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Electric Program Investment Charge

2025 Annual Report

Gavin Newsom, Governor

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PREFACE

The California Energy Commission's (CEC) Energy Research and Development Division (ERDD) supports energy research and development programs to spur innovation in energy efficiency, load flexibility, renewable energy and advanced clean generation, transportation, grid transmission and distribution, and energy-related environmental protection.

In 2011, the California Public Utilities Commission (CPUC) established the Electric Program Investment Charge (EPIC) to fund public investments in research that create and advance new energy solutions, foster regional innovation, and bring ideas from the laboratory to the marketplace. The CPUC initially authorized the program through 2020 and selected the CEC and the state's three largest electric investor-owned utilities (IOUs) — Pacific Gas and Electric Company, San Diego Gas & Electric, and Southern California Edison — to administer EPIC funds. EPIC is funded by a ratepayer surcharge from customers of these IOUs, and the investments from EPIC deliver benefits back to ratepayers.

In 2020, the CPUC renewed EPIC for an additional ten years, through 2030, and approved the CEC to continue as an EPIC program administrator. In 2021, the CPUC extended the role of the IOUs as administrators of EPIC until 2025. In addition, the CPUC established a mission statement that EPIC investments provide "equitable access to safe, affordable, reliable, and environmentally sustainable energy for electricity ratepayers" (Decision 21-11-028). The CPUC revised the guiding program principles to ensure ratepayer benefits of improved safety, increased reliability, increased affordability, improved environmental sustainability, and improved equity. Moreover, the CPUC established several administrative requirements to increase transparency and better align future EPIC investments with its Environmental and Social Justice and Distributed Energy Resources action plans, as well as the federal Justice40 Initiative. The CPUC updated the program planning and coordination process in 2023 and adopted five EPIC strategic goals in 2024: Transportation Electrification, Distributed Energy Resource Integration, Building Decarbonization, Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas, and Climate Adaptation.

The ERDD is responsible for executing EPIC at the CEC. For more information about ERDD's work on EPIC, please visit the CEC's website at https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program.

ABSTRACT

The Electric Program Investment Charge (EPIC) is California's premier electricity sector research and development program. EPIC drives innovation and advances science and technology in energy efficiency, load flexibility, renewable energy and advanced clean generation, transportation, grid transmission and distribution, and energy-related environmental protection, among other areas important to improving and decarbonizing California's electricity system. EPIC is funded by a ratepayer surcharge from the state's electric investor-owned utilities, and EPIC investments deliver benefits back to ratepayers.

EPIC is overseen by the California Public Utilities Commission (CPUC) and administered separately by the California Energy Commission (CEC) and the state's three largest electric investor-owned utilities. CEC-administered EPIC investments support applied research and development, clean energy demonstration and deployment projects, and market facilitation activities that benefit electric ratepayers and lead to technological advancements that, in turn, can overcome key barriers to the state's energy and climate goals.

This report summarizes the progress and status of EPIC-funded CEC activities from January 1, 2025, through December 31, 2025. In 2025, EPIC continued to invest in promising clean energy innovations while leveraging existing federal, public, and private capital to maintain and accelerate the development of novel technologies to benefit California's electricity ratepayers. Many companies and projects funded in prior years began to achieve technology validation, at-scale deployment, early-stage manufacturing, and product commercialization, enhancing the affordability, sustainability, reliability, equity, and safety of the clean energy transition.

The report was prepared in accordance with applicable CPUC Decisions and California Public Resources Code Section 25711.5.

Keywords: Advanced generation, affordability, agriculture, battery, behind-the-meter, bioenergy, buildings, California Energy Commission, California Public Utilities Commission, clean energy economy, climate change, decarbonization, demand response, disadvantaged community, distributed energy resources, DER integration, distributed generation, Electric Program Investment Charge, electric vehicles, electricity, electrification, energy efficiency, energy equity, energy policy, energy research, energy storage, entrepreneurial ecosystem, environmental, environmental and social justice community, equity, grid, floating offshore wind, geothermal, global warming potential, greenhouse gas, heat pumps, heat pump water heaters, industrial, interoperability, investor-owned utilities, jobs, load flexibility, low-income community, medium-duty and heavy-duty vehicles, offshore wind, public engagement, ratepayer benefits, renewable energy, research and development, resilience, safety, solar,

startups, sustainability, technology development and demonstration, transmission, transportation, tribal, U.S. Department of Energy, virtual power plant, water, zero-carbon

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EXECUTIVE SUMMARY

Program Overview

Through the Electric Program Investment Charge (EPIC), the California Energy Commission (CEC) funds innovation to advance an affordable, clean, safe, and reliable electricity system that benefits all California ratepayers. EPIC was established in 2011 and, as of December 31, 2025, had invested $1.5 billion across 602 public research and development projects. Collectively, private companies that have received EPIC funding have attracted more than $19.8 billion in subsequent private funding — a greater than 13-fold amplification that demonstrates the success of EPIC in launching innovative and important clean energy technologies. The California Public Utilities Commission (CPUC) oversees and monitors the implementation of EPIC.

Key Successes and Highlights at a Portfolio Level

The CEC's EPIC research portfolios are advancing innovations that make California's electricity system more affordable, clean, resilient, and nimble. These advancements help to manage electric rates and avoid costly system upgrades by dispatching energy more efficiently and optimizing use of existing electric infrastructure. EPIC demonstration projects, sited in investor-owned utility service territories, have validated novel technologies and approaches to address key sectors and issues, supporting renewable energy supplies, managing flexible loads, and mitigating grid impacts from extreme weather events driven by climate change. Examples include second-life battery repurposing, through which used electric vehicle batteries are leveraged to support stationary applications, and industrial decarbonization use cases where new technologies improve the efficiency of and reduce emissions from energy-intensive industrial processes. These innovations help transform and modernize California's electricity system and clean energy economy.

EPIC also supports companies and innovations that maximize electric vehicle charging infrastructure buildout, user experience, affordability, interoperability, and behavior optimization for the more than 1.4 million fully electric vehicles on California's roads. For example, the Advanced Technology Research Center opened its testing facility in 2025 to support research that advances electric refueling practices and charging infrastructure buildout for heavy-duty electric trucks. The research center was co-developed by the Electric Power Research Institute and CALSTART, a national clean transportation nonprofit organization, sited at Southern California Edison's High-Power Charging Lab. Moreover, grid-supportive transportation projects featuring on-site solar, storage, and load flexibility are demonstrating

the ability to expand charging infrastructure while reducing the need for grid upgrades. Such EPIC investments are developing solutions to support a reduction in the disproportionate burden of transportation emissions in the state.

EPIC load flexibility research aims to maximize the benefits that distributed energy resources like battery energy storage, electric vehicles, and smart devices provide to the grid by shifting energy use to time periods when electricity is cleaner and less expensive. Distributed energy resources have diverse use cases that can support community benefits like energy resilience, affordability, and decarbonization. To enhance the ability of electricity users to shift or adjust their electricity demand, EPIC-funded research and demonstration projects test whole-system and component solutions, such as communication and control technologies. Several load flexibility projects are also advancing virtual power plants, which are aggregations of distributed energy resources that operate in concert to reduce load or contribute electricity supply to the grid in response to stressed grid conditions.

EPIC provides grant funding to accelerate electrification and improve energy efficiency in the industrial sector. Projects supporting industrial decarbonization include efforts to automate and better manage water and energy usage at farms, wastewater treatment centers, dairies, and cold storage facilities. The potential for ratepayer benefits, including significant cost, energy, and peak load savings, from these projects is promising. Field tests from CEC solicitations serve to familiarize industrial sector end users with the benefits of emerging decarbonization technologies, promoting future deployments. Most industrial customers hesitate to install emerging technologies that have not been demonstrated in similar settings. Demonstration projects thus serve an important role that is a precursor to deployment-focused incentive programs.

To advance building decarbonization, EPIC continues to fund a wide array of efforts to make electrification more affordable and accessible, and guide policies, planning, codes, and standards. In support of the state's goal of installing 6 million heat pumps by 2030, the portfolio includes demonstration and deployment projects in disadvantaged and low-income communities where advanced electric appliances are being installed on-site. The projects include assessments of performance and cost, with a particular focus on electrification technologies that can be deployed affordably without requiring electrical panel upgrades.

Other demonstration projects are testing retrofit strategies and refrigerants that directly reduce energy consumption or emissions, thereby improving comfort and affordability for occupants while decreasing environmental impacts and strain on the grid. Additional projects are introducing new tools into the field to make it easier to check the performance of

buildings, find electrification solutions, and manage permits and purchases. These tools help customers electrify their homes and businesses more affordably, quickly, and effectively.

Many companies and projects previously funded by EPIC progressed in 2025 to achieve technology validation, at-scale deployment, early-stage manufacturing, or product commercialization. The significant amount of follow-on (subsequent) and match funding that the program has leveraged greatly amplifies the effects of EPIC clean energy research, demonstration, and deployment portfolios. EPIC, therefore, has an outsized effect on enhancing the state's ability to achieve climate and energy goals, deliver affordability and other ratepayer benefits, and lead in advancing the clean energy transition across the United States.

EPIC enables and accelerates this transition by investing in technologies that can lower production costs, expand equitable access to clean energy resources and benefits, improve grid planning and operations, and significantly decrease greenhouse gas emissions with novel approaches.

Grant recipients made progress on project agreements while CEC staff planned, scoped, and disbursed grant opportunities from the current EPIC 4 Investment Plan. That plan, approved by the CPUC in April 2022, codified EPIC 4 program guidelines. CEC staff also engaged with the CPUC to help guide development of strategic objectives and initiatives for the EPIC 5 Investment Plan that will establish a program investment framework for 2026 to 2030.

The CEC made significant progress in 2025 toward achieving the strategic objectives and initiatives of the previous and current EPIC investment plans. Most active projects in the portfolio are funded from the EPIC 3, EPIC 4 Interim, and EPIC 4 Investment Plans. This annual report highlights progress toward the most recent EPIC 4 Investment Plan strategic objectives and initiatives.

Challenges and Impediments at a Portfolio Level

In 2025, new challenges emerged with the change in the federal administration. New tariffs on imported materials and specialized equipment led to longer lead times, higher equipment costs, and delays in project implementation as companies and supply vendors had to adjust. Shifting policy priorities under the current federal administration led to the reduction or cancellation of nearly $8 billion in federal funding opportunities. Reductions in solar and wind tax credits and electric vehicle manufacturing incentives, among other federal policy actions and signals, greatly impacted clean energy momentum—and a willingness to support research, development, and demonstration (RD&D)—across the country. These changes particularly impacted investments in emerging technologies that rely on long-term market stability and

clear policy signals. In addition to this general unpredictability and decreased support, several EPIC projects had federal funding rescinded, stalling key cost-share agreements.

Persistent challenges in 2025 included the following:

- Inflation, market volatility, and supply chain instability.
- Device interoperability and system integration challenges for distributed energy resources projects amid a fragmented regulatory landscape.
- Limitations on data availability and approaches to incorporating research in legacy planning processes.
- Permitting and interconnection delays (up to 18 months).
- Workforce and contractor availability.
- Delays with obtaining third-party certifications of new technologies.

Advancing Energy Equity

Energy equity, the fair distribution of the costs and benefits of energy use and climate change responses across all segments of society, is essential to a just and fair clean energy transition. One crucial focus of EPIC is expanding opportunities for participation from disadvantaged and low-income communities, tribes, and rural communities in developing the state's clean energy economy. In addition to program development, project investment and benefits must reach California's priority populations. Through 2025, 67 percent of CEC EPIC technology demonstration and deployment funds were invested in projects with demonstration sites in low-income communities or disadvantaged communities, as defined by Assembly Bill (AB) 523 (Reyes, Chapter 551, Statutes of 2017). This total excludes projects involving combustion. Also through 2025, $46.7 million of technology demonstration and deployment funds were invested in projects on California Native American tribal lands.

Status of EPIC

In 2020, the CPUC renewed EPIC for ten years through 2030 and authorized the CEC to continue as an EPIC administrator with an annual budget of $147.26 million for the first five years (Decision 20-08-042). In 2022, the CPUC approved the CEC's EPIC 4 Interim Investment Plan, covering the first year of EPIC 4 funding. A year later, the CPUC approved the EPIC 4 Investment Plan covering 2022 to 2025.

In 2024, the CPUC adopted the following five strategic goals for EPIC 5, which spans 2026 to 2030:

- Transportation Electrification
- Distributed Energy Resources Integration
- Building Decarbonization
- Achieving 100 Percent Net-Zero Carbon and the Coordinated Role of Gas
- Climate Adaptation

In March 2025, the CPUC issued a ruling seeking comments on its staff proposal for 13 draft strategic objectives for the EPIC 5 investment cycle. In 2026, the CPUC will issue a proposed decision, consider comments, and issue a final decision adopting final strategic objectives.

CHAPTER 1:
Introduction and Overview

Background on EPIC

In 2011, the California Public Utilities Commission (CPUC) established the Electric Program Investment Charge (EPIC) and authorized the California Energy Commission (CEC) as one of four administrators alongside California's three largest electric investor-owned utilities (IOUs) — Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE). This program is funded by California electric utility customers under the auspices of the CPUC. The CEC administers 80 percent of the total program funds, investing in clean energy technologies and approaches to provide benefits and "equitable access to safe, affordable, reliable, and environmentally sustainable energy for electricity ratepayers."[1]

The CEC funds projects in all three investment areas of EPIC: applied research and development, technology demonstration and deployment (TD&D), and market facilitation.[2] Using a competitive selection process, the CEC awards EPIC funding to advance technological breakthroughs and accelerate the achievement of the state's statutory clean energy goals affordably and equitably.

The CPUC oversees the administration of EPIC funds, including approval of the CEC's EPIC investment plans that outline proposed project concepts for an investment period. Investment plans are shaped by CPUC decisions voted on by the five CPUC Commissioners. In 2021, the CPUC issued Decision 21-11-028, adopting the EPIC Mission Statement and streamlining EPIC's Mandatory Guiding Principles to provide greater focus to the program and improve

[1] California Public Utilities Commission. 2021. *Decision Approving the Utilities as Electric Program Investment Charge Administrators with Additional Administrative Requirements, Appendix A*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M425/K515/425515575.PDF.

[2] CPUC Decision 12-05-037 defines the three investment areas as follows:

- Applied research and development — activities supporting pre-commercial technologies and approaches that are designed to solve specific problems in the electricity sector.
- Technology demonstration and deployment — the installation and operation of pre-commercial technologies or strategies at a scale sufficiently large and in conditions sufficiently reflective of anticipated actual operating environments to enable appraisal of the operational and performance characteristics and the financial risks
- Market facilitation — a range of activities including program tracking, market research, education and outreach, regulatory assistance and streamlining, and workforce development to support clean energy technology and strategy deployment

transparency. The five streamlined principles for EPIC are to improve safety, increase reliability, increase affordability, improve environmental sustainability, and improve equity.[3]

The California Legislature must grant the CEC spending authority in an annual state budget to disburse EPIC funds for project awards and to use EPIC funds for administrative expenses. State law requires EPIC projects to not only benefit electricity ratepayers and help achieve California's statutory clean energy goals but also reduce the costs of building electrification and strategically focus investments on overcoming significant technological challenges.[4]

This *Electric Program Investment Charge 2025 Annual Report* (2025 EPIC Annual Report) is provided to the CPUC in accordance with CPUC decisions to date. To ensure consistent reporting among all four administrators, those decisions specify the outline and contents of this report, including project reporting requirements. The CEC also provides the 2025 EPIC Annual Report to the Legislature, as required by California Public Resources Code Section 25711.5, and makes the report publicly available on the CEC website (https://www.energy.ca.gov).

Program Components

The CEC has awarded 602 EPIC projects to date, spanning 14 years and five EPIC investment plans, including an EPIC 4 Interim Investment Plan.[5] Detailed information on these projects (cumulative through December 31, 2025) and respective statuses (active, completed,

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[3] California Public Utilities Commission. 2021. *Decision Approving the Utilities as Electric Program Investment Charge Administrators with Additional Administrative Requirements, Appendix A*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M425/K515/425515575.PDF.

[4] California Public Resources Code, Section 25711.5.

[5] The five plans are referred to as EPIC 1, EPIC 2, EPIC 3, EPIC 4 Interim, and EPIC 4 Investment Plans. Citations for each are given below in date order, beginning with EPIC 1.

- Bauer, Silas, Beth Chambers, Pamela Doughman, Sherrill Neidich, Joe O'Hagan, Garry O'Neill Mariscal, Jamie Patterson, Michael Sokol, and Erik Stokes. 2012. *The Electric Program Investment Charge: Proposed 2012-14 Triennial Investment Plan*. California Energy Commission. Publication Number: CEC-500-2012-082-CMF. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M031/K735/31735968.PDF.
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- Gutierrez, Aleecia, Virginia Lew, Anthony Ng, Fernando Pina, Linda Spiegel, Erik Stokes. 2017. *Electric Program Investment Charge: 2018–2020 Triennial Investment Plan*. California Energy Commission. Publication Number: CEC-500-2019-017. https://www.energy.ca.gov/sites/default/files/2019-02/CEC-500-2019-017-CMF.pdf or https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M185/K575/185575884.PDF.
- California Energy Commission. 2021. *Appendix A: California Energy Commission Proposed EPIC Interim Investment Plan 2021*. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M365/K279/365279384.PDF.
- Lew, Virginia, Anthony Ng, Mike Petouhoff, Jonah Steinbuck, Erik Stokes, Misa Werner. 2023. The Electric Program Investment Charge 2021-2025 Investment Plan: EPIC 4 Investment Plan. California Energy Commission. https://www.energy.ca.gov/publications/2021/electric-program-investment-charge-2021-2025-investment-plan-epic-4-investment.

terminated with funds spent, or pending final approval) can be found in Appendix C. Project background information, funding, and recipient details can also be found on the Energize Innovation Project Showcase (https://www.energizeinnovation.fund/projects) by searching on the agreement numbers, which begin with "EPC." Chapter 4 describes how the CEC project portfolio is driving progress, achieving project and program goals, and addressing barriers across EPIC 4 strategic objectives and initiatives.

Tables 1 and 2 summarize quantifiable impacts and benefits that EPIC-funded projects have achieved. Impacts are grouped into the following overarching categories: technology advancement and commercialization, technology diffusion, knowledge generation and dissemination, and diversity and equity.

Table 1: Quantifiable Benefits of CEC EPIC Investments by Impact Category

Impact Category	Quantifiable Benefits
Technology Advancement and Commercialization	• Private companies that have received EPIC funding have attracted more than $19.8 billion in private funding.[6] • Recipients of agreements active during 2025 have received more than $365 million in non-CEC public funding.[7]
Knowledge Generation and Dissemination	• CEC hosted the 11th annual EPIC Symposium to share research findings. Total in-person and online attendance reached nearly 850. • The CEC's Empower Innovation platform[8] had 5,300 members with more than 1,300 organizations and more than 700,000 page views.
Diversity and Equity	• About 67 percent of CEC EPIC TD&D funding has been awarded to projects located in and benefiting disadvantaged and low-income communities.[9] • About $46.7 million of the CEC's technology demonstration and deployment funds have been invested in projects on California Native American tribal lands.

[6] This number comes from Pitchbook, which tracks the financial information of more than a million companies. However, not all EPIC award recipients are included in its database. Some larger research partners, like the national laboratories and the University of California, are tracked, but individual research centers within these institutions are often not separately identified. As a result, CEC staff tracks only private companies with Pitchbook, leading to a smaller total for private funding than would be possible if accurate tracking were possible for all EPIC recipients.

[7] Figure provided by EPIC awardees who responded to the 2025 EPIC Annual Report Recipient Survey.

[8] Empower Innovation (https://www.empowerinnovation.net/) is an initiative of the CEC, in partnership with leading California technology accelerators, fellowship programs, nonprofits, and private partners. Empower Innovation strives to accelerate the cleantech journey with easy access to funding opportunities, curated resources, and connections to people and organizations working toward a clean energy economy for all.

[9] These data exclude combustion-related TD&D projects.

Source: California Energy Commission staff

As part of EPIC administration, CEC staff surveyed recipients of EPIC-funded agreements that were active during the 2025 calendar year. Table 2 summarizes quantifiable impacts and benefits of CEC EPIC-funded projects based on survey responses from 195 EPIC funding recipients.

Table 2: Benefits Enabled by CEC EPIC Investments in 2025 by Impact Category From the 2025 EPIC Annual Report Recipient Survey

Impact Category	Quantifiable Benefits
Technology Advancement and Commercialization	• More than $2.2 million in on-bill energy savings • 370 residential units with electrification projects • Nearly 5.3 gigawatt-hours (GWh) of electricity consumption and more than 178,000 therms of fossil gas consumption avoided • More than 850 full-time-equivalent jobs enabled • More than 6 million kilograms of carbon dioxide equivalent emissions avoided; this is equivalent to removing 1,400 gasoline-powered passenger vehicles from the road
Technology Diffusion	• 554 non-CEC-funded demonstrations/deployments of EPIC technologies/innovations in California
Knowledge Generation and Dissemination	• 52 tools and resources developed or enhanced by EPIC-funded projects • 396 community engagement events conducted, reaching more than 17,000 participants
Diversity and Equity	• 53 percent of respondents from businesses with 100 or fewer employees

Figures provided by EPIC awardees who responded to the 2025 EPIC Annual Report Recipient Survey.

Source: CEC staff

Table 3 shows the match funds that CEC EPIC projects attracted to California. For every $1 million of EPIC funding, partners of grant recipients contributed approximately $536,000 in match funding as part of the project award.

Table 3: Total Match Funds

Match Funding	EPIC Funding Awards	Match as Percentage of EPIC Awards
$830 million	$1,548 million	54 percent

Match funds are funds contributed by partners of grant recipients as part of the project award.

Source: CEC staff

Investing in Disadvantaged and Low-Income Communities

EPIC administrators are required to invest at least 25 percent of their TD&D funding to projects located in and benefiting disadvantaged communities and an additional 10 percent to projects located in and benefiting low-income communities.[10] The Legislature originally directed this requirement toward the CEC's EPIC funding in Assembly Bill (AB) 523 (Reyes, Chapter 551, Statutes of 2017), which expired in 2023. The CPUC extended those requirements permanently in April 2023 and expanded them to include the IOUs' TD&D investments.[11]

The CEC's EPIC TD&D investments exceed the minimum investment requirements for projects located in and benefiting disadvantaged and low-income communities. Through 2025, 41 percent of TD&D project funding was awarded to projects located in and benefiting disadvantaged communities, and an additional 26 percent was awarded to projects located in and benefiting low-income communities. Together, 67 percent[12] of EPIC TD&D funding has been awarded to projects located in and benefiting disadvantaged and low-income communities. Moreover, $46.7 million of TD&D funding was awarded to projects on California Native American tribal lands, an increase of $16 million compared to last year's total.[13]

Figure 1 illustrates the cumulative number of EPIC TD&D project sites through December 31, 2025, in disadvantaged communities, in low-income communities that are not also designated as disadvantaged communities, and on California Native American tribal lands. This mapping approach avoids double-counting, as several of California's disadvantaged communities are also low-income communities, and these communities are accounted for in the disadvantaged communities category only.

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[10] *Disadvantaged communities* are those designated under Health and Safety Code Section 39711 as representing the 25 percent highest-scoring census tracts in California Communities Environmental Health Screening (CalEnviroScreen) Tool 4.0, https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40. *Low-income communities* are those within census tracts with median household incomes at or below 80 percent of the statewide median income or the applicable low-income threshold listed in the state income limits updated by the California Department of Housing and Community Development.

[11] California Public Utilities Commission. 2023. *Decision on Phase 2-C of Electric Program Investment Charge Rulemaking*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M507/K499/507499284.PDF.

[12] These data exclude combustion-related technology demonstration and demonstration projects.

[13] "Tribal lands" are lands in California that are tribally owned lands, buildings, or facilities; lands a tribe exercises jurisdiction over; or lands that the Bureau of Indian Affairs holds in trust for tribes, individual allottees, or public domain allottees, or lands managed through conservation easements or through lease agreement, or through co-management agreements, for the benefit of tribes.

Geographic Diversity to Accelerate Technology Diffusion and Technological Learning

The successful emergence and diffusion of clean energy innovations from laboratory to market involves technological learning and iterative feedback from local installers, workers, early adopters, inspectors, regulators, and communities, among others. Technological learning within EPIC is cultivated primarily in the TD&D program area, in which new technologies, devices, and equipment are tested in the real world through careful observation, measurement, and performance verification. To ensure direct benefits to the ratepayers who fund EPIC, the siting of these projects is limited to California electric IOU service territories.

Figure 2 shows EPIC awardee headquarters and project sites across California, illustrating the wide reach and range of EPIC projects across the state. This map includes a cumulative total of EPIC awards through 2025 for applied research and development, TD&D, and market facilitation projects.

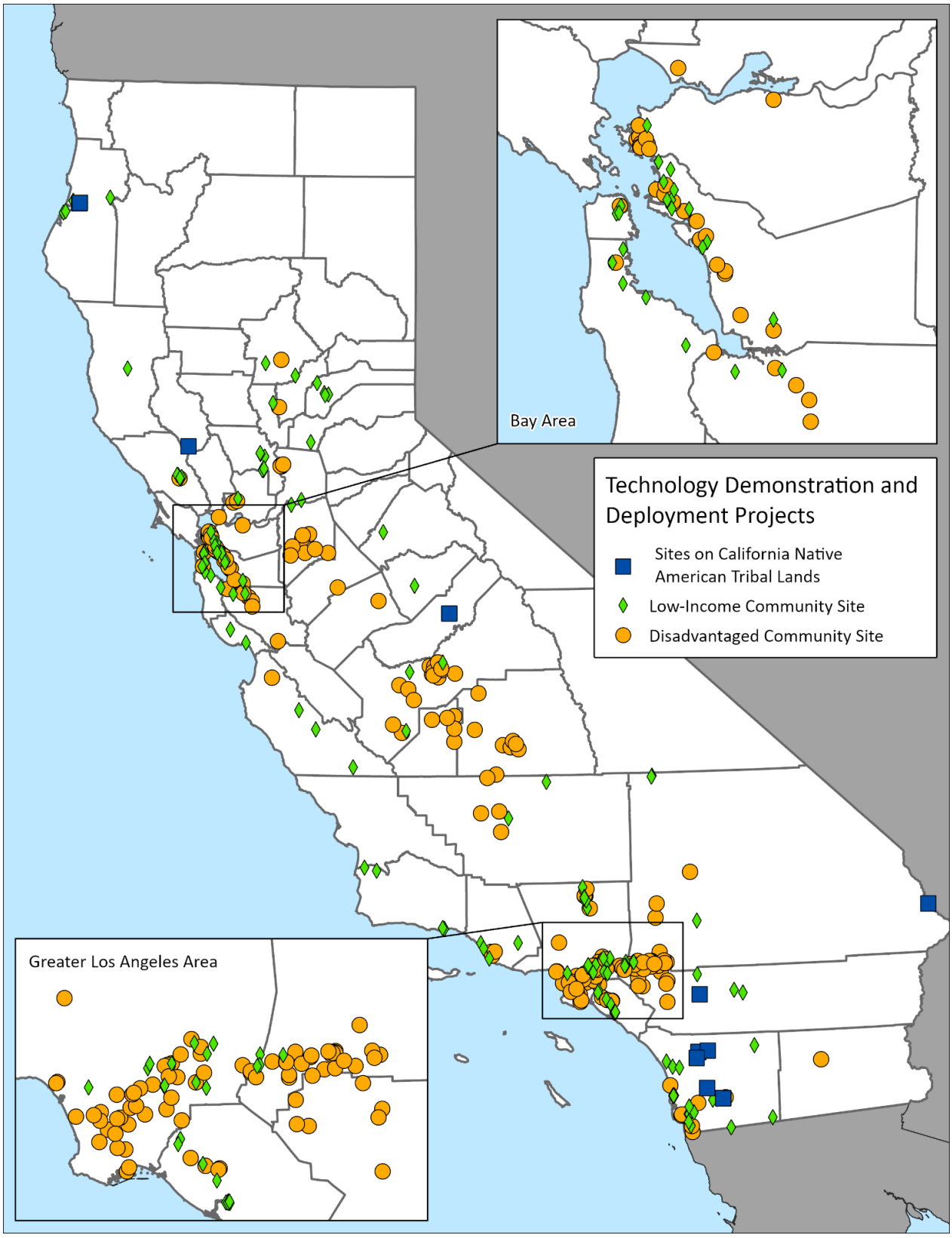
Increasing Diversity and Equity in EPIC

California's promise, successes, and innovations stem from the rich and diverse qualities and abilities of its people. While the CEC recognizes that there are many terms that can be used to describe similar populations, for this report and to align with EPIC requirements, "environmental and social justice (ESJ) communities"[14] is used as a broad term to include disadvantaged communities, low-income communities, and all California Native American tribes. The CEC is committed to conducting outreach to inform diverse business entities and ESJ communities about opportunities to participate in EPIC solicitations[15] and activities.

[14] ESJ communities are predominantly communities of color or low-income communities that are underrepresented in the policy setting or decision-making process, subject to a disproportionate impact from one or more environmental hazards, and likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities. ESJ communities target "disadvantaged communities" designated by the California Environmental Health Screening (CalEnviroScreen) Tool, all California tribal lands as defined in 18 U.S.C. 1151 subsection (a), low-income households with incomes below 80 percent of the area median income, and low-income census tracts with aggregated household incomes that are less than 80 percent of area or state median income.

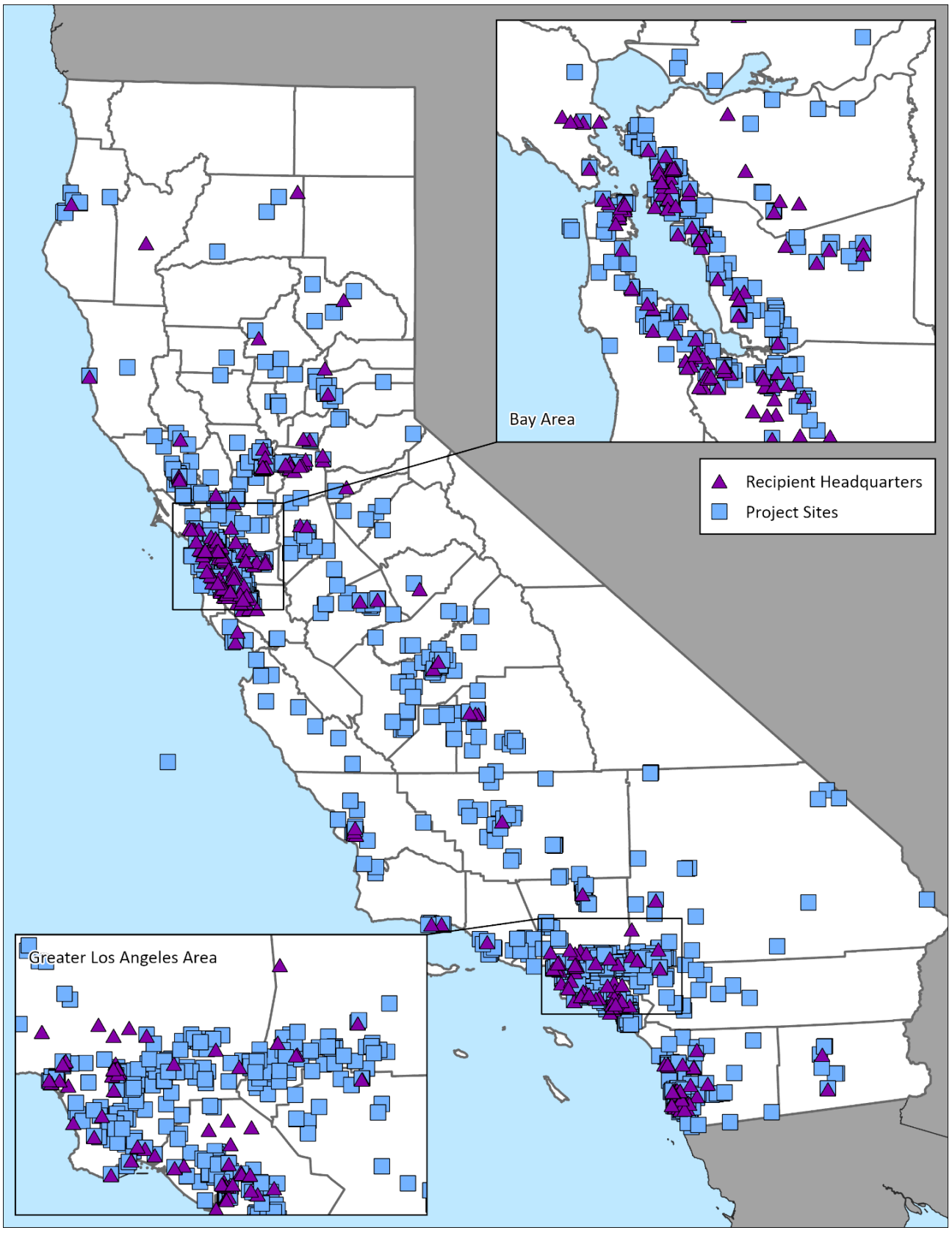
[15] Also known as grant funding opportunities (GFOs).

