BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

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Order Instituting Rulemaking on the Commission's Own Motion to consider renewal of the Electric Program Investment Charge Program.	Rulemaking 19-10-005

OPENING BRIEF OF THE CALIFORNIA ENERGY COMMISSION TO THE PHASE 1 ISSUES IDENTIFIED IN THE ASSIGNED COMMISSIONER'S SCOPING MEMO AND RULING

Allan L. Ward, II, Esq.
Gabriel Herrera, Esq.
California Energy Commission
Chief Counsel's Office
1516 9th Street, MS 14
Sacramento, CA 95814-5512
Telephone (916) 654-3951
Fax (916) 654-3843
Email: allan.ward@energy.ca.gov
Email: gabe.herrera@energy.ca.gov

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SUMMARY OF RECOMMENDATIONS

- The EPIC program should be renewed because it directly benefits California electric ratepayers, gives the state the best opportunity to realize its energy policy goals and mandates, and is a critical driver of innovation-driven economic development in the state. Additionally, renewing the program will accelerate the achievement of California's climate and energy goals.
- The EPIC program should be renewed given the importance of public interest research and the numerous benefits it provides to a broad set of stakeholder groups. This includes providing independent validation of a new technology's merits to policymakers, private sector investors, and customers, and accelerating the pace of innovation and technology scale-up by ensuring project results are shared and disseminated publicly so future activities can build on successes and learn from and avoid unsuccessful approaches.
- The EPIC program should be renewed to leverage the successes to date and accelerate the technology innovation that is in the development pipeline. Examples of these successes include:
    - Companies that have received EPIC funding or support have collectively received over **$1.8 billion in follow-on private investment.**
    - More than **34 technologies and related services companies** have been successfully commercialized and dozens more are moving towards commercialization.
    - **34 EPIC projects** have improved the effectiveness of energy-related codes and standards, a key tool to enabling widespread diffusion of new technologies and data-driven practices. 5 of these projects could lead to over **$1 billion in annual energy cost savings** if adopted in regulatory codes.
    - EPIC Annual Symposium in-person attendance grew from roughly 100 in the first year (2015) to **approximately 800 in 2019**.
    - EPIC projects have **advanced 17 tools** that make complex information and data more accessible, scalable and lower cost to operationalize. These tools are estimated to have **over 700,000 users**.

  - CEC staff have participated in nearly **100 outreach and community** events to promote knowledge about EPIC funding opportunities
  - This outreach as helped result in over **65 percent** of the CEC's Technology Demonstration and Deployment funds going to projects located in and benefitting low-income or disadvantaged communities as defined by CalEnviroScreen.

- The EPIC program should be renewed through at least 2031 and funded at no less than the current funding level, adjusted annually to keep pace with inflation based on the projected California Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), as published by the California Department of Finance.
- The investment cycles for the EPIC program should be changed from 3-year cycles to 5-year cycles to enable an expanded research planning horizon for technology development and new investment plans, and to retain flexibility in implementation to respond to evolving needs.
- Allowable administrative expenses for the EPIC program should be increased from the current cap of 10 percent of an Administrator's budget to a cap of 15 percent of the Administrator's budget to reflect the Administrators' added workload, which has increased over time as the program has developed and new administrative requirements have been added.
- To avoid any disruption to the EPIC program or its administration, the Commission should approve one year of bridge funding in Phase 1 of the proceeding to support the Administrators' ongoing implementation of the program while the Commission considers the remaining programmatic issues during Phase 2 of the proceeding. Approval of bridge funding would additionally signal a sustained commitment to RD&D and help move the marketplace and effectuate change at this crucial time in our economy as the state endures the COVID-19 pandemic.
- At this time, the CEC does not see a need to change the relative share of program funding among the four EPIC Administrators.

- If Commission approves one year of bridge funding, the new, successor EPIC program should begin on January 1, 2022, and end on December 31, 2031. During the one year period of bridge funding, the Administrators would continue to implement the EPIC program under the current program rules and prepare investment plans for the new, successor EPIC program under the program rules as updated under Phase 2 of the proceeding.

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I. INTRODUCTION

The California Energy Commission (CEC or Energy Commission) respectfully submits this opening brief in response to the California Public Utilities Commission's (Commission) *Assigned Commissioner's Scoping Memo and Ruling* (Scoping Memo) in Rulemaking 19-10-005. This brief is submitted in accordance with Rule 13.11 of the Commission Rules of Practice and Procedure (Rules) and address the Phase 1 issues identified in the Scoping Memo.

The CEC agrees with the Commission that the Electric Program Investment Charge (EPIC) program has successfully driven efficient, coordinated investment in new and emerging energy solutions,[1] and believes the program is on track to achieve the program objectives of providing electric ratepayer benefits, producing energy innovations, and helping California meet its energy policy goals.[2]

The CEC strongly supports the renewal of the EPIC program. The EPIC program directly benefits California's electric ratepayers and is essential to support the state's clean energy mandates. EPIC-funded research and development gives California the best opportunity to achieve these mandates at lower costs and possibly even ahead of schedule. Because California is leading the nation in creating a clean energy economy, it is vital for the state to support the development and demonstration of clean energy technologies to meet these mandates. EPIC research funded through the CEC has been instrumental in informing state policy and developing

[1] Order Instituting Rulemaking 19-10-005 (OIR), p. 2.
[2] OIR, pp. 5-6.

and demonstrating technologies to further California's progress toward its clean energy mandates.

The CEC recommends the EPIC program be renewed through at least 2031 and funded at no less than the current level, adjusted annually to keep pace with inflation. The CEC also recommends that the investment cycles for the EPIC program be changed from 3-year cycles to 5-year cycles to enable an expanded research planning horizon for technology development and new investment plans and retain flexibility in implementation to respond to evolving needs. It also recommends that allowable administrative expenses be increased from the current cap of 10 percent of an Administrator's budget to a cap of 15 percent of an Administrator's budget to reflect the Administrators' added workload, which has increased overtime as the program has developed and new administrative requirements have been added.

Lastly, to avoid any disruption to the EPIC program or its administration, the CEC recommends that the Commission approve one year of bridge funding in Phase 1 of the proceeding to support the Administrators' ongoing implementation of the program while the Commission considers the remaining programmatic issues during Phase 2 of the proceeding. Approval of bridge funding would additionally signal a sustained commitment to RD&D and help move the marketplace and effectuate change at this crucial time in our economy as the state endures the COVID-19 pandemic. If the Commission approves one year of bridge funding, the CEC recommends that the new, successor EPIC program begin on January 1, 2022, and end on December 31, 2031. During the one-year period of bridge funding, the Administrators would continue to implement the EPIC program under the current program rules and prepare investment plans for the new, successor EPIC program under the program rules as updated under Phase 2 of the proceeding.

At this time, the CEC does not see a need to change the relative share of program funding among the four EPIC Administrators – the CEC, Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company.

The CEC looks forward to continuing its work with the Commission to implement the renewed EPIC program and building on the program's ability to shape California's clean energy market and enable the state to more effectively and efficiently meet its energy mandates.

II. DISCUSSION

A. Phase 1 Issues

The Scoping Memo states that the proceeding will be conducted in two phases, each of which will address a separate set of program-related issues.[3] In Phase 1, the Commission will determine whether EPIC funding should be renewed, and if so, at what funding level, for how long, and under what conditions, and whether bridge funding should be approved for the EPIC Administrators. If the Commission decides to renew the EPIC program in Phase 1 of the proceeding, Phase 2 of the proceeding will evaluate whether changes to the guiding principles and policy priorities for the EPIC program are needed, whether administrative and program structure improvement are needed, how the Commission will address recommendations from the Evergreen Evaluation that have not been fully addressed, and how to address future program and Administrator evaluations.[4] The Scoping Memo identifies a number of issues within Phase 1 and Phase 2 of the proceeding.

This brief addresses the issues identified for Phase 1 of the proceeding. It is organized to address these issues in the same manner listed in the Scoping Memo and makes the following recommendation with respect to these issues.

