incentives.
    - Apply discrete choice models or logistic regression to forecast adoption probability under various incentive and constraint scenarios.
- Heat Pumps:
    - Map building energy consumption and HVAC system types using utility benchmarking data and property characteristics.
    - Prioritize census tracts based on heating demand, fuel type, retrofit feasibility, and energy cost savings.
    - Incorporate social vulnerability indices to identify underserved areas with the highest co-benefits.

Each submodel will consider constraints related to financial resources, policy limitations (e.g., zoning, incentive eligibility), and supply chain or workforce readiness. Scenario analyses will simulate adoption trajectories under various constraint combinations.

Task 3. Developing strategic plans to accelerate adoption.

We will use multi-objective optimization to identify city-specific strategies that maximize emissions reductions and co-benefits under different budget scenarios. The optimization model will:

- Allocate financial incentives across census tracts to maximize technology adoption and equity outcomes.
- Incorporate social cost of carbon, marginal abatement costs, and energy burden metrics.
- Provide policy-relevant outputs, such as target maps, investment efficiency curves, and technology-specific adoption pathways.

The results will support cities in designing cost-effective, equitable, and technically feasible climate action strategies tailored to local conditions.

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 informaion 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)?

Addressing barriers

While the original data covers residents in the state of California, there is no actionable information for local governments. We delivered synthesized and actionable information to local governments.

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[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.

a. Uncertainty about return on investment and system performance (especially for lower-income households or older buildings) limits consumer adoption.
b. Lack of location-specific deployment potential data hinders utilities, cities, and CBOs from targeting resources or infrastructure upgrades efficiently.

Technological and Analytical Innovation

The proposed project provides a scalable, data-driven framework for identifying cost-effective, place-based pathways to accelerate clean energy adoption, focusing on:

- Developing geospatial models to assess rooftop solar potential using ML-based rooftop detection and hourly PV simulations.

- Estimating EV tipping points by incorporating infrastructure readiness, socioeconomic profiles, and behavioral thresholds.

- Mapping heat pump feasibility based on energy use patterns, HVAC compatibility, and building characteristics.

This approach will generate decision-support tools that integrate spatial equity, technical feasibility, and financial impact, allowing stakeholders to prioritize adoption strategies that maximize emissions reductions per dollar invested.

Data gaps

- Integrated metrics combining technical, economic, and equity considerations.

- Modeling tools to simulate policy scenarios under varying financial, regulatory, and social constraints.

Primary beneficiaries:

- City and county governments: For building climate action plans with reduced planning costs and improved technical accuracy.
- State agencies (CEC, CARB, CPUC): For better targeting of incentive programs and tracking progress toward energy equity and decarbonization goals.
- Community-based organizations (CBOs): To identify disadvantaged communities most in need of support and clean energy investment.
- Utilities and regional planning agencies: To plan grid upgrades and forecast distributed energy resource (DER) deployment under realistic adoption scenarios.

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]

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

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

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[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.

[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

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.

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