Figure 1: EPIC TD&D Project Sites in Disadvantaged or Low-Income Communities or on California Native American Tribal Lands Through 2025



Source: California Energy Commission staff

Figure 2: EPIC Recipient Headquarters and Project Site Locations Through 2025



Source: California Energy Commission staff

Furthermore, the CEC continually reviews and improves its solicitations to reduce barriers that might prevent ESJ communities from accessing clean energy research opportunities. Appendix C of this annual report identifies EPIC award recipients that are California-based entities; small businesses; or businesses owned by women, minorities, or disabled veterans.

CEC staff will monitor the development of equity metrics through the CPUC Policy + Innovation Coordination Group (PICG)[16] workshop process for EPIC 5 to continue to improve, in conjunction with other efforts, the CEC's integration of equity into all aspects of EPIC administration.

Transparent Public Process and Competitive Solicitations

The CEC has a robust outreach strategy to shape research priorities, investment planning, and grant solicitations. Public workshops, conducted virtually and in person throughout all stages of a solicitation, are a core method by which the CEC shares information with and solicits input from interested parties. Other outreach efforts include:

- Broadening scoping and engagement efforts with local governments, community-based organizations, environmental justice (EJ) advocates, academics, industry representatives, state and federal agencies, and market actors.
- Sharing knowledge, results, and lessons learned to inform policies, proceedings, codes, standards, and protocols.
- Promoting geographic diversity in CEC EPIC project funding to accelerate technology learning and diffusion.

Scoping Efforts

CEC staff typically solicits broad input on competitive research solicitation concepts by holding staff workshops or issuing requests for information (RFIs). For example, staff conducted a public scoping workshop on March 18, 2025, titled "Electric Vehicle Charging with Solar Microgrids"[17] to gather comments that will inform the development of a potential future funding opportunity. Input was solicited on electric vehicle (EV) charging solutions that can

[16] CPUC Decisions 18-10-008 and 18-10-052 established the EPIC Policy + Innovation Coordination Group (PICG). The PICG is composed of a project coordinator, the four program administrators, and the CPUC. The PICG ensures meaningful collaboration among its members and that EPIC investments align with and are guided by CPUC and California energy innovation needs and goals.

[17] California Energy Commission. 2025. "Electric Vehicle Charging with Solar Microgrids – EPIC Scoping Workshop." https://www.energy.ca.gov/event/workshop/2025-03/electric-vehicle-charging-solar-microgrids-epic-scoping-workshop.

integrate direct current (DC)-coupled solar microgrids and connect to the grid through flexible service agreements.[18]

Representatives from SCE and PG&E presented information on their flexible service pilot programs, which are central to the proposed solicitation. The workshop drew attendees from the CPUC; CEC; investor-owned and publicly owned utilities; California research institutions; national labs; public advocacy groups; and industry leaders in fleet electrification, power electronics, and EV charging. Several attendees, including the Clean Coalition, PG&E, SCE, and others, submitted public comments. Feedback from the workshop helped shape GFO-25-301, which was released in September.

Preapplication Workshops

For all solicitations, CEC staff holds preapplication workshops with potential applicants to discuss the solicitation's purpose and scope in a public forum. These workshops provide an opportunity for attendees to ask in-depth questions about the application process and connect with potential project partners. All questions and answers are posted online following preapplication workshops. In 2025, CEC staff held eight preapplication workshops.

Sharing Knowledge and Lessons Learned

As a public research program administrator, the CEC shares knowledge and lessons learned from EPIC projects with:

- Technology innovators, adopters, and investors.
- Architectural and engineering firms.
- Industry leaders.
- Start-up and product incubator services.
- Public funding providers.
- Local communities and governments.
- State and federal agencies.
- EJ advocates.
- Researchers.

[18] "Flexible service agreements" are contracts between utilities and customers for new load to be added to the electrical grid under dynamic operating conditions with special terms. Customers agree to reduce or shift their energy use during periods of local grid constraints, such as peak demand hours, reducing the need for distribution infrastructure upgrades and accelerating grid connection.

- Policymakers.
- The public.

This exchange is important for scientific and technological diffusion and accelerates the uptake of innovative achievements. CEC staff participation at external events and meetings is critical to enabling direct knowledge transfer of CEC EPIC-funded research, findings, and lessons learned for dissemination, replicability, and discussion that, in turn, can help identify future investment needs.

In 2025, the CEC participated in various knowledge-sharing efforts. Examples of efforts to which the CEC contributed include:

- February 25: CEC staff hosted a webinar[19] to showcase five EPIC projects that demonstrate the use of solar microgrids to support charging infrastructure for medium-duty and heavy-duty (MDHD) electric trucks and buses. The webinar featured informational presentations from each grant recipient, a presentation by CEC staff summarizing lessons learned, and a dedicated time for grant recipients to answer questions from the public. The highlighted projects included:
    - "Artificial Intelligence-Based Heavy-Duty Fleet Charging to Enable Distributed Energy Resource Integration" (EPC-20-038), MOEV Inc.
    - "Innovative School Bus Charging for Resilient Communities" (EPC-20-040), Lawrence Berkeley National Laboratory (LBNL).
    - "TAking Charge: TravelCenters of America Ultra-Fast En-Route Charging" (EPC-20-042), TA Operating LLC.
    - "Solar-Powered Fleet Charging at Sysco Riverside" (EPC-20-046), Sysco Riverside.
    - "Solar-Powered Charging for Medium- and Heavy-Duty Fleets" (EPC-21-006), WattEV, Inc.
- March 11–12: CEC staff organized a panel discussion at the 2025 Electrification Summit on Health Benefits of Building Decarbonization,[20] including a presentation of the results of the "Cooking Electrification and Ventilation Improvements for Children's Asthma"

[19] California Energy Commission. 2025. "Fleet Charging with Solar Microgrids – EPIC Project Showcase." https://www.energy.ca.gov/event/webinar/2025-02/fleet-charging-solar-microgrids-epic-project-showcase.

[20] California Energy Commission. 2025. "2025 CEC/EPRI Electrification Summit – Day 1." https://www.energy.ca.gov/event/meeting/2025-03/2025-cec-epri-electrification-summit-day-1.

project (EPC-21-033). The panel discussed the interface of air quality-related health, equity, energy, and the impacts and challenges of residential electrification at the household and community levels. Research indicates that the health and climate benefits associated with building electrification are substantial and may outweigh the upfront costs.

- August 6: CEC staff collaborated with project recipient Eagle Rock Analytics (EPC-20-007, EPC-21-038, and EPC-23-024) and provided the "Analytics Engine & Data Explorer Training: Reintroduction to the Analytics Engine and Data Explorer," which gave an overview of Cal-Adapt,[21] the new California Fifth Climate Change Assessment (Fifth Assessment)[22] tools, and guidance resources. The training helped increase the knowledge base for and expand the number of tool users. The project team also created reference materials for future users.
- Examples of ongoing knowledge dissemination efforts include the following:
    - Updated EPIC project information and results are shared through the Energize Innovation Project Showcase
    - Project recipients are encouraged to share project results in academic and scientific journals, industry-recognized publications, and public conferences.

Overview of Strategic Objectives

The CPUC approves new strategic objectives and initiatives with each investment cycle. In 2025, active EPIC projects spanned multiple investment plan cycles, and projects from different investment cycles correspond to the strategic objectives and initiatives of distinct plans. For simplicity, progress in this 2025 EPIC Annual Report is reported in relation to the current EPIC 4 Investment Plan strategic objectives and initiatives. The summary below details how 2025 EPIC activities made progress in addressing EPIC 4 strategic objectives and initiatives.

Strategic Objective 1: Accelerate Advancements in Renewable Generation Technologies

Investments under this objective fund research and development (R&D) activities advancing key renewable energy technologies in support of Senate Bill (SB) 100 (De León, Chapter 312,

[21] *Cal-Adapt* is California's public climate data platform that provides access to climate projections and historical weather data to help communities, agencies, utilities, and others understand climate risks and plan for resilience.

[22] *California's Fifth Climate Change Assessment* is a statewide report that synthesizes the latest climate science to evaluate current and future climate impacts in California and guide policy, planning, and resilience decisions.

Statutes of 2018) implementation. The four main topic areas for CEC investments are offshore wind (OSW), bioenergy, geothermal energy, and solar photovoltaic (PV) generation. Notable progress toward this objective in 2025 included the following:

- The CEC published final reports for two OSW-related research projects. A study conducted under EPC-19-010, Integrated Distributed Fiber-Optic Sensing for Real-time Monitoring of Offshore Wind Turbine Gearboxes, Tower Operations, and Marine Animal Activities,[23] demonstrated the versatility of distributed fiber-optic sensing technologies for industrial diagnostics and marine conservation with the ability to enhance wind turbine performance monitoring and detect underwater whale vocalizations. In addition, the final report from EPC-19-007, "On-site 3D Concrete Printing for Next-generation Low-cost Wind Plants,"[24] summarized applied research validating the structural performance of three-dimensional (3D) printed concrete towers. The report proved that the innovation can lower the cost and environmental impact of wind energy generation, create local jobs, enable new offshore applications, and support California's climate goals.
- CEC staff approved a final report (published in 2026) relating to geothermal energy and lithium recovery innovations under EPC-19-029, Improved Silica Removal for Enhanced Geothermal Plant Performance.[25] This project developed and demonstrated the capability of a geothermal mesofluidic enhanced particle separator[26] technology for removing silica, a commercially valuable mineral, in geothermal plants in the Salton Sea Geothermal Field.

[23] Wu, Yuxin, Linqing Luo, Kenichi Soga, Matthew DeJong, Jaewon Saw, and James Xu. 2025. *Integrated Distributed Fiber-Optic Sensing for Real-Time Monitoring of Offshore Wind Turbine Gearboxes, Tower Operations, and Marine Animal Activities.* California Energy Commission. Publication Number: CEC-500-2025-023. https://www.energy.ca.gov/publications/2025/integrated-distributed-fiber-optic-sensing-real-time-monitoring-offshore-wind.

[24] Falzone, G. 2025. *On-Site 3D Concrete Printing for Next-Generation Low-Cost Wind Plants*. California Energy Commission. Publication Number: CEC-500-2025-003. https://www.energy.ca.gov/sites/default/files/2025-01/CEC-500-2025-003.pdf.

[25] Shelby, Tyler, Raymond S. Addleman, Debra Barnett, Carolyn Burns, Chad Haugen, Dan Palo, Leonard Pease. 2025. *Improved Silica Removal for Enhanced Geothermal Plant Performance*. California Energy Commission. Publication Number: CEC-500-2026-002. https://www.energy.ca.gov/sites/default/files/2026-01/CEC-500-2026-002.pdf.

[26] The geothermal mesofluidic enhanced particle separator is a device that filters valuable minerals from geothermal brine. It also removes minerals that cause corrosion in geothermal plants, reducing operating costs of geothermal power plants and providing more flexibility than conventional silica management technologies.

Strategic Objective 2: Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy

There is a critical need to modernize and increase grid load flexibility. Improving the delivery of variable electricity supply to loads with flexible demand will allow clean, dispatchable resources to meet California's clean energy goals affordably and reliably. The CEC made notable progress toward this objective in 2025, from launching new funding opportunities and kicking off new projects to closing out existing projects and publishing final reports. Examples include the following milestones:

- Kicked off six new energy storage projects totaling more than $30 million, advancing a variety of technologies — including sodium-ion, nickel-zinc, and gravity-based storage through repurposing idle oil wells — that provide zero-carbon dispatchable resources in support of grid resilience and reliability
- Kicked off a $4 million project, "Biogas Microgrid for Clean Dispatchable Electricity for Linear Generators" (EPC-25-001), for the deployment of linear generators powered by renewable gas as part of a larger campus microgrid
- Released a $26 million solicitation, "Advanced Grid Technology Acceleration Projects," in June 2025, focused on advancing, validating, and informing future deployments of technologies that increase the flexibility and controllability of the grid
- Released a $7.2 million solicitation, "Coordinated, Holistic Orchestration of Inverter-Based Resources (CHOIR)" in October 2025, focused on optimizing operator and aggregator dispatch of customer-owned, distributed energy resources (DERs)
- Closed out successful projects and published final reports. For example, grant recipient Form Energy completed the first independent third-party validation of its 100-hour iron-air long-duration energy storage (LDES) product.[27] Furthermore, grant recipient Dash2Energy completed a pilot test of one of the state's first hydrogen-based power-to-power systems for dispatchable clean power.[28]

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[27] Baldwin, Annie, Mark Thompson, and Nicole Vadivel. 2025. *Demonstrating an Aqueous Air-Breathing Energy Storage System for Multi-Day Resiliency.* California Energy Commission. Publication Number: CEC-500-2025-045. https://www.energy.ca.gov/sites/default/files/2025-11/CEC-500-2025-045.pdf.

[28] Dash, Gordon H., III. 2025. *Demand Based Renewable Hydrogen Power-to-Power Project*. California Energy Commission. Publication Number: CEC-500-2025-043. https://www.energy.ca.gov/publications/2025/demand-based-renewable-hydrogen-power-power-project.

Strategic Objective 3: Increase the Value Proposition of Distributed Energy Resources

Distributed energy resources (DERs) are key components of California's clean energy future and economywide decarbonization. DERs refer to any grid resources on the distribution system or located on a customer's property, known as behind-the-meter (BTM) resources, because the energy systems are on the customer's side of the utility meter. DERs include but are not limited to energy generation, storage, demand flexibility, energy efficiency, and electric vehicles (EVs). In a high-renewables, high-electrification future, DERs can deliver significant benefits to the electric grid and ratepayers, such as reducing peak demand, supporting renewable integration, reducing or deferring grid upgrades and associated costs, and improving climate resiliency and grid reliability. EPIC investments toward this objective focus on topics such as:

- Improving grid reliability through load flexibility.
- Advancing planning, communication, and control technologies for DER integration.
- Aligning transportation electrification with grid needs.
- Supporting recycling and reuse of critical energy storage materials.
- Exploring innovative financing and business models.

Notable progress toward this objective in 2025 included the following milestones:

- Released the solicitation titled "Improving Net-Load Forecasting Models by Integrating Data on Behind-the-Meter Resources" (Forecasting BTM Resources, GFO-25-303). This solicitation funds up to $3 million for advanced short-term net-load forecasting research, including improved visibility of rooftop solar, battery storage, EV charging, and flexible loads for operational and planning use.
- Advanced eight active community-scale DER demonstrations under the Design-Build Competitions portfolio. Four advanced energy community (AEC) projects moved from construction into commissioning, measurement and verification (M&V), and early operational testing. Four grid-interactive efficient building (GEB) projects achieved key preconstruction and early implementation milestones.
- Accelerated commercialization of next-generation power electronics devices that will enable more cost-effective deployment of renewable backup power in single-family and multi-family residences. Three grant agreements advanced safety certifications, streamlined interconnection pathways, and kicked off commercial demonstrations.

- Launched the solicitation titled "Distributed Resources for Innovative Vehicle Energization Strategies" (DRIVES, GFO-25-301), which will establish several demonstrations pairing commercial EV charging infrastructure with microgrid technologies such as on-site generation, energy storage, and power control systems, energized through flexible service agreements
- Expanded statewide field demonstrations of demand flexibility and advanced Open Automated Demand Response (OpenADR) 3.0 communication capabilities through the California Load Flexibility Research and Deployment Hub (CalFlexHub) (EPC-20-025), which implemented projects across more than 100 sites and contributed findings toward a flexible-load valuation methodology adopted by the CPUC. This methodology evaluates demand-flexible technologies using a key set of metrics to determine costs and benefits of demand flexibility.
- Developed publicly available digital tools that allow buildings to automatically shift their electricity use in response to greenhouse gas and price signals through the "HP-Flex: Next Generation Heat Pump Load Flexibility" project (HP-Flex, EPC-19-013). The tools resulted from a field validation of model-predictive controls for heat pumps in small commercial buildings that reduced peak loads.
- Launched the "Industrial, Agricultural, and Water Demand Flexibility Research and Deployment Hub" (IAW FlexHub) (EPC-24-045) by establishing governance structures, evaluation frameworks, and working groups for statewide demonstrations of flexible load strategies. Early 2025 work included the development of project selection criteria and the scopes of work for the first demonstration projects.
- Kicked off seven new projects under GFO-23-309 "Virtual Power Plant Approaches for Demand Flexibility (VPP-FLEX)" — four community-based virtual power plant demonstrations and three interoperable commercial energy management systems (EMS) demonstrations. An EMS is a platform that coordinates BTM assets, such as heating, ventilation, and air-conditioning (HVAC), lighting, or on-site storage, at the building scale to optimize energy performance and costs in response to external conditions like utility rates and weather patterns.
- Kicked off eight projects and awarded a total of $21.6 million through the "Grid-Supportive Transportation Electrification" (GFO-23-306) solicitation, to develop innovative solutions that maximize the use of existing distribution infrastructure to minimize costly upgrades

- Approved nine new projects awards totaling $15.6 million through the "Enabling Electric Vehicles as Distributed Energy Resources" (GFO-24-302) solicitation to address barriers to more effectively integrating EVs with the electricity grid
- Validated a new, direct recycling process for lithium-ion batteries (LIBs) that requires 80 percent less energy consumption and reduces costs by up to 38 percent. The University of California, San Diego (UCSD), published a final report, *Development of Efficient and Scalable Direct Recycling Technology for Lithium-Ion Batteries* (EPC-21-008), with findings that its innovative process produces recovered material with equivalent performance to unused material when fabricated into new battery cells.[29]
- Achieved several key milestones with the "Electric Truck Research and Utilization Center (eTRUC)" project,[30] led by Electric Power Research Institute (EPRI) and CALSTART (EPC-21-010), including:
    - Closing out valuable engagement conducted with communities and workforce development stakeholders.
    - Opening the Advanced Technology Research Center (ATRC) to support high-power charging technology advancement.
    - Starting construction at pilot sites that will demonstrate innovative approaches to public access truck charging.
    - Producing modeling results that can guide planning.

Strategic Objective 4: Improve the Customer Value Proposition of End-Use Efficiency and Electrification Technologies

EPIC funding has been crucial in accelerating California's industrial and building decarbonization efforts, enabling the development and demonstration of technologies that might not otherwise reach the market. Through the support of EPIC, the CEC has advanced a diverse suite of industrial innovations — including electrified process heating, energy-efficient cold storage and wastewater systems, artificial intelligence (AI)-enabled demand flexibility, and low-carbon materials and manufacturing processes. These investments are bridging the gap between research and commercialization, helping overcome cost and technical barriers that slow industry adoption. Collectively, EPIC-funded projects are reducing emissions,

[29] Gupta, Varun and Zheng Chen. 2025. *Development of Efficient and Scalable Direct Recycling Technology for Lithium-Ion Batteries.* California Energy Commission. Publication Number: CEC-500-2025-044. https://www.energy.ca.gov/sites/default/files/2025-10/CEC-500-2025-044.pdf.

[30] This project is referred to as "eTRUC" hereafter. RHETTA stands for "Research Hub for Electric Technologies in Truck Applications."

improving efficiency, and strengthening California's global leadership in building a cleaner, more affordable, and more resilient industrial economy.

In the buildings sector, EPIC supports technologies and tools that overcome barriers to electrification; improve energy efficiency and load flexibility; lower emissions; and promote a healthier, more comfortable building stock. For example, low- and ultra-low global warming potential (GWP) refrigerants for HVAC systems can enable further emissions reductions as consumers adopt more electric appliances. These refrigerants can accelerate cost reductions for electric appliances as the usage scales to meet demand and regulations. Below is a discussion of notable progress toward this strategic objective in 2025.

- The CEC awarded more than $63 million for 13 projects addressing decarbonization and electrification of industrial processes through various strategies, including load flexibility, thermal energy storage, energy efficiency, advanced separations,[31] and electrification of industrial processes. The awards leverage more than $34 million in match funding.
- The project titled "Demonstration & Deployment of Nelumbo's Ice-Nein Evaporator Coating" (EPC-24-014) received strong market validation. Nelumbo Inc. was acquired by Kuraray Co., Ltd., in April 2025, underscoring the high commercial potential and impact of its innovative technology. The project developed an advanced ceramic coating for refrigeration coils that minimizes frost buildup and reduces the need for energy-intensive defrost cycles in cold-storage facilities. By improving coil efficiency, the technology can cut refrigeration energy use by up to 20 percent, delivering significant cost savings, greenhouse gas (GHG) reductions, and operational benefits across California's cold-chain industry. The initial EPIC funding provided by the CEC helped launch this innovation from pilot to near-commercial scale — support that ultimately positioned the company for acquisition and broader deployment through global commercialization.
- The "High Efficiency Magnetic Refrigeration[32] for Industrial Cryogenic Applications" (EPC-19-021) project demonstrated a breakthrough approach to ultra-low-temperature cooling that could dramatically reduce energy use in industries such as microelectronics manufacturing and hydrogen fueling. Led by General Engineering & Research, LLC, the

[31] Advanced separations are emerging electricity-driven technologies that separate liquid or gas mixtures with significantly lower energy use than traditional thermal-based methods.

[32] Magnetic refrigeration uses magnets and special solid materials instead of chemical refrigerants like conventional refrigerators. It offers much higher efficiency, especially for extremely low temperatures needed in some industrial processes.

team developed and tested a magnetic refrigeration system that achieved sustained cooling below 80° Kelvin (-316°F) without using energy-intensive compressors. This first-of-its-kind demonstration proved that magnetic refrigeration could deliver up to 10 times greater efficiency than conventional cryogenic systems. If deployed throughout California, it could save 2,500 GWh of electricity per year — enough to power about 200,000 homes — and prevent 7 million metric tons[33] of carbon dioxide (CO_2) emissions annually, paving the way for cleaner, more efficient cooling in California's high-tech industries.

- Build It Green is developing a panel optimization tool to make home electrification more affordable and accessible by solving one of the most persistent hidden barriers — limited electrical panel capacity. The project, "A Decision Tool to Electrify Homes With Limited Electrical Panel Capacity" (EPC-24-005), is designing, developing, and demonstrating an intuitive panel optimization tool (computer application) that empowers single-family homeowners to electrify their homes within their existing infrastructure. By applying power-efficient design principles — using efficient appliances, smart load controls, and intelligent sequencing[34] — the tool shows how homes can integrate heat pumps, induction stoves, and electric water heaters without costly service upgrades.
- EPRI continued significant progress on its project, "Advancing Energy Efficiency in Manufactured Homes Through High Performance Envelope" (EPC-19-035). This project designed and developed envelope strategies for all-electric manufactured homes that meet 2019 state energy efficiency building codes (also known as Title 24 requirements), improve thermal performance, and provide increased fire resilience. Beyond the direct envelope measures, the project also integrated smart panels to manage the electric loads of the manufactured homes, which often have constrained electric service, such as service up to only 100 amps (A).

Strategic Objective 5: Enable Successful Clean Energy Entrepreneurship Across California

Strategic Objective 5 has two initiatives. "Entrepreneurial Support" funds the California Energy Entrepreneurial Ecosystem (entrepreneurial ecosystem) that supports innovators through the early to middle stages of technology development and commercialization. Scaling Clean Energy

[33] A metric ton (also called a tonne) is 1,000 kilograms — roughly 2,205 pounds.

[34] Refers to a recommended order of electrification technologies to adopt to balance available budget and potential savings (for example, heat pump first, then EV charging, then induction cooking and so on). Intelligent sequencing is important because most people cannot afford to fully electrify their homes all at once.

Technology provides financial and technical resources that entrepreneurs need to bring their innovations to scale.

The entrepreneurial ecosystem supports new clean energy technology ventures by providing entrepreneurs with access to the networks, funding opportunities, mentoring, facilities, and expertise needed to take their inventions from idea to market. The entrepreneurial ecosystem is made up of six ongoing programs and two recurring direct solicitations. The ongoing programs are the California Sustainable Energy Entrepreneur Development Initiative (CalSEED), California Test Bed Initiative (CalTestBed), and four Regional Energy Innovation Clusters (REICs): Southern California Energy Innovation Network (SCEIN), Los Angeles Cleantech Incubator (LACI), Activate Berkeley, and BlueTech Valley (BTV). The two recurring direct solicitations are Bringing Rapid Innovation Development to Green Energy (BRIDGE) and Realizing Accelerated Manufacturing and Production (RAMP).

By the close of 2025, these programs supported more than 450 companies, with more than 25 new additions in the past year. These companies are developing, deploying, or demonstrating innovative clean energy technologies that include renewable generation, advanced battery chemistries, battery testing, energy efficiency, recycling and reuse of critical materials, demand flexibility, and transportation electrification. Collectively, companies in the entrepreneurial ecosystem have attracted more than $6.4 billion in additional funding. The entrepreneurial ecosystem builds on California's strong culture of innovation, with many technologies emerging from California universities and companies headquartered in the state. New participants and significant milestones reached by past and present entrepreneurial ecosystem members in 2025 are highlighted by program in Chapter 4.

The first solicitation under the Scaling Clean Energy Technology initiative ("California Battery Pilot Manufacturing Line," GFO-24-304) was released in 2025 and awarded to a team that will develop and operate California's first battery pilot line hub for entrepreneurs to produce and test innovative battery components.

Strategic Objective 6: Inform California's Transition to an Equitable, Zero-Carbon Energy System That Is Climate-Resilient and Meets Environmental Goals

California continues to advance climate resilience and environmental sustainability as core elements of electricity sector planning. In 2025, the CEC continued to foster integration of health, equity, and climate considerations into electricity sector advancement.

The Cal-Adapt Analytics Engine team, in close collaboration with IOUs and other electricity sector stakeholders, has continued to codevelop decision-support tools. In 2025, efforts focused on:

- Tools to assess weather-related risks to IOUs' electric infrastructure.
- Support for IOU filings of Climate Adaptation and Vulnerability Assessments (CAVA), which are required by CPUC's Climate Adaptation Rulemaking (R.18-04-019).
- Continued support for state agency planning processes, including providing open data (publicly available) that contribute to CEC's energy demand forecast.

Throughout 2025, CEC staff worked with state agencies involved with the Fifth Climate Assessment, led by the Governor's Office of Land Use and Climate Innovation (LCI, formerly the Office of Planning and Research), to support knowledge transfer of EPIC-funded climate projections, wildfire scenarios, and hydrological modeling efforts. Specifically, EPIC recipients submitted plain-English memos describing key data products that have been adopted by the Fifth Climate Assessment, made openly available through the Cal-Adapt Analytics Engine, and used to support energy sector resilience planning and research. After cross-agency review, these memos were posted on CEC's Climate Data and Analysis Working Group (C-DAWG) website).

In July 2025, CEC approved five applied research projects under the solicitation "Environmental Sustainability of a Clean Energy Transition (Enviro-SET)." These projects will address California-specific knowledge gaps regarding the environmental impacts from clean energy projects. Preventing and reducing these impacts can sometimes add costs and delays to clean energy projects. The portfolio seeks to guide California's transition to an equitable, zero-carbon energy system that is climate resilient and more cost-effectively meets environmental goals.

CHAPTER 2:
Coordination Activities in EPIC

The CEC continues to build partnerships and engage with diverse groups, networks, and interested partners as it develops and implements EPIC. Collaborators include EPIC administrators, federal and state agencies, the Disadvantaged Communities Advisory Group (DACAG), ESJ communities, EJ advocates, and other clean energy market actors. The CEC also regularly engages with technology developers, academia, and industry associations as part of its statutory activities, including the development of grant solicitations, the annual Integrated Energy Policy Report (IEPR) or IEPR Update, and public knowledge-sharing events.

The "Transparent Public Process and Competitive Solicitations" section of this report provides detailed information and data demonstrating how the CEC as an EPIC administrator leverages public processes, workshops, CPUC proceedings, policies, legislation, and other direction to continually refine coordination and engagement processes. Table 4 summarizes the various engagement activities CEC staff conducted in 2025.

Table 4: Summary of EPIC CEC Staff Engagement Activities in 2025

Type of Engagement	Number of Efforts
Interagency Coordination With Local, State, and Federal Agencies	16
EPIC Administrator/CPUC/PICG Coordination	7
ESJ Community Engagement	9
DACAG Engagement	2
Total	**34**

Note: This table does not reflect the total number of events under each category, as several efforts include monthly, quarterly, or semiregular meetings.

Source: California Energy Commission staff

Market and Other Actors

This section summarizes the types of EPIC coordination efforts with various actors in 2025.

U.S. Government, National Organizations, and Other States

Coordination between the CEC and the United States Department of Energy (U.S. DOE) was significantly reduced in 2025 under the new federal administration. However, the CEC continued to exchange information with the U.S. DOE and national laboratories on certain topics such as demand flexibility, entrepreneurial support, and advancing the commercialization of promising new clean energy innovations. CEC staff attended the Advanced Research Projects Agency — Energy (ARPA-E) summit in March to gain a better

perspective on shifting federal priorities and stay apprised of the latest technologies, projects, and companies being funded by the U.S. DOE. Similarly, collaboration with the United States Department of Defense has been reduced to focus on new energy resilience efforts, while maintaining coordination on existing military projects.

Ongoing coordination with out-of-state agencies and national organizations continued. Notable efforts included collaboration with the National Offshore Wind Research and Development Consortium, Massachusetts Clean Energy Center, and the New York State Energy Research and Development Authority on R&D for OSW planning with five block grant subrecipients. Knowledge gained will be valuable to California for meeting Assembly Bill 525 (Chiu, Chapter 231, Statutes of 2021) goals, specifically on permitting pathways, wildlife monitoring, mitigation efforts, and reducing developers' soft costs (which can lead to lowering ratepayer costs).

In March, CEC staff attended the American Council for an Energy-Efficient Economy's 2025 Hot Water and Hot Air Forum to learn about the latest efficiency and decarbonization results relating to water and space heating. Knowledge gained was valuable to staff in managing existing projects, as well as informing scoping for EPIC 5 initiatives. In addition, CEC staff exchanged information on community engagement for community-scale electrification and decarbonization efforts, including progress and lessons learned from the Lancaster Advanced Energy Community project (EPC-18-011) at the New Buildings Institute's Getting to Zero National Forum.

Other California State Agencies

In 2025, CEC staff coordinated with several California state agencies to help advance research development and demonstration (RD&D) activities for emerging clean energy technologies. Agencies included the California Air Resources Board (CARB), California Department of Transportation, Department of General Services, Department of Housing and Community Development, the CPUC, and multiple University of California and California State University campuses. Efforts included participating in working groups and attending ad hoc meetings to share information on project results and challenges related to transportation electrification, indoor air quality, automated demand response, and more.

For example, CEC staff briefed state agency fleet managers and procurement experts on the "Heavy-Duty Vehicle Electrification and its Potential as a Clean Energy Alternative for Critical Operations" project (EPC-22-002) and explored the potential of government fleets for supporting early adoption of innovative technologies like bidirectional charging.