1. Should the EPIC Program be renewed?

   Yes. The EPIC program should be renewed because it directly benefits California electric ratepayers, gives the state the best opportunity to realize its energy policy goals and mandates, and is a critical driver of innovation-driven economic development in the state. Renewal of the program will leverage the successes to date and accelerate the technology innovation that is in the development pipeline.

a. Has the program yielded quantifiable result, impacts and benefits?

   Yes. EPIC investments have led to successful technology advancement and commercialization and helped enable broad diffusion of emerging energy technology. Through these investments the CEC has successfully facilitated the dissemination of new knowledge and results of funded RD&D to accelerate development and adoption of new science and technological advancements and inform state and local policymakers, and provided benefits to underrepresented groups, including diverse businesses and disadvantaged- and low-income communities and tribal nations.

[3] Scoping Memo, p. 2.
[4] Scoping Memo, pp. 2-4.

b. Is the program showing current value and the potential for future value?

Yes. The program has played a crucial rule at a time when the clean energy sector was at a critical crossroads. Ongoing EPIC projects and planned investments have breakthrough potential, and based on CEC implementation, EPIC impact and benefit metrics are in line with those of other public RD&D programs.

c. Are there reasons the program should not be continued?

No. The CEC sees no reason why program should not be continued.

2. If the EPIC Program is renewed:

a. Should the current funding level be continued?

Yes. The EPIC program should be renewed and funded at no less than the current funding level.

b. For how long should the program be authorized?

The EPIC program should be renewed through at least 2031.

c. How long should the program investment cycles last?

The investment cycles for the program should be changed from 3-year cycles to 5-year cycles to enable an expanded research planning horizon for technology development and new investment plans and retain flexibility in implementation to respond to evolving needs.

d. Are changes to the relative share of funding among the program Administrators needed?

No. At this time the CEC does not see a need to change the relative share of program funding among the four EPIC Administrators.

e. Should the Commission continue to apply inflation adjustments in the future?

Yes. The program should be funded at no less than the current funding level and adjusted annually to keep pace with inflation based on the projected California Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), as published by the California Department of Finance.

f. Should the 10 percent cap on program administrative expenses remain?

No. Allowable administrative expenses for the program should be increased from the current cap of 10 percent of an Administrator's budget to a cap of 15 percent of an Administrator's budget to reflect the Administrators' added workload, which has increased overtime as the program has developed and new administrative requirements have been added.

3. Should bridge funding be approved?

   Yes. To avoid any disruption to the EPIC program or its administration, the Commission should approve one year of bridge funding in Phase 1 of the proceeding to support the Administrators' ongoing implementation of the program while the Commission considers the remaining programmatic issues during Phase 2 of the proceeding. Approval of bridge funding would additionally signal a sustained commitment to RD&D and help move the marketplace and effectuate change at this crucial time in our economy as the state endures the COVID-19 pandemic. The Commission should approve bridge funding consistent with the Joint Administrator's Bridge Funding Proposal. If the Commission approves one year of bridge funding, the new, successor EPIC program should begin on January 1, 2022, and end on December 31, 2031. During the one-year period of bridge funding, the Administrators would continue to implement the EPIC program under the current program rules and prepare investment plans for the new, successor EPIC program under the program rules as updated under Phase 2 of the proceeding.

1. The EPIC Program Should Be Renewed Because It Directly Benefits California Electric Ratepayers, Gives the State the Best Opportunity to Realize its Energy Policy Goals and Mandates, and is a Critical Driver of Innovation-driven Economic Development in the State.

The CEC strongly recommends renewing the EPIC program and at a funding level no less than the current level. California is leading the nation in creating a clean energy economy with some of the most advanced energy mandates. It is vital for the state to support the development and demonstration of clean energy technologies to meet these mandates. EPIC-funded research and development gives California the best opportunity to achieve these mandates at lower costs and possibly even ahead of schedule. EPIC research funded through the CEC has a strong track record of informing state policy and developing and demonstrating technologies to further California's progress toward its clean energy mandates.

EPIC currently fills an important role in the California clean energy policy framework, by providing the technology push needed to complement the state's market pull policies. Policy is often the driver that creates a market for new technologies (i.e., market pull) by assuring manufacturers and investors of technology deployment opportunities. However, without a pathway for new technologies to be developed and demonstrated to inform policy (technology push), policy will inevitably lock in existing technology.

For example, Assembly Bill (AB) 2514[5] directed the Commission to open a proceeding to consider whether an energy procurement requirement should be established. Prior to the proceeding, the CEC funded several energy storage demonstration projects under its Public Interest Energy Research (PIER) Program, the result of which would inform the energy storage procurement requirements adopted by the Commission, which established one of the first markets for energy storage. Due in large part to these policies and programs, California currently accounts for over 30 percent of all energy storage technology companies in the United States.[6]

Private Investments Alone are Not Sufficient. Studies have demonstrated that there is a critical role for government funding to support innovations in the clean energy sector. The American Energy Innovation Council found that the private sector either doesn't invest or under invests because of the high capital costs, long lead times and regulatory uncertainty in the sector.[7] When the private sector invests, it is usually in incremental production improvements and not innovations.[8]

California has made a substantial commitment to funding clean energy. However, according to a report published by the California Senate Office of Research, entitled *State Investment in Clean Energy and Transportation Technology*, state spending is predominantly for deployment of current technologies. As shown in Table 1, the report indicates that, "state investments in clean energy and transportation are primarily in the commercial deployment stage of development, where the programs have a pulling influence on moving technology through the pipeline."[9] Research studies have found that market pull policies are only effective at fostering incremental innovation and do not, by themselves, foster non-incremental or breakthrough innovation.[10] Research studies have found that non-incremental innovation and technology

[5] AB 2514 (Stats. 2010, ch 469).
[6] CEC staff analysis using data from Pitchbook.
[7] American Energy Innovation Council, "Five Reasons Energy Innovation Matters, May 2018.
[8] International Energy Agency, Energy Technology RD&D Budgets: Overview, May 2019.
[9] Paul Jacobs and John Thompson (Senate Office of Research), *State Investments in Clean Energy and Transportation Technology*, 2019, p. 9. https://sor.senate.ca.gov/sites/sor.senate.ca.gov/files/policy%20matters%2003.19%20final.pdf (Accessed April 10, 2010.)
[10] National Academies of Sciences, Engineering, and Medicine 2017. *An Assessment of ARPA-E*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24778.

breakthroughs, like those that are needed to support California's clean energy policy goals, are only accomplished through technology push programs such as EPIC.[11]

Table 1. Fiscal 2018-19 Funding Levels for State Programs Supporting Clean Energy and Transportation Technology ($ in Millions)[12]

Technology Category	Fundamental Research	Applied Research	Prototype	Demonstration	Commercial Deployment
Renewable Energy	$0	$20	$20	$90	$420
Energy Efficiency	$0	$20	$20	$80	$930
Clean Transportation	$0	<$2	<$2	$50	$1,080

Deliberate and Targeted Policy Relevant Research. The CEC's administration of EPIC is responsive to and informs state energy policy. State law directs the CEC to help achieve the state's statutory energy goals by investing in a strategically focused portfolio of projects designed to address the most significant technological barriers and challenges.[13] The CEC has developed portfolios of research grouped into six Investment Topics aligned to address the state's energy policies and Commission proceedings. Table 2 shows how the CEC EPIC Investment Topics and their related portfolio topics map to state policies and the Commission proceedings. Additional discussion of the connection between CEC's EPIC research and policy is provided in subsequent sections of this brief. Note that policy guidance for equity and diversity in clean energy development – specifically AB 523,[14] AB 865,[15] and the SB 350[16] Barriers Study – is embedded in all six investment topics listed in Table 2.

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[11] Ibid.
[12] Ibid.
[13] Refer to Pub. Resources Code, sec. 25711.5, subd. (a), as enacted by SB 96 (Stats. 2013, ch. 356).
[14] AB 523 (Stats. 2017, ch. 551).
[15] AB 865 (Stats. 2015, ch. 583).
[16] SB 350 (Stats. 2015, ch. 547).