EPIC Administrator and CPUC Coordination

Coordination among administrators maximizes EPIC's effectiveness by ensuring implementation across the program is complementary. Sharing lessons learned from the most significant technological innovations can also enhance future grant offerings. The CEC is committed to ongoing coordination and collaboration with the CPUC, the three IOU administrators of EPIC funds, and the PICG.

IOU Administrators

CEC staff regularly engages with the three IOU EPIC administrators by sharing project results and best practices in administering the program and by discussing opportunities for collaboration on technology areas of shared interest. These activities align resources across the program and amplify meaningful outcomes from the most promising innovations. The administrators hold biweekly meetings, coordinate notification and outreach for upcoming events, and participate in joint public workshops. Efforts in 2025 continued exploration of potential mechanisms for cross-administrator coordination in EPIC. Such mechanisms included establishing topical technical advisory committees and identifying priority low technology readiness level (TRL) areas that would benefit from CEC's ability to fund applied R&D. Administrators also continued exploring methods to co-fund projects with higher potential impacts.

Notable activity includes collaborating with the IOUs to help test and provide feedback on Cal-Adapt tools. Moreover, CEC staff and EPIC recipients participated in the annual EPIC workshop hosted by the IOUs in July, discussing cross-administrator perspectives on EPIC investments to date, organized around the five strategic goals approved for EPIC 5:

- Transportation Electrification
- Distributed Energy Resource Integration
- Building Decarbonization
- Achieving 100 Percent Net-Zero Carbon and the Coordinated Role of Gas
- Climate Adaptation

Finally, CEC staff coordinated with the IOU administrators to showcase some of their projects at the "Affordability Enabled by Utility Grid Modernization" breakout session of the CEC's 2025 EPIC Symposium, CEC's premier EPIC convening for highlighting cutting-edge, energy-related research.

PICG and EPIC 5 Development

Following Decision 24-03-007[35] and the adoption of the five strategic goals for EPIC 5, the CPUC continues to implement the second half of the planning process to assist program administrators in developing their investment plans.

In March 2025, CPUC published a staff proposal[36] containing a list of 13 draft strategic objectives for the EPIC 5 budget cycle:

1. Reducing Medium-/Heavy-Duty Vehicle Charging Infrastructure Costs
2. Overcoming Barriers to EV Benefits in Disadvantaged Vulnerable Communities
3. Smart Systemwide Planning Tools for New Load
4. Reducing Cost of Whole Home Electrification[37]
5. Innovative Approaches for Difficult-to-Decarbonize Sectors
6. Community-Scale Decarbonization
7. Impacts Research for New Generation and Storage
8. Increase Predictability of Weather, Intermittent Resources, and Load
9. Leveraging DERs for Grid and Community Resiliency
10. Expediting and Streamlining Interconnection and Energization Processes
11. Providing Data Input into a Value of DER Framework
12. Reducing Feeder/Circuit Peaks
13. Cost-Effective Grid Hardening for Long-Term Climate Impacts

In June 2025, the CEC opened Docket 25-EPIC-01 and created its EPIC 5 website (http://www.energy.ca.gov/epic5) to formally begin developing its EPIC 5 Investment Plan. CEC staff solicited research concept ideas by publicly releasing a proposal. As of December 2025, the CEC has received nearly 150 submissions from a diverse set of interested parties, including private individuals, private companies/startups, nonprofits/advocacy groups, research

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[35] California Public Utilities Commission. March 14, 2024. *Decision Adopting Strategic Goals for the Electric Program Investment Charge Program*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M527/K228/527228647.PDF.

[36] Beck, Fredric and Upadhyaya, Nidhi. California Public Utilities Commission. 2025. *Energy Division Staff Proposal Identifying Strategic Objectives and Criteria to Guide the Electric Program Investment Charge (EPIC) Program*. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M558/K340/558340127.PDF.

[37] Home electrification refers to switching all home energy uses, such as heating, cooking, and powering appliances, to electricity instead of gas.

institutions/national labs, local agencies/public agencies/community choice aggregators (CCAs), and industry/trade associations. The submissions cover a wide range of research proposals and comments in areas such as offshore wind and other renewable energy technologies, grid modernization, energy storage, EVs, and environmental and public health impacts.

In December 2025, CEC staff participated in three days of PICG workshops to present draft EPIC 5 research initiatives under the five strategic goals and collaborate with CPUC and IOU subject matter experts. Feedback received at the meetings will be used by CEC staff to refine the EPIC 5 Investment Plan.

CPUC

In addition to the efforts with PICG mentioned above, the CEC and its EPIC recipients coordinated with the CPUC on specific technical topics, including transportation electrification, hydrogen, and climate adaptation. For example, CEC staff presented relevant EPIC activities and updates at the 2025 Vehicle Grid Integration Forum,[38] which is jointly hosted by the IOUs in collaboration with the CPUC as part of the Transportation Electrification Proceeding (R.23-12-008 — Transportation Electrification Policy and Infrastructure). CEC staff also briefed CPUC staff on the results of EPIC projects with RAND (EPC-23-004) and E3 (EPC-23-009) that assessed the role of hydrogen in decarbonizing California's electric system. Subject matter experts from Eagle Rock Analytics (EPC-20-007 and EPC-23-024) participated in a Climate Lexicon Working Group hosted by the CPUC. The participation consisted of providing feedback on definitions of sensitivity, vulnerability, resilience, climate readiness, and climate risk as they relate to impacts to infrastructure, assets, and communities. This work pertains to the Climate Adaptation Rulemaking (R.18-04-019 — Order Instituting Rulemaking to Consider Strategies and Guidance for Climate Change Adaptation).

Coordination on the CPUC's Distributed Energy Resources Action Plan 2.0

California has been at the forefront of distributed energy resource (DER) integration into the electric grid for more than 10 years. Under California's Assembly Bill 327 (Perea, Chapter 661, Statutes of 2013) and Public Utilities Code Section 769(a), DERs include:

- Distributed renewable generation resources (for example, solar PV panels).
- Energy efficiency in buildings.
- Energy storage.

[38] CEC presentation by Peter Chen. April 16, 2025. "2025 Vehicle-Grid-Integration Forum." https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/transportation-electrification/energization/2025-vgi-forum-slide-deck.pdf.

- EVs.
- Demand response (DR) technologies.

In 2016, the CPUC published the *Distributed Energy Resources Action Plan: Aligning Vision and Action*,[39] known as *DER Action Plan 1.0*, to align the organization's visions and actions. The plan guided the development of the Distribution Resources Plans Proceeding and Integrated Distributed Energy Resources Proceeding — two proceedings established to guide state efforts on utility DERs. The CPUC updated and approved the current *DER Action Plan 2.0* in 2021 and subsequently issued an Order Instituting Rulemaking to Modernize the Electric Grid for a High Distributed Energy Resources Future, known as the High DER Proceeding (R.21-06-017), to implement the overall vision and action elements of the DER Action Plan.

The CEC has closely coordinated with the CPUC and considered its proceedings and action plans to develop DER-related advancements in technology and cost declines that help the state achieve its clean energy goals. In April 2023, the CPUC directed EPIC administrators to "demonstrate that they have taken the *DER Action Plan 2.0* (covering 2022–2026) into account in developing their Strategic Initiatives," starting with the EPIC 4 Investment Plan. Although the CEC's EPIC 4 Investment Plan[40] was approved in June 2022, projects funded across EPIC's investment plans and strategic objectives have helped meet the goals of the *DER Action Plan 2.0* by addressing barriers to adoption for the DER technologies listed above.

CEC staff closely monitors developments in the High DER Proceeding and coordinates on biweekly calls with CPUC Energy Division and IOU staff to ensure that future CEC solicitation development is closely aligned with *DER Action Plan 2.0*. In 2025, CEC staff met with several groups of interested parties concerning DERs, including:

- Electric vehicle supply equipment (EVSE) technology developers.
- State agencies, including CARB, California Department of Transportation, and Department of General Services.
- California ISO.
- Think tanks, national laboratories, and academic institutions.
- U.S. Environmental Protection Agency.
- DER aggregators.

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[39] See links to DER Action Plans at https://www.cpuc.ca.gov/about-cpuc/divisions/energy-division/der-action-plan

[40] Lew, Virginia, Anthony Ng, Mike Petouhoff, Jonah Steinbuck, Erik Stokes, and Misa Werner. 2023. *The Electric Program Investment Charge 2021–2025 Investment Plan: EPIC 4 Investment Plan*. California Energy Commission. Publication Number: CEC-500-2023-048-CMF-REV. https://www.energy.ca.gov/publications/2021/electric-program-investment-charge-2021-2025-investment-plan-epic-4-investment.

The CEC hosted, participated in, and supported EPIC recipient participation in several events in 2025 to support EPIC coordination with the CPUC *DER Action Plan 2.0*. Some notable events included the following:

- 2025 Vehicle Grid Integration Forum
- Fifth Vehicle-to-Grid Forum
- Electric Vehicle Charging Summit and Exp.
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers Summer Conference
- Clean Air Technology Initiative Liaison Meeting
- 2025 Behavior, Energy & Climate Change conference Workshop: Community-Led Decarbonization — Behavioral Opportunities and Barriers

ESJ Communities

The CEC is committed to ensuring all Californians benefit from clean energy research. Consistent with legislative and CPUC direction and CEC commitments, the CEC has prioritized energy equity in its research programs to ensure that California's most vulnerable communities benefit from emerging clean energy technologies. In 2015, the CEC adopted a diversity policy resolution (https://www.energy.ca.gov/sites/default/files/2020-07/diversity_policy_resolution_ada.pdf) outlining its commitment to ensure all Californians have an opportunity to participate in and benefit from CEC programs. In 2016, the CEC's *Low-Income Barriers Study* (https://efiling.energy.ca.gov/getdocument.aspx?tn=214830) recommended that EPIC target a minimum of 25 percent of technology demonstration and deployment funding for sites in disadvantaged communities.

Alignment With ESJ Action Plan and Justice40 Initiative

In 2022, the CPUC adopted the *ESJ Action Plan 2.0,* containing nine goals and objectives and 91 action items.[41] The action plan informs programmatic considerations when incorporating equity into investment planning. In 2023, Decision 23-04-042[42] directed EPIC administrators to address the CPUC's *ESJ Action Plan 2.0* goals and objectives in future investment plans. The decision also required administrators to engage ESJ communities and California Native American tribes early in the scoping process and consult with them on workforce development opportunities. In addition, the decision requires EPIC administrators to implement the program

[41] California Public Utilities Commission. April 2022. *Environmental & Social Justice Action Plan Version 2.0*. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/news-office/key-issues/esj/esj-action-plan-v2jw.pdf.

[42] California Public Utilities Commission. 2023. *Decision on Phase 2-C of Electric Program Investment Charge Rulemaking*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M507/K499/507499284.PDF.

in alignment with the federal Justice40 Initiative[43] goals and criteria that at least 40 percent of benefits are allocated to "disadvantaged vulnerable communities."[44]

The CPUC provided additional guidance on which projects may count toward alignment with the Justice40 Initiative goal. This includes EPIC-funded projects that are owned and operated by the electric utility and that provide clear and verifiable benefits to disadvantaged and low-income communities. However, projects "with state- or region-wide impacts (such as wildfire reduction) are excluded because that may circumvent the legislative requirement for disadvantaged/low-income-specific-benefits." The CPUC distinguishes that its *ESJ Action Plan 2.0* uses a metric based on the project location, while Justice40 measures the accrual of benefits from the investment.[45]

The following is a list of notable efforts conducted in 2025 to illustrate how CEC aligned EPIC investments and activities with select *ESJ Action Plan 2.0* goals that are most relevant to the CEC's work in administering the EPIC Program. The goals listed below reflect modified language to provide context for CEC activities.

Goal 1: Consistently Integrate Equity and Access Considerations Throughout CEC's EPIC Activities

The CEC continued applying specific scoring criteria to TD&D solicitations issued with designated funding to ensure ESJ communities benefit from clean energy resources. The criteria included considerations for anticipated benefits, community engagement efforts conducted before project development and during project implementation, localized health impacts, budget allocation for community engagement activities, support from the community on where the project will be located, and a proposed community partner.

The CEC ERDD Equity Team also continued meeting monthly to discuss equity-related topics and funding opportunity considerations and disseminate knowledge from the DACAG and its

[43] On January 27, 2021, President Joseph R. Biden Jr. issued EO 14008, Tackling the Climate Crisis at Home and Abroad. Section 223 of EO 14008 establishes the Justice40 Initiative, which directs 40 percent of the overall benefits of federal investments to flow to disadvantaged communities, including in areas such as clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and development of clean water infrastructure.

[44] *Disadvantaged vulnerable communities* consist of communities in the 25 percent highest scoring census tracts according to 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% of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

[45] California Public Utilities Commission. April 28, 2023. *Decision on Phase 2-C of Electric Program Investment Charge Rulemaking*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M507/K499/507499284.PDF.

Equity Framework[46] and the CEC's Office of the Public Advisor, Energy Equity, and Tribal Affairs. The team develops resources for CEC staff to implement in projects and outreach activities, including best practices for community engagement. The CEC also prioritized discussions on equity, affordability, accessibility, and energy resiliency at the 2025 EPIC Symposium.

Goal 2: Increase Investment in Clean Energy Resources to Benefit ESJ Communities, Especially to Improve Local Air Quality and Public Health

The CEC finalized a solicitation titled "Modeling and Monitoring Air Quality and Co-Benefits of Energy Interventions to Inform Clean and Equitable Energy Transition" to be released in early 2026. The solicitation aims to research methods for improving existing ambient air quality modeling and measurement approaches and conduct analysis quantifying the air quality implications and related human health impacts of clean energy interventions across energy use sectors.

Goal 4: Increase Climate Resiliency in ESJ Communities

The Next EPIC Challenge: Reimagining Affordable Mixed-Use Development in a Carbon-Constrained Future (GFO-20-305) is a design-build competition developing all-electric, multiuse building designs throughout the state. A $9 million award, "Mutual Housing at Fairview Terrace" (EPC-23-025), will build permanent, new, affordable, all-electric housing for seniors in Stockton, and additional community resources such as a resilient cooling center and community kitchen. The design includes grid-interactive technologies unified by a building management system controller to offer climate resiliency and up to 85 percent utility bill savings.

The CEC issued a $5 million follow-on (subsequent) funding award ("Design and Construction of a System of Nested Microgrids," EPC-24-053) to support the expansion of the Blue Lake Rancheria's microgrid in Humboldt County. The project will help reduce costs, improve reliability, and demonstrate advanced protection and control strategies. The results may lead to innovative approaches to a resilient decarbonization of distribution circuits.

[46] Joint California Energy Commission and California Public Utilities Commission Disadvantaged Communities Advisory Group. 2024. *California Disadvantaged Communities Advisory Group (DACAG) Equity Framework 2024 Update*. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/infrastructure/disadvantaged-communities/2024-dacag-equity-framework.pdf.

Goal 5: Enhance Outreach and Public Participation Opportunities for ESJ Communities to Meaningfully Participate in the CEC's Decision-Making Process and Benefit From EPIC

CEC staff participated in monthly DACAG meetings and engaged with ESJ advocates to stay informed about ESJ priority concerns, provide updates on EPIC activity, and respond to public comments on EPIC.

CEC staff worked with the CEC's Office of the Public Advisor, Energy Equity, and Tribal Affairs and met with EJ advocates to plan roundtable discussions to engage with ESJ communities, tribes, and advocates on the CEC's administration of EPIC and the upcoming EPIC 5 Investment Plan. These discussions are planned for 2026, after CPUC approval of EPIC 5 strategic objectives. Input will be used to inform the CEC's EPIC 5 research and identify possible areas needing improvement to enable greater ESJ community participation in EPIC.

Goal 7: Promote High Road Career Paths and Economic Opportunity for Residents of ESJ Communities.

The Electric Truck Research and Utilization Center (eTRUC; EPC-21-010) project team, including the Electric Power Research Institute (EPRI), CALSTART, and Grid Alternatives, engaged its workforce development advisory committee to help inform a Workforce Development Report[47] that provides a comprehensive set of recommendations to guide equitable workforce development in support of clean freight and goods movement. The advisory committee also informs the development of the Zero-Energy Vehicle Training Hub — an online resource listing training programs, certifications, and college-level degrees available in California.[48]

Goal 8: Improve Training and CEC Staff Development Related to ESJ Issues Within EPIC's Electricity Service Territories

The ERDD Equity Team conducted monthly internal meetings to discuss equity-related challenges and solicitation considerations and disseminate updates on terminology usage, ESJ concerns, and priorities. In May, the Department of Conservation presented on its Rubin Race & Equity-Focused Engagement Model. The model provided team members with a framework of engagement approaches and guidance on how to apply them to different projects.

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[47] eTRUC and EPRI. 2026. *Workforce Development Report: Electric Truck Research and Utilization Center (eTRUC) Project* (Task 2.4). Product ID 3002034480. https://www.epri.com/research/programs/053122/results/3002034480.

[48] Resources and updates are available at the project website, etruc.org. In addition, recordings of committee meetings are available at https://etruc.org/engagement/workforce-development-advisory-committee-wdac/.

In August, the director of the Wisconsin Office of Sustainability and Clean Energy presented its approach and lessons learned in conducting robust engagement. The purpose was to engage communities, EJ advocates, and others to enroll in programs as well as advisory committees to give input on project planning and management efforts. The information gained was valuable in thinking about ways to strengthen current and future projects. Members of the ERDD Equity Team also attended California Natural Resources Agency training sessions on cultural awareness and best practices for tribal engagement, as well as a summer series on community engagement.

Outreach and Engagement with ESJ Communities

CEC staff participated in several programmatic and project-related outreach and engagement activities throughout 2025 with ESJ communities, California Native American tribes, and EJ advocates, including DACAG monthly meetings. Notable efforts in 2025 include the following:

- The eTRUC (EPC-21-010) project team, including EPRI, CALSTART, and Grid Alternatives, engaged with its community-first, technical advisory committee and provided feedback on community concerns and priorities related to heavy-duty truck charging infrastructure planning. Feedback helped inform project products such as the Community Engagement and Equity Implementation Report, as well as modeling tools to support MDHD charging infrastructure planning in California.
- CEC staff regularly interacts with California Native American tribes in planning and executing projects, including connecting them with promising energy technology innovators and topical areas that may be eligible for funding through forthcoming EPIC solicitations. In 2025, staff helped establish an interdivisional CEC Tribal Energy Grants Best Practices Working Group.
- In March, several tribes and CEC grant collaborators came together for the 2025 Tribal Energy Summit held in Sacramento. Speakers included EPIC project recipients from the Schatz Energy Center and Prosper Sustainability, who spoke about project progress. Moreover, CEC staff participated in three regional tribal roundtables held throughout California between August and October, as part of the CEC's Order Instituting an Informational Proceeding for Tribal Affairs and Tribal Energy Sovereignty.[49] The roundtables discussed CEC funding programs, including EPIC.

[49] The CEC's Order Instituting an Informational Proceeding for Tribal Affairs and Tribal Energy Sovereignty (25-OIIP-01) was opened in March 2025 to promote frequent and meaningful engagement between tribes and the CEC. More information about the proceeding and activity is available at https://www.energy.ca.gov/proceeding/order-instituting-informational-proceeding-oiip-tribal-affairs-and-tribal-energy.

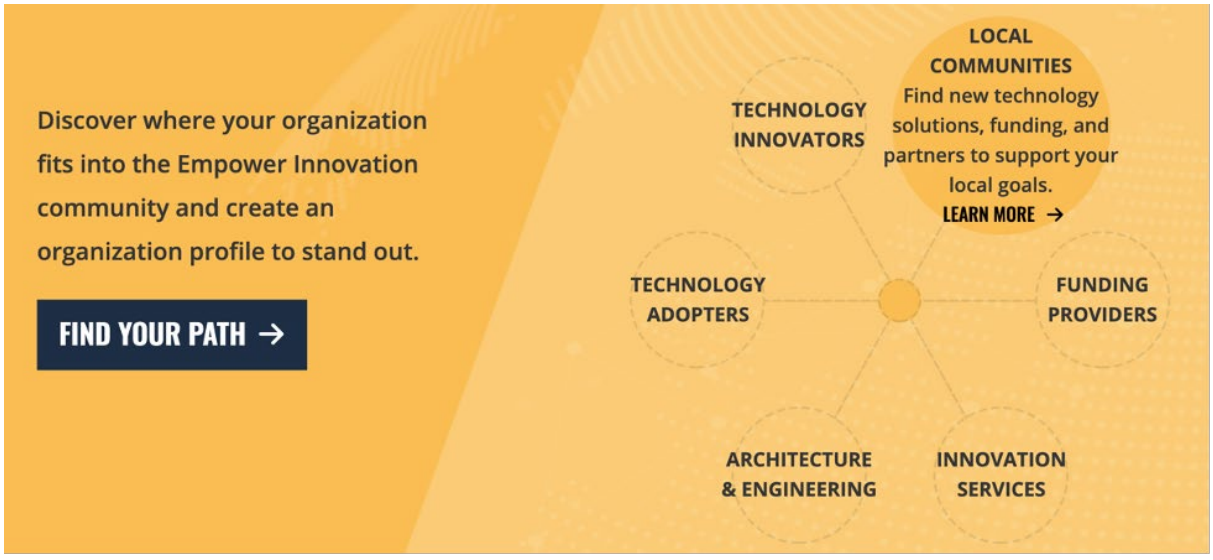
- In 2025, CEC collaborated with several tribes in California's North Coast region who received a conditional award in 2024 under the U.S. DOE's Grid Resilience and Innovation Partnership Program, for which the CEC had committed $6 million in EPIC cost-share funding. Given the uncertainty of the federal award, CEC staff met with tribes to discuss alternative strategies for enabling critical infrastructure projects to proceed, including potential opportunities under EPIC.

Promoting Partnerships for EPIC Projects

Participation from a broad range of interested parties helps ensure that local insights and concerns inform the development of, and improve the outcomes resulting from, demonstration and market facilitation projects. Additionally, contributions from interested parties can help accelerate access, affordability, and adoption of clean energy innovation across California. The partnerships developed in EPIC are the result of intentional actions, consistent dialogue, and deliberate structuring of solicitation documents for the program.

Launched in 2019, the Empower Innovation Network (https://www.empowerinnovation.net/) was the first clean energy networking platform designed for professionals seeking to advance and improve the accessibility of the clean energy economy. Participation in the platform has grown quickly. As of December 16, 2025, the Empower Innovation Network platform had 5,300 members and more than 1,300 organizations. Notably, since the inception, the platform has received nearly 700,000 page views and 3,000 funding opportunities and hosted more than $167 billion in funding opportunity announcements. Figure 3 shows the different types of partner groups represented in the Empower Innovation Network.

Figure 3: California Energy Commission Empower Innovation Network Platform



Source: Empower Innovation, an initiative funded by the CEC, https://www.empowerinnovation.net/

CHAPTER 3:
EPIC Budget

This chapter summarizes the CPUC-authorized budget for the CEC's EPIC, as well as funding commitments and encumbrances, dollars spent on program administration, and other budget-related topics.

Authorized Budget

The CPUC approved the following overall budget totals for each of the following investment plans:

- 2021–2025 EPIC 4 Interim Investment Plan (Year 1): $147,260,000
- 2021–2025 EPIC 4 Investment Plan (Years 2–5): $589,040,000

These totals include the amount allocated for EPIC projects and CEC administration activities. Summaries of these investment plan budgets, divided by program area or funding initiative, can be found in Appendix A (Tables A3–A5).

Funding Commitments and Encumbrances

To clarify the difference between commitments and encumbrances for EPIC, the CPUC adopted the following definitions in Decision 13-11-025:

> "'Committed funds' are funds identified during the planning of a solicitation for a specific project that will be needed to fund a contract or grant for that project at the conclusion of a planned or released solicitation . . . 'Encumbered funds' are funds that are specified within contracts and grants signed during a previous triennial investment plan cycle and associated with specific activities under the contract or grant. All activities carried out under a contract or grant during a specific triennial investment plan cycle need not be completed, and funds need not be spent during that program cycle if the activities undertaken pursuant to the contract or grant are expected to be completed. Only funds that are committed or encumbered during the prior program cycle are eligible for being rolled into the following program cycle."[50]

[50] California Public Utilities Commission. 2013. Ordering Paragraphs 44 and 45. *Decision Addressing Applications of the California Energy Commission, Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company for Approval of Their Triennial Investment Plans for the Electric Program Investment Charge Program for the Years 2012 Through 2014*.
https://docs.cpuc.ca.gov/publisheddocs/published/g000/m081/k773/81773445.pdf.

As of December 31, 2025, the CEC has committed 100 percent of the approved project funding for the EPIC 4 Interim 2021 and 2022–2025 Investment Plans and encumbered about 78 percent of those funds. Table A-5 in Appendix A summarizes encumbered funding for all EPIC cycles to date.

Approved Awards in 2025

In 2025, the CEC approved 60 new projects at CEC business meetings, totaling more than $214 million in investments.

Direct Awards Made Through an Interagency Agreement or Sole Source Method

As of December 31, 2025, CEC has approved four direct project awards, totaling $7.5 million through either an interagency agreement or a sole source method. Pursuant to Public Resource Code Section 25711.5(h)(2)(A), the CEC must notify the Joint Legislative Budget Committee when it is preparing to enter into a sole source agreement. Table A-8 in Appendix A summarizes these projects, as well as the corresponding action of the Joint Legislative Budget Committee for each agreement.

Follow-On Project Awards

Public Resources Code Section 25711.5(f)(8) requires the CEC's EPIC Annual Report to provide "[a] brief description of each project for which follow-on funding was awarded in the immediately prior calendar year, including the amount of follow-on funding awarded for the project and the method and criteria used to select that project." Requirements for noncompetitive follow-on funding awards are set forth in Section 25711.5(h)(4)(A).

As of December 31, 2025, the CEC had approved 14 follow-on projects since 2011, totaling more than $82 million. These projects were initially awarded EPIC project funds through competitive solicitation. CEC staff identified grant recipients who could best leverage and benefit from follow-on funding based on prior project performance, policy impact, and statutory requirements. The CEC then invited those grantees to submit a proposal for follow-on funding. A CEC technical evaluation committee then evaluated the proposal and recommended whether the project merited a follow-on award. Each proposed follow-on agreement was subsequently considered for approval at a CEC business meeting. Details for the 14 follow-on projects and the statutory criteria that authorize CEC to award EPIC project funds to follow-on projects can be found in Tables A-9 and A-10 in Appendix A.

Funding Shifts

In prior EPIC plans, EPIC administrators were required to obtain CPUC approval if seeking to shift more than 5 percent of budgeted funds from one funding category or program area to another existing or new category or program area within an approved EPIC investment plan.[51] However, Decision 21-11-028, Ordering Paragraphs 9 and 10, updated that requirement. Beginning with the 2022–2025 EPIC 4 Investment Plan, the CEC is "authorized to reallocate up to 15 percent of funds among each of their approved initiatives without additional [CPUC] approval."[52]

In 2025, the CEC did not shift or apply to shift more than 15 percent of funds between funding categories or program areas or to new categories or program areas. Tables A-12 and A-13 in Appendix A summarize the shift of funds for each open EPIC investment plan (2021–2025 EPIC 4 Interim Investment Plan [Year 1] and 2021–2025 EPIC 4 Investment Plan [Years 2–5], respectively) as of December 31, 2025.

Uncommitted and Unencumbered Funds

Uncommitted funds are those not committed during the planning of a solicitation. Unencumbered funds meet one of the following conditions:

- The funds are committed but have not been encumbered.
- After funds were encumbered, the funds were disencumbered for projects in which the encumbrance period had expired. These projects include projects canceled or terminated with no EPIC funds spent, as well as projects amended to reduce the original budget. No projects were terminated in 2025.

As of December 31, 2025, the CEC has committed 100 percent of the approved project funding for the 2021–2025 EPIC 4 Interim (Year 1) and EPIC 4 (Years 2–5) Investment Plans and encumbered about 78 percent of those funds. Table A-5 in Appendix A provides a summary of encumbered funding for all EPIC cycles to date. Table A-6 in Appendix A summarizes the unencumbered project funds for each EPIC investment plan. CEC plans to

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[51] California Public Utilities Commission. 2013. *Decision Addressing Applications of the California Energy Commission, Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company for Approval of Their Triennial Investment Plans for the Electric Program Investment Charge Program for the Years 2012 Through 2014*.
https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M081/K773/81773445.PDF.

[52] California Public Utilities Commission. 2021. *Decision Approving the Utilities as Electric Program Investment Charge Administrators with Additional Administrative Requirements*.
https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M425/K515/425515575.PDF.

encumber the balance from the 2021–2025 investment plans by June 30, 2027. Chapter 5 provides a list of anticipated solicitations for 2026.

Interest Accrual

In Fiscal Year 2024–2025, the CEC accumulated about $19.5 million in interest from all funds in the EPIC account. Because of administrative limitations, instead of returning accumulated interest, the CEC takes accumulated interest into account when submitting invoices to the IOUs.[53] After the accumulated interest is determined for the prior year, the CEC subtracts the amount of accrued interest from invoices it submits to the IOUs.[54]

[53] EPIC is funded by California electric IOU ratepayers. The IOUs collect funds from ratepayers, and the CEC invoices the IOUs for those funds when EPIC projects are approved at CEC Business Meeting.

[54] California Public Utilities Commission. 2013. *Decision Addressing Applications of the California Energy Commission, Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company for Approval of Their Triennial Investment Plans for the Electric Program Investment Charge Program for the Years 2012 Through 2014*. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M081/K773/81773445.PDF.

CHAPTER 4:
EPIC Projects

Through EPIC, the CEC funds innovations in clean energy technologies and solutions to advance the safety, reliability, sustainability, and affordability of California's electricity system for the benefit of ratepayers. Using a competitive process, the CEC awards EPIC funds to projects that will accelerate the achievement of California's ambitious clean energy, GHG emissions reduction, and climate adaptation policies.

The EPIC portfolio of public-interest projects is making the state's transition to 100 percent clean energy lower-cost, faster, and more inclusive by supporting entrepreneurship and deployment of clean energy technologies in California's communities and providing public access to data and lessons learned. The benefits also extend beyond California's borders. EPIC-funded companies have developed innovative technologies and services that have been adopted in other states, and they have collaborated with partners with an international presence. Moreover, national research groups have used research findings validated through EPIC projects.

EPIC advances innovations for the decarbonization, affordability, resilience, energy equity, and safety of California's building, industrial, agricultural, water treatment, transportation, and electricity sectors. Since the beginning of EPIC, the CEC has funded 602 project awards, investing about $1.5 billion to benefit California electricity ratepayers.

Summary of Project Data and Information

Appendix C of this report includes a detailed list of the CEC's EPIC-awarded projects from the inception of the program through December 31, 2025. Appendix B (Tables B-1 through B-5) summarizes each EPIC investment plan, including the number of active, completed, and terminated (with funds spent) projects, and total funding for 2025 by strategic objective and initiative. Projects span from the first EPIC investment cycle, starting in 2012, through the current EPIC 4 investment cycle. Several projects are funded from multiple investment plans, strategic objectives, initiatives, or a combination. Appendix D provides a comprehensive list of the associated agreement numbers, investment plans, strategic objectives, and initiatives for projects in 2025.

In 2025, grant recipients completed 38 EPIC projects and submitted final project reports to the CEC. Once approved, finalized, and formatted for digital accessibility, each final project report is published on the CEC website at the Research and Development Reports and Publications web page (https://www.energy.ca.gov/energy-rd-reports-n-publications). Table A-11 in

Appendix A contains information about the final report status and links to published reports for projects completed in 2025.

Description of Projects by Strategic Objective

The sections that follow provide 2025 project overviews categorized by EPIC 4 Investment Plan[55] strategic objective. The overviews comprise a representative, rather than comprehensive, list of the projects funded and active in 2025, showcasing successes, challenges, lessons learned, and anticipated next steps from across the EPIC portfolio. To view other project information for all projects funded by EPIC through 2025, see Appendix C. Project background information, funding, and recipient details can also be found on the Energize Innovation Project Showcase (https://www.energizeinnovation.fund/projects) by searching on the agreement numbers, which begin with "EPC."

Strategic Objective 1: Accelerate Advancements in Renewable Generation Technologies

Introduction

Strategic Objective 1, "Accelerate Advancements in Renewable Generation Technologies," focuses on R&D activities that advance key renewable energy technologies in support of Senate Bill 100 (De León, Chapter 312, Statutes of 2018) implementation. The objective includes two strategic initiatives: one for nonvariable forms of renewable energy and one for variable forms of renewable energy. The four primary areas of CEC investments focus on OSW, biomass,[56] geothermal, and solar PV energy generation.

Technologies that promote the growth and commercialization of renewable and zero-carbon energy sources are essential to meeting the state's 2045 climate goal of providing 100 percent clean electricity. Investing in research to speed the development of cutting-edge renewable generation technologies will provide a clean supply of electricity to the grid, resulting in substantially reduced GHG emissions as fossil gas power plants are phased out. Moreover, such investments can help make renewable generation more affordable, lowering technology capital and operational costs, increasing energy output, and improving the value proposition. These anticipated benefits are key to scaling these technologies and accelerating progress toward California's climate and energy goals.

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[55] Lew, Virginia, Anthony Ng, Mike Petouhoff, Jonah Steinbuck, Erik Stokes, and Misa Werner. 2023. *The Electric Program Investment Charge 2021–2025 Investment Plan:* EPIC 4 Investment Plan. *https://www.energy.ca.gov/publications/2021/electric-program-investment-charge-2021-2025-investment-plan-epic-4-investment.*

[56] Biomass generation converts organic materials, such as wood, agricultural and food waste, or crops, into electricity and/or usable heat.

Progress and Successes

Significant progress under this strategic objective occurred in 2025; milestones are described per strategic initiative on the following pages.

Strategic Initiative: Variable Renewable Energy

Solar Energy

More than 19 percent of in-state electricity generation is provided by solar resources. CEC staff focused its 2025 variable renewable energy activity on identifying solar technology improvements. In 2025, staff prepared to release a solicitation for $6 million[57] that will support solar energy development on uneven terrain, aiming to lower soft costs and ease land-use conflicts. This solicitation builds on extensive research and analysis conducted in 2024 and 2025, valuable input from key experts, and responses to an RFI[58] on research and development needs.

Offshore Wind (OSW)

Potential California OSW energy, which would be floating instead of fixed bottom, can play a role in diversifying California's clean energy generation portfolio and advancing the state's climate and grid decarbonization goals. AB 525 (Chiu, Chapter 231, Statutes of 2021) mandated the development of CEC's Offshore Wind Energy Strategic Plan, which established aspirational planning goals for OSW of 2 to 5 gigawatts (GW) for 2030 and 25 GW for 2045.[59]

The CEC oversees seven EPIC-funded projects that advance technologies to reduce FOSW-related environmental impacts. The projects total $20.8 million in investment and support the design of mooring lines and anchors that secure FOSW turbines, as well as biological monitoring technologies. These projects, with 2025 milestones, include:

- "Low-Carbon Concrete Anchor Systems for Floating Offshore Wind Infrastructure in California" (EPC-23-003): Sperra achieved major milestones in advancing sustainable OSW infrastructure, including:

[57] California Energy Commission 2025. Grant Funding Opportunity. "Emerging Solar Energy Technologies (EPIC IV)." https://www.energy.ca.gov/solicitations/2026-01/emerging-solar-energy-technologies-epic-iv.

[58] California Energy Commission. 2024. *Request for Information Solar on Uneven Terrain.* Publication Number: CEC-700-2023-009. https://efiling.energy.ca.gov/GetDocument.aspx?tn=256700&DocumentContentId=92516.

[59] Jones, Melissa, Jim Bartridge, and Lorelei Walker. 2024. *Assembly Bill 525 Offshore Wind Energy Strategic Plan.* California Energy Commission. Publication Number: CEC-700-2023-009-V1-CMF. https://www.energy.ca.gov/publications/2023/ab-525-offshore-wind-strategic-plan.

- Completing front-end engineering design and detailed drawings for reinforced concrete suction and torpedo anchors[60] tailored to California's FOSW energy areas.
- Conducting manufacturing planning, centrifuge testing, and environmental assessments, culminating in a life-cycle analysis that demonstrated up to a 78-percent reduction in CO_2 emissions compared to steel anchors, while lowering costs and boosting local manufacturing.
- Finalizing plans for large-scale structural and qualification testing to support 2026 certification and demonstration.
- Advancing automated 3D concrete printing and spraying techniques for scalable, low-carbon production at California ports, including prototype fabrication.

- "Offshore Geotechnical Investigation and Anchor Procurement Planning for Floating Offshore Wind Systems" (EPC-23-007): Triton Anchor completed its offshore geotechnical investigation and anchor procurement roadmap. This roadmap will serve as the operating procedure for the 2026 offshore activities and the supply chain capabilities analysis of the proposed OSW anchoring system.
- "Design, Testing, and Deployment Planning of Deep-Water Mooring Systems for Utility-Scale Floating Offshore Wind" (EPC-23-005): The University of Maine tested an initial deep-water mooring system design using a scale model basin test and developed a construction and operations plan. The team used the results of previous work to guide the mooring design such that a developer could easily use the system designs for utility-scale FOSW arrays off the California coast.
- "Conceptual Design and Evaluation of Hybrid Shared Mooring Systems for Floating Offshore Wind" (EPC-23-008): Alliance for Sustainable Energy, LLC, completed conceptual designs of several hybrid shared mooring systems and identified three solutions that will be evaluated in 2026 for the ability to minimize costs, failure risks, and environmental impacts.
- "Advanced Radar-Based Avian and Bat Detection Software for Collision Avoidance at Offshore Wind Facilities" (EPC-23-001): Integral Consulting, Inc., made significant software upgrades to a computer system intended to detect and categorize seabird and bat flight patterns for potential collision avoidance maneuvers. Upgrades improved

[60] *Suction and torpedo anchors* are prominent anchor technologies for offshore floating platforms. Suction and torpedo anchors use suction force and weight, respectively, to anchor platforms to the seafloor.

performance and successfully integrated the radar system after several rounds of validation testing.

- "Fiber-Optic Sensing and Soil–Anchor Interaction Testing for Resilient Floating Offshore Wind Mooring Systems" (EPC-23-002): LBNL tested mooring lines fitted with fiber-optic sensors in water tanks and conducted a soil-anchor interaction test that simulated landslide-induced sediment movement and seismic events.
- "Modeling and Detection of Marine Animal Entanglement Risks Associated with Floating Offshore Wind Mooring Lines" (EPC-23-006): California Polytechnic State (Cal Poly) University, Humboldt, Sponsored Programs Foundation began modeling the effects of derelict fishing gear and marine animal entanglements with FOSW mooring lines. An entanglement detection system is under development.

In February 2025, CEC staff released GFO-24-307 to advance designs and analysis of high-voltage direct-current (HVDC) substations and environmental monitoring solutions for FOSW. This solicitation received 11 proposals and resulted in four awards totaling $12.2 million in investment. In November 2025, three EPIC-funded awards from this solicitation were presented and approved at a CEC business meeting. A fourth award will be considered for approval at a CEC business meeting in 2026. These projects include:

- "A Reference Floating HVDC Substation Design for California" (EPC-25-035), awarded to Alliance for Sustainable Energy, LLC (as the manager and operator of National Laboratory of the Rockies [NLR]) to develop a standardized approach for transmission of OSW generation to shore through an open-source floating HVDC substation concept design.
- "Development of an Autonomous Detection and Mitigation Framework for Entanglements Around Offshore Wind Farms" (EPC-25-037), awarded to Integral Consulting, Inc. to detect and mitigate marine entanglements and perform environmental and structural health monitoring of OSW infrastructure through an integrated system of uncrewed surface and underwater vehicles.
- "SEA-Scan: Structural and Environmental Algorithms for Sensing of Offshore Systems" (EPC-25-038), awarded to Sofar Ocean Technologies, Inc. to detect marine entanglements and perform structural health monitoring of FOSW infrastructure through a novel buoy system with integrated sensors, AI, and digital twin models.
- "Distributed Real-time Entanglement, Acoustic, and Mooring Structural Health Monitoring System (DREAMS)" (EPC-25-039), proposed award to LBNL to detect marine

entanglements and perform structural health monitoring of FOSW infrastructure through a system of distributed fiber-optic sensors embedded within the mooring lines.

In September 2025, seven subawards were approved at a CEC business meeting from a block grant agreement under EPIC (EPC-22-009) with the National Offshore Wind Research and Development Consortium, following the scoring of proposals from a competitive grant opportunity released in 2024. The agreement totals more than $4.3 million and leverages substantial co-funding from state agencies in New York and Massachusetts to advance FOSW technologies. The subawards include:

- Sperra will develop a 3D-printed, concrete floating construction station to assist the manufacturing, assembling, and launching of concrete FOSW foundations.
- Foss Maritime Company, LLC will develop a concept-level design using two extra-large, ocean-going deck barges that can be joined and used as a floating dry dock, adding flexibility for port facilities to accommodate various-sized FOSW components.
- Monterey Bay Aquarium Research Institute will develop an environmental monitoring system for a FOSW farm that uses autonomous underwater vehicles (AUVs) equipped with sensor packages.
- Orpheus Ocean, Inc. will further develop an existing AUV for environmental monitoring around an FOSW farm by integrating and validating a sensor package. The AUV is intended to collect high-resolution images and data of the sea floor for biodiversity assessments and subsurface geohazards mapping.
- Teledyne Marine will develop an environmental conditions monitoring system using both an AUV and an uncrewed surface vehicle equipped with sensors capable of collecting data at various depths surrounding FOSW turbines.
- Geo SubSea, LLC will develop a small, maneuverable uncrewed underwater vehicle capable of deepwater seabed mapping and environmental data collection near FOSW structures.
- The Candide Group, LLC will conduct laboratory testing on the technical feasibility of a bio-inspired uncrewed underwater vehicle intended for subsea environmental monitoring and inspection in FOSW developments.

CEC staff also released a cost-share solicitation for a U.S. DOE Funding Opportunity Announcement (FOA, DE-FOA-0003334) for regional OSW R&D. The CEC issued an intent to award five projects in November 2024. If federal grants were awarded, more than $15 million

in federal funding would be leveraged from about $2 million in state ratepayer investments.[61] As of December 2025, no awards have been announced; consequently, CEC rescinded the solicitation and will use the funding to support other EPIC projects.

The CEC published final reports for two OSW-related agreements in 2025, the findings of which help to reduce the cost of wind energy to reach net-zero carbon emissions while creating good-paying jobs and using existing, local supply chains:

- *Integrated Distributed Fiber-Optic Sensing for Real-time Monitoring of Offshore Wind Turbine Gearboxes, Tower Operations, and Marine Animal Activities*[62] (EPC-19-010): LBNL demonstrated that distributed fiber-optic sensing technologies are effective for monitoring strain profiles in wind towers and gearboxes while enabling detailed operational diagnostics and early detection of potential equipment failures. Furthermore, this study showed that these technologies can reliably detect whale vocalizations despite the ocean's challenging acoustic environment, underscoring the value as a noninvasive tool for monitoring marine mammal communication.
- *On-Site 3D Concrete Printing for Next-Generation Low-Cost Wind Plants*[63] (EPC-19-007): Sperra successfully designed a 3D-printed concrete tower and foundation for a 7.5-megawatt (MW) wind turbine in California. The team:
    - Validated the design through large-scale structural testing of three-dimensional, concrete-printed tower subassemblies under simulated fatigue and seismic loading.
    - Quantified the life-cycle costs and environmental impacts of a 3D-printed concrete tower and identified routes to reduce them.
    - Completed a large-scale outdoor tower printing demonstration and assessed the feasibility of using 3D-printed concrete to fabricate anchors and subsea energy storage systems for OSW energy.

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[61] California Energy Commission. 2025. "GFO-21-901 — Cost Share for Federal Clean Energy Funding Opportunities." https://www.energy.ca.gov/solicitations/2022-03/gfo-21-901-cost-share-federal-clean-energy-funding-opportunities.

[62] Wu, Y., L. Luo, K. Soga, M. DeJong, J. Saw, and J. Xu. 2024. *Integrated Distributed Fiber-Optic Sensing for Real-Time Monitoring of Offshore Wind Turbine Gearboxes, Tower Operations, and Marine Animal Activities*. California Energy Commission. Publication Number: CEC-500-2025-023. https://www.energy.ca.gov/sites/default/files/2025-05/CEC-500-2025-023.pdf.

[63] Falzone, Gabriel, Charlotte Marston, Jason Cotrell, Mo Li, Wei Geng, Amadeu Malats Domènech, and Kathryn Jones. 2024. *On-Site 3D Concrete Printing for Next-Generation Low-Cost Wind Plants*. California Energy Commission. Publication Number: CEC-500-2025-003. https://www.energy.ca.gov/sites/default/files/2025-01/CEC-500-2025-003.pdf.

Strategic Initiative: Nonvariable Renewable Energy

Geothermal and Lithium Recovery

More than 5 percent of California's in-state electricity generation is provided by geothermal resources.[64] Geothermal resources in the Salton Sea area of Imperial County have significant stores of lithium, a critical mineral used in batteries for EVs and energy storage. A 2023 LBNL study estimated that the Salton Sea area possesses enough lithium to produce 11.3 million EV batteries per year.[65] In addition, other valuable minerals in Salton Sea brine include zinc and manganese, which could also support domestic battery production.

About 95 percent of the world's lithium is produced in just four countries — Australia, Chile, China, and Argentina — through either hard-rock mining or large evaporation ponds.[66] These methods result in significant environmental impacts.[67] While California has a substantial lithium resource contained in the mineral-rich geothermal brine that lies deep underground in the Salton Sea area of Imperial County, research and demonstration projects are needed to scale and improve the cost-effectiveness of recovery. Direct lithium recovery in-state from geothermal brine is expected to have lower environmental impacts, better cost efficiency and safety, and a smaller operational footprint compared with traditional methods of sourcing lithium outside California.

Advancing geothermal brine-related technologies to enable recovery of lithium and other valuable minerals and improving the economics of geothermal power plants will support the achievement of California's clean energy goals. In addition, in-state lithium production may also lead to new manufacturing plants across the battery supply chain and can increase tax revenues to benefit local communities.

In 2024, CEC staff released GFO-23-304,[68] which resulted in four awards totaling $13.8 million in investment:

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[64] California Energy Commission. 2023. "2023 Total System Electric Generation." https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2023-total-system-electric-generation.

[65] Dobson, Patrick, Naod Araya, Maryjo Brounce, et al. 2023. *Characterizing the Geothermal Lithium Resource at the Salton Sea.* University of California, Davis. Publication Number: LBNL-2001557. https://escholarship.org/uc/item/4x8868mf.

[66] U.S. Geological Survey. 2024. *Mineral Commodity Summaries 2024*. pg. 212. https://doi.org/10.3133/mcs2024.

[67] Petrakis, E., I. Alexopoulos, O. Pantelaki, et al. 2025. "Advances in Mineral Processing of Hard-Rock Lithium Ores: A Comprehensive Review." *Mining, Metallurgy & Exploration:* 42, 1251–1283. https://doi.org/10.1007/s42461-025-01227-y.

[68] California Energy Commission 2024. "GFO-23-304, Geothermal Energy Operations and Lithium Innovation (GEO/LI)." https://www.energy.ca.gov/solicitations/2024-01/gfo-23-304-geothermal-energy-operations-and-lithium-innovation-geoli.

- "Geothermal Brine Pretreatment and Metal Recovery" (EPC-24-043) to Materials Research to develop and demonstrate a process using metal sulfide precipitation to recover zinc and manganese as saleable products and remove interfering minerals from geothermal brines, making them suitable for direct lithium recovery
- "Preventing Scaling and Corrosion in Geothermal Facilities With Novel Lubricant-Infused Barrier Coating" (EPC-24-044) to Barr Engineering to develop and demonstrate a lubricant-infused, scaling and corrosion-resistant coating optimized for the harsh environmental conditions found in the Salton Sea geothermal field
- "High-Efficiency Mineral Recovery System With Reduced Waste Output" (EPC-24-048) to Power Environmental Energy Research Institute to develop and demonstrate a foam fractionation process to recover zinc and manganese from geothermal brine as saleable products and remove interfering minerals to improve lithium recovery
- "Integrated Smart Brine Management Approach to Reduce Geothermal Plant Operating Costs and Improve Mineral Recovery" (EPC-24-028) to DNV Energy USA, Inc., to develop and demonstrate a comprehensive system model for brine chemistry management that reduces scaling and corrosion impacts at geothermal plants and supports lithium recovery and power generation operations

Two projects were completed in 2025, including EPC-19-019, which published a final report titled *Joint Time-lapse Acquisition and Inversion of Passive Seismic and Magnetotelluric Data for Monitoring Reservoir Processes at the Geysers Geothermal Field*.[69] This project helped make geothermal energy more efficient and affordable by improving the understanding and management of underground steam and water flow at The Geysers in Sonoma and Lake Counties, the world's largest geothermal power facility. Using a new combination of low-cost seismic sensors and advanced imaging techniques, the project findings will allow operators to better pinpoint where to drill wells and manage water injections, essential to maintaining steam production. The improvements could lead to a 5 to 10 percent increase in efficiency, saving between $370,000 and $635,000 each year across power plant operations.

Improved well targeting also means fewer dry and underperforming wells, which can cost up to $6.5 million each to improve and could reduce the number of new wells needed over time. The technology may also reduce the need for costly tracer studies and cut monitoring

[69] Gritto, Roland, Evan S. Um, Jared Peacock, Steve P. Jarpe, Craig Ulrich, Craig S. Hartline, and David L. Alumbaugh. 2024. *Joint Time-Lapse Acquisition and Inversion of Passive Seismic and Magnetotelluric Data for Monitoring Reservoir Processes at The Geysers Geothermal Field*. California Energy Commission. Publication Number: CEC-500-2024-075. https://www.energy.ca.gov/sites/default/files/2024-07/CEC-500-2024-075_0.pdf.

expenses by using more affordable seismic equipment. Altogether, these innovations advance California's clean energy goals by making geothermal power more cost-effective and reliable.

The final report for project EPC-19-029, *Improved Silica Removal for Enhanced Geothermal Plant Performance*,[70] showcased the development and demonstration of a fundamentally new method for managing silica in geothermal operations. The new technology, known as a geothermal mesofluidic enhanced particle separator, separates solid particles by size as they flow through tiny channels, gently driving the larger particles to one side of the device. As a result, the bulk of the flow is cleared of particles, and a concentrated slurry containing the particles is separated from the stream. This separation technology eliminates the need to add any extra chemicals to prevent rust or clumping, and the separation system does not require cycling or allowance for large settling volumes. Larger particles separate faster than smaller particles, enabling size separation and purification for value-added products. Novel designs and manufacturing methods allow these geothermal mesofluidic enhanced particle separator devices to be made cost-effectively, at an industrial scale, and in a form-factor that allows deployment within existing geothermal piping.

Bioenergy

Dead and dying trees can elevate the risk of catastrophic wildfires, which pose a significant threat to human safety, health, and the environment. Federal and state forest services, fire officials, local air districts, landowners, and rural communities, among others, have expressed a need to develop methods for turning forest biomass into value-added products, as this can improve the cost-effectiveness of removing dead and dying trees. The CEC initiated EPIC's bioenergy portfolio in 2016 in response to Governor Edmund G. Brown Jr.'s emergency proclamation on the tree mortality epidemic.[71] Subsequently, CEC invested in four bioenergy research projects to demonstrate and evaluate environmentally and economically sustainable woody biomass-to-electricity systems.

In 2025, these projects made progress on permitting, construction, installation, and leveraging additional funding from federal, state, and local government agencies to expand the initial work, including these two highlighted projects from the portfolio:

- The "Burney-Hat Creek Bioenergy Project" (EPC-17-019) team completed construction, underwent commissioning, and started commercial operation of the biomass power

[70] Shelby, Tyler, Raymond S. Addleman, Debra Barnett, Carolyn Burns, Chad Haugen, Dan Palo, Leonard Pease. 2025. *Improved Silica Removal for Enhanced Geothermal Plant Performance*. California Energy Commission. Publication Number: CEC-500-2026-002. https://www.energy.ca.gov/publications/2026/improved-silica-removal-enhanced-geothermal-plant-performance.

[71] State of California. 2015. News release. "Governor Brown Takes Action to Protect Communities Against Unprecedented Tree Die-Off." https://archive.gov.ca.gov/archive/gov39/2015/10/30/news19180/index.html.

plant in 2025 (Figure 4). This 3-MW plant is converting approximately 30,000 bone-dry tons per year of forest waste and sustainably sourced wood to renewable electricity for export to PG&E's grid under the Bioenergy Market Adjusting Tariff Program. The plant is the first Category 3 (forest residues) Bioenergy Market Adjusting Tariff project in operation.

- For the "Mariposa Biomass Project" (EPC-17-021), the Mariposa County Resources Conservation District received $2 million from the California Department of Forestry and Fire Protection to grade and install a water tank and hydrant at the biomass-to-energy conversion site in Mariposa. The recipient secured conditional use, building, and grading permits in 2024 and is awaiting approval of interconnection with PG&E in December 2025. The project is expected to start grading and construction in 2026.

Figure 4: Ribbon-Cutting Ceremony for Burney-Hat Creek Bioenergy Power Plant

Burney-Hat Creek Bioenergy, LLC began commercial operations of this forest biomass bioenergy facility located in Shasta County, reducing fire-prone waste and risk for the community.

Photo credit: Mercedes Lane Photography

Impediments and Setbacks

In 2025, the OSW and solar energy sectors faced significant headwinds in the United States due to market and federal regulatory challenges. Global supply chain disruptions related to tariff uncertainty, coupled with domestic inflation and rising interest rates, drove up costs, leading to widespread project delays and cancellations. At the federal level, new restrictions on OSW and solar leasing and permitting created uncertainty, while claw-backs of previously awarded clean energy funding and federal tax credits undermined investor confidence and impacted EPIC-funded R&D projects, putting some projects at risk of losing match funding.

For bioenergy projects, communities have raised concerns regarding combustion-based generators, which convert the gas produced by the gasifier systems into renewable electricity. The CEC takes these concerns seriously. The EPIC-funded systems all plan to meet or exceed local air district standards for stationary power generation. Through community engagement and education, many of these projects have garnered significant local community and local government support, such as a grant and a loan from Yuba Water Agency.

Lithium recovery from geothermal brine requires field demonstrations to accurately test methods and technologies. The volatile properties of active geothermal brine depend highly on temperature, pH, and flow rate, all of which change if the brine is shipped to a lab. As a result, grant recipients must work with one of only three geothermal developers and operators in the Salton Sea region. These developers are focused on near-term commercialization, which may not be compatible with R&D activities due to restrictions on potentially competing technologies. Several experts have expressed interest in a geothermal test well that will enable all technology providers to have a venue for testing their technologies under real-world conditions; however, no leading organization has stepped forward to offer shared access to its site, and a funding source for such a test well has not yet been identified.

In addition to these logistical hurdles, scaling direct lithium extraction remains a technical and economic challenge, and community engagement and environmental permitting are critical factors that must be addressed early in the development process. Demonstration projects and regulatory clarity will be essential to proving commercial viability and ensuring that lithium recovery aligns with California's clean energy and environmental goals.

Next Steps

CEC staff anticipates awarding projects totaling $6 million in 2026 under a solicitation for AI tools that lower costs and enable increased energy output for utility-scale solar in non-traditional locations. These locations might include sloped terrain, brownfields, roadside land, public water bodies, and other locations where land use and environmental impacts would be minimized. CEC staff also anticipates releasing a cost-share solicitation to leverage federal

funding opportunities in 2026 to advance geothermal technology and enhance lithium recovery.

Strategic Objective 2: Create a More Nimble Grid to Maintain Reliability as California Transitions to 100 Percent Clean Energy

Introduction

As the share of electricity provided by variable renewable resources increases alongside rapid deployment of DERs that can flex loads, there is a growing need to modernize to increase visibility and controllability of the electricity grid. CEC investments in these two initiatives — clean dispatchable generation and grid modernization — advance technologies to create a more nimble grid that can affordably and reliably meet the state's energy goals.

Progress and Successes

Significant progress under this strategic objective occurred in 2025; milestones are described per strategic initiative on the following pages. They include new solicitation releases, new project kickoffs, project closeouts, and publication of final reports.

Strategic Initiative 2.1: Clean, Dispatchable Resources

Clean dispatchable resources can ramp electricity output up or down, complementing variable renewable generation like solar and wind with zero carbon emissions. CEC EPIC investments support a portfolio of dispatchable resources with different operating durations that can address a wide variety of grid needs throughout the state, including clean renewable fuels that can provide power for hundreds of hours or longer. Modeling for SB 100 reveals that a relatively small amount of energy from clean dispatchable resources can reduce the total capacity and cost of new variable renewable resources needed to reach 100-percent renewable or zero-carbon retail sales of electricity.[72]

GFO-23-317 "Energy Storage Innovations to Support Grid Reliability"

In April 2025, under GFO-23-317 "Energy Storage Innovations to Support Grid Reliability," CEC staff proposed awards for six energy storage projects totaling just over $30 million. These awards include three applied R&D projects and three demonstration projects across a variety of technologies aimed to improve the performance, cost competitiveness, materials selection, and design decisions that support scalability and commercial readiness. Through R&D findings

[72] California Energy Commission, California Public Utilities Commission, and California Air Resources Board. 2021. *2021 SB 100 Joint Agency Report: Achieving 100 Percent Clean Electricity in California: An Initial Assessment*. Publication Number: CEC-200-2021-001. https://efiling.energy.ca.gov/EFiling/GetFile.aspx?tn=237167&DocumentContentId=70349.

and pilot demonstrations, these projects will support improvements in grid resiliency and provide reliable power for community centers and critical facilities across the state:

- "Next-Generation Solid State Sodium Polymer Batteries for Stationary Storage Applications with a Recyclable Design" (EPC-25-008, DarmokTech) to advance a solid-state sodium-ion battery for grid applications by optimizing both the polymer electrolyte formulation and a recyclable cell design
- "Iron and Sodium Next Generation Battery for Long Duration Energy" (EPC-25-018, Inlyte Energy) to validate a low-cost iron-sodium chloride battery with both long-duration and daily cycling capabilities, first optimizing a large-format module and then testing it at UC Irvine
- "Advanced Zn Electrode to Enable Rechargeable Alkaline Zinc Batteries for a More Resilient Grid" (EPC-25-007, Enzinc Inc.) to develop and optimize manufacturing processes for an improved porous zinc sponge anode for low-cost nickel-zinc batteries and validate a 100-Amp-hour (Ah) system at a UC Riverside testing laboratory
- "Storage Technology and New Energy Resiliency Demonstration" (EPC-25-010, Long Hill Energy Partners, LLC) to demonstrate a 500-kilowatt (kW)/5-megawatt-hour (MWh) quinone-based organic redox flow battery at a critical healthcare facility in Lancaster for energy resilience and cost reduction benefits
- "Innovative Hybrid Battery Energy Storage Solution for Value-Stacked Grid Services" (EPC-25-036, Gridscape Energy Solutions, Inc.) to demonstrate the benefits of combining lithium-ion, sodium-ion, and second-life EV batteries into one system to improve performance and lower costs
- "Rigs to Renewables: Demonstrated Application of Networked, Gravity-Based Multi-Duration Energy Storage in Idle Oil and Gas Wells" (EPC-25-009, Renewell Energy Inc.) to repurpose idle oil and gas wells into gravity-based storage assets, demonstrating a network of five, 36-kW/36-kilowatt-hour (kWh) gravity wells in Kern County to support grid reliability and flexibility

GFO-23-315 "Clean, Dispatchable Generation"

In October 2025, the CEC kicked off the "Silicon Valley Clean Water Biogas Microgrid for Clean Dispatchable Electricity from Linear Generators" project (EPC-25-001, Silicon Valley Clean Water) to develop and demonstrate a facility-scale microgrid that flexibly dispatches 730 kW of energy produced from biogas-fueled linear generators. The technology is installed at a municipal wastewater treatment plant located in Redwood City. In addition to the three linear

generators, the microgrid includes a 1-MW/2-MWh battery and will participate in DR programs while reliably meeting critical load from wastewater treatment operations and anaerobic digesters. The project will validate the performance and support the commercial viability of linear generator technology, particularly for scaling across California's wastewater sector. This project is expected to be completed in 2028.

The CEC also closed out successful projects under this initiative and published final reports on its website. One example is Form Energy, Inc.'s project, "Demonstrating an Aqueous Air-Breathing Energy Storage System for Multi-Day Resiliency" (EPC-19-041).[73] The company had its first independently verified, prototype-scale demonstration of a 100-hour iron-air battery energy storage system. The project encompassed several core activities, including codes and standards analysis and safety testing, battery module design and commissioning, independent measurement and verification, and market participation modeling. Safety testing of short circuits resulted in no adverse events and demonstrated electric current and temperature generation that was several orders of magnitude lower than that of commercially available batteries. Market participation modelling highlighted the potential to provide seasonal energy shifting as well as short-term charging and discharging based on daily fluctuations in wholesale energy prices. The project helped advance the commercialization of a novel and safe long-duration energy storage technology that can cleanly dispatch energy when needed and help California cost-effectively reach its energy goals.

Strategic Initiative 2.2: Grid Modernization

Increasing the use of existing transmission and distribution assets can unlock affordability benefits. Deployment of advanced grid technologies, such as dynamic line ratings and power flow controllers, coupled with coordination and dispatch of customer-owned DERs via aggregators and utility distributed energy resource management systems (DERMS), can significantly increase the value extracted from existing grid infrastructure. These technologies typically combine improved sensing, communications, controls software, and hardware, supporting grid reliability by enhancing utility situational awareness and electric load flexibility.

In June 2025, the CEC released a $26 million solicitation titled "Advanced Grid Technology Acceleration Projects" (GFO-24-312), followed by a pre-bid workshop in July.[74] This funding opportunity seeks to improve and validate the performance and benefits of advanced grid technologies and accelerate future deployments by informing how advanced grid technologies

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[73] Baldwin, Annie, Mark Thompson, and Nicole Vadivel. 2025. *Demonstrating an Aqueous Air-Breathing Energy Storage System for Multi-Day Resiliency*. California Energy Commission. Publication Number: CEC-500-2025-045. https://www.energy.ca.gov/sites/default/files/2025-11/CEC-500-2025-045.pdf.

[74] California Energy Commission. 2025. "GFO-24-312 — Advanced Grid Technology Acceleration Projects." https://www.energy.ca.gov/solicitations/2025-06/gfo-24-312-advanced-grid-technology-acceleration-projects.

can be incorporated into operations, planning, and capital investment processes. Applications were received on November 14, 2025.

In February 2025, the CEC released an RFI on research needs to support grid-beneficial orchestration of DERs. This informed the release of a $7.2 million solicitation in October 2025 titled "Coordinated Holistic Orchestration of Inverter-based Resources (CHOIR)" (GFO-25-302). The solicitation will support projects that advance and demonstrate the capabilities of load aggregators and grid operators to dispatch customer-owned DERs, such as solar PV, batteries, and EVs, for distribution and bulk grid services.[75] Proposals were due December 18, 2025.

Impediments and Setbacks

One of the principal challenges experienced in 2025 was the change in federal administration priorities. The CEC had previously committed approximately $6.5 million in cost-share funding and provided letters of support to several California-based projects pursuing funding from the U.S. DOE related to this strategic objective. Some of these entities have reported significant delays in verifying go/no-go milestones, while others have received no formal communication from the U.S. DOE after being announced as an awardee.