Table 2. CEC EPIC Investment and Portfolio Topics Mapped to Policies and Proceedings

Investment Topics	State Policies	Commission Proceedings
Entrepreneurial Ecosystem • CalSEED[17] • Innovation Clusters[18] • CalTestBed[19] • BRIDGE[20] • RAMP[21]	• SB 96 (Stats. 2013, ch. 356) • AB 327 (Stats. 2013, ch. 611) • SB 350 (Stats. 2015, ch. 547) • SB 32 (Stats. 2016, ch. 249) • AB 2514 (Stats. 2010, ch. 469)	• R.11-10-003
Resiliency and Safety • Microgrids • Energy Storage • Solar + Storage • Climate Adaptation • Forest Biomass Utilization	• SB 1339 (Stats. 2018, ch. 556) • SB 379 (Stats. 2015, ch. 608) • SB 246 (Stats. 2015, ch. 606) • AB 1482 (Stats. 2015, ch. 603) • SB 901 (Stats. 2018, ch. 626) • Governor Brown's Executive Order for Tree Mortality (B-52-18) • AB 2514	• R.17-07-007 • R.18-04-019 • R.18-12-005 • R.19-09-009
Building Decarbonization • Load Flexibility/Dynamic Efficiency • Whole Building Upgrades • Low-carbon HVAC and Water Heating	• SB 350 • AB 758 (Stats. 2009, ch. 470) • SB 100 (Stats. 2018, ch. 312) • AB 2137 (Stats. 2014, ch. 290) • SB 1477 (Stats. 2018, ch. 378) • AB 3232 (Stats. 2018, ch. 373)	• R.17-07-007 • R.19-01-011 • R.13-11-005 • R.15-03-010 • R.13-09-011

[17] CEC's California Sustainable Energy Entrepreneur Development Initiative (CalSEED) is a small grant program under EPIC that provides help to early stage California clean energy startups to bring their concepts and prototypes to market. More information available at: www.calseed.fund

[18] The Innovation Clusters are a set of four EPIC funded projects that collectively provide entrepreneurial support services —such as laboratory equipment and buildings, business plan development, and connections to investors —throughout the state.

[19] CalTestBed is a voucher program that provides clean energy entrepreneurs access to nearly 30 testing facilities throughout the state to conduct independent technology testing and validation. More information available at www.caltestbed.com

[20] Bringing Rapid Innovation Development to Green Energy (BRIDGE) is an EPIC solicitation program that provides clean energy start-ups that have previously received federal or Energy Commission funding to continue working on their technology without waiting for a new public funding opportunity or pausing to raise private funding.

[21] Realizing Accelerated Manufacturing Production (RAMP) is an EPIC solicitation program that supports clean energy entrepreneurs' transition from one-off prototype manufacturing to an initial pilot production line capable of conducting low-rate initial production.

• High-efficiency Plug-load Devices and Appliances • Solid-state Lighting • Advanced Building Envelopes and Fenestration		
Grid Decarbonization and Decentralization • Variable Renewable Generation • Low-carbon Dispatchable Generation • Energy Storage • DER Optimization/ Virtual Power Plants	• SB 350 • SB 100 • Commission DER Action Plan • AB 2868 (Stats. 2016, ch. 681) • AB 2514	• R.15-03-011 • R.17-07-007 • R.12-11-005 • R.14-08-013 • R.14-10-003 • R.19-09-009 • R.16-02-007
Industrial and Agriculture Innovation • Wastewater Treatment and Recycling • Smart Manufacturing and Industrial Processes • Precision Irrigation • Load Flexibility • Low-carbon Process Heating • Waste-to-Energy	• Sustainable Groundwater Management Act (Water Code, Section 10720, et seq.) • SB 32 • SB 1383 (Stats. 2016, ch. 395) • Governor Brown's Executive Order for Drought (B-37-16)	• R.13-02-008 • R.18-07-003
Transportation Electrification • Vehicle-Grid Optimization • Advanced EV Battery Technology • Smart EV and EV Infrastructure Deployment	• SB 676 (Stats. 2019, ch. 484) • AB 2127 (Stats. 2018, ch. 365)	• R.18-12-006

Designing Effective Economic Stimulus. In addition to helping California realize its energy policy goals, EPIC has been a critical driver for innovation-driven economic development in the state. Clean energy innovation has emerged as an important sector in the California economy. EPIC plays a critical role in bringing top innovation talent as well as investment to California. For example, California is home to 107 of the 318 energy storage technology companies in the United States.[22] In addition, in 2019 California attracted over 51% of all venture capital in the United States for clean energy innovation. In addition to providing public

[22] Ibid.

funding at critical stages, continuing EPIC would also provide certainty to the private sector that the public sector is willing to share the financial risk to bring new technologies to market as well as provide the technical validation and due diligence that most private investment firms have traditionally lacked. Under normal circumstance, not continuing the program would significantly slow clean energy innovation. However, given the current federal position on clean energy innovation as well as the unprecedented economic circumstances caused by the COVID-19 pandemic, not continuing EPIC at this time could set clean energy innovation in California back several years as private sector investors would likely withdraw again from cleantech.

While this brief focuses on CEC-funded EPIC research and the benefits it has brought to the state, the CEC values having all four Administrators as part of the EPIC program. This structure expedites coordination and communication of promising research results to accelerate adoption and realization of ratepayer benefits.

a. <u>EPIC Has Yielded Quantifiable Results, Impacts, and Benefits.</u>

While EPIC is still in midstream (only **145 of the CEC's 332 EPIC-funded projects** have concluded, including 83 completed in 2019), the program has already provided quantifiable benefits. These impacts and benefits are quantified differently, depending on the technology stage or project type. For example, success for a technology in the pre-prototype stage may entail successful validation at the lab scale and using the results to secure additional public and/or private funding to further develop and scale the technology. Success for a technology at the full-scale demonstration stage includes, but is not limited to, identifying and overcoming scale-up challenges, successfully validating the real-world performance of the technology, and using the results to prove-out the technology's merits to customers and policymakers. Some of the programmatic-level benefits are highlighted below. They demonstrate the ability of EPIC funding to support the development of new technologies, including commercialization; enabling technologies to move into the market (e.g., through supporting codes and standards); sharing the research findings broadly; and working to ensure that the solutions support ratepayers in vulnerable communities.

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Table 3. Quantifiable Benefits for Each Impact Category[23]

Impact Category	Quantifiable Impacts and Benefits
Technology Advancement and Commercialization	• Companies that have received EPIC funding or support have collectively received over **$1.8 billion in follow-on private investment,** significantly leveraging EPIC's initial investment. • EPIC recipients were able to leverage their EPIC awards to attract nearly **$180 million** in federal and state (non-EPIC) funding. • More than **34 technologies and related services companies** have been successfully commercialized. • **5 companies** supported by EPIC have executed successful exits, defined as a merger, acquisition, or secondary transaction. This is a significant measure of market interest in the technologies developed in EPIC.
Technology Diffusion	• **34 EPIC projects** have improved the effectiveness of energy-related codes and standards, a key tool to enabling widespread diffusion of new technologies and data-driven practices. • 5 of these projects could lead to over **$1 billion in annual energy cost savings** if adopted in regulatory codes. • The CEC has built an extensive EPIC network with **over 1,600 people** representing a broad and diverse set of stakeholder groups critical to meeting the program's multiple objectives. • CEC EPIC funding has reached over **580 organizations**, which include entrepreneurs, start-ups, community-based organizations, universities, national labs, project developers, local governments and nonprofits, at over **650 sites throughout** California.
Knowledge Generation and Dissemination	• EPIC Annual Symposium in-person attendance grew from roughly 100 in the first year (2015) to **approximately 800 in 2019**. • Results of CEC EPIC-funded projects have been published in more than **230 academic publications** with more than **1,300 citations**. • EPIC projects have been viewed **over 120,000 times** by **over 9,000 users** on the CEC's online project database, the Energy Innovation Showcase.

[23] Quantifiable Impacts and Benefits reported in Table 3 were developed by CEC staff from various data sources; primarily the CEC's Project Information Management System, various data collection tools developed by CEC staff, EPIC recipient surveys, EPIC Symposium attendee surveys, Google Analytics, and Pitchbook.