As described in the CEC's 2024 EPIC Annual Report, the CEC released a notice of letter of intent through the federal cost-share solicitation to provide $6 million in cost-share funding to the Tribal Energy Resilience and Sovereignty (TERAS) Project. TERAS was conditionally awarded more than $87 million in federal funds to construct a network of microgrids serving tribes in Northern California that are served by low-reliability circuits that are highly impacted by public power safety shutoffs. However, following the change in federal administration, negotiations on this award have been paused, and there is a high risk that the award will be terminated. While the CEC has other opportunities to redirect this funding, this significant loss of federal resources was a setback to EPIC and California ratepayers.

Next Steps

In 2026, the CEC anticipates sustaining progress on both clean dispatchable resources and grid modernization initiatives. Plans include:

- Awards and project kickoffs for the "Advanced Grid Technology Acceleration Projects" solicitation.
- Awards and project kickoffs for the CHOIR solicitation.

[75] California Energy Commission. 2025. "GFO-25-302 — Coordinated Holistic Orchestration of Inverter-based Resources (CHOIR)." https://www.energy.ca.gov/solicitations/2025-10/gfo-25-302-coordinated-holistic-orchestration-inverter-based-resources-choir.

- Agreement execution and project kickoff for one agreement from the "Clean, Dispatchable Generation" solicitation.
- Redirection, as needed, for the EPIC funding committed to TERAS and other federal cost-share agreements stalled by federal inaction.

Strategic Objective 3: Increase the Value Proposition of Distributed Energy Resources

Introduction

DERs are key components of California's clean energy future and economy-wide decarbonization. DERs have the potential to lower costs for the electric grid and deliver significant benefits to ratepayers and end-users, particularly in a high-renewables, high-electrification future. DERs encompass distribution-connected generation, EVs, energy storage, energy efficiency, and load flexibility technologies. CEC investments in two initiatives — DER integration and load flexibility, and transportation electrification — advance technologies to increase the value proposition of DERs to customers and the grid.

Progress and Successes

Significant progress under this strategic objective occurred in 2025; milestones are described per strategic initiative below.

Strategic Initiative 3.1: DER Integration and Load Flexibility

Improving Forecasts of Behind-the-Meter Resources

In October 2025, the CEC released a $3 million solicitation titled "Improving Net-Load Forecasting Models by Integrating Data on Behind-the-Meter Resources" (GFO-25-303). The solicitation seeks research that will improve short-term forecasting of BTM resources, such as rooftop solar, battery energy storage systems (BESS), EV charging, and flexible loads to support grid reliability and reduce costs for ratepayers.

The solicitation builds on a 2024 joint scoping workshop with California ISO and public engagement throughout 2025 and establishes a coordinated research agenda that reflects operational priorities from California ISO, utilities, LSEs, aggregators, and public input. It lays the groundwork to improve net load visibility in high-DER futures, reduce operational uncertainty, and enable more reliable, cost-effective integration of DERs. Resulting awards are expected to kick off in late 2026.

Power Electronics

As California transitions toward widespread building and transportation electrification, customers — particularly those in older single-family homes, multifamily buildings, and disadvantaged communities — continue to face high balance-of-system costs, panel upgrade

requirements, and lengthy interconnection timelines. These systemic barriers slow electrification, limit participation in clean energy programs, and prevent customers from accessing reliable, zero-emission backup power. EPIC is investing in projects that advance next-generation power electronics technologies to reduce installation costs, improve system efficiency, and expand access to clean, resilient BTM energy solutions.

In 2025, projects funded out of the "Power Electronics for Zero-Emission Residential Resilience (PEZERR)" solicitation (GFO-23-302) achieved meaningful milestones related to UL certification[76] pathways, installer readiness, IOU coordination, and early technology-market traction. For example, "Energy Quarterback Development and Demonstration Project" (EPC-24-016), led by NeWorld Energy, achieved UL field approval for its second-generation Energy Quarterback device, and completed battery interoperability testing in coordination with all three IOUs. Milestones such as these position the power electronic devices for accelerated interconnection approval, simplifying zero-emission backup power installations and making them more accessible to all.

The "Distributed Resources for Innovative Vehicle Energization Strategies (DRIVES)" solicitation (GFO-25-301) was also released in 2025, which will fund a DC-integrated EV microgrid demonstration expected to kick off in 2026. This investment will validate high-efficiency DC architectures and expedite energization timelines for and provide other benefits to the commercial charging sector. Collectively, these achievements demonstrate meaningful EPIC progress toward reducing balance-of-system costs, validating next-generation power electronics, and supporting equitable access to clean backup power and electrification solutions.

Design-Build Competitions

EPIC invested in two major design-build competitions across the EPIC 3 and EPIC 4 funding cycles focused on enabling widespread adoption of advanced energy communities[77] (AECs) and grid-interactive efficient buildings (GEBs) that improve resilience, lower costs, and expand equitable access to clean energy technologies. Each competition followed a two-stage structure. First, a design phase funded multi-disciplinary teams to develop holistic concepts,

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[76] UL certification refers to safety and performance testing conducted by Underwriters Laboratories (UL), an independent standards and certification organization. For electrical and energy-related equipment, UL certification verifies that a product meets nationally recognized safety, reliability, and performance standards and can be safely installed and operated in buildings and on the electric grid.

UL certification is often required by utilities, local building officials, and fire authorities before new technologies can be permitted, interconnected, or deployed at scale. Achieving UL certification, therefore, represents a critical step in moving innovative power-electronics devices from prototype or pilot stages into commercially viable, widely deployable products.

[77] A community-scale approach to deploying DERs and other clean energy technologies that can serve as a model for other communities.

designs, and implementation plans. A build phase followed that funded a subset of teams to construct and operate real-world demonstrations, validate performance, and document implementation approaches that can be applied to future projects.

Resulting projects are installing commercially available technologies — solar PV, battery storage, advanced controls, and building electrification and efficiency measures — at a community-scale to mitigate the barriers that prevent their integration into communities and affordable housing projects. These investments help builders, developers, and local governments learn how to deploy proven technologies faster, at lower cost, and in ways that deliver tangible benefits to residents, especially those in ESJ communities.

In 2025, the eight active design-build competition projects made substantial progress, with AEC projects moving into final field implementation and measurement and GEB projects advancing from pre-construction into detailed design, permitting, and early site work.

The four AEC build-phase projects completed major field activities in 2025, transitioning from intensive design and construction to commissioning, M&V, and preparation for final reporting. For example, the "Bassett-Avocado Advanced Energy Community" project (EPC-19-006), led by the Energy Coalition, installed rooftop solar and BESS for 44 income-qualified homes, launched an EV carshare pilot, collected case-study data, and is developing a scalability toolkit to support CCAs, utilities, and local governments in deploying AECs in an expedited plug-and-play model (Figure 5).

The four GEB build-phase projects achieved key pre-construction and early implementation milestones, setting the stage for major construction and commissioning activities in 2026. Notably, the "Minimal Unidirectional Zero-Net Energy Community through a Stand-by Grid Connection" (EPC-23-026) project, led by EPRI, broke ground in Petaluma in 2025 and is advancing an all-electric, affordable housing community powered primarily by solar and battery storage. Designed to operate almost entirely off-grid with a simple backup grid connection for resilience, the project prioritizes carbon reduction, lower tenant energy costs, and replicability as a model for sustainable housing aligned with California's clean energy goals. EPRI also finalized PV and storage specifications in 2025 and explored bidirectional EV charging options under evolving national standards.

Figure 5: Basset-Avocado Advanced Energy Community Demonstration Home

Bassett-Avocado Advanced Energy Community staff attending a battery storage and solar installation at the home of the advanced energy community's first participant.

Photo credit: The Energy Coalition

Demand Flexibility

The demand flexibility portfolio encompasses EPIC agreements that advance flexible-load technologies across buildings, campuses, industrial facilities, agricultural operations, and water infrastructure and support dozens of demonstrations.

The California Load Flexibility Research and Deployment Hub, or CalFlexHub, (EPC-20-025) and the Industrial, Agriculture, and Water (IAW) FlexHub (EPC-24-045) use a hub-and-spoke demonstration model, which enables multiple field demonstrations, coordinated research, and cross-site comparison under a unified hub administrator. Another project, HP-FLEX (EPC-19-013), is a standalone technology demonstration focused on model-predictive controls (MPCs) for heat pump systems in small commercial buildings.

These efforts aim to help California scale the use of demand flexibility as a reliable and cost-effective grid resource. They seek to address challenges such as the lack of field validation for flexible-load strategies, lack of interoperable controls, unclear customer value propositions, workforce gaps, and data-access and cybersecurity constraints.

In 2025, CalFlexHub, led by LBNL, achieved significant progress in advancing demand flexibility across California. The initiative expanded its portfolio to more than 100 field sites, with more than half located in ESJ communities, and conducted large-scale demonstrations of load-flexibility technologies, including heat pumps, heat pump water heaters (HPWHs), integrated heat pumps, and thermal storage. A key achievement was the advancement of OpenADR 3.0, which made substantial progress toward certification and integration with the CEC's Market Informed Demand Automation Server (MIDAS). MIDAS is a transformative platform that provides access to utilities' time-varying electricity rates and other signals, enabling precise timing of demand flexibility actions.

HP-Flex (EPC-19-013) demonstrated that low-cost, open-source MPCs can transform heat pumps in small commercial buildings into grid-responsive assets. Field demonstrations at six sites achieved an average 21 percent peak load reduction and up to 12 percent electricity cost savings while maintaining comfort. A key achievement was developing an open-source MPC platform that is deployable without centralized automation, removing a key barrier for small buildings. HP-Flex also integrated training materials into workforce programs, supporting broader adoption of these solutions.

Led by Build Momentum, IAW FlexHub (EPC-24-045) established a platform for demand flexibility research in the IAW sectors, historically underserved by demand response and load management programs. In 2025, the project team kicked off the initiative, launched the public Industrial, Agriculture, and Water Load Flexibility Hub (https://iawflexhub.org/), and began developing the first cohort of four demonstration projects focused on industrial refrigeration, water and wastewater treatment, and electric manufacturing processes.

VPP-FLEX

EPIC 4 demonstration projects are advancing virtual power plants (VPPs) and interoperable commercial energy management systems (EMS) that transform customer-sited DERs — energy storage, EV charging, smart appliances, HVAC, and smart building controls — into reliable, dispatchable grid assets. These projects aim to improve DER visibility, device interoperability, telemetry and data access, and cybersecurity. Expected outcomes include demonstrated load flexibility performance across building types, open standards-based control architectures to enable building-scale load flexibility, replicable VPP program models, and increased participation among low-income communities.

Projects awarded out of GFO-23-309 "Virtual Power Plant Approaches for Demand Flexibility" (VPP-FLEX) are developing or broadening the scale of community-based VPPs in 2025:

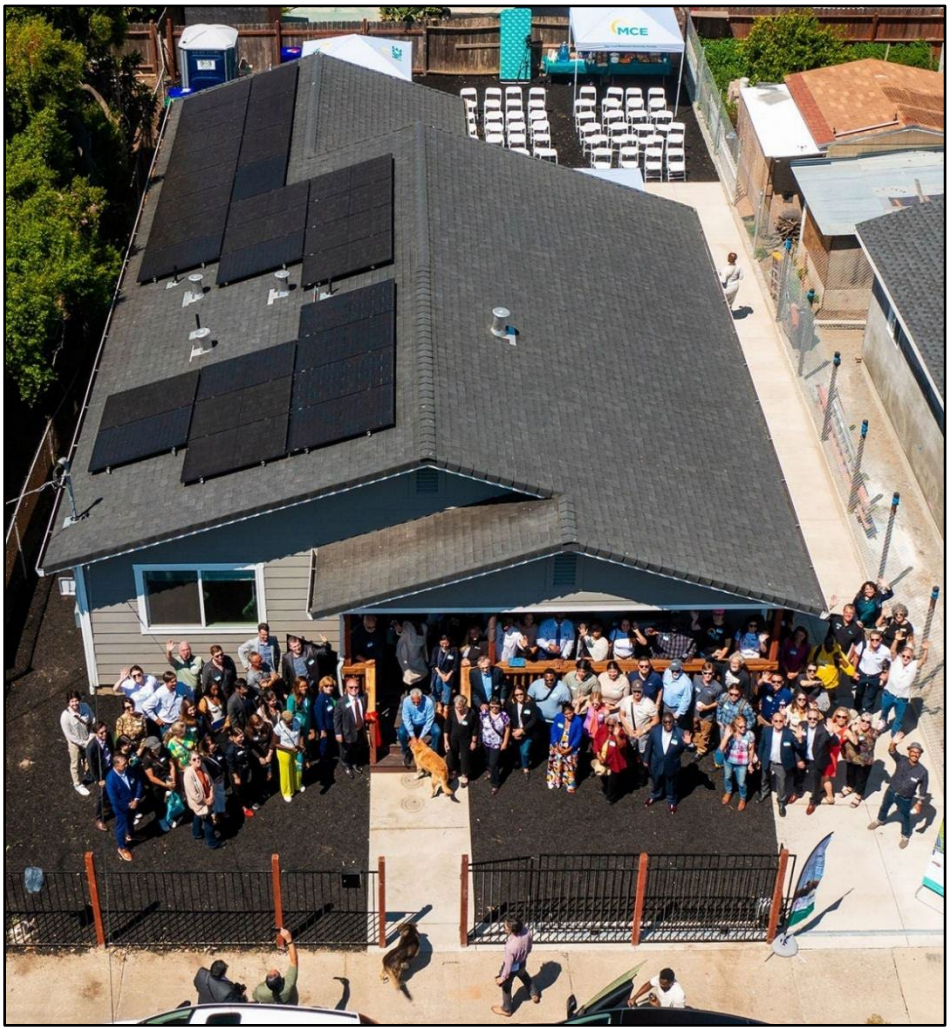
- "Expansion of a Virtual Power Plant Using Automated Devices in Low-Income and Disadvantaged Communities" (EPC-24-039), led by Sonoma Clean Power, is expanding and automating a community-based VPPs across Sonoma and Mendocino counties.
- "Valuing People Power" (EPC-24-040), led by MCE, is augmenting its in-house DERMS platform, originally developed under the CEC's Advanced Energy Communities (EPC-19-005) initiative, to serve all 37 jurisdictions in MCE's service area (Figure 6).
- "Powering Yolo Forward" (EPC-24-034), led by UC Davis, is developing a coordinated community VPP spanning public buildings, university facilities, and municipal assets.
- "California Campus Load Flexibility" (EPC-25-027), led by LBNL, is developing an open-source software platform that transforms large institutional campuses into VPPs to be demonstrated on three California campuses.

From the same solicitation, these projects were demonstrating interoperable EMS in commercial buildings in 2025:

- "SUPPLIES – Scaling Up Virtual Power Plants through Interoperable Energy Management Systems in K-12 Schools" (EPC-24-030), led by EPRI, is advancing an interoperable EMS platform at two Los Angeles Unified School District sites.
- "Super-GX: Scale Grid-responsive Supervisory Control for Multiple Commercial Buildings and EV Charging," led by UC Berkeley (EPC-24-035), is demonstrating an open-source software that coordinates behind-the-meter EV chargers and traditional building loads to enable demand flexibility in commercial buildings.
- "OBC-Flex: Enabling Interoperable Demand Flexibility in Commercial Buildings" (EPC-24-041), led by LBNL, is developing and testing a suite of open-source demand-flexible control sequences and integration tools in multiple commercial buildings to enable load flexibility across summer and winter months.

The VPP-FLEX portfolio made strong progress in 2025, with community-based VPP projects advancing customer enrollment strategies and projects focused on commercial buildings initiating development and testing of open-standard control frameworks. The portfolio also established technical advisory committees that represent the load flexibility ecosystem, including utilities, aggregators, original equipment manufacturers, community-based organizations (CBOs), campus operators, researchers, and regulators.

Figure 6: A Retrofitted Home Participates in a Virtual Power Plant Pilot



Guests visit MCE's VPP pilot in Richmond, California – a main component of the Richmond Advanced Energy Community Project. The VPP and DERs aim to make the community's energy cleaner, more affordable, and more reliable.

Photo credit: MCE

Strategic Initiative 3.2: Transportation Electrification

Efficient Transportation Electrification and Charging Technologies

As EV adoption accelerates, efficiently integrating new EV charging infrastructure with the grid is critical to meeting customer needs while managing system constraints. CEC's EPIC projects are developing innovative solutions that maximize the use of distribution infrastructure to minimize costly upgrades and put downward pressure on electricity rates. These efforts are focused across single-family and multifamily residences, public access sites, and MDHD fleet depots. In 2025, projects made steady progress navigating an evolving landscape of utility capabilities, regulations, and codes and standards to safely implement new technologies that offer more cost- and time-efficient alternatives to traditional infrastructure upgrades.

CEC kicked off eight EPIC projects awarded under the "Grid-Supportive Transportation Electrification" (GFO-23-306) solicitation, totaling $21.6 million.[78] This portfolio aims to advance innovations in managed charging responsive to grid conditions, avoid costly electrical service upgrades for EV charger installations, improve efficiency and scalability of high-power charging, and demonstrate mobile charging solutions that leverage existing infrastructure. Project progress achieved in 2025 includes:

- "Residential EV Deferred Distribution Upgrade Project" (EPC-24-023): WeaveGrid, in partnership with SCE, is demonstrating a managed charging program called Charge Smart – SoCal[79] to coordinate charging schedules and lessen local peaks on the distribution grid. The program emphasizes equitable access with the goal of enrolling 3,000 residential EV drivers in the Gateway Cities region of Southeast Los Angeles, including more than 900 participants in disadvantaged and low-income communities. As of September 2025, more than 1,000 participants had enrolled and early results showed a 68 percent reduction in peak load for given vehicle groups.
- "Transformer-Level Automated Load Management for EV Charging in Multi Unit Dwellings" (EPC-24-026): GoPowerEV is developing an automated load management system that adjusts EV charging based on near real-time conditions to safely stay within capacity constraints and avoid costly upgrades. GoPowerEV aims to use this technology to simplify the deployment of EV charging infrastructure at multifamily homes and enable flexible expansion as tenant needs evolve. In 2025, GoPowerEV selected key vendors for electrical monitoring equipment and prepared its load management system for third-party safety certifications, including UL 3141 for power control systems.
- "Deployment and Demonstration of a Novel DC-Coupled Fast Charging Technology with Low Grid Impact in the Central Valley" (EPC-24-024): Intertie is working to demonstrate a DC-coupled microgrid technology that integrates solar, BESS, existing electrical service, and a grid-tied bidirectional converter to power EV fast chargers. In 2025, Intertie completed the system design and layout for its site in the San Joaquin Valley and developed a controller to manage the DERs. Intertie tested functionality and performance of system components, including its DC/DC converter, and conducted

[78] California Energy Commission. 2024. "GFO-23-306 – Grid-Supportive Transportation Electrification." https://www.energy.ca.gov/solicitations/2024-01/gfo-23-306-grid-supportive-transportation-electrification

[79] WeaveGrid. July 2025. "WeaveGrid Launches "Charge Smart - SoCal" Initiative with Southern California Edison for EV Drivers in Gateway Cities Corridor." https://www.weavegrid.com/news/weavegrid-launches-charge-smart-socal-initiative-with-southern-california-edison

simulations to quantify site load impacts and support tariff selection, improving affordability outcomes.

- "Mobile EV Charging Site (MEVCS): An innovative opportunity charging solution for PEV load shifting and challenging duty cycles" (EPC-24-032): IXP, LLC is demonstrating a mobile EV charging system that integrates BESS and EVSE to shift loads and enable charger deployment where permanent installation is infeasible. In 2025, IXP continued assembly and integration of its mobile EV charging site trailers, pedestals, and charging skids and revised internal control modules to enable full communications, relay control, and sensor input.

Awarded through the "Research Hub for Electric Technologies in Truck Applications" (GFO-20-306) solicitation, EPRI and CALSTART (EPC-21-010) co-led the EPIC-funded "Electric Truck Research and Utilization Center (eTRUC)" project, which advances innovations for high-power heavy-duty truck charging infrastructure along key freight corridors. In May 2025, eTRUC held a ribbon-cutting for the Advanced Transportation Research Center (ATRC) (Figure 7).[80] Located at the SCE Electric Vehicle Technical Center in Pomona, the ATRC serves as a user facility for third parties, including vehicle, charger, and DER manufacturers, to conduct system-level functionality tests and grid integration tests at MW power levels. The ATRC is an actively testing laboratory well-positioned to advance enabling technologies and interoperability for high-power truck charging.[81]

Construction at the two eTRUC pilot sites began in 2025. The sites include (1) a transload facility in Carson, where quasi-public chargers will be demonstrated to provide opportunity charging for visiting trucks and (2) a truck stop in Ontario, where a high-power truck charger will be demonstrated. Both sites also have on-site DERs to reduce peak charging demand and high charging costs. Through the project's regular committee meetings with CBOs and workforce development representatives, the project team developed a Zero-Emission Vehicle (ZEV) Training Hub and an online inventory of ZEV training opportunities in California.[82] The inventory included more than 75 programs identified by the end of 2025. The eTRUC team also published a heat map resource that visually shows results of modeling to project heavy-duty charging infrastructure demand based on vehicle telematics data, fleet assessments, and

[80] CALSTART. May 2025. "EPRI, CALSTART, and eTRUC Partners Celebrate the Launch of the CEC-Funded Advanced Transportation Research Center; Charging Testing Hub for Heavy-Duty (HD) Electric Trucks." https://calstart.org/etruc-celebrates-launch-of-atrc-truck-charging-lab/.

[81] eTRUC. 2025. "eTRUC Advanced Transportation Research Center (ATRC)." https://etruc.org/etruc-laboratory/

[82] eTRUC. 2025. "eTRUC ZEV Training Hub." https://etruc.org/engagement/zev-training/

technology maturity.[83] CALSTART filed a comment under CPUC Rulemaking R.23-12-008 to share learnings and perspectives gained from the eTRUC project and inform CPUC's development of a transportation electrification proactive planning framework.[84]

Figure 7: Ribbon-Cutting Ceremony for eTRUC's Advanced Transportation Research Center

eTRUC partners cut the ribbon to launch the Advanced Transportation Research Center.

Photo credit: Doug Cupid Photography.

Technology Enablers for Using Electric Vehicles as DERs

EVs can quickly become California's largest DER as adoption accelerates. However, fully realizing the benefits of EVs serving as DERs requires technological advancements and vehicle-grid integration (VGI) strategies. VGI is any method of altering the time, charging level, or location at which grid-connected EVs charge or discharge to optimize interactions with the electric grid. VGI encompasses a range of use cases, including aligning charging with time-of-use rates or dynamic pricing, managed charging, and bidirectional charging. While the potential value of VGI at scale is immense for achieving system cost savings, driving

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[83] eTRUC. 2025. "California Modeled Energy Consumption Heatmap." https://etruc.org/maps-tools/ca-modeled-energy-consumption-heatmap/.

[84] California Public Utilities Commission. November 2025. *Opening Comments of CALSTART, Inc. on Administrative Law Judge's Ruling Requesting Comments on Transportation Electrification Proactive Planning Modeling Inputs and Assumptions*. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M587/K371/587371233.PDF.

downward pressure on rates, and achieving other net benefits for ratepayers, additional RD&D is essential to realize this value.

In 2025, CEC approved nine projects through "Enabling Electric Vehicles as Distributed Energy Resources" (GFO-24-302), investing $15.6 million to address VGI knowledge gaps, reduce costs for bidirectional charging enabling equipment, and develop submetering solutions to facilitate VGI.[85]

- "Charging Harmonization and Analysis for Resilient, Grid-Efficient Utilization and Planning (CHARGE UP)" (EPC-25-015): San Diego Community Power will analyze opportunities to realize the full grid benefits from managed charging for unbundled customers that receive CCA generation services and IOU distribution services.
- "Assessing VGI in California: Techno-Economic Merit and Implementation Strategies" (EPC-25-017): EPRI will model real-world IOU distribution infrastructure and evaluate benefits and equity implications of practical VGI mechanisms, including flexible connections, distribution grid services, and time-varying pricing.
- "Low-Cost Interoperable AC Bidirectional Charging Solution" (EPC-25-012): Rivian will develop a lower-cost bidirectional charging system for residential homes comprising an AC bidirectional EVSE and an automatic islanding device, while supporting interoperability by leveraging open industry standards.
- "Next Gen LEAP (Lucid Electric Advanced Platform)-V2X"[86] (EPC-25-013): Lucid will develop a bidirectional onboard charger with a single DC to AC power conversion stage as a lower cost and more energy-efficient way to introduce bidirectional capability to EVs.
- "Urban Resilience with Curbside Bidirectional Electric Vehicle Charging" (EPC-25-019): It's Electric will develop a curbside bidirectional "bring your own cable" charging system to expand access to V2X for customers living in multifamily homes and dense urban communities. This work aims to reduce peak demand, increase resiliency, and save costs for drivers and building owners (Figure 8).
- "Bidirectional Residential Integration for Dispatchable Grid Energy (BRIDGE)" (EPC-25-020): Nuvve will develop an energy management kit that coordinates bidirectional

[85] California Energy Commission. September 2025. "Energy Commission Business Meeting." https://www.energy.ca.gov/event/meeting/2025-09/energy-commission-business-meeting.

[86] Vehicle-to-everything (V2X) refers to using bidirectional energy transfer capability to discharge energy from an electric vehicle to a variety of destinations, including the electric grid, buildings, homes, or loads.

charging, load management, and DERs to be demonstrated at single-family homes in partnership with Kia and Wallbox.

- "V2X Cost Reduction in Electric Trucks" (EPC-25-021): UC Riverside will develop and demonstrate control strategies and technologies to maximize the benefits of V2X services that fleet vehicles can deliver and minimize negative impacts such as battery degradation.
- "Demonstrating Electric Vehicle Sub-Metering Solutions (DEVS)" (EPC-25-016): UC Davis will develop a virtual submetering solution for commercial customers that can separate EV loads from building loads and automate billing to multiple parties, simplifying cost allocation.
- "Fully Unified EV Submetering & Intelligent Optimization Nexus (FUSION)" (EPC-25-014), NeoCharge will develop a circuit pauser and submetering platform capable of combining low-cost data sources to meet accuracy requirements in aggregate and simplify EV submetering for single-family residential customers.

Figure 8: It's Electric Enables Bi-Directional Charging

An EV driver uses the It's Electric free bi-directional EV charger cable, distributed to EV drivers, to plug into a charger in San Francisco.

Photo credit: It's Electric

The "Vehicle-to-Building Technologies for Resilient Backup Power" solicitation (GFO-21-303) advanced the use of EVs and bidirectional charging technology to supply backup power to buildings and other sites. Projects are validating the use of EVs to provide similar backup power services to those provided by behind-the-meter stationary storage in addition to fulfilling conventional transportation needs at a lower cost. These solutions can reduce dependence on diesel backup generators. Progress made in 2025 included site preparations, interoperability testing, and hardware upgrades to enable bidirectional charging. For example, "Heavy-Duty Vehicle Electrification and its Potential as a Clean Energy Alternative for Critical Operations" (EPC-22-002): UC Davis and its project partners worked on site designs for installing bidirectional chargers that can provide backup power to a California Department of Transportation building in Oakland and modifications to EV street sweepers to enable controlled discharge.

Originally awarded through the "Evaluating Bi-Directional Energy Transfers and DER Integration for Medium- and Heavy-Duty Fleet Electrification" (GFO-20-304) solicitation," Building a Scalable and Repeatable School Bus Electrification Business (BuSy Bees)" (EPC-21-007): eIQ Mobility is preparing a V2X demonstration at a school bus depot located in Richmond and operated by First Student, a school transportation services company. In 2025, First Student expanded its involvement in the project to resolve outstanding firmware and interoperability issues with the bidirectional chargers it installed. The experience gained from the project team's navigation through market volatility, technical integration, and vendor reliability issues will help inform and de-risk similar V2X initiatives going forward.

Integrating DERs for Grid-supportive Vehicle Charging

Deploying DERs alongside new high-capacity EV charging sites can help enable charging in grid-constrained areas where additional electric load would otherwise require costly conventional upgrades. EPIC projects are demonstrating DER-coupled EV charging that appropriately accounts for customer-owned DERs, which, in turn, inform future policy frameworks and utility planning.

In 2025, projects funded through the "Evaluating Bi-Directional Energy Transfers and DER Integration for Medium- and Heavy-Duty Fleet Electrification" (GFO-20-304) solicitation made progress in demonstrating integrated DER-coupled charging systems across MDHD fleet applications. These projects will generate valuable data on capacity utilization trends, load and generation profiles, and costs to improve future deployments.

- "Distributed Resources for Diversified Renewable Energy Project" (EPC-20-046): Sysco commenced full operations and began data collection at its DER-coupled charging depot in Riverside, supporting its heavy-duty truck and refrigerated trailer fleet operations.

- "21st Century Truck Stop: 1st MD/HD eTruckStop in California" (EPC-21-006): WattEV commenced full operations and began data collection at its DER-coupled heavy-duty truck stop along State Route 99 in Bakersfield.
- "TAking Charge: TravelCenters of America Ultra-Fast En-Route Charging" (EPC-20-042): TA Operating dba Travel Centers of America began construction in Ontario (Figure 9).

Figure 9: Travel Centers of America's Heavy-Duty Truck Charging Depot

Rendered image depicting a heavy-duty truck pulling into the Travel Centers of America facility for fast charging in Ontario, California.

Credit: BP Pulse

Through these projects, a gap in current utility energization and interconnection frameworks has come to light. New charging loads and on-site DERs are treated as separate systems. This disconnect can lead to redundant grid upgrades that do not account for the capacity value of co-located customer-owned DERs.

In February 2025, CEC staff hosted a project showcase webinar to publicly share findings and identify opportunities for reforms to more fully value DERs supporting EV charging sites.[87] In March 2025, CEC staff hosted a scoping workshop to gather public feedback on a new funding opportunity concept, which developed into the DRIVES solicitation (GFO-25-301) to directly

[87] California Energy Commission. February 2205. "Fleet Charging with Solar Microgrids – EPIC Project Showcase." https://www.energy.ca.gov/event/webinar/2025-02/fleet-charging-solar-microgrids-epic-project-showcase.

target the barriers identified.[88] PG&E and SCE participated in the scoping workshop to present on flexible service connection pilots as near-term pathways to allow customers with controllable loads to connect to the grid without a capacity upgrade.

Lithium-ion Battery Reuse and Recycling Technologies

End-of-life management for BESS is critical to ensuring effective collection, safe transport, and environmentally responsible recycling or reuse of DERs. LIBs in EVs and stationary energy storage are reaching their end of life in growing volumes. EPIC is advancing innovations to support a circular economy to help lower lifecycle costs and environmental impacts, strengthen supply chain resilience, and reduce reliance on raw material extraction.

EV batteries typically reach the end of their automotive service life with 60 to 80 percent of original capacity remaining, making them suitable for second-life applications such as stationary energy storage. By repurposing these batteries before recycling them, California can expand its supply of low-cost energy storage to support affordable renewable generation integration, grid reliability, and community resilience. Direct recycling processes that are emerging can reduce energy use and environmental impacts associated with recovering materials from spent batteries. By preserving the structure of key components like the cathode, direct recycling can reduce waste, lifecycle environmental impacts, and costs of LIBs. EPIC projects are collectively demonstrating that second-life batteries can be safely integrated into stationary energy storage, developing direct recycling processes that can efficiently recover cathode material and yielding findings that help to resolve outstanding barriers to commercialization. In 2025, performance data were collected from installed second-life batteries at commercial buildings to quantify degradation rates under typical stationary energy storage cycling conditions.

"Reuse of Electric Vehicle Batteries for Solar Energy Storage" (EPC-19-039): RePurpose Energy became the first United States-based company to achieve UL 1974 certification for the repurposing of EV batteries at its facility in Fairfield in April 2025.[89] Achieving this certification has been an industry-wide challenge, as it requires demonstrating that batteries with prior use meet the same stringent safety standards as new batteries. The certification is a landmark step in helping to resolve permitting barriers for second-life battery systems across the field.

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[88] California Energy Commission. March 2025. "Electric Vehicle Charging with Solar Microgrids – EPIC Scoping Workshop." https://www.energy.ca.gov/event/workshop/2025-03/electric-vehicle-charging-solar-microgrids-epic-scoping-workshop.

[89] RePurpose Energy. April 2025. "RePurpose Energy Becomes First US-Based Company to Achieve Groundbreaking UL 1974 Certification for EV Battery Repurposing." https://www.repurpose.energy/blog.

"Development of Efficient and Scalable Direct Recycling Technology for Lithium-Ion Batteries" (EPC-21-008): UCSD successfully completed its project to develop and demonstrate an LIB direct recycling process.[90] The project innovations included safe de-energization of EV batteries with varying chemistries, enhanced cathode and anode material separation processes, and a direct regeneration process. The project demonstrated the recycling process at scale, achieved more than 90 percent yield of active material from spent batteries, and validated that the recovered material had equivalent performance. Compared to conventional LIB recycling processes, UCSD's process requires 80 percent less energy consumption and can achieve 12 to 38 percent cost savings. UCSD transferred its patented direct regeneration process to ExPost Technology, a spin-off company based in San Diego that aims to further scale and commercialize the process.

Impediments and Setbacks

In 2025, the DER integration, load flexibility, and transportation electrification portfolios faced common challenges due to changing market conditions, institutional and regulatory impediments, and typical setbacks observed with first-of-its-kind technology demonstration projects.

Projects encountered persistent interoperability barriers across DERs, controls, and EMS. In the VPP-FLEX portfolio, a project experienced unexpected failures due to backend firmware changes that were incompatible with the DERMS. In the Power Electronics portfolio, projects faced certification delays due to lack of access to high-current test facilities and new utility tariff requirements. These issues reinforce the need for early and explicit alignment with open standards in demonstrations.

Projects that required granular operational data from utilities or devices encountered delays in securing data access. Inconsistent access to meter-level or submeter data complicated baseline development and dispatch verification. Data-standardization and privacy-compliant access issues continued to limit forecasting and interoperability. These challenges affirm the need for coordinated data governance frameworks across CPUC, California ISO, IOUs, and public-interest researchers.

Projects involving demonstrations located in ESJ communities reported challenges achieving early enrollment, often due to trust gaps, lack of awareness, reliable internet connectivity, or unfamiliarity with DER programs. In the Design-Build portfolio, a project struggled to recruit homeowners for PV and electrification upgrades due to skepticism resulting from negative

[90] Gupta, Varun and Zheng Chen. 2025. *Development of Efficient and Scalable Direct Recycling Technology for Lithium-Ion Batteries.* California Energy Commission. Publication Number: CEC-500-2025-044. https://www.energy.ca.gov/sites/default/files/2025-10/CEC-500-2025-044.pdf.

experiences with previous contractors or scams. Low-income and disadvantaged community households targeted for participation had low tolerance for bearing additional costs associated with building remediation and long-term uncertainties, particularly from possible electricity-bill increases after installation of electrification measures. These findings emphasize the importance of fostering deep partnerships with CBOs, in conjunction with strategies to address digital access, tenant protections, and customer education at the onset of projects.

Since January 2025, the change in federal administration has led to several setbacks affecting EPIC projects, industry partners, and the clean energy industry broadly. For example, in October, U.S. DOE announced the cancellation of nearly $8 billion in awards to clean energy projects, several of which were awarded to companies located in California.[91] EPIC grant recipients Smartville, Rejoule, and UCSD received notice of cancelled or paused federal funding in 2025. Inconsistent federal government support will continue to be a risk, underscoring the role of steady state leadership and continuity in spurring and scaling clean energy innovation.

Changing market conditions can influence key project partners to drop out of EPIC projects. For example, in Q2 2025, BorgWarner announced its exit from the EV charging business, including its bidirectional charger offerings, in response to changing market conditions.[92] EPIC projects planning to use BorgWarner bidirectional chargers to demonstrate various V2X use cases had to change course. As EPIC continues to advance bidirectional charging technology, it will be important to support the build-out of a robust market with multiple vendors and broad interoperability capabilities based on open standards.

EPIC projects often involve permitting or interconnecting new DER technologies, which requires close coordination among project partners, local authorities having jurisdiction, and IOU interconnection teams. To mitigate risks, CEC has emphasized the need for project partners to conduct early engagement with IOUs and closely track interdependencies with site host commitments, contracting, procurement, and local permitting. Even when the technical concept is sound for a project, timelines might shift as teams work through unfamiliar issues, evolving codes and standards, and unclear processes. EPIC projects play a valuable role in

[91] Allsup, Maeve. October 2025. "Scoop: These are the 321 awards DOE is canceling." Latitude Media. https://www.latitudemedia.com/news/scoop-these-are-the-321-awards-doe-is-canceling/.

[92] BorgWarner. May 2025. "BorgWarner Reports Strong First Quarter 2025 Results, Announces Exit of Charging Business, Secures New Business Across Portfolio to Support Future Growth." https://www.borgwarner.com/newsroom/press-releases/2025/05/07/borgwarner-reports-strong-first-quarter-2025-results--announces-exit-of-charging-business--secures-new-business-across-portfolio-to-support-future-growth.

stress-testing these processes and keeping them updated to deploy emerging technologies safely and efficiently.

Current utility planning and processes separate energization of new loads from interconnection of DERs, preventing coordinated evaluation of DER-integrated EV charging sites that simultaneously introduce new load and generation onto the distribution system. This siloed approach leads to potentially redundant and overly expensive grid upgrades and limits the opportunity for DERs to offset infrastructure costs. For example, a project required extensive upgrades to energize heavy-duty truck chargers at its food distribution warehouse site despite the presence of large on-site DERs capable of mitigating capacity constraints. The DRIVES solicitation (GFO-25-301)[93] is seeking to fund EPIC projects that can energize more quickly on constrained circuits as long as they manage demand and DERs within agreed-upon limits using certified power control systems.

While these impediments slowed the progress of several projects, each challenge and the work done to overcome it also produced insights and lessons learned that will strengthen future EPIC investments, improve project design, reduce future costs, identify key gaps worthy of additional focus, and guide policy coordination and development.

Next Steps

In the coming year, the CEC anticipates releasing the notices of proposed awards for the DRIVES (GFO-25-301) and Forecasting BTM Resources (GFO-25-303) solicitations. The DRIVES solicitation will launch at least three new demonstration projects testing DER-integrated EV charging systems operating under flexible service agreements with IOUs. The Forecasting BTM Resources solicitation will fund a project aimed at advancing short-term forecasting models by integrating advanced metering infrastructure data, DER behavior, and improved solar irradiance forecasting under smoke, cloud, and extreme weather conditions.

CEC staff will continue monitoring and seeking opportunities for EPIC-funded research to inform and better align with policy activity in CPUC proceedings, including the following that relate to increasing the value proposition of DERs to customers and the grid:

- R.21-06-017 (High DER Future) — examining the modernization of distribution grid planning and operations in high electrification and DER scenarios

[93] California Energy Commission. September 2025. "GFO-25-301 – Distributed Resources for Innovative Vehicle Energization Strategies (DRIVES)." https://www.energy.ca.gov/solicitations/2025-09/gfo-25-301-distributed-resources-innovative-vehicle-energization-strategies.

- R.23-12-008 (Transportation Electrification) — considering transportation electrification policy matters, including VGI, proactive planning, EV submetering
- R.24-01-018 (Energization Timelines) — exploring bridging solutions and improving utility processes for timely and cost-effective project energization
- R.25-08-004 (Distribution-Level Interconnection Rules and Regulations) — developing updated frameworks for DER interconnection, including for AC V2X
- R.25-09-004 (Demand Response) — enhancing consistency, predictability, reliability, and cost-effectiveness of DR resources

Strategic Objective 4: Improve the Customer Value Proposition of End-Use Efficiency and Electrification Technologies

Introduction

Strategic Objective 4 focuses on improving the value proposition and affordability of end-use efficiency and electrification technologies across California's industrial and building sectors. Advancing energy efficiency while electrifying end uses is essential to achieving the state's clean energy and climate goals, and EPIC has been pivotal in accelerating the development and demonstration of affordable, scalable solutions for industry and buildings alike.

Industrial Decarbonization

Through EPIC support, CEC has advanced a diverse portfolio of technologies that address some of the most energy- and carbon-intensive processes in California's industrial economy. These efforts span several key research areas:

- Industrial and commercial cold storage innovations that lower refrigeration and defrost energy use
- Cement and concrete decarbonization technologies that reduce process emissions and support low-carbon materials
- Electrification of high-temperature process heating and energy storage systems that replace fossil fuel combustion with efficient, flexible, and electric alternatives
- Water and wastewater treatment improvements that enhance energy efficiency and operational performance
- Artificial intelligence (AI)- and data-driven demand flexibility tools that help agricultural and manufacturing facilities manage energy use and reduce costs

California's industrial sector, responsible for roughly one-third of statewide fossil gas consumption, one-sixth of electricity demand, and more than 20 percent of total GHG

emissions,[94] is a cornerstone of both the state's economy and its decarbonization challenge. Reducing emissions in this sector is essential to meeting statutory climate targets such as those established under SB 350 (de León, Chapter 547, Statutes of 2015) while maintaining global competitiveness. To reduce emissions while sustaining or boosting industrial productivity, new technology advancements must enable affordable electrification of high-temperature process heating; recover and reuse waste heat through advanced heat pump systems; and integrate emerging decarbonization fuels and technologies like renewable hydrogen and electricity-driven carbon capture and use. Continued demonstration and technology transfer efforts must also validate cost-effective solutions and further improve their affordability to enable widespread adoption.

EPIC funding has been critical in making industrial clean energy advancements possible — reducing financial risk, improving affordability, and accelerating the commercialization of next-generation technologies. These investments not only advance California's climate objectives but also strengthen the state's industrial competitiveness by proving that affordability and decarbonization can coincide. Several projects funded under this initiative exemplify how innovation, collaboration, and equitable access are driving progress toward a low-carbon, resilient, and affordable industrial economy in California.

Building Decarbonization

Decarbonizing buildings is critical for California to meet its climate goals, which include reducing statewide GHG emissions to 40 percent below 1990 levels by 2030. California's homes and businesses account for approximately 25 percent of the state's total GHG emissions. This includes emissions from electricity use for heating, cooling, lighting, and appliances, as well as emissions from on-site combustion of fossil fuels. In addition to that estimate, refrigerants used in building cooling systems, refrigeration systems, and heat pumps can contribute to building-related GHG emissions when leaked into the atmosphere, such as when appliances are improperly installed or discarded. To meet the Governor's ambitious goals of building 3 million climate-resilient homes and deploying 6 million heat pumps by 2030 affordably and equitably, advancements in several key areas of technology will be necessary.

- Improving Building Performance: Poorly performing buildings can lead to higher costs for building owners, homeowners, and residents. Installing appliances and technologies

[94] California Energy Commission. 2026. "California Energy Consumption Database." CEC staff estimate from 2016 dataset. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-energy-consumption-dashboards-0.

Energy Futures Initiative. 2019. *Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California*. https://efifoundation.org/wp-content/uploads/sites/3/2022/03/OptionalityFlexibilityInnovation_Report_compressed.pdf

in buildings that are not properly retrofitted undermines the value proposition of building sector electrification and may lead to avoidable challenges such as oversized equipment requirements and increased operational costs.

- Electrifying Without Capacity Upgrades: Many existing buildings have limited electrical capacity and cannot upsize their electrical systems due to high costs or technical infeasibility. Providing pathways to electrify buildings, without requiring extensive and often cost-prohibitive electrical infrastructure upgrades, will accelerate the proliferation and benefits and reduce the overall cost of electric appliance technologies.
- Developing Low-GWP Refrigerants for Heat Pumps: Current refrigerants used in heat pumps often have high GWP. Refrigerants that leak or are not recovered at end of life can greatly undercut the emissions reductions of heat pumps. Natural ultra-low GWP refrigerants that avoid unhealthy chemicals can help California ratepayers to decarbonize more quickly and safely.
- Decarbonizing Large Buildings: Multi-story buildings with large footprints face unique decarbonization challenges. For example, heat pump systems for larger buildings are more complex to design and may not be as cost-effective to operate in certain climate zones. Identifying solutions and installation methods that reduce costs or simplify planning can improve the decarbonization of these buildings.

Funding projects that address these issues will move California closer to achieving its ambitious climate goals while ensuring a just and economically viable transition for building owners, occupants, and ratepayers.

Progress and Successes

Significant progress under this strategic objective occurred in 2025; milestones are described per the strategic initiative below.

Strategic Initiative 4.1: Accelerate Electrification and Improve Energy Efficiency in the Industrial Sector

Advancing industrial decarbonization depends on making clean technologies more affordable, energy-efficient, and cost-effective to install and operate. Increasing affordability not only strengthens the business case for adoption, but also broadens participation across industries of all sizes. To accelerate market uptake, demonstration projects and knowledge sharing efforts are essential to showcase proven solutions, raise awareness of emerging opportunities, and build confidence in new approaches. Several projects highlighted on the following pages exemplify how these strategies are driving tangible progress toward a more sustainable, affordable, and competitive industrial sector.

Agricultural Load Flexibility

The project "Accelerated Deployment of Irrigation Pumping Demand Flexibility" (EPC-20-019), led by Polaris Energy Services Inc., advanced agricultural energy management by helping growers reduce costs and support grid reliability through smart automation (Figure 10). Based in San Diego, Polaris deployed its demand flexibility platform across more than 200 agricultural sites within the Valley Clean Energy[95] and PG&E service territories, including designated low-income communities. The project expanded agricultural DR participation and enabled farmers to automatically adjust irrigation schedules in response to curtailment events, time-of-use rates, and dynamic pricing signals. Using enhanced hardware and software for real-time irrigation control, the platform allowed irrigators to shift or shed up to two-thirds of their pumping load, collectively achieving 40 MW of flexible capacity — enough to power approximately 35,000 homes.

This demonstration proved that integrating automation and incentives can deliver substantial peak demand reduction, lower utility bills, and improve grid stability, all while maintaining agricultural productivity. The success of this project directly influenced PG&E's new Hourly Flex Pricing pilot,[96] which builds on Polaris' approach to make dynamic pricing and load flexibility scalable, practical, and affordable for California's agricultural sector and beneficial for all ratepayers.

[95] Valley Clean Energy serves residents and businesses in Yolo County, California, specifically the cities of Davis, Woodland, and Winters, plus the unincorporated areas within the county.

[96] Hourly Flex Pricing is a dynamic, hourly priced electricity rate pilot offered by PG&E that lets customers pay prices that change each hour based on market and grid conditions, with final prices set one day in advance. By planning or shifting electricity use to hours when prices are lower, customers can save money and support cleaner energy and grid reliability. The program is risk-free — participants continue to be billed on their current rate plan and receive a credit if they would have paid less on Hourly Flex Pricing after 12 months — and runs through December 31, 2027, for eligible agricultural, business, and residential customers. More information available at https://www.pge.com/en/account/rate-plans/hourly-flex-pricing.html.

Figure 10: Polaris Energy Services Enables Real-Time Irrigation Monitoring and Controls

Agricultural professionals and project site staff demonstrate the capabilities of automated irrigation controls developed by Polaris Energy Services at a farm site in the Central Valley. The EPIC-funded technology allows for remote monitoring and adjustments to irrigation practices.

Photo credit: Polaris Energy Services

Next-generation Wastewater Treatment Systems

The project "Demonstration of Advanced Primary and Secondary Treatment Technologies for Energy and Performance Benefits to Wastewater Treatment" (EPC-20-044) evaluated next-generation wastewater treatment systems designed to improve energy efficiency, performance, and capacity at municipal facilities. Conducted over three years, the demonstration took place at the Linda County Water District wastewater treatment plant in Olivehurst, a designated disadvantaged and low-income community. Led by Caliskaner Water Technologies, Inc., the project provided a comprehensive assessment of four advanced primary treatment and three advanced secondary treatment technologies, comparing them against conventional systems. It also examined the benefits of integrating advanced primary and secondary treatment technologies into a unified treatment approach to assess combined performance, energy savings, and capacity improvements. Results from the full-scale demonstration showed that the integrated system can enable up to 40 percent reductions in energy use, 20 to 30 percent cost savings, and a 40percent smaller facility footprint — all while maintaining or improving water quality.

This integration of innovative modeling and controls represents a significant advancement in sustainable wastewater management, proving that next-generation treatment systems can deliver both environmental and economic benefits for California communities, particularly those most in need of cost-effective and resilient infrastructure.

AI and Machine Learning in California Dairies

The project "Leveraging Artificial Intelligence and Machine Learning to Increase Energy Efficiency in California Dairies" (EPC-20-047) demonstrated how advanced digital technologies can drive measurable energy and emissions reductions in one of California's most energy-intensive industrial sectors. The effort focused on helping dairy processing facilities optimize their operations using AI, machine learning, and data-driven energy management tools. Demonstrations were conducted across a wide geographic range — from Crescent City and the Bay Area through the Central Valley to Los Angeles and San Diego — representing the state's major dairy and food-processing regions. Led by The Zira Group, Inc. of San Mateo, the project deployed Zira's AI-powered, cloud-based energy management platform to provide real-time visibility into energy use, detect inefficiencies, and optimize key systems such as refrigeration, compressed air, and production lines. The platform made sophisticated analytics accessible to mid-sized facilities that often lack dedicated energy management staff or resources. Participating dairies achieved verified energy savings of 3 to 13 percent, with some sites reducing consumption by more than 70,000 kWh annually, equivalent to cutting more than 16 metric tons of CO_2 emissions per facility.

These results highlight the power of digital tools to unlock efficiency improvements, even in resource-constrained operations. At scale, adoption across 10 percent of California's industrial food-processing sector could save more than 42.7 terawatt-hours of energy and avoid 7.3 million metric tons of CO_2 emissions each year — enough electricity to power approximately 6.6 million California homes annually or the equivalent of removing more than 1.6 million passenger vehicles from the road. This project demonstrates the transformative potential of AI and machine learning to enhance sustainability, resilience, and competitiveness in California's dairy and food-processing industries.

Cryogenic Refrigeration

The project "High Efficiency Magnetic Refrigeration for Industrial Cryogenic Applications" (EPC-19-021) demonstrated a breakthrough approach to ultra-low-temperature cooling that could dramatically improve the efficiency of energy-intensive refrigeration systems used in California's high-tech industries (Figure 11).

Cryogenic refrigeration is essential for sectors such as microelectronics manufacturing, semiconductors, and hydrogen fueling infrastructure. Yet, today's systems operate at just 5 to

10 percent of their theoretical efficiency at temperatures below -300°F (-184°C). Led by General Engineering & Research, LLC, the project successfully demonstrated a magnetic refrigeration system operating at cryogenic temperatures using a permanent magnet, achieving sustained cooling below -316°F (-193°C). To achieve this, the team built a new type of heat-transfer system and developed specialized magnetic materials that get colder when exposed to a magnetic field. The prototype successfully validated a proof of concept and advanced the technology from early research to a working laboratory system. With additional improvements to insulation and system design, the technology could reach 5 to 10 times greater efficiency than today's cryogenic cooling methods. If widely adopted in California, magnetic refrigeration could save 2,500 GWh of electricity per year by 2040. This breakthrough opens the door to more affordable low-energy cooling systems in microelectronics, hydrogen fueling stations, and other advanced industries, benefiting ratepayers and reinforcing California's leadership in clean, high-tech innovation.

IAW FlexHub

A key new effort in the industrial decarbonization portfolio is the IAW FlexHub (EPC-24-045), launched in 2025 to advance demand flexibility and load management technologies across California's industrial, agricultural, and water sectors. With participation from leading research institutions and industry partners, this hub will demonstrate and deploy innovative solutions that enhance grid reliability, optimize energy use, and support statewide decarbonization goals. By accelerating the readiness and adoption of DR and flexible load technologies, this long-term initiative strengthens the connection between industrial electrification and grid integration for a more affordable and balanced energy system of the future.

Figure 11: Developing a Cryogenic Magnetic Refrigeration Prototype

A staff member at General Engineering & Research works on the cryogenic magnetic refrigeration prototype.

Photo credit: General Engineering & Research

Strategic Initiative 4.2: Accelerate Electrification and Improve Energy Efficiency in the Building Sector

In 2025, the CEC released two solicitations supporting improvements to building energy efficiency and electrification.

Low-GWP Refrigerants

Although high-efficiency electric heat pumps are gaining acceptance, the current refrigerants used for these appliances often have high GWP values, which correspond with more severe impacts on the atmosphere. For example, innate carbon dioxide (CO_2) has a GWP of 1, while the most common air conditioning refrigerant, R410A, has a GWP value of 2,088.

GFO-24-305 funded the development of next-generation, all-electric heat pumps using low-GWP refrigerants. The goal of this solicitation was to accelerate the development of efficient

electric heat pump technologies that use refrigerants with GWP values significantly lower than CARB Refrigerant Regulations.[97] Specifically, this solicitation required refrigerants with values of GWP equal to or less than 150 — and, for the ultra-low solicitation groups, GWP less than 10 — while maintaining heat pump efficiency and cost-effectiveness. Seven projects across three technology groups were selected for awards:

- Low-GWP 120-V heat pump water heating system grantees will test and develop heat pump water heaters using propane refrigerant.
- Ultra-low GWP heat pump awardees will develop, test, and demonstrate combined hot water and space conditioning systems using propane and CO_2-based refrigerants.[98]
- Ultra-low GWP space-conditioning project teams will develop and test heat pumps for space heating and cooling using propane and CO_2 refrigerants.

GFO-24-310 funded the development and demonstration of innovative envelope solutions for retrofitting existing residential buildings. Although most new construction must meet California's Building Energy Efficiency Standards, known as Title 24, existing buildings with poor insulation or building envelopes leak air and are less efficient at maintaining indoor comfort. Tighter and more energy-efficient building envelopes are particularly valuable to reduce heating and cooling loads and costs, improve occupant comfort, and reduce infiltration of outside air. Retrofits in existing buildings offer significant opportunities to address decarbonization, energy use and costs, occupant health and comfort, and GHG emissions. However, existing building retrofits face considerable challenges as well, from high upfront costs and occupant disturbance to remediation concerns and split incentives for renter-occupied homes. Overcoming these challenges is a priority for meeting the state's GHG reduction goals affordably and equitably. Four projects across four research groups were selected for awards:

- Residential opaque envelope retrofits promote greater building energy efficiency and indoor comfort. The selected project will demonstrate aerogel-based insulation in manufactured homes across multiple California climate zones.
- Residential Vacuum Insulated Glass (VIG) retrofits promise high performance for better building energy efficiency and indoor comfort, and hybrid systems combine the VIG unit

[97] CARB has a series of high-GWP refrigerants restrictions for new equipment including less than 750 GWP for most new air conditioning units by 2025, less than 150 GWP for new retail food systems, and less than 2,200 GWP for some chillers, while also mandating leak checks, repairs, and emissions reporting for existing systems. More information available at https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hfc2020/frorevised.pdf

[98] Propane, also known as R-290, has a GWP of 3; CO_2 has a GWP of 1.

and a single glass pane with a traditional air- or argon-filled gap between panes to blend the high performance of VIG with the benefits of traditional double-glazing. The selected project will develop and demonstrate standard VIG and hybrid VIG systems in single-family and multifamily homes.

- Residential envelope retrofits with advanced building construction techniques can greatly improve building energy efficiency and performance. The selected project will demonstrate the combination of a robotics-based attic cleaning solution, an aerogel[99]-based sealant, and a spray-on wall insulation to form a turnkey solution for attic insulation retrofits.
- Residential window retrofits using existing frames can significantly improve building energy efficiency and insulation properties with less disturbance and cost. The selected project will develop and demonstrate VIG and triple-thin insulated glass prototypes designed specifically to retrofit existing frames.

The portfolio of existing building decarbonization projects continued to showcase valuable progress in 2025 as well:

"A Decision Tool to Electrify Homes with Limited Electrical Panel Capacity" (EPC-24-005) by Build It Green is a statewide initiative to make home electrification more affordable and accessible by navigating one of the most persistent challenges — limited electrical panel capacity. In many California homes, particularly older homes and those located in low-income neighborhoods, 100-amp electrical panels are common. Homeowners, tenants, and contractors often assume these panels are insufficient for full electrification. Replacing home electrical panels can cost $3,000 to $10,000 per upgrade and take months to complete, preventing or delaying many households from transitioning to clean energy technologies.

This project will design, develop, and demonstrate an intuitive panel-optimization tool called the Home Power Planner that empowers single-family homeowners to electrify their homes with their existing infrastructure. In 2025, the project team developed frameworks for the tool's decision engine, assessed power-efficient technologies for inclusion in the tool, and launched a panel capacity calculator module for initial testing and feedback. These steps pave the way for upcoming demonstrations across all three investor-owned utility territories in California, including in underserved and disadvantaged communities. By helping homes reduce peak demand and defer grid infrastructure upgrades, this project will deliver GHG reductions,

[99] An aerogel is a solid material of extremely low density, produced by removing the liquid component of a conventional gel with a gas, resulting in a solid with up to 99.8 percent air. Its extremely low density and high porosity make it an exceptional thermal insulator.

cost savings, and equitable access to electrification for everyone, not just those who can afford major electrical work.

EPRI's project, "Advancing Energy Efficiency in Manufactured Homes through High Performance Envelope" (EPC-19-035), is working to demonstrate the viability of all-electric, zero-net-energy manufactured homes. Manufactured housing in California is subject to national U.S. Department of Housing and Urban Development standards, which are significantly less stringent than California Title 24 requirements, disproportionately increasing the energy burden on the low-income families who commonly reside in manufactured homes.[100]

This project demonstrated three all-electric, net-zero energy manufactured home prototypes deployed in California. The homes included factory-installed heat pumps and 120V heat pumps, solar PV, envelope measures for improved efficiency and fire resilience, and low-amperage appliances. The project conducted energy monitoring and technology assessments that informed electrification strategies for homes operating on 100-amp service in extreme heat. Two approaches, smart panels and an "economy of wattage" design, were tested to manage loads while maintaining comfort and resilience. As of the end of 2025, the homes have been occupied for two years, and the project team is finishing data collection and analysis, with a final report expected in 2026.

Impediments and Setbacks

While California continues to make strong progress toward industrial and building electrification, several ongoing challenges continue to shape the pace and scale of deployment. One of the most persistent barriers remains the energy cost imbalance between electricity and fossil fuels that continues to complicate the economic case for electrification.

Another critical barrier is the lack of familiarity and confidence among end users with emerging technologies. Building owners, industrial operators, and facility managers often prefer to see technologies proven in real-world, California-based demonstrations before committing to new equipment or system redesigns. EPIC-funded projects directly address this barrier by providing local field data, performance validation, and case studies that help build trust in new solutions.

In addition to cost and awareness challenges, supply chain disruptions have become a significant impediment. Worsening during the COVID-19 pandemic when global manufacturing

[100] As a group, residents of manufactured housing are lower income than average. Over 40 percent have income at or below 200 percent of the poverty guidelines, and more than half qualify as low-income under the eligibility guidelines for the Family Electric Rate Assistance (FERA) program. More information available in the Mobile and Manufactured Housing Market Characterization Study, available at https://calnext.com/wp-content/uploads/2023/12/ET23SWE0017_Mobile-and-Manufactured-Housing-Market-Characterization-Study_Final-Report.pdf.

and logistics networks were severely constrained, supply chains have been further hindered by recent federal trade policies, including new tariffs on imported materials and equipment, such as heat pumps, advanced controls, and specialty materials. These supply chain disruptions have resulted in longer lead times, higher equipment costs, and delays in project implementation.

Adding to these challenges, cancellations of federal awards and tighter budgets for industrial and building decarbonization projects have created additional uncertainty. The reduction in federal funding opportunities and shifting policy priorities under the current federal administration have slowed national support for clean energy demonstrations and deployments. This uncertainty has made many industrial and building stakeholders hesitant to invest in emerging technologies, especially those that rely on long-term market stability and clear policy signals.

Industrial decarbonization projects also tend to involve large, complex facilities that require detailed engineering, permitting, and economic analysis. Given that energy typically represents only 10 to 20 percent of total operating expenses in many industries, investments in decarbonization may not appear to offer immediate returns. Together, high electricity costs, limited familiarity, supply chain volatility, and reduced federal support pose ongoing obstacles to scaling clean energy technologies in the industrial sector.

In the buildings sector, affordable pathways for homes and businesses to adopt electrification technologies remain a challenge, both from an upfront cost and an operational cost perspective. As electric load is added to the grid from a variety of sources, grid constraints can pose significant cost hurdles. EPIC research targets technologies and strategies that allow fuller use of existing grid capacity to support electrification without the need for unnecessary capacity upgrades, both behind- and front-of the meter. Continued improvements to traditional energy efficiency strategies, such as building envelope sealing and appliance efficiency, remain key to decarbonizing and lowering operational costs of electrification technologies.

Nevertheless, the EPIC portfolio has been an exemplar in demonstrating that strategic state-level investment can bridge gaps; help buildings and industries overcome barriers through technology demonstrations, cost reductions, and partnerships; and keep California at the forefront of affordable innovation and equitable climate action for a cleaner, healthier, and more efficient energy future.

Next Steps

With the majority of the EPIC 4 industrial and building decarbonization portfolio fully launched, the CEC will continue to closely monitor and support project implementation to ensure that the

funded research, development, and demonstration activities deliver measurable progress toward California's industrial and building decarbonization goals, including improving affordability, lowering emissions, and providing ratepayer energy and non-energy benefits.

In this next phase, the CEC will place particular emphasis on evaluating project performance, tracking outcomes, and ensuring the affordability and effectiveness of technologies developed with EPIC support. Continued engagement with project teams, industry partners, communities, and research institutions will help identify best practices and lessons learned that can guide future investments. Additionally, the CEC will strive to disseminate research findings and promote technology transfer and market adoption through outreach, publications, and collaboration with utilities, manufacturers, community partners, and trade associations. These activities will help extend the benefits of EPIC-funded innovations well beyond the term of individual projects, accelerating the broader commercialization and adoption of emerging clean energy technologies across California's buildings and industrial sectors.

Strategic Objective 5: Enable Successful Clean Energy Entrepreneurship Across California

Introduction

Strategic Objective 5 aims to grow the California clean energy sector; provide resources to bring new inventions from idea to market; increase affordability, access, equity, and other ratepayer benefits; and accelerate achievement of the state's climate and energy goals. EPIC resources and investments are pivotal for overcoming market obstacles, commercializing innovations, and sustaining an affordable, inclusive clean energy economy.

Progress and Successes

Significant progress under this strategic objective occurred in 2025; milestones are described per strategic initiative below.