	• EPIC projects have **advanced 17 tools** that make complex information and data more accessible, scalable and lower cost to operationalize. • These tools are estimated to have **over 700,000 users**.
Diversity and Equity	• **65 percent** of the CEC's Technology Demonstration and Deployment funds have gone to projects located in and benefitting low-income or disadvantaged communities as defined by CalEnviroScreen. • Although not a program requirement, **$7.6 million** have gone to projects located in and benefitting a tribal community, including the world-renowned microgrid at the Blue Lake Rancheria. • **19 percent** of EPIC agreements include a women-, minority-, or LGBTQ-owned business as the prime recipient or a subcontractor. • CEC staff have participated in nearly **100 outreach and community** events to promote knowledge about EPIC funding opportunities

i. EPIC Investments Have Led to Successful Technology Advancement and Commercialization.

One of the primary purposes of the EPIC program is to provide benefits to California's electric ratepayers by bringing to market new energy technologies that promote greater reliability, lower costs, and increased safety.[24] "Most transformative energy technologies require many years, often several decades, to go from nascent research to first marketable product."[25] While EPIC is in relatively early stages, the program has already shown success in supporting the advancement and commercialization of new technologies.

EPIC has provided critical signals to private sector investors. The EPIC framework developed in Commission Decision (D.) 12-05-037 envisioned EPIC funds filling critical funding gaps within the energy technology development pipeline not addressed by the private sector. However, in 2013, a year before the first CEC EPIC awards were made, venture capital and other early-stage private sector investors largely pulled out of the clean energy innovation

[24] Commission Decision (D.) 12-05-037, Ordering Paragraphs 2-4; OIR, p. 4.
[25] National Academies of Sciences, Engineering, and Medicine 2017. *An Assessment of ARPA-E*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24778.

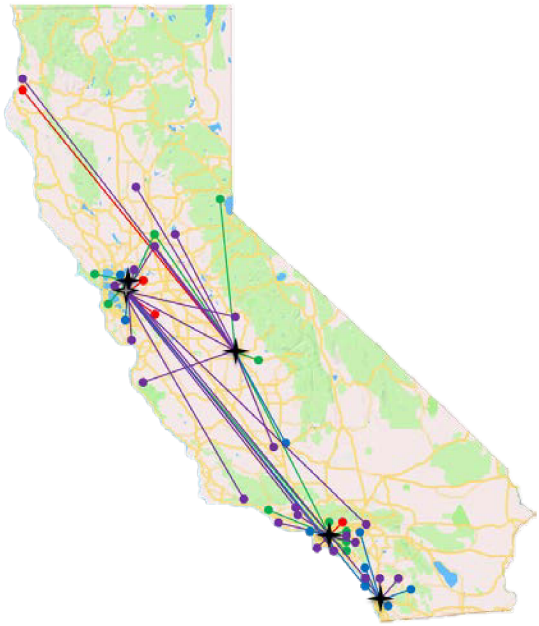
sector after a series of failed investments.[26] In a July 2016 Energy Initiative paper,[27] Massachusetts Institute of Technology (MIT) reported that venture capital investment had dropped to $2 billion, down from a peak of $5 billion in 2008, after investors learned through firsthand experience that new energy technologies have longer development timelines and higher capital requirements than software start-up ventures. Additionally, a study conducted by the National Academies of Sciences found that, "many investors at the venture and similar investment stages lack the technical capability to assess which energy technologies hold the greatest potential."[28] The CEC through EPIC has taken significant steps to bring private investment back into clean energy innovation. EPIC has provided certainty to the private sector that the public sector is willing to share the financial risk to bring new technologies to market. More importantly, the CEC has provided validation to the private sector of a new energy technology's merits. As of February 2020, companies who have received EPIC funding have attracted more than **$1.8 billion in follow-on private investment**.[29] The primary driver has been the Entrepreneurial Ecosystem developed by the CEC under EPIC to mobilize California's vast resources around clean energy entrepreneurship and make new clean energy ventures investable. Figure 1 shows this interconnected network which includes nine University of California (UC) campuses, 12 California State University (CSU) campuses, two private universities, two national labs, six economic development organizations, seven nonprofit organizations, and six incubators/accelerators. Together, the Entrepreneurial Ecosystem provides clean energy startups with the technical and business support they need to advance their technologies and overcome the barriers and challenges common in bringing innovations to market. To date the Entrepreneurial Ecosystem has:

- Supported over 220 startups and entrepreneurs across the state;

[26] Gaddy, Benjamin, Varun Sivaram, Francis, O'Sullivin 2016. *Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation.* http://energy.mit.edu/wp-content/uploads/2016/07/MITEI-WP-2016-06.pdf
[27] Ibid.
[28] National Academies of Sciences, Engineering, and Medicine. 2016. *The Power of Change: Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies*. Washington, DC: The National Academies Press. https://doi.org/10.17226/21712
[29] Staff analysis based on data from Pitchbook.

- With these startups employing over 1,000 people[30]; and
- Funded 10 companies to develop initial manufacturing production lines in California.[31]

Figure 1. Entrepreneurial Ecosystem[32]



EPIC has leveraged additional funding to further advance new technologies and increase the efficient use of electric ratepayer monies. The CEC and other stakeholders have long recognized that one of the key benefits of state-funded R&D programs is the ability to attract and leverage additional funding, including attracting federal funding to California. In administering EPIC, the CEC has developed and implemented several approaches to utilize EPIC funding to leverage non-EPIC funding.

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[30] This information is based on a survey of companies that have received a CalSEED award or were accepted into an Innovation Cluster Program.

[31] Results from CEC EPIC solicitation GFO-18-302 – Production Scale-Up for Clean Energy Technologies, available at: https://www.energy.ca.gov/sites/default/files/2019-05/GFO-18-302_NOPA_Revised.pdf

[32] The Entrepreneurial Ecosystem is primarily comprised of five EPIC funded entities – (1) California Clean Energy Fund which administers the CalSEED and CalTestBed programs (https://calseed.fund/, https://caltestbed.com/), (2) Activate which operates Cyclotron Road (https://www.cyclotronroad.org/), (3) CSU Fresno which operates BlueTechValley (http://bluetechvalley.org/), (4) Cleantech San Diego which operates the Southern California Regional Energy Network (https://cleantechsandiego.org/scein/), and (4) Los Angeles Cleantech Incubator which operates the LACI Innovators Program (https://laincubator.org/innovators/).

- The CEC has leveraged more than **$590 million** in additional funding for EPIC projects.
- This includes bringing more than **$385 million in co-funding** to EPIC projects by requiring a minimum match share amount or awarding preference points for applicants that provide cost share for their project.
- In addition, recipients have used their EPIC award to leverage nearly **$180 million in additional federal and state (non-EPIC) funding**.
- The CEC has leveraged an additional **$25 million** in federal funding through BRIDGE, its sub-program designed to competitively award follow-on funding for successful projects that have previously received a government award and are receiving interest from the private sector.[33]

EPIC has helped move new energy technologies into the marketplace. Even the most forward-looking customers are unwilling to adopt new energy technologies without real-world demonstrations to verify and validate the technology's performance. Demonstration projects provide developers, investors, and potential customers with information about the cost, performance, safety, and reliability of the technology when used in a typical operational setting. In this stage, technology transitions from the small-scale, controlled setting of a prototype to the larger scale necessary for commercial deployment, allowing developers to address problems that arise from operating in real-world conditions and reducing technological, regulatory, and business risks to levels that would allow private investment in the first few commercial projects. Through demonstrations, EPIC has already enabled a number of new energy technologies to reach commercialization and enter the market. Appendix A provides a list of new energy technologies and related services the CEC has supported through EPIC that are now being commercially offered. For each technology or related service, Appendix A identifies the company providing the technology or related service, EPIC investment topic, company description, commercialized technology or service, and the webpage address that provides information on the technology or related service.

Table 4 below summarizes the results of Appendix A.

[33] Information is from CEC staff analysis of EPIC project data as well as analysis of Federal funding award databases.

Table 4. Number of Commercialized EPIC-funded Technologies and Related Services.

Investment Topic	Technologies/Services
Resiliency and Safety	3
Building Decarbonization	7
Grid Decarbonization and Decentralization	12
Industrial and Agriculture Innovation	7
Transportation Electrification	6

EPIC has addressed critical barriers and challenges to increased adoption of technologies that will benefit ratepayers. As noted earlier in the brief, the law directs the CEC to help achieve the state's statutory energy goals by investing in a strategically focused portfolio of projects designed to address the most significant technological barriers and challenges. Appendix B shows how the various EPIC investment portfolios address specific barriers and challenges. For each EPIC investment portfolio area, Appendix B identifies the project and whether it has addressed barriers and challenges specific to the investment portfolio area. For example, in the portfolio area for microgrids, Appendix B identifies funded microgrid projects and whether those projects have: 1) advanced technologies, tools, or practices that reduce the capitol costs required to design, install and commission a new microgrid system; 2) successfully islanded in on the following scenarios – emergency grid outage, non-emergency outage, and simulated outage; and 3) quantified the value streams of a new microgrid installation to better assess the business case.

The CEC regularly invites stakeholder perspectives and expertise reflecting various policy, market, and technology drivers affecting the energy sector into EPIC planning and administration to help inform identification of the most critical technological barriers. Additionally, future customers inform the success criteria new energy technologies need to meet in order to gain market acceptance. Because these different perspectives are brought into the CEC's solicitation scoping, selection, and project management, the success rate is amplified. The following describes specific EPIC projects for the portfolio topics listed above and how they have addressed key technological barriers and challenges.

Resiliency and Safety. After CEC research in its PIER Program focused on improving functionality of major microgrid equipment and controllers, the CEC began a targeted effort

under EPIC to advance microgrid technology to the commercial stage – addressing the needs of critical facilities, such as hospitals, emergency response shelters, and fire stations; demonstrating resilience values; and developing replicable business models and use cases with this new solution. These microgrids span a variety of technical configurations and ownership models. In 2015, the CEC awarded seven microgrid research grants to evaluate the ability of microgrids to support critical facilities or to use microgrid configurations to integrate higher levels of renewable systems. These microgrids have completed their on-site installations and many have been successfully operating for more than two years. Table 5 shows the various performance attributes for a sample of these EPIC-funded and completed microgrids.

A key barrier to commercial adoption of microgrid technology has been customer concerns about whether the sophisticated control systems would respond quickly and reliably during a grid outage and whether microgrids can provide cost savings throughout the year. Through the EPIC-funded microgrid projects, these questions have largely been answered; most notably by the microgrid at the Blue Lake Rancheria, a casino resort in a tribal community and disaster-prone region. The microgrid has been a lifeline for the community, successfully islanding on several critical occasions. Highlights are shown below:

- 78: number of minutes the microgrid powered the central command center for fire crews during a wildfire in 2017.
- 10,000: Californians who still had power during a planned grid outage, thanks to EPIC investment in their community microgrid.
- 4: number of lives saved thanks to emergency power during the Public Safety Power Shutoff.
- 3: number of awards for project excellence.

Additionally, the CEC awarded nine new microgrid grants in 2018 to develop replicable business models for implementing microgrids in a broad spectrum of applications and end customer locations. These microgrids include:

- The Rialto Resilient Clean Power Microgrid and the Urban Microgrids for Grid Resiliency and Disaster Readiness located in disadvantaged communities (DACs) that provide critical support to key facilities and also support the residents of the DAC.

- The Redwood Coast Airport microgrid and Santa Rosa Junior College microgrid to support the local community and improve the ability of the communities to provide emergency services.
- Three microgrids located on military bases that are demonstrating key features useful beyond the military, such as for using landfill gas, supporting backup for data centers, and creating nested microgrids in communities.
- Microgrids located at the Port of San Diego and the Port of Long Beach, supporting critical facilities at these economic engines.

The EPIC portfolio of microgrids has been informing the Commission's resiliency and microgrid proceeding (R.19-09-009) in response to SB 1339. The CEC has also responded to requests from the legislature, the California Office of Emergency Services, and the Commission's wildfire mitigation efforts to brief on lessons learned from the EPIC research. CEC also has been assisting the Department of General Services in evaluating microgrid options for critical state facilities. Without the EPIC program, the state would have very limited capability, in terms of technology readiness and technical expertise, to develop microgrids to provide resiliency and make this a valuable and proven option to address the impacts of wildfires and Public Safety Power Shutoffs at a reduced cost.

Table 5. Comparison Table of EPIC-Funded Microgrids

	Fremont Fire Station Microgrids	**Kaiser Richmond Microgrid**	**Blue Lake Rancheria Microgrid**	**Borrego Springs Microgrid**
Use Cases	Critical facilities	Critical facilities	Community microgrid with critical facilities	Utility Microgrid
Core Innovation	EnergyScope controller with cloud + modular functions	Charge Bliss supervisory controller with PMU for continuous optimization	Demonstration of improved resiliency in disaster-prone region	Integration of utility-scale assets + demonstration of distribution circuit microgrid
Demonstrated Value Streams	Energy savings	Demand charge management and energy savings	Demand charge management and energy savings	Resiliency

Islanding Capabilities (hrs)	6-10	3+	28-30	4.5
Islanding Events	Four planned during grant + several unplanned	One planned	Four unplanned/several planned during grant term Successfully islanded during October 2019 PSPS events	Three planned/several unplanned
Estimated Cost Savings	$10,440/year	15%/year	$160,000/year	N/A

Building Decarbonization. Achieving the major GHG reductions from buildings anticipated by SB 350 and SB 1477 will require both substantial efficiency improvements in end use devices such as lighting, electronics, and other plug loads, and sector-wide substitution of electric for natural gas-fueled space and water heating equipment. The CEC has been focusing EPIC investments on lighting systems, low-carbon HVAC systems that incorporate high-efficiency heat pump technologies and low global warming potential refrigerants, and load flexibility technologies and strategies to move loads toward times when carbon emissions from the grid are lowest. CEC demonstration projects have, at the same time, focused on the challenge of making sure the benefits of EPIC investments apply to all Californians.

One example of an innovative approach to decarbonization is CEC's EPIC investment with OhmConnect, Inc. OhmConnect is a residential demand response software platform that pays households to reduce their energy use when the electric grid is stressed or shift their consumption to times when low or zero-carbon generation is abundant. The EPIC OhmConnect project proves that large numbers of small customers are willing and able to be flexible with their electricity consumption when provided a reason, a goal, a modest incentive, and the means to participate easily.

During the EPIC project, OhmConnect leveraged its existing platform to improve and expand their ability to successfully engage residential utility customers, adding over 450,000 signups that yielded more than 115,000 active participants and encouraging them to save energy during DR events. Those participants provided over 27.8 megawatt-hours over the course of the project, avoiding 9 metric tons of carbon emissions while earning $668,000 and donating an

estimated $65,000 to non-profit organizations.[34] Table 6 below shows a comparison of additional projects within the Building Decarbonization research portfolio.

Table 6. Comparison Table for EPIC-Funded Building Decarbonization Projects

Core Innovation	**Baseline (standard controls)**	**UCD Heat Pump Controller**	**LBNL Integrated Open Source Control**	**Itron-AESC Residential DER Management System**	**CIEE-Customer Controlled, Auto DR**	**OhmConnect, Inc. Empowering Prosumers**
Equipment or Sector Targeted/ Optimization Potential	All loads/None	HVAC/Yes	HVAC/Yes	Residential Loads/Yes	Commercial Loads/Yes for electricity pricing + grid needs	Residential Loads/Yes
Communication Method	Proprietary	Open-ADR-Open Source	Open-ADR-Open Source	Proprietary	Proprietary	Proprietary
Responds to Grid Signals	No	Yes	Yes	Yes	Yes	Yes
Demand response type	None	Shift, Shed, Shape, Shimmy	Shift, Shed, Shape, Shimmy	Shift	Shift	Shift, Shed
Automation	Requires programming	Yes	Yes	Yes	Yes	Capable of both on-site and off-site control
Estimated Savings (Grid)	None	0-5 kW	7.5 kW	23%	25-70%	27.8 MWh for 115,000 active participants
Estimated Savings (Customer)	Depends on programming	5-30% from baseline	20%	30%	7-9%	Variable

[34] Doughman, Pamela. 2020. Electric Program Investment Charge 2019 Annual Report. California Energy Commission. Publication Number: CEC-500-2020-009 Appendix B. https://ww2.energy.ca.gov/2020publications/CEC-500-2020-009/CEC-500-2020-009-AP.pdf

Another example is CEC's EPIC research on advancing low carbon HVAC systems. As part of the decarbonization strategy for buildings, there is much attention on using non-fossil sources for space and water heating. The key strategies have focused on solutions that integrate high efficiency components into heat pump systems to increase efficiency and reduce the carbon footprint. These strategies have included integration of highly efficient components, such as a variable capacity compressor and blower, automated demand response, fault detection and diagnostics, intelligent dual fuel heating, integrated ventilation, and zonal control. An alternative low global warming refrigerant, R-32, was evaluated as a possible future enhancement.

The main takeaways from the research was that systems that incorporated high efficiency components could potentially save 22-32% of cooling energy compared to a current code compliant HVAC system (14 SEER single speed) and satisfy over 90% of annual heating load for most of California without electrical or natural gas back-up. Daikin/Goodman, a manufacturer of HVAC equipment and project partner, are evaluating the project results for inclusion in future products. Additionally, the CEC is further expanding research in this area in 2020 by focusing on heat pumps that use low or no global warming refrigerants and on hot water heat pump systems that can serve multifamily units.

Table 7 below shows the technical advancements associated with the CEC EPIC research projects for HVAC.

Table 7. Comparison Table for EPIC-Funded Building Decarbonization Projects

Core Innovation	**Baseline (T-24 Compliant)**	**EPRI-Next Generation Residential Space Conditioning System**	**UCD Integration of Low GWP Heat Pumps**	**EPRI: Zero GWP Heat Pump and Distribution System**	**EPRI Climate Appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand**
Use Cases	All	Residential	Residential	Commercial	Commercial

Core Innovation	N/A	Integration of variable capacity compressor and blower, automated demand response, fault detection and diagnostics, intelligent dual fuel heating, integrated ventilation, and zonal control.	Novel compressor, next generation heat pumps that utilize low (<750) or ultra-low (<10) global warming potential refrigerants, high efficiency micro channel heat exchanger	Reversible heat pump that uses ammonia (NH_3) and carbon dioxide (CO_2) as a unique cascading t hermal cycle and distribution system	Combines variable refrigerant flow (VRF), indirect evaporative cooling integrated and operationally optimized through the building control system
Demonstrated Value Streams	N/A	Energy savings	Energy savings, and applicable to low GWP refrigerant technology	Energy efficiency improvement, reduction in installation cost, and reduction in O&M cost	Energy savings, cost savings
Potential to Provide Grid Flexibility	No	Yes	Maybe	No	Yes
Estimated Cost Savings	N/A	Avg 22-32% cooling savings vs. current code compliant HVAC system	10% lower equipment cost compared to standard systems	10% installation cost reduction	Up to 40 percent depending on location and efficiency of current equipment

Grid Decarbonization and Decentralization.

Smart Inverters. Inverters convert the DC power produced by solar PV into AC power that can be used onsite by homes and businesses or can be exported to the electric grid. Smart inverters go far beyond this basic functionality, providing benefits to the grid that include voltage ride-through, anti-islanding, and providing reliability or resilience services when needed by the distribution grid operator. CEC's EPIC program has focused on research to harness the full potential of smart inverters that can alleviate some of the unmanaged impact a high penetration

rooftop solar can have on the distribution grid. The CEC and Commission jointly facilitated a Smart Inverter Working Group under the Commission's Rule 21 Interconnection proceeding that recommended smart inverter functionality be developed and implemented for new inverters in three phases: 1) Phase 1, autonomous functions that inverters can perform without communications; 2) Phase 2, the ability to communicate and respond to signals; and 3) Phase 3, advanced functions, including those that respond to signals from grid operators. The EPIC program funded five projects that informed the development of smart inverter functionality and communications protocols under the three phases:

1. Two projects in Phase 1:
    a. Standardized smart inverter functionality across multiple manufacturers.
    b. Developed a Rule 21 test framework and test scripts as well as open source software tools to enable product development and safety testing.
    c. Enabled coordination of smart inverters with one another and with other consumer devices, EV charging, and storage to further enable high levels of PV penetration.
2. Two projects in Phase 2:
    a. Enabled smart inverter compliance with Rule 21 default communication standard, IEEE 2030.5.
        i. Developed a free, open source communication software.
        ii. Developed test procedure and associated test software.
    b. Enabled smart inverter and storage compliance with DNP3, a legacy communication standard under which much of the distribution grid infrastructure operates.
        i. Developed an application note "DNP3 Profile for Communications with DERs" that is referenced by the IEEE 1547 standard (national standard that outlines the requirements for interconnecting DERs) as the requirement for using DNP3 in DERs.
        ii. Developed open source DNP3 software.
        iii. Developed a testing framework.
3. One project in Phase 3:
    a. Evaluated Phase 3 functions, including distribution modeling, lab testing, field testing at dozens of residential sites, development of test procedures, economic analysis, and cyber security testing.

b. Validated that Phase 3 functions can enable dispatch of aggregations of variable renewable resources that enhance grid stability.

The researchers on these smart inverter projects participated extensively in the Smart Inverter Working Group and in the development of California's Rule 21 and national IEEE standards that govern the functionality of smart inverters, their communications, and how they interact with other components of the electric grid. This EPIC-funded research ensured that smart inverters deployed on the grid will improve grid stability, increase the amount of variable renewable capacity that can be safely interconnected, and enable the interoperability of solar PV and storage with consumer devices and the broader distribution grid.

Energy Storage. Lithium-ion batteries are the market leader in energy storage technologies, driven in large part by major federal research investments under the American Recovery and Reinvestment Act and the growth of consumer electronics and electric vehicle (i.e., mobile) markets. In its PIER program, the CEC helped pave the way to greater understanding of the use of advanced stationary energy storage technologies by sponsoring critical and timely field demonstrations, sharing research results with industry, investors, the California Independent System Operator (CAISO), and the Commission. Additionally, AB 2514 required the Commission to consider whether to establish an energy storage procurement requirement for the investor owned utilities (IOUs). Information from PIER established a cost effectiveness methodology, which helped inform Commission deliberations, leading to the Commission mandate for the procurement of 1.3 GW of energy storage.[35]

The Commission's procurement target created a robust market in California and the nation for Lithium Ion (LI) storage. However, LI batteries may not be optimally suited for larger-scale energy storage applications. Furthermore, LI batteries rely on materials that may have future supply chain issues, including concerns as to whether the supply of cobalt and lithium metals that compose these batteries can meet the expected global demand for mobile and stationary energy storage. Through $35 million of EPIC funding of multiple non-LI energy

[35] For example, see Abrams, Alicia, Fioravanti, Rick, Harrison, Jessica, Katzenstein, Warren, Kleinberg, Michael, Lahiri, Sudipta, Vartanian, Charles. (DNV KEMA Energy & Sustainability). 2013. Energy Storage Cost-effectiveness Methodology and Preliminary Results. CEC. Entered into the Commission Energy Storage proceeding R.10-12-007 on July 8, 2013. See http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M071/K159/71159691.PDF for the report and http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M071/K162/71162662.PDF for the applicable ruling: "Administrative Law Judge's Ruling Entering Cost Effectiveness Studies into Record."

storage technologies, the CEC is aiming to diversify the options available for California's energy storage needs. Key objectives are to support improvements in design and manufacturing to reduce costs and make the systems more competitive with LI storage. Another important objective is to demonstrate the performance and safety to give the finance community sufficient confidence to back the systems. Two successful technologies, Eos' Zinc Hybrid and Amber Kinetics' flywheel, reduced technology costs in half and received over $150 million in follow-on investment. Table 8 below shows how the current performance of these non-lithium energy storage solutions compared with current lithium-ion technology.

Table 8. Comparison of Non-Lithium Energy Storage Technologies

	LI Baseline for utility storage	**Eos**	**Amber Kinetics**	**UniEnergy Technologies**
Core Innovation	Lithium Ion	Zinc hybrid cathode battery technology	First 4-hour commercial flywheel storage system	Vanadium flow battery with high energy density and no-fade performance
Duration (hrs)	Up to 4	3-8+	4+	4-12
System Round-Trip Efficiency	80%-90% at 80% DoD	75%-80% at 100% DoD	Up to 86%	Up to 75%
Cycle Life at High Capacity (cycles)	3500	5,000	11,000	Cycle independent or 25 years
Estimated Cost ($/kWh)	200-300	$150-250/kWh	$525/kWh	$575/kWh
Operating Temperature	10 to 45°C	-20 to 45°C	-40 to 50°C	Up to 60°C electrolyte temperature
Energy Density (Wh/L)	90 - 130	14-17	16	30-35

Currently, EPIC is leading the nation in providing grant opportunities for new and emerging non-lithium energy storage solutions and will provide California safer, more reliable and longer lasting energy storage solutions to help California accelerate the adoption of its clean energy goals

In early 2019, the CEC issued a Bringing Rapid Innovation Development to Green Energy (BRIDGE) Solicitation to continue the momentum for emerging technologies to accelerate their commercialization success. With new demonstration awards: 1) Eos is working to increase the Zinc Hybrid system's energy density by 25 percent, lower upfront costs, and complete Underwriters Laboratory (UL) certification; 2) Natron is aiming to make a Prussian Blue Sodium Ion technology cost competitive with LI and support economic deployment of high power EV fast charging infrastructure to increase EV adoption; and 3) Element 16 is moving their large scale Sulfur Thermal energy storage to commercial deployment by demonstrating cost savings, safety, and ability to reduce peak load. The CEC sees the need for and is committed to additional EPIC investments in non-LI technologies.

In 2020, the CEC will invest $11 million to develop non-LI technologies that show promise from earlier stage research and $20 million to demonstrate long-duration non-LI energy storage technologies (10 to 100 hours) - a research gap not met anywhere in the country.

LI energy storage is valuable in many applications, including helping the state meet its electric vehicle deployment goals. The CEC has begun to evaluate technologies that could address potential lithium supply issues by extracting lithium from the state's geothermal brine. All of these investments are supporting California's efforts to decarbonize the grid with a competitive portfolio of safe, reliable and cost-effective energy storage systems.

Industrial and Agricultural Innovation. A portfolio of projects funded under the EPIC program has targeted improvements to reduce electricity use primarily in the areas of smart manufacturing and industrial processes, wastewater treatment and recycling, precision irrigation, load flexibility, low carbon process heating and waste to energy. Due to the diversity and uniqueness of individual sites' industrial processes, it is difficult to develop and implement cost-effective, scalable solutions that are applicable to all industries, especially as it relates to electricity use. One technology area that does apply to many industrial and agricultural processes is network connected sensors and controls – broadly categorized as internet of things (IoT) devices. IoT devices allow for much more granular and centralized monitoring and control of

equipment such as pumps, motors, and compressors, than traditional manual methods of decentralized equipment monitoring. This allows facility managers to optimize their processes, which can result in energy and water savings.

A common research objective of several projects was to test the use of IoT devices in different use-cases and applications. These projects were able to:

- Capitalize on the benefits of declining communicating-sensor costs and cloud-based analytic tools to provide them at reasonable cost to industry.
- Demonstrate time, operation, and cost savings to industry – overcoming industrial inertia to change.
- Demonstrate technologies that could be applied and scaled to multiple industries.
- Create a service business based on the IoT control technologies by showing the savings and benefits in participation.

These benefits are best exemplified in a project with UC Berkeley in partnership with Lightapp that focused on implementing IoT controls targeting compressed air systems. Compressed air systems are ubiquitous in the industrial sector and compressed air systems account for 8-12 percent of all industrial electricity consumption.[36] Thus, the project would be directly applicable to many industries. In this project, the IoT controls were tested in over 100 industrial plants located throughout California with more than 50% in a low income or disadvantaged community.[37] Using these controls, industries achieved energy savings and other benefits, such as improvements in equipment operation and optimization and potential reduction in other operating costs, such as maintenance. When the CEC project ended, a large number elected to continue with the subscription service because they saw value in the service provided. By enabling industrial and manufacturing facilities to lower their electricity costs, this could lead to lower prices for the final goods and materials produced by the participating facilities. Table 9 shows how the Lightapp platform compares with the traditionally manual method of controlling compressed air systems.

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[36] Greenstone, Michael, et al., 2019. Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems. CEC. Publication Number: CEC-500-2019-060.
[37] Ibid.

Table 9. Comparison Table for EPIC-Funded Industrial Projects

Core Innovation	Baseline: Manual Control of Compressed Air Systems	Smart Controls: LightApp – Energy Management Controls
Leak Detection Frequency	Infrequent	Automatic
Labor Requirements	High	Low
Energy Benchmarking	None	Yes-compare with other similar industries
Electricity Savings	N/A	17% reduction from baseline
Potential to Provide Grid Flexibility	No	Yes
Potential to Identify Equipment Inefficiencies	No	Yes

Similarly, IoT controls also have relevant application for agriculture irrigation pumping. EPIC recipient PowWow Energy, Inc. developed a software platform that uses smart meter data to measure water volumes from pumps without installing hardware devices on site. The software also communicates with the farmer and irrigator to optimize crop yields and water applications. The platform was demonstrated at six commercial farming sites in the Sacramento Valley and San Joaquin Valley, and resulted in 13 percent energy savings and 9 percent water savings.

Transportation Electrification and Vehicle-Grid Integration. By 2030, California aims to achieve 5 million zero emission vehicles (ZEVs) and 250,000 ZEV charging stations.[38] EPIC plays a central role in advancing the technologies needed to meet these goals while also managing the incremental demands on the electricity system, increasing the use of renewable electricity, and lowering costs for electric ratepayers and plug-in electric vehicle (PEV) owners. EPIC investments in transport electrification and vehicle-grid integration (VGI) have totaled $30.2 million of funding and secured an additional $14.7 million of match funding. EPIC funding recipients – researchers and innovators in universities, national laboratories, and private companies – are contributing new knowledge and technology advancements that are informing

[38] Executive Order B-48-18.

governmental planners and decision-makers and a range of market actors – including equipment procurement managers, fleet managers, and electric vehicle supply equipment (EVSE) providers. These research projects have and will continue to inform and respond to the Joint Agencies' (Commission, CEC, CAISO, and CARB) VGI Working Group under R.18-12-006.

Specific EPIC advancements include:

(1) Demonstrated the ability of EVSE to respond to ISO/Utility signals that enable peak demand reduction and associated customer savings. EPIC projects demonstrated electricity demand reduction and customer cost savings from hardware and software that enable PEVs to modulate charging patterns and, in some cases, provide bi-directional discharging in response to grid operator or third-party aggregator signals. For example, Lawrence Berkeley National Laboratory (LBNL) demonstrated more than 10 kW peak demand reduction and $2,500 monthly savings at the Alameda County Garage.[39] Nuvve Corporation is currently achieving similar cost savings at the University of California San Diego campus microgrid, demonstrating bi-directional discharge from fleets of PEVs. (CEC award EPC-16-61, "Intelligent Electric Vehicle Integration – INVENT").

(2) Informed communication standards that will lead to greater interoperability among PEV's and EVSE. EPIC is advancing VGI by demonstrating alternative communication standards that improve the interoperability of grid managers, vehicles, and chargers (including bi-directional chargers which must accommodate multiple standards and associated protocols under Rule 21). For example, EPIC-recipient EPRI is developing a bi-directional residential charger and integrated energy management system with plans to begin product certification and UL Listing with follow-on funding support from the U.S. Department of Energy (DOE). (CEC award EPC-16-054, "Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services").

(3) Advanced high-power charging for medium- and heavy-duty vehicles and long-distance passenger travel. EPIC is also enabling electrification of medium- and heavy-duty vehicles and facilitating long-distance passenger travel with limited downtime. For example, Greenlots demonstrated cost savings from demand charge reductions by installing a 56 kWh second-life battery with four direct current fast chargers in a Monterey Park shopping center.

[39] CEC award EPC-14-057, "Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets."

(CEC award EPC-16-055, "Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers"). Other EPIC projects are demonstrating managed charging of municipal buses (e.g., CEC award EPC-17-020, "Demonstration of Vehicle-Grid Integration under Non-residential Scenarios" and EPC-016-065, "California E-Bus to Grid Integration Project"). Table 10 shows the benefits demonstrated from a sample of EPIC-funded vehicle-grid integration projects.

Table 10. Comparison Table for EPIC-Funded Vehicle-Grid Integration Projects

	ChargePoint	**LBNL-Alameda County Garage**	**BMW, Total Charge Management**	**Nuvve, INVENT**
Core Innovation Demonstrated	Optimized charging utility price signals	Optimized charging w/ fleet management and user engagement	Submetering and App for customer engagement	Bi-directional charging hardware; Market participation platform
Communication Standard Supported	OpenADR[40] and ISO/IEC 15118	ChargePoint API (XML SOAP)	OpenADR and Telematics	TCP IP and CHAdeMo
PEV segment and total charger power (kW)	~30 residential L2 AC ~230 kW	Public, Fleet ~310 kW	~300, Residential mixed L1/L2 AC	Public ~110kW ~54kW V2G
Use-case benefit quantified	Rate optimization $0.13/kWh reduction	Demand management 10-12kW reduction	Renewable energy increase 1,200 kWh/PEV-yr	Demand management *Pending* Market participation *Pending*
Economic benefits	$460/PEV-year savings on charging	$2,500/year at site	$45/PEV-yr from charging optimization	$270-$380 /month at site

[40] OpenADR was supported by the CEC Public Interest Energy Research (PIER) Program. OpenADR is an open, highly secure, and two-way information exchange model and global smart grid standard originally targeted for buildings and extended here to transportation.

ii. EPIC Has Helped Enable Broad Diffusion of Emerging Energy Technologies.

Once a new technology has been successfully proven at the demonstration stage, significant effort and investment are still needed to enable their diffusion from the initial core group of researchers and adopters to a wide general audience to spur innovation to scale. The CEC has implemented several strategies in EPIC to enable the widespread diffusion of new clean energy technologies, a few of which are highlighted below.

The CEC has facilitated partnerships and connections among the broad range of actors responsible for successful technology diffusion. Successful technology diffusion requires coordination and partnerships among a wide range of actors with diverse disciplines and varying degrees of expertise. The CEC has built an expansive network of stakeholders that include academia, industry, investors, incubators, accelerators, entrepreneurs, local governments and community-based organizations. To effectively mobilize this network, the CEC has encouraged, and in some cases required, partnerships in its funding opportunities while also providing the tools and opportunities to facilitate these partnerships. For example, the CEC has put in place the digital infrastructure to facilitate partnerships and connections, particularly around EPIC funding opportunities where multi-disciplinary teams are critical for project success. This initially began with the CEC LinkedIn Networking Hub,[41] which currently has over 1,600 members. The CEC augmented the LinkedIn Networking Hub by conducting networking webinars to allow prospective applicants to meet and form project teams. In 2019, the CEC developed its own networking platform called Empower Innovation to overcome major limitations with the LinkedIn Network Hub.[42] Since its soft launch in October 2019, Empower Innovation has quickly grown **to over 1,000 members representing over 300 organizations**.[43]

Figure 2 below shows a screenshot from the Empower Innovation homepage.[44]

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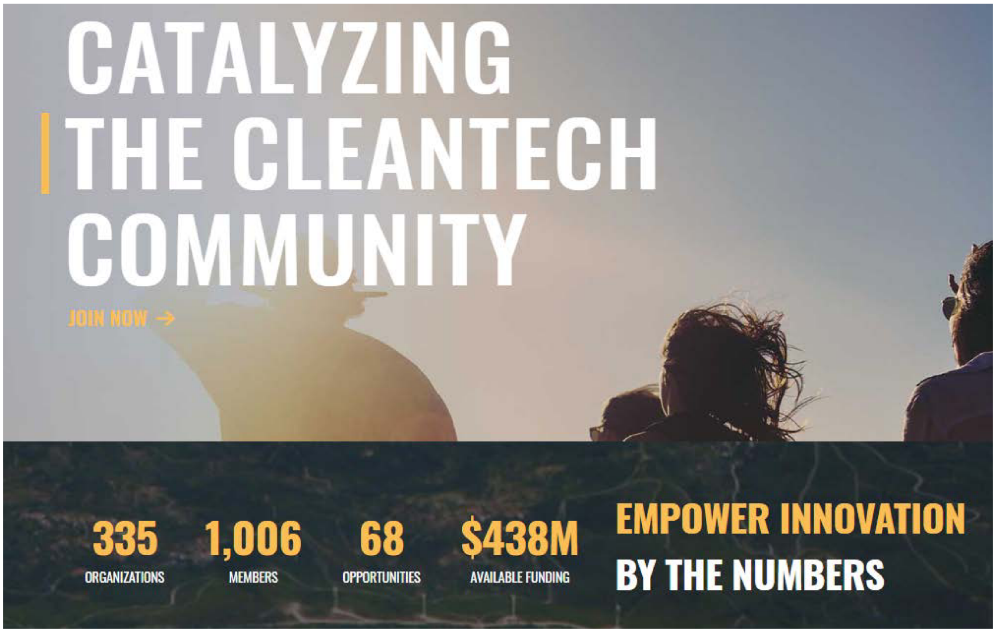
[41] The CEC's LinkedIn Networking Hub is accessible at https://www.energy.ca.gov/programs-and-topics/topics/research-and-development/energy-innovation-ecosystem

[42] The Empower Innovation networking platform is accessible at https://www.empowerinnovation.net/

[43] Registration numbers are shown on the home page of Empower Innovation at https://www.empowerinnovation.net

[44] Screenshot from https://www.empowerinnovation.net/

Figure 2. Number of Members and Organizations Registered on Empower Innovation



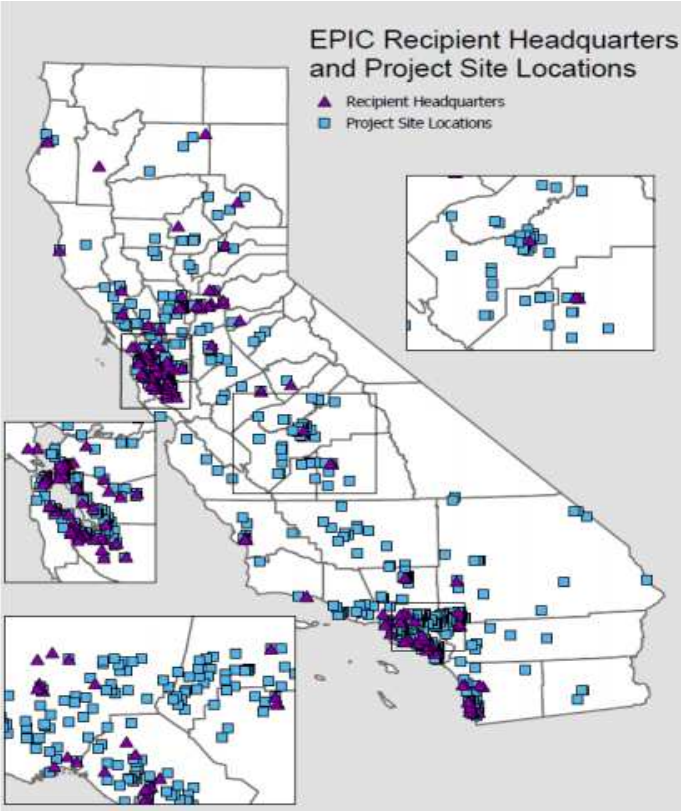
As an example of the value of diverse