Strategic Initiative 5.1: Entrepreneurial Support

This strategic initiative fosters a robust and inclusive statewide entrepreneurial ecosystem that supports innovators through the critical stages of the energy technology innovation pipeline. The entrepreneurial ecosystem is made up of six ongoing programs that support the earliest stages and two recurring direct solicitations that advance mid-stage innovation. The ongoing programs are:

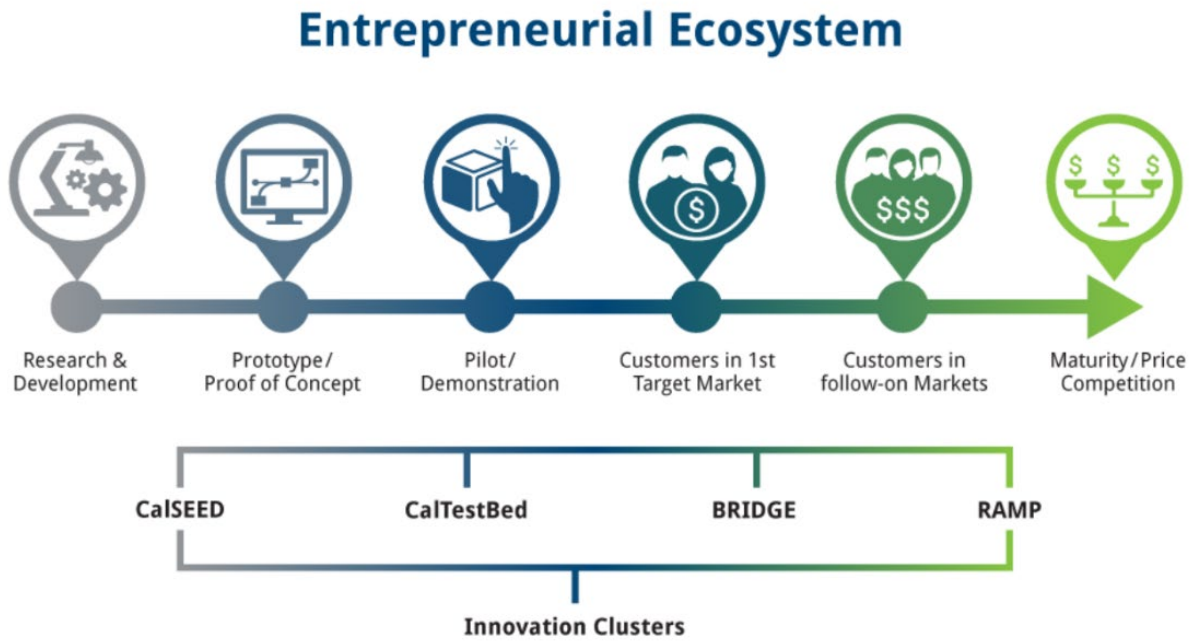
- California Sustainable Energy Entrepreneur Development Initiative (CalSEED, Contract #300-15-007).
- California Test Bed Initiative (CalTestBed, EPC-18-002).
- Regional Energy Innovation Clusters (REICs):

- Southern California Energy Innovation Network (SCEIN, EPC-15-030)
- Los Angeles Cleantech Incubator (LACI, EPC-16-015)
- Activate Berkeley (EPC-15-032)
- BlueTech Valley (BTV, EPC-15-038)

The two recurring solicitations are Bringing Rapid Innovation Development to Green Energy (BRIDGE) and Realizing Accelerated Manufacturing and Production (RAMP).

Figure 12 illustrates the entrepreneurial ecosystem components and their connections. Combined, these efforts have established a highly effective innovation roadmap that has delivered external resources and expertise to propel breakthrough ideas to commercialization and scale.

Figure 12: California Energy Entrepreneurial Ecosystem



Source: CEC staff

In 2025, EPIC funding successfully mobilized diverse resources to help innovators in California advance clean energy technologies. By the close of 2025, the EPIC entrepreneurial ecosystem had supported more than 450 companies since the start of CEC support. Collectively, these companies have attracted more than $6.4 billion in additional funding from private and public sources, including over $750 million in 2025 alone, and employed more than 6,000 people since 2021, contributing significant workforce and economic benefits to California.

CalSEED

CalSEED is CEC EPIC's small grant program designed to support early-stage concepts and prototypes with a TRL between 2 and 4. CalSEED provides funding at two levels. Concept

Awards offer up to $200,000 to innovators through open solicitations. Prototype Awards provide funding of up to $500,000 and are only available to companies that have received a Concept Award. CalSEED has been highly successful in offering the services that innovators need to get off the ground, including:

- A powerful network of experts and investors.
- Mentorship from experienced clean energy entrepreneurs and an entrepreneurial community of fellow CalSEED awardees.
- Access to operational and technical resources, such as guidance on contracting protocols, budgeting, and market fit, and online trainings on business development.
- Introduction to cutting-edge facilities for lab-scale technology development and an accelerator program.
- An entrepreneurial community of fellow CalSEED awardees.

CalSEED awarded a total of $4 million in prototype awards to eight California companies in 2025:

- Sunchem, Inc.: A low-cost, precision nano-filtration tool that can recycle clean energy devices' critical metals, like copper and gold, at a lower cost than conventional methods
- Project K Energy, Inc.: A single-layer pouch cell form factor and design optimization of a multi-layer pouch cell form factor for potassium-ion batteries aiming to provide lithium-free, low-cost, energy-efficient, and long-lived grid-scale energy storage
- ThermoShade Solutions Inc.: A high-tech, passive cooling shade panel that creates a shady space that feels up to 20°F (–7°C) cooler than under a basic awning
- Westwood Aerogel Co.: A novel automated manufacturing process for aerogel insulation material that increases the rate of manufacturing
- Sperra: An energy storage technology that can be easily co-located with OSW development
- Activated Energy, LLC: An LDES system comprising high- and low-pressure CO_2 storage tanks and components that convert thermal energy into mechanical work and enable gas transfer
- ExPost Technology, Inc.: An end-to-end direct recycling line to recover and recycle cathode active material at the scale of 10 kilograms per batch

- Aepnus Technology Inc.: An electrolyzer to recycle chemical waste generated from battery manufacturing into valuable reagents, such as sulfuric acid and caustic soda

Past CalSEED awardees that achieved significant milestones in 2025 include:

- Helios Climate Industries, developer of an adaptive heat pump controller, reported more than $2 million in sales in the third quarter of 2025 alone, with revenue in September 2025 reaching $600,000. This explosive growth led to the hiring of new installers to meet demand and signifies a successful transition from R&D to a rapidly scaling, job-creating enterprise that is actively decarbonizing California's built environment.
- Tyfast, a Prototype awardee, validated a commercially-relevant solid-state battery with landmark performance metrics critical for mass-market vehicle-to-grid adoption, including ultrafast charging in less than six minutes to 80 percent state of charge and reproducible charge capability at temperatures as low as -40°F. This breakthrough addresses a fundamental failure point of current lithium-ion technologies, positioning the innovation to enable reliable EV and grid-storage solutions in all climates.
- Climformatics, an AI-driven climate-risk platform, demonstrated a direct path to public benefit, delivering its predictive wildfire-risk and grid-forecasting pilots to key state parties, including the California Department of Forestry and Fire Protection and Sonoma Clean Power. Climformatics is now in direct contract discussions with these entities, marking a successful graduation from a research grantee to a commercial partner that also enables California's climate resilience.

CalTestBed

CalTestBed is a voucher program that provides entrepreneurs access to more than 70 world-class testing facilities across nine University of California campuses and LBNL to test innovation prototypes at TRLs 5 to 7. Entrepreneurs receive valuable independent third-party testing and validation of their technologies at a testing facility and can leverage the results to attract customers and investment. CalTestBed has supported 60 startups since 2021. In 2025, the fourth cohort of 12 companies began testing their technologies.

Key CalTestBed milestones in 2025 include:

- Three companies completed testing, bringing the total number of entities that have completed testing to 46:
    - ChargePodX invented "Level 2.5" charging to provide a Level 3 DC Fast Charging experience on Level 2 (240V AC) infrastructure.

- McEachern Laboratories developed a hardware technology integrated with firmware and software that enhances grid reliability, efficiency, and solar deployment capacity by measuring the stability of distribution grids and facilitating the addition of solar power where stability is high.
- Pulsenics performed in-situ characterization of electrochemical stacks without requiring stack shutdown or disruption.

- UNIGRID received a CEC EPIC RAMP award to manufacture sodium-ion batteries in California, became certified to ship sodium-ion cells globally, and achieved UN38.3 certification for its 9.5-Ah cylindrical and 210-Ah prismatic cells.
- Nelumbo, which had developed a frost resistance technology for residential heat pump outdoor heat exchangers, was acquired by Kuraray Co Ltd., a chemical company, to accelerate the global expansion of its products.

Regional Energy Innovation Clusters (REICs)

Since 2016, each CEC EPIC-supported REIC has developed a program tailored to its region to support clean energy entrepreneurs with technologies ranging from early-stage proof-of-concept to system development, providing services such as external funding, mentorship, laboratory facilities, and business development guidance and networks. Figure 13 shows the region served by each REIC.

Activate Berkeley

Activate Berkeley, administered by the nonprofit Activate Global in partnership with LBNL's Cyclotron Road program, serves the nine Bay Area counties, as well as Santa Cruz and Mendocino counties. Activate Berkeley operates a two-year fellowship program that provides entrepreneurs with intensive clean energy startup education and access to world-class research expertise at LBNL. Projects seek to advance a wide variety of innovations, including energy efficiency, energy storage, distribution system optimization, transportation electrification, grid management, and power generation. Since the REIC's inception in 2015, 87 companies have participated in the program.

Figure 13: EPIC Regional Energy Innovation Clusters

Source: CEC staff

Three new companies joined Activate Berkeley in 2025:

- 4th State Energies uses an innovative process to produce silicon powders smaller than 10 nanometers for lithium-ion anodes, which inherently stabilizes the silicon while remaining compatible with roll-to-roll manufacturing.
- AlkaLi Labs bioengineers microbes to selectively extract valuable minerals from low-grade industrial waste streams.
- Membravo's next-generation filtration membranes reduce energy use and improve purity in applications such as battery recycling and critical mineral extraction.

Notable 2025 successes across Activate Berkeley cohorts include:

- Brimstone, which develops low-carbon cement, signed a commercial agreement with Amazon to reserve annual volumes of Brimstone's cement from its forthcoming plant in Oakland. Anthro Energy, which develops novel battery electrolytes that provide enhanced safety, performance, and mechanical integrity compared to traditional LIBs, opened a new pilot production facility in Alameda that will begin production of battery cells for customers.
- Tandem PV, which is developing perovskite solar panels that are thinner, more efficient, and more cost-effective than traditional silicon-based solar panels, received $50 million

in private investment to support scaling production of its panels and a $4 million BRIDGE award from CEC.

BTV Innovation Cluster

The BTV Innovation Cluster, administered primarily by California State University (CSU), Fresno in partnership with five other universities in the CSU system and the Sierra Small Business Development Center in Truckee, serves 39 counties of the Central Valley and the North Coast of California. BTV identifies entrepreneurs who are developing technology solutions to address the region's acute needs in the energy-water-food nexus and provides them with the necessary tools and business guidance to commercialize clean energy solutions in the Central Valley and North Coast. BTV provides access to free or low-cost commercialization services, including technology evaluation, proof-of-concept validation, office spaces, testing facilities, networking opportunities, and participation in a cohort-based accelerator program called the Valley Ventures Accelerator. The accelerator provides customized advisory services to ventures seeking support with funding, business development, and revenue generation. Across nine cohorts, the Valley Ventures Accelerator has supported 110 companies, adding two new companies focusing on clean energy in 2025:

- Agroptics optimizes irrigation water usage and energy consumption by leveraging real-time satellite remote sensing, weather forecasts, and crop growth data to inform agricultural practices. The software can enhance crop yield and reduce water consumption by up to 15 percent.
- DoubleLand offers a versatile solar agrivoltaic mounting system and software for use on agricultural land, allowing more than 98 percent of cultivatable land to remain accessible for traditional farming. It provides shade for low-water cover cropping and can be adjusted during extreme heat.

Notable 2025 successes across BTV cohorts include:

- Xerohome, an advanced mobile app that models building energy usage and helps communities reduce energy consumption, accelerate home electrification, and advance decarbonization, reached more than one million homes modeled. The cities of Sacramento and Irvine adopted XeroHome as a free resource for single-family homeowners to estimate their carbon footprint, explore efficiency upgrades like heat pump water heaters and HVAC systems, and access rebates and projected savings.
- Thermoshade, which has developed an innovative passive-cooling shade panel system designed to reduce heat exposure significantly, raised $100,000 in pre-seed funding to

accelerate pilot projects, secured a United States patent, and received a CEC EPIC CalSEED Prototype award.

- Nitricity uses renewable electricity, air, and water to create nitrogen-based fertilizers, eliminating the use of fossil fuels. It sold out of its flagship product, Ash Tea, a liquid organic fertilizer made from recycled almond shells, through 2028 under binding offtake agreements. Nitricity also raised $50 million in Series B funding to scale production, and construction began on its first-of-a-kind organic nitrogen fertilizer facility in Delhi, California.

LACI

The nonprofit LACI runs programs to support entrepreneurship, focusing on energy, transportation, and the circular economy, across Los Angeles, Orange, Santa Barbara, and Ventura counties. The 12-month Innovators Program caters to very early-stage ventures that are pre-seed or pre-prototype. The program provides workshops, advisory services, access to LACI's network of entrepreneurs, spaces to conduct business and research, and other resources to support prototype development. The two-year Incubation Program expands this support, offering both pre-seed and seed-stage companies an investment readiness curriculum, mentorship, exposure to investors, and pilot preparation training. LACI also runs a Market Access Program to facilitate partnerships for pilot demonstration projects. Twelve new companies focusing on clean energy technologies joined LACI in 2025, including:

- ChargePodX, which is developing a range of EV charging products to address charging needs for businesses and underserved communities.
- ClearWay Software, which is developing an AI-powered platform that automates and accelerates EV charger deployment by streamlining site planning, cost estimation, construction documentation generation, and permitting.
- Nano DC HVAC, which produces affordable, high-efficiency HVAC systems that optimize integration of hybrid air-to-water heat pumps operating on DC power with solar and battery systems.
- Intrinsic Power, Inc., which is developing a building-level, AI-driven power management system coupled with DERs that unlocks electrical capacity at sites with distribution system constraints, enabling circuit breaker sharing and EV charger installation without significant infrastructure upgrades and using machine learning to reduce electricity bills.

Notable 2025 successes across LACI participants include:

- ReJoule was awarded more than $700,000 in cash and $150,000 in vouchers throughout the U.S. DOE's three-phase American-Made Solar Prize competition. Its battery diagnostics tool won additional American-Made competition cash prizes, such as the U.S. DOE's Energy Program for Innovation Clusters Pitch Competition and Re-X Before Recycling Prize Phase 1.
- ElectricFish concluded a successful deployment entirely off-grid with The Burning Man Project. The containerized, battery-integrated DC fast chargers maintained greater than 99 percent uptime and delivered approximately 2,200 miles of essential charging to EV drivers stranded at the Burning Man festival, which had experienced unprecedented dust and lightning storms.

SCEIN

SCEIN is a program for startups based in the counties of San Diego, Riverside, San Bernardino, and Imperial that are developing solutions to help California meet its clean energy goals. The program, managed by Cleantech San Diego, provides access to resources from regional partner organizations and offers industry connections to accelerate the commercialization of emerging energy technologies. Companies accepted into the program receive a range of services, including industry connections, one-on-one mentoring, regulatory and policy guidance, and access to research and testing facilities. Three new companies joined the SCEIN network in 2025:

- Alderbuck Energy is developing solid-state power electronics that modernize and streamline grid infrastructure, reducing costs and enhancing safety; providing localized power conversion, control, and management; and helping to relieve stress on utility infrastructure.
- AquaPoro develops advanced atmospheric water generation systems that extract clean drinking water from air, even in low-humidity environments, in compact residential units up to large-scale municipal systems. ZNRG Innovations is innovating an AI-powered, 120-V plug-in water heater to offer a high-performance, affordable, and energy-efficient alternative to traditional gas and electric water heaters that avoids the need for costly electrical panel upgrades.

Notable 2025 successes across SCEIN participants include:

- Occuspace raised $6 million in Series A funding to advance its AI-powered building-occupancy intelligence platform that can be easily installed to gather building data and scale operations across sectors.

- Sonocharge raised $23.5 million in Series A funding to scale its acoustic wave battery technology and accelerate commercialization across EVs and energy storage applications.

BRIDGE

Through the BRIDGE Program, CEC provides supplemental funding to clean energy companies that have garnered prior public and private funding to rapidly develop or demonstrate their innovative clean energy technologies. BRIDGE specifically targets applied research and development projects at TRL 6 or less and TD&D projects at TRL 7 or 8. Since 2017, the CEC has released four BRIDGE solicitations and awarded more than $112 million to 47 companies. Five of these projects published final reports in 2025.[101]

From the fourth round of BRIDGE funding, the CEC approved eight awards, totaling $25.8 million, in 2025:

- Tandem PV (EPC-25-022): Test and validate high-efficiency perovskite/silicon tandem PV panels for utility deployment at a lower cost of energy than standard silicon PV panels.
- Community Energy Labs, Inc. (EPC-25-023): Deploy an energy management system that integrates connected devices, hardware, and software as a service for HVAC in K-12 school sites across the state, reducing costs through load shifting and decreased energy use while increasing comfort for occupants.

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- Verne, Inc. (EPC-25-026): Design, build, and demonstrate a low-cost hydrogen distribution method to supply zero-emission electricity in areas with grid supply constraints.
- Tyfast Energy Corp. (EPC-25-028): Develop lithium vanadium oxide battery technology that can electrify heavy-duty off-highway equipment, such as excavators and utility tractors, offering greater power, longer cycle life, and a wider range of operating temperatures than traditional LIB technology.
- Indian Energy, LLC (EPC-25-029): Develop and demonstrate an integrated microgrid and building orchestration system that co-optimizes energy use to enhance efficiency and grid resilience.
- SirenOpt (EPC-25-030): Advance innovative battery manufacturing inspection and process control technologies to the pilot-scale demonstration stage.
- SolarApp (EPC-25-031): Expand the existing SolarAPP+ platform's capabilities to include virtual inspections for solar, storage, and residential EVSE.
- Coreshell Technologies, Inc. (EPC-25-033): Advance a silicon-lithium manganese iron phosphate battery technology from a coin cell to a battery module to be piloted in an electric mobility vehicle.

Among earlier BRIDGE recipients, the Noon Energy project, "Pilot Demo of Ultra Low Cost, Long-Duration Energy Storage Coupled to Solar Power," (EPC-20-013) achieved particularly notable progress in 2025. Noon Energy successfully completed the mechanical and electrical integration and testing of its first demonstration-scale system. The solid oxide battery system demonstrated its capacity to deliver more than 100 hours of duration and attained a 40-fold scale-up in technology and system complexity. The design is inherently safe, compact, and highly efficient, using abundant materials instead of lithium and rare earth elements. The innovation supports front-of-the-meter reliability, enabling utilities to store surplus carbon-free renewable energy during the day, reduce reliance on fossil-fueled peaker plants during periods of high demand, and provide clean firm power year-round regardless of weather conditions. Noon validated its novel electrochemical approach, achieving TRL 6 and positioning the company to secure additional EPIC funding. In EPC-23-036, Noon will scale its system to 10 MWh/100 kW in a disadvantaged community.

RAMP

The CEC's EPIC RAMP Program supports companies with validated technologies or prototypes ready to enter early-stage production. Since 2019, the CEC has supported 31 companies via RAMP. Of particular note in 2025, the ElectricFish Energy project, "Low Rate of Initial

Production of a Modular EV Charger with Extreme-Fast Vehicle Charging Capability" (EPC-22-015), advanced the scale-up of containerized, battery-integrated DC fast chargers. The plug-and-play energy storage system is designed to support community electrical loads via a bidirectional electricity meter. It features an ultrafast, combined charging system connector that enables both AC (standard) and DC (fast) charging through the same port, capable of delivering extreme-fast charging to EVs operating between 300 and 950 V DC. ElectricFish reduced the final product's physical footprint and streamlined the power distribution unit, leading to shorter assembly times, lower bill-of-material costs, and simplified maintenance procedures.

To date, ElectricFish has built four units and completed deployments with customers including Hyundai, the city of Detroit, and the Burning Man festival in Nevada. None of these installations required upgrades to existing electrical service infrastructure. Ratepayers also benefit from the innovation's success in charging vehicles through onboard batteries rather than drawing peak power directly from the grid.

Success of the California Energy Entrepreneurial Ecosystem

The CEC's EPIC entrepreneurial ecosystem accelerates the deployment of a broad range of clean energy technologies that contribute to ratepayer benefits of affordability, equity, safety, reliability, and environmental sustainability. CalSEED awardee GridWave, for example, contributes to affordability by building modular, solar-powered charging stations for electric MDHD vehicles that avoid costly electrical infrastructure upgrades, helping utilities keep rates down for all customers. Improving safety and sustainability of batteries is another notable benefit that multiple entrepreneurial ecosystem members are delivering. Coreshell, a recipient of CalSEED, CalTestBed, and BRIDGE grants, is developing a coating that protects battery electrodes against hazardous reactions. Wayside Energy, a CalSEED and LACI recipient, is building a battery pack that makes it easier to recover materials at the end of life, facilitating battery repurposing and recycling.

The entrepreneurial ecosystem pulls companies through the innovation pipeline from idea to deployment, providing key funding and services to overcome barriers and lower costs along the way. By the end of 2025, more than 25 companies that started in CalSEED, CalTestBed, or one of the REICs have advanced to receive BRIDGE or RAMP awards. Tyfast, for example, which received a BRIDGE award in 2025, had previously received CalSEED, CalTestBed, Activate, and SCEIN awards due to its promise, progress, and successes.

Entrepreneurial ecosystem companies are also well represented in achievements advancing other EPIC Strategic Objectives. For example, BRIDGE recipient Noon Energy, which previously received awards from CalSEED, CalTestBed, and Activate Berkeley, received an award under

GFO-22-307 to scale up its system for deployment in a disadvantaged community (EPC-23-036). Four recipients of the Energy Storage Innovations to Support Grid Reliability (GFO-23-317) solicitation highlighted under Strategic Objective 2 are entrepreneurial ecosystem members: Inlyte Energy (Activate), Enzinc (CalSEED, CalTestBed, BRIDGE), DarmokTech (CalSEED), and Renewell (BTV). Two recipients of awards under Strategic Objective 3's "Grid-Supportive Transportation Electrification" (GFO-23-306) solicitation received previous funding though the entrepreneurial ecosystem: NeoCharge (CalSEED, LACI, SCEIN) and Intertie (CalSEED, BRIDGE). Entrepreneurial ecosystem members also received awards under "Enabling Electric Vehicles as Distributed Energy Resources" solicitation (GFO-24-302) under Strategic Objective 3: Nuvve (SCEIN), It's Electric (LACI), and NeoCharge (CalSEED, LACI, SCEIN).

ReJoule, which is completing an EPIC project to install its second-life battery storage system at a museum in Pomona, described under Strategic Objective 3 (EPC-19-055), demonstrates the benefits of participation in the entrepreneurial ecosystem. It received a CalSEED award that enabled it to build out testing capabilities. CalTestBed provided validation before ReJoule had customer data and supported due diligence analysis, and SCEIN helped Rejoule build its network, connecting the company to investors and commercial contacts.

Strategic Initiative 5.2: Scaling Clean Energy Technology

This initiative provides resources and support to enable clean energy entrepreneurs to scale their validated technologies.

In 2025, the solicitation "California Battery Pilot Manufacturing Line" (GFO-24-304) was posted and awarded. The CEC approved a $28 million award to the Electrochemistry Foundry to build and operate a 20,000-square-foot open-access battery pilot manufacturing line in Hayward that will address a significant challenge for the advanced lithium battery industry. Battery innovators often develop advancements at the component level, such as anodes, cathodes, and electrolytes, but cannot afford the expensive and time-consuming investment in manufacturing capacity needed to produce full battery cells for customers and investors. This state-of-the-art hub will provide full-service battery cell fabrication, from electrode mixing to cell formation, and testing services to support advanced lithium-ion innovations and adjacent chemistries like sodium-ion and potassium-ion batteries. Beyond accelerating commercialization, the transformative project is also partnering with labor unions and academic institutions to accelerate in-state workforce development through hands-on training and job readiness programs.

The Electrochemistry Foundry's shared pilot manufacturing facility will catalyze the development and commercialization of safer, more reliable, and more sustainable battery

technologies in California by providing battery innovators access to advanced equipment and processes that enable cell manufacturing, improve product quality, facilitate commercialization, and reduce environmental impact. By lowering the high upfront costs of pilot-scale production, this battery hub will make it easier for innovators to develop affordable advancements and alternatives to conventional LIBs. These advances will drive down the cost of electrification, enabling broader, safer, more reliable, more sustainable, and more affordable access to EVs, BESS, and clean energy technologies for all ratepayers. Specific examples of ratepayer benefits include:

- Safety: The battery hub will advance non-flammable electrolytes.
- Reliability: The battery hub will deploy advanced in-line battery component and cell characterization and testing innovations from California companies to reduce defective batteries and thereby battery failures in the field.
- Environmental Sustainability: The battery hub will advance LIB manufacturing that reduces the overall environmental footprint of production.

Impediments and Setbacks

Supply chain problems, lengthy delivery times for equipment, interconnection queue delays, inflation, and high interest rates were challenging in 2025. These factors increased overall costs and delayed schedules for many project activities, including procurement of labor, materials, and equipment. The retreat of the federal government from the clean energy and climate space was newly challenging in 2025, as was the imposition of unpredictable tariffs on critical technology inputs. Permitting and coordination with California utilities on pilots, demonstrations, and deployments involved setbacks as well.

Next Steps

The CEC plans to release one solicitation under Strategic Objective 5 in 2026. This solicitation will seek to pair entrepreneurs with research institutions, such as national labs and universities, to support the commercialization of clean energy intellectual property developed at those institutions.

By the end of 2025, 25 BRIDGE projects, covering the technology categories of energy efficiency, renewable generation, energy storage, advanced power electronics, AI and machine learning, and advanced sensing, were active and making progress. Seven of these projects are expected to be completed in 2026.

There were 15 RAMP projects active at the end of 2025 in the technology categories of energy efficiency, renewable generation, energy storage, end-use electrification, AI and machine learning, and advanced sensing. Three are expected to be completed in 2026.

Among the REICs, several new cohorts are expected in 2026. LACI will admit new spring and fall incubator cohorts, one market access cohort, and one innovators cohort. BTV and Activate Berkeley will each admit new cohorts, and SCEIN will continue accepting entrepreneurs on a rolling basis.

CalSEED will offer prototype awards in 2026. CalTestBed will complete testing for all cohorts and publish a report on opportunities and gaps for entrepreneurs conducting pilot projects in California.

Strategic Objective 6: Inform California's Transition to an Equitable, Zero-carbon Energy System That Is Climate-Resilient and Meets Environmental Goals

Introduction

Strategic Objective 6 of the EPIC 4 Investment Plan supports public interest research to facilitate climate resilience, reliability, and environmental sustainability of California's rapidly evolving electricity grid. Activities under this strategic objective provided direct support for CPUC's climate adaptation rulemaking and for weather-related planning activities such as California's energy demand forecast. Research also supported California's broader environmental goals, with particular attention to health and equity concerns associated with California's transition to a 100-percent clean energy future.

Progress and Successes

In 2025, research under this strategic objective further progressed the development of analytical tools, in close collaboration with electricity IOUs, to support CAVA filings and infrastructure vulnerability assessments. Key knowledge transfer efforts included providing easy-to-understand, public-facing descriptions of climate projections and related data projects, including wildfire and hydrological scenarios, all of which are openly available to support transparent regulatory, planning, and compliance activities.

Five research efforts from the funding opportunity Enviro-SET (GFO-24-301) were approved in July 2025. The resulting agreements will investigate various environmental impacts of clean energy technologies, which can sometimes hinder energy deployments. Another research effort that kicked off in June 2025 under this objective, "Tri-County[102] Benefits of Electrification for Air Quality, Comfort, and Health (3C-BEACH)" (EPC-24-042), is partnering

[102] The Tri-County area comprises Ventura, Santa Barbara, and San Luis Obispo Counties.

with a county-led energy-savings program to assess the non-energy benefits of decarbonization and electrification retrofits. Broadly, this portfolio complements private sector innovation and public sector investments to advance California's clean energy transition.

EPIC recipients and CEC staff continued to engage a wide range of interested parties, including but not limited to utility technical staff and representatives, state agency technical staff and policy analysts, researchers, universities and national labs, California-based small businesses, federal and local government institutions, and CBOs. Robust external engagement supported the development and execution of grant agreements, while knowledge transfer ensured that data and analytical products were not only publicly available but also sufficiently documented to support transparency and coordination. Research findings and data products were integrated into electricity sector planning, rulemakings, and related research efforts, and future investment opportunities began development.

Highlights include comprehensive knowledge transfer for open data portraying projected climate, as well as related stressors like sea level rise and processes like hydrological modeling. Information dissemination involved publicly posting easy-to-understand memos describing each data set and continued engagement with IOUs to foster application of climate data to asset vulnerability analysis and CAVA filings. In addition, more than half a dozen new research efforts began work.

Additional milestones are described per the strategic initiative below.

Strategic Initiative 6.1: Climate Resiliency

In 2025, EPIC efforts under the Climate Resiliency strategic initiative continued to support rigorous application of weather data and climate projections by IOUs and state agencies; maintain climate and weather data, plus associated analytics, as resources that are openly available to support transparency and collaboration across electricity sector stakeholders; and advance energy system modeling that enhances California's ability to anticipate and prepare for climate-related challenges to the grid. Contributing projects to advancements described here include:

- The Cal-Adapt Analytics Engine led by Eagle Rock Analytics (EPC-23-024).
- An effort by UC San Diego, with major contributions from UC Los Angeles, to develop high-resolution climate projections with variables and processes relevant to California's increasingly renewable energy system (EPC-20-007).
- An effort by Lumen Energy Strategy (EPC-22-001) to advance resilient electricity sector planning through Weather-Adapted Resource Planning (WARP) to Resilience.

The Cal-Adapt Analytics Engine continued to provide crucial data and analytical products that inform IOU and state agency activities related to grid resilience and planning. These data products are also foundational to modeling, research, and CPUC's Adaptation Proceeding (R.18-04-019). In 2025, the Cal-Adapt Analytics Engine convened three working groups to gather product and research feedback, informing the design of user-friendly applications. Participation in these working groups included IOUs, publicly owned utilities, CPUC, CEC, the California Department of Water Resources, LCI, and energy consultants. The resources developed included analyses of extreme ("1-in-x") temperature and precipitation events; global warming level-based analyses for regional climate responses to changes in global mean temperature; threshold assessments of extreme events; analyses to discover user-specified, anomalously high or low temperature and precipitation periods in projected climate; and location-specific climate profiles based on hourly data for typical and extreme meteorological conditions (known as 8760s). These resources support the evaluation of ratepayer-funded investments and infrastructure resilience. The Analytics Engine team also developed two trainings in 2025 to support users in understanding and accessing the datasets. All datasets, tools, and underlying code are publicly available at analytics.cal-adapt.org and customizable for broader energy stakeholder applications.

Since early 2025, enabled by EPIC funding, Lumen Energy Strategy has been using its resilience framework, demand re-parameterization, and supply re-parameterization analyses to construct a climate resilience evaluation model (EPC-22-001). This high-performing project has resulted in sustained and significant collaboration with CEC's Demand Forecasting Team; the integration of climate change data into resilience-related topics for SB 100 efforts; and coordination with CPUC efforts on the Integrated Resource Plan, CAVA, and Microgrids Rulemaking (R.19-09-009). In late 2025, the team was nearing completion of a model to evaluate both the resilience of future electricity resource portfolios and service to ratepayers under projected climate trends and extremes as the grid transitions. This project has also made substantial contributions toward integrating a variety of data and concepts into existing state processes, compiling various electricity-system-related datasets, and collaboratively advancing working concepts and definitions of resilience.

Under EPC-21-041, E3 has updated a key energy system modeling tool known as PATHWAYS to include the Western Electricity Coordination Council region and to portray projected policy scenarios that harmonize with CEC's IEPR, CARB's Scoping Plan, and CPUC's Integrated Resource Plan efforts. The research team also used future weather years based on downscaled climate projections to produce climate-informed load profiles that respond to increased temperatures and increased adoption of air conditioning. These efforts enable comparison of load growth based on different policy and electrification scenarios, with or

without climate impacts on temperature. To explore supply-side implications of climate change on electricity system resource planning, E3 updated its RESOLVE model to intake climate-informed load forecasts and renewable supply portfolios, including solar, wind, and hydroelectric, developed by another EPIC project (EPC-21-037). This will enable comparison of modeled outputs, including costs, capacity additions needed, generation mix, and hourly dispatch, under different policy and climate change scenarios.

A project partner to this effort, LBNL is also working on RESOLVE functionality that can incorporate uncertainty and risk metrics and enable the model to produce risk-averse resource portfolios. The research team engaged IOU planners at SCE, SDG&E, and PG&E; researchers at UC Irvine, UC Santa Barbara, Lumen, and NLR; and agency staff at the California ISO, CEC, and LCI to ensure knowledge transfer and that analyses were considering salient questions and real-world conditions.

Strategic Initiative 6.2: Environmental Sustainability

In 2025, EPIC published[103] and shared findings from a high-profile project that made important advances in the understanding of OSW energy development and potential risks to California seabirds (EPC-19-011, "Seabird 3D Distribution and Relative Risk from California Offshore Wind Turbines"). State and federal agencies closely tracked the progress of the project, led by California Polytechnic Humboldt's Sponsored Programs Foundation, because its research outcomes could address major knowledge gaps in the OSW environmental review process. The project modeled OSW generation across several areas along the California coast, including the Bureau of Ocean Energy Management OSW lease areas, as well as seabird density across the study region. Researchers' analyses indicate that the majority of seabird density is focused below 10 meters in altitude and therefore below the tips of turbine blades. Only 8 percent of the estimated density of seabirds in the study area is above 10 meters, where they could come into contact with the wind turbine blades. Whether birds fly around wind turbine blades to avoid collisions could not be accounted for in the study. Since the best wind resources, such as those identified in the lease areas, typically occur further offshore and seabirds tend to be more concentrated closer to shore, final results do not suggest that risks to seabirds appreciably conflict with the safe development of OSW generation in California.

In June 2025, CEC met County of Ventura staff and project partners at Frontier Energy to kick off a pioneering effort (EPC-23-042) through which the county will identify and demonstrate commercially available electrification and decarbonization measures. Frontier Energy will work

[103] Wallach, Eli, et al. 2025. "Seabirds in 3D: A Framework to Evaluate Collision Vulnerability With Future Offshore Wind Developments." California Energy Commission. Publication number: CEC-500-2025-037. https://www.energy.ca.gov/sites/default/files/2025-07/CEC-500-2025-037.pdf

with project partners to evaluate non-energy impacts on residents in approximately 100 single-family homes in Ventura, San Luis Obispo, and Santa Barbara counties. The effort will provide energy upgrades and the expected co-benefits of improved air quality and comfort for at least 58 homes in ESJ communities and at least 10 homes near the once-through cooling Ormond Beach power station.

Impediments and Setbacks

Under the Climate Resiliency Strategic Initiative, integration of data into policy analyses and planning efforts remained challenging and resource-intensive. Challenges stemmed in part from the fact that best available climate projections are validated on a multi-decadal, regional perspective, but some planning processes, such as demand forecasting with its concern for "net peak load," consider sub-daily variables at discrete locations, such as PV-relevant solar radiation in coastal population centers where BTM rooftop solar is a critical determinant of net peak load.

Another challenge was rooted in the limitations of observational datasets that provide an empirical anchor for climate modeling efforts. For example, data on sub-daily solar radiation observations, wind gusts, and hub-height wind observations — all of which are critical in the context of California's zero-carbon grid — are limited. Additionally, one EPIC recipient found, congruent with emerging findings in the peer-reviewed literature, that best-available global climate model outputs fail to capture recent trends in relative humidity in some arid regions such as parts of California. This is problematic because relative humidity is a key determinant of wildfire risk and a critical input for wildfire risk modeling. This relative humidity issue caused a delay in delivery of long-term wildfire scenarios because a humidity data product had to be created that coheres with recent observations and trends.

Yet another challenge to integrating advanced climate and weather data into policy contexts encompassed legacy processes and decisions. Even where demonstrably improved data were available, use of other data by these legacy processes created a discontinuity that could require additional analysis, necessitate redoubled socialization of results with key parties, and create problematic policy implications. The lesson learned was that it is critical to build a demonstration phase into future EPIC portfolios that would engage researchers, energy system modelers, and technical staff from state agencies and IOUs outside the fast pace of policy and planning workflows. Effectively, this would be a safe space to test new data and analytical approaches before rolling them into sensitive or costly decision-making processes.

Past and ongoing EPIC 4 efforts offer lessons learned from challenges associated with current best-available data products, integration of data into policy efforts, advancement of novel techniques such as generative AI, and federal retreat from roles that EPIC research grants

historically leveraged, including supercomputing resources and data storage. These lessons and continually evolving contexts will inform public workshops that engage electricity sector interested parties in the identification of the most impactful data gaps, which can then lead to appropriate structures and programs for research and collaboration. These lessons could apply beyond climate data, including detailed data on meter-level demand and on grid operations that can also be of critical importance when planning for a resilient and cost-efficient electricity system. Additionally, development of a long-term data storage and management strategy for EPIC-funded data products will be needed to preserve key data in the open domain, especially data used in state agency planning or IOU regulatory filings. A sustainable strategy would offer cost-effective alternatives to exclusive reliance on short-term installments of private sector match funding.

Next Steps

Moving into 2026, a suite of new agreements and solicitations will continue to strengthen the scientific foundation for advancing a clean, affordable, reliable, equitable, and safe energy transition. The following noteworthy agreements were approved at CEC business meetings under Strategic Objective 6 in 2025.

CEC approved five new grant agreements from GFO-24-301, titled "Environmental Sustainability of a Clean Energy Transition (Enviro-SET)." The research grants aim to:

- Test bird-friendly windows for decarbonized buildings and incorporate bird-safety requirements into energy standards (EPC-25-002, LBNL).
- Study soil carbon storage and biodiversity at large ground-mounted PV sites to provide a scientific basis for soil carbon offsets, improve PV performance, accelerate renewable energy buildouts, and support native plant communities and fossorial (burrowing) wildlife (EPC-25-003, UC Davis).
- Develop environmental cost-benefit valuation of power-over-water deployment to support increased solar panel efficiency, cost savings in permitting and interconnection, habitat impact mitigation, and water conservation (EPC-25-004, UC Merced).
- Investigate biologically appropriate exterior lighting, ultimately mitigating outdoor lighting impacts on essential nocturnal species and supporting efficient lighting standards (EPC-25-005, UC Davis).
- Develop strategies for adaptively managed translocation and propagation of State-listed Threatened Mohave ground squirrels that can streamline environmental permitting and

compliance and facilitate solar project siting (EPC-25-006, Mohave Ground Squirrel Conservation Council).

Additionally, a solicitation on "Applications of Open Data to Support Climate Resilience in California's Electricity Sector" (GFO-24-306) resulted in four approved awards totaling approximately $5.4 million. These applied research efforts will support:

- Improved near-term wildfire projections and risk assessments, leveraging advances in AI (EPC-25-024, Lawrence Livermore National Security, LLC).
- Continued development and enhancement of PyreCast, an open-source software platform that provides near-term wildfire forecasting and situational awareness, to advance forecasting capabilities and decision-support tools for California's electricity sector (EPC-25-025, Spatial Informatics Group, LLC).
- Use of prior EPIC-funded data portraying long-term wildfire scenarios in a changing climate to investigate mid- and long-term, bidirectional wildfire risks to and from electricity infrastructure; the results and portrayal of these risks on an open-source platform will enable strategic grid expansion and wildfire mitigation planning (EPC-25-032, UC Los Angeles).
- Development of participant-informed, easy-to-use tools on the Cal-Adapt: Data Explorer, which is a web application that makes high-resolution climate projections and quality-controlled historical weather data publicly available to inform electricity sector resilience planning (EPC-24-034, Eagle Rock Analytics, Inc).

The following solicitations under Strategic Objective 6 were under development in 2025:

- A $6 million solicitation titled "Modeling and Monitoring Air Quality and Co-Benefits of Energy Interventions to Inform Clean and Equitable Energy Transition" is expected to be released in early 2026. The solicitation proposes to fund research to improve existing ambient air quality modeling and measurement approaches and quantify the air quality implications and related human health impacts of clean energy interventions across energy use sectors. The research will support the development of new tools to monetize the non-energy benefits of clean energy interventions. CEC held a public scoping workshop to help inform solicitation development in early 2024.
- The solicitation "Non-Energy Impacts of Integrated Energy Retrofit Packages in California's Residential Buildings from EBD Program" also has an anticipated release in early 2026. It is expected to support a $3 million effort to evaluate the non-energy

impacts of building retrofits, studying the impacts and benefits of the CEC's Equitable Building Decarbonization Direct Install Program.

CHAPTER 5: Conclusion

Key Results for the Year

The CEC's EPIC Program continues to invest in promising clean energy innovations while leveraging existing federal, public, and private capital to maintain and accelerate the development of novel technologies to benefit California's electricity IOU ratepayers. EPIC activities have included continued progress in completing project agreements funded under investment plans while concurrently planning, scoping, disbursing, and managing grant opportunities detailed in the CEC's EPIC 4 Investment Plan. In addition, many companies and projects funded in prior years began to achieve technology validation, at-scale deployment, early-stage manufacturing, and product commercialization in 2025, enhancing the sustainability, affordability, reliability, equity, and safety of the clean energy transition.

Some of the most notable impacts include the following:

- 38 EPIC projects were completed by grant awardees in 2025.
- 67 percent of CEC EPIC TD&D funding has been awarded to projects located in and benefiting disadvantaged and low-income communities through 2025.
- $46.7 million of the CEC EPIC technology demonstration and deployment funds has been invested on California Native American tribal lands through 2025.
- Private companies that have received EPIC funding collectively have attracted more than $19.8 billion in additional private funding through 2025.
- Recipients for 195 EPIC projects that were active during 2025 reported the following on-the-ground benefits for the 2025 calendar year:
    - On-bill energy savings of more than $2.2 million
    - Avoided consumption of nearly 5.3 GWh of electricity and more than 178,000 therms of fossil gas
    - More than 850 full-time-equivalent jobs enabled
    - More than 6 million kilograms of carbon dioxide equivalent emissions avoided (equivalent to removing 1,400 gasoline-powered passenger vehicles from the road)

As shown in Table A-6 in Appendix A, EPIC has encumbered a cumulative total of more than $1.7 billion in approved plan project funds. As outlined below, the CEC has a series of solicitations in progress and plans to encumber the remaining funds on schedule.

Issues

Some key challenges across the portfolio continue to have major impacts on project progress. Interconnection queues and permitting issues remain a barrier for clean energy infrastructure buildout, particularly demonstration projects with complex systems or novel technologies. These factors have created hurdles in securing and retaining host sites. Long equipment lead times and supply chain issues persist, causing delays as grantees struggle to obtain necessary materials and equipment to manufacture their products or implement their projects. Inflation and rising electricity rates relative to fossil gas, in addition to shifting federal policies and funding programs, also inhibit headway, with projects and companies needing to accommodate budget shifts, raise money for unforeseen needs, or reassess cost-effectiveness. The lack of a dynamic pricing program and clear submetering rules may impact the financial and technical viability of technologies with the ability to flex load, such as energy storage and electric vehicles.

Next Steps for the EPIC Investment Plan

EPIC Funding Opportunities in 2026

In 2026, the CEC anticipates releasing EPIC solicitations that affordably and equitably advance the state's transition to 100 percent clean energy. Table 5 summarizes these anticipated 2026 EPIC funding opportunities. Anticipated solicitations are posted on the CEC funding web pages.[104]

Table 5: EPIC 2026 Posted Funding Opportunities

Title	Anticipated Release Dates
Enabling Load Shifting and Energy-Efficiency in Indoor Farms (ELSE-IF)	January 2026–February 2026
Emerging Solar Energy Technologies (EPIC IV)	January 2026–February 2026
Modeling and Monitoring Air Quality and Co-benefits of Energy Interventions	January 2026–February 2026

[104] California Energy Commission. 2025. "Solicitations." https://www.energy.ca.gov/funding-opportunities/solicitations?field_solicitation_status_target_id%5B37%5D=37&field_solicitation_type_target_id=All&field_division_1_target_id=All.Filter status for "Anticipated/Upcoming" and "Energy Research and Development." Solicitations under EPIC are indicated within the links to individual solicitations.

Title	Anticipated Release Dates
Non-energy Impacts of Integrated Energy Retrofit Packages from EBD Program	February 2026–March 2026

Source: California Energy Commission staff

CPUC Commissioners voted to adopt the strategic goals for EPIC 5 in March 2024. The CPUC will adopt a decision on strategic objectives for EPIC 5 in 2026. After the CPUC adopts the strategic objectives, CEC staff will finalize development of its EPIC 5 (2026–2030) investment plan based on the adopted goals and objectives and submit the plan for approval to the CPUC.

Conclusion

A publicly funded research, development, and demonstration program, EPIC has been highly successful over the years. The CEC looks forward to building on EPIC successes to date and further accelerating clean energy innovation in the development pipeline after a productive and ground-breaking year in 2025. CEC EPIC advances are enabling California to meet its clean energy mandates and aspirations more affordably, quickly, equitably, safely, and efficiently. EPIC investments provide critical validation to policymakers, private sector investors, and ratepayers regarding the performance, cost savings, and safety of new clean energy technologies. Results generated through EPIC increase the pace of innovation and technology scale-up across public and private sectors by sharing lessons learned broadly and openly. The CEC's EPIC benefits to ratepayers are vast and will have positive, far-reaching, and transformative impacts on Californians' pocketbooks, environment, health, and safety for years to come.

LIST OF ACRONYMS

Term	Definition
3D	three-dimensional
AB	Assembly Bill
AC	alternating current
AEC	Advanced Energy Community
Ah	amp hour
AI	artificial intelligence
ARPA-E	Advanced Research Projects Agency-Energy — a United States Department of Energy Program advancing high-impact energy technologies by providing funding, technical assistance, and market readiness
ATRC	Advanced Technology Research Center
AUV	autonomous underwater vehicles
BESS	battery energy storage system
BRIDGE	Bringing Rapid Innovation Development to Green Energy
BTM	behind-the-meter
BTV	BlueTech Valley
Cal Poly	California Polytechnic State University
CalEnviroScreen	California Communities Environmental Health Screening Tool
CalFlexHub	California Load Flexibility Research and Deployment Hub
California ISO	California Independent System Operator
CalSEED	California Sustainable Energy Entrepreneur Development Initiative
CARB	California Air Resources Board
CAVA	Climate Adaptation and Vulnerability Assessments
CCA	community choice aggregator
C-DAWG	Climate Data and Analysis Working Group
CEC	California Energy Commission
CHOIR	Coordinated, Holistic Orchestration of Inverter-Based Resources
CNRA	California Natural Resources Agency
CO_2	carbon dioxide
CPUC	California Public Utilities Commission
CSU	California State University
DACAG	Disadvantaged Community Advisory Group

Term	Definition
dba	doing business as
DC	direct current
DER(s)	distributed energy resource(s)
DERMS	distributed energy resources management system
DR	demand response
DRIVES	Distributed Resources for Innovative Vehicle Energization Strategies
EJ	environmental justice
Enviro-SET	Environmental Sustainability of a Clean Energy Transition
EMS	energy management systems
EPIC	Electric Program Investment Charge
EPRI	Electric Power Research Institute
ERDD	Energy Research and Development Division (CEC)
eTRUC	Electric Truck Research and Utilization Center for RHETTA (Research Hub for Electric Technologies in Truck Applications)
ESJ	environmental and social justice
ETCC	Emerging Technologies Coordinating Council
EV	electric vehicle
EVSE	electric vehicle supply equipment
Fifth Assessment	California's Fifth Climate Change Assessment
FOSW	floating offshore wind
GEB	grid-interactive efficient buildings
GFO	grant funding opportunity
GHG	greenhouse gas
GW	gigawatt
GWh	gigawatt-hour
GWP	global warming potential
HP-Flex	Next Generation Heat Pump Load Flexibility
HPWH	heat pump water heater
HVAC	heating, ventilation, and air conditioning
HVDC	high-voltage direct-current
IAW FlexHub	Industrial, Agriculture, and Water Demand Flexible Research and Deployment Hub
IEPR	Integrated Energy Policy Report
IOU	investor-owned utility

Term	Definition
kW	kilowatt
LACI	Los Angeles Cleantech Incubator
LBNL	Lawrence Berkeley National Laboratory
LCI	Governor's Office of Land Use and Climate Innovation
LDES	long-duration energy storage
LIB	lithium-ion battery
LSE	load serving entities
M&V	measurement and verification
MDHD	medium-duty and heavy-duty
MIDAS	Market Informed Demand Automation Server
MPC(s)	model predictive control(s)
MW	megawatt
MWh	megawatt-hour
Next EPIC Challenge	Reimagining Affordable Mixed-Use Development in a Carbon-Constrained Future Program
NLR	National Laboratory of the Rockies (formerly National Renewable Energy Laboratory)
NREL	National Renewable Energy Laboratory (renamed to National Laboratory of the Rockies in 2025)
OpenADR	Open Automated Demand Response
OSW	offshore wind
PEZERR	Power Electronics for Zero-Emission Residential Resilience
PG&E	Pacific Gas & Electric Company
PICG	Policy + Innovation Coordination Group
PV	photovoltaic
R&D	research and development
RAMP	Realizing Advanced Manufacturing and Production for Clean Energy Technologies
RD&D	research, development, and demonstration
REIC	Regional Energy Innovation Cluster
RFI	Request for Information
RPS	Renewables Portfolio Standard
SB	Senate Bill
SCE	Southern California Edison Company

Term	Definition
SCEIN	Southern California Energy Innovation Network
SDG&E	San Diego Gas & Electric
TD&D	technology demonstration and deployment
TERAS	Tribal Energy Resilience and Sovereignty
TRL	technology readiness level
U.S. DOE	United States Department of Energy
UC	University of California
UL	Underwriters Laboratories
VPP-FLEX	Virtual Power Plant Approaches for Demand Flexibility
V2X	vehicle-to-everything
VGI	vehicle-to-grid-integration
VPP	virtual power plant

GLOSSARY

For additional information on commonly used energy terminology, see the following glossary links:

- California Energy Commission Energy Glossary, available at https://www.energy.ca.gov/resources/energy-glossary
- California Air Resources Board Glossary, available at https://ww2.arb.ca.gov/about/glossary
- California Public Utilities Commission Glossary of Acronyms and Other Frequently Used Terms, available at https://www.cpuc.ca.gov/glossary/

Advanced Research Projects Agency-Energy (ARPA-E): ARPA-E is a United States Department of Energy Program advancing high-impact energy technologies by providing funding, technical assistance, and market readiness.

Behind-the-Meter (BTM): Electricity resources located on the customer side of the utility meter that serve on-site load, including solar photovoltaic, batteries, electric vehicle charging, and flexible loads, and may interact with the grid through exports or load management. Resources located on the utility side of the utility meter are sometimes referred to as front-of-the-meter (FTM).

California Load Flexibility Research and Deployment Hub (CalFlexHub): Established through the EPIC program in 2021 and administered by Lawrence Berkeley National Laboratory, CalFlexHub conducts electricity sector technology research, demonstration, and deployment projects that increase the use and market adoption of advanced, interoperable, and flexible demand technologies and strategies as electric grid resources and facilitate integration of distributed energy resources.

CalSEED: The California Sustainable Energy Entrepreneur Development Initiative (CalSEED) is an EPIC-funded program administered by nonprofit New Energy Nexus that provides small grants to entrepreneurs and researchers to advance their clean energy concepts or prototypes.

CalTestBed: The California Test Bed Initiative is an EPIC-funded program administered by nonprofit New Energy Nexus that provides clean energy entrepreneurs access to testing facilities to accelerate technology commercialization.

Carbon capture, utilization, and storage: This term refers to the process of capturing carbon dioxide, either from a concentrated stream or from the atmosphere, then containing it for further use or storage.

Carbon dioxide (CO_2): Carbon dioxide, a naturally occurring gas, also referred to as carbon, is also a by-product of burning fossil fuels (such as oil, gas, and coal), burning biomass, land-use changes, and industrial processes (for example, cement production). It is the principal anthropogenic greenhouse gas (GHG) that affects the Earth's radiative balance. It is the reference gas against which other GHGs are measured and therefore has a global warming potential of 1.

Carbon neutrality: Carbon dioxide and other GHG emissions generated by sources such as transportation, power plants, and industrial processes must be less than or equal to the amount of carbon dioxide that is stored, both in natural sinks such as forests and mechanical sequestration such as carbon capture and sequestration. Executive Order B-55-18 established a target for California to achieve carbon neutrality by 2045 and maintain net negative emissions thereafter. For more information, see the CARB Carbon Neutrality Web page (https://ww2.arb.ca.gov/our-work/programs/carbon-neutrality).

Climate: Climate is the average course or condition of the weather at a place, usually over a period of years, as exhibited by temperature, wind velocity, and precipitation. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. Climate, in a wider sense, is the state, including a statistical description, of the climate system.

Climate change: Climate change refers to a change in the state of the climate that can be identified (for example, by using statistical tests) by changes in the mean or variability (or both) of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic (human-induced) changes in the composition of the atmosphere or in land use. Anthropogenic climate change is defined by the human impact on Earth's climate, while natural climate changes are the natural climate cycles that have been and continue to occur throughout Earth's history.

Anthropogenic climate change is directly linked to the amount of fossil fuel burning, aerosol releases, and land alteration from agriculture and deforestation.

Combustion: The chemical process of burning, which produces gases and particulate matter that can affect air quality.

Community choice aggregator: The term used to describe a local government that procures power on behalf of its residents, businesses, and municipal accounts from an alternative supplier while still receiving transmission and distribution service from its existing utility provider.

Decarbonization: The process by which countries, individuals, or other entities aim to reduce or achieve zero fossil carbon emissions. This typically refers to a reduction of the carbon emissions associated with electricity, industry, and transport. Decarbonization involves increasing the share of no- or low-carbon energy sources (renewables such as solar and wind) and decreasing the use of fossil fuels.

Demand flexibility: The ability of customers to reduce or increase load (electricity demand) in response to grid conditions, usually through a proxy price signal or system operator or utility signal and facilitated by automation (also called "load flexibility").

Distributed energy resources (DERs): A diverse category of devices and technologies that connect to the electric grid at the distribution level, either directly connected to a distribution utility's wires or on an end-use customer's premises behind the utility meter. Examples include distributed generation and storage, electric vehicles and charging stations, grid-interactive buildings and microgrids, and more traditional demand response or load flexibility resources.

Distributed energy resources management system — Distributed energy resources management system (DERMS) controls systems and software that are implemented by utilities to increase visibility, awareness, and grid benefits from distributed energy resources.

Disadvantaged community: Disadvantaged communities refer to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes, as well as high incidence of asthma and heart disease. One way that the state identifies these areas is by collecting and analyzing information from communities all over the state. CalEnviroScreen, an analytical tool created by the California Environmental Protection Agency, combines different types of census tract-specific information into a score to determine which communities are the most burdened or "disadvantaged." Disadvantaged communities are those designated as representing the 25 percent highest-scoring census tracts in CalEnviroScreen Tool 4.0. For more information, see the California Office of Environmental Health Hazard Assessment's CalEnviroScreen Web page (https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40).

Disadvantaged Communities Advisory Group (DACAG): The Clean Energy and Pollution Reduction Act of 2015 (also known as Senate Bill 350) called upon the California Public Utilities Commission (CPUC) to help improve air quality and economic conditions in disadvantaged communities by, for example, changing the way the state plans the development and future operations of power plants, and rethinking the location of clean energy technologies to benefit burdened communities. In addition, SB 350 required the CPUC and the CEC to create a group

representing disadvantaged communities to advise the agencies in understanding how energy programs impact these communities and could be improved to benefit these communities.

Distributed Energy Resources (DER) Action Plan: A CPUC planning document that outlines a vision of DERs over the next several years, and serves as a roadmap in coordinating activities across multiple proceedings as California continues its commitment to greenhouse gas emission reduction and reform of utility distribution planning, investment, and operations.

Electric Program Investment Charge (EPIC) Program: The CEC's EPIC Program invests in scientific and technological research to accelerate the transformation of the electricity sector to meet the state's energy and climate goals. Investments of about $150 million annually support research and development in renewable energy, energy storage, electric system resilience, and electric technologies for buildings, businesses, and transportation. For more information, see the CEC EPIC Web page (https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program) and the CPUC Energy Research, Development, and Deployment Web page (https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/energy-research-development-and-deployment).

Electrolyzer: A device that uses electricity to split water into hydrogen and oxygen molecules.

End use, end user: End use refers to the final applications for which energy is ultimately used, such as heating, power generation, transportation, or a combination of these applications. An end user is the person who ultimately uses the energy (or associated innovation). This term is preferred over "user" because it provides more specificity, distinguishing the final user from other roles like developers or intermediaries.

Energy efficiency: Energy efficiency means adapting technology to meet consumer needs while using less energy. The CEC adopts energy efficiency standards for appliances and buildings, which reduces air pollution and saves consumers money. The CPUC regulates ratepayer-funded energy efficiency programs and works with the IOUs, other program administrators, and vendors to develop programs and measures to transform technology markets within California using ratepayer funds. For more information, see the CEC Energy Efficiency Web page and the CPUC Energy Efficiency Web page.

Environmental and Social Justice Action (ESJ) Plan: the CPUC has created the Environmental and Social Justice (ESJ) Action Plan to serve as both a commitment to furthering ESJ principles, as well as an operating framework with which to integrate ESJ considerations throughout the agency's work.

Environmental and social justice (ESJ) communities: ESJ Communities are predominantly communities of color or low-income communities that are underrepresented in

the policy setting or decision-making process, subject to a disproportionate impact from one or more environmental hazards, and likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities. It targets "Disadvantaged Communities" designated by the California Environmental Health Screening (CalEnviroScreen) Tool, all California tribal lands as defined in 18 U.S.C. 1151 subsection (a), low-income households with incomes below 80 percent of the area median income, and low-income census tracts with aggregated household incomes that are less than 80 percent of area or state median income.

Equity (energy equity): Energy equity is the principle of fairness in burden sharing and is a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed in and by society in equal ways. It is often aligned with ideas of equality, fairness, and justice and applied with respect to equity in the responsibility for, and distribution of, climate impacts and policies across society, generations, and gender, and in the sense of who participates and controls the processes of decision-making.

Follow-on funding: This report uses the term "follow-on funding" to describe when an EPIC recipient receives subsequent EPIC funding from the CEC for a project that meets the statutory criteria under Public Resources Code Section 25711.5(h)(4)(A)-(F). Appendix A (Table A-10) provides a summary of these awards of follow-on funding.

Greenhouse gas (GHG): GHGs are those gaseous constituents of the atmosphere, natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and clouds. This property causes the greenhouse effect. Water vapor, carbon dioxide, nitrous oxide, methane, and ozone are the primary GHGs in the Earth's atmosphere. Moreover, there are several entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides carbon dioxide, nitrous oxide, and methane, the Kyoto Protocol deals with the GHGs sulfur hexafluoride, HFCs, and perfluorocarbons. In response to Assembly Bill 32 (California Global Warming Solutions Act of 2006), the definition of GHGs in Health and Safety Code Section 38505 includes nitrogen trifluoride in addition to those defined under the Montreal and Kyoto Protocols.

Grid-interactive Efficient Buildings (GEB): GEBs combine energy efficiency and demand flexibility with smart technologies and communications to deliver greater affordability, comfort, productivity, and performance to homes and buildings.

Global warming potential (GWP): GWP is an index to measure how much infrared thermal radiation a greenhouse gas would absorb over a given timeframe after it has been emitted to

the atmosphere. The unit of measurement is expressed as a multiple of the radiation that would be absorbed by an equivalent mass of added carbon dioxide, which has a GWP of 1.

Heat pump water heater (HPWH): The U.S. Department of Energy defines heat pump water heaters as appliances that use electricity to move heat from the surrounding air into a tank of water, rather than generating heat directly like conventional electric resistance heaters.

High Road careers: Pathways with jobs that are framed by California Jobs First as quality, family-sustaining and are created through economic development that invests in workers and innovation rather than solely competing on low wages. These roles offer living wages, benefits, safe work conditions, worker voice, and reliable schedules that are often supported by state programs like the High Road Training Partnerships and High Road Construction Careers, focused on sectors like green energy, construction, and healthcare.

Investor-owned utility (IOU): Investor-owned utilities (IOUs) provide transmission and distribution services to all electric customers in their service territories. The utilities also provide generation service for "bundled" customers, while "unbundled" customers receive electric generation service from an alternate provider, such as a community choice aggregator. California has three large IOUs offering electricity service: Pacific Gas and Electric Company, Southern California Edison, and San Diego Gas & Electric.

Load Flexibility: The ability of customers to reduce or increase load (electricity demand) in response to grid conditions, usually through a proxy price signal or system operator or utility signal and facilitated by automation (also called "demand flexibility").

Low-income communities: This term refers to communities within California census tracts with median household incomes at or below either of the following levels: 1) 80 percent of the statewide median income or 2) the applicable low-income threshold listed in the state income limits updated by the Department of Housing and Community Development and filed with the Office of Administrative Law pursuant to subdivision (c) of Section 50093 of the Health and Safety Code.

Methane: Methane (CH_4) is one of the six GHGs to be mitigated under the Kyoto Protocol and is the major component of natural gas. Emissions also occur as a result of dairy and livestock operations and disposal of organics in landfills, and the management of these organics represents a major mitigation option. Methane is a short-lived climate pollutant. Unlike carbon dioxide, which lasts for about 100 years in the atmosphere, reductions of methane can create a relatively quick reduction in global warming.

Open Automated Demand Response (OpenADR): An open-source standard for secure and interoperable communication of demand response and demand flexibility signals to end-use devices.

Photovoltaic (PV): This term refers to materials that generate an electric potential or current when exposed to sunlight.

Regional Energy Innovation Cluster: These four sites were funded by the CEC in 2016 as part of the creation of its California Energy Entrepreneurial Ecosystem and serve as physical locations to support local clean energy technology developers. Services provided on-site include research and laboratory facilities, meeting spaces to convene investors and share learnings, and immediate availability of technical and business consultation.

Smart thermostat: A smart thermostat is one that can be controlled with an internet-connected device such as a phone, tablet, or smart speaker.

Sustainability: A dynamic process that guarantees the persistence of natural and human systems equitably.

Tribal Energy Resilience and Sovereignty: A conditionally awarded grant of more than $87 million through the U.S. Department of Energy's Grid Resilience and Innovation Partnerships Program.

Transportation electrification: This term refers to the replacement of fossil fuels in the transportation sector with electrical power.

Utility: A utility is an organization supplying the community with electricity, gas, water, or sewerage.

Vehicle-to-Building: This term refers to leveraging bidirectional energy transfer capability to discharge from an electric vehicle to a home or building.

Vehicle-to-Everything (V2X): This term refers to leveraging bidirectional energy transfer capability to discharge energy from an electric vehicle to a variety of destinations, including the electric grid, buildings, homes, or loads.

Vehicle-to-Grid (V2G): This term refers to leveraging bidirectional energy transfer capability to discharge energy from an electric vehicle to the electric grid.

Vehicle Grid Integration (VGI): This term refers to any method of altering the time, charging level, or location at which grid-connected light-duty electric vehicles, medium-duty electric vehicles, heavy-duty electric vehicles, off-road electric vehicles, or off-road electric

equipment charge or discharge in a manner that optimizes plug-in electric vehicle or equipment interaction with the electrical grid and provides net benefits to ratepayers.

Virtual Power Plant (VPP): An aggregation of distributed energy resources (DERs), such as energy storage, smart thermostats, and/or electric vehicles, which are capable of balancing electrical loads and providing utility-scale and utility-grade grid services like a traditional power plant.

Appendices

The following appendices are available as a separate volume (Publication Number CEC-500-2026-024-AP):

- Appendix A: 2025 CEC EPIC Reporting Requirements and Budget Summaries
- Appendix B: CEC EPIC Project Summary Tables by Strategic Objective, Initiative, and Investment Plan in 2025
- Appendix C: All EPIC Projects Awarded (Cumulative through December 31, 2025) with Fiscal and Diversity Details
- Appendix D: 2025 EPIC Projects by Agreement Number with Strategic Initiative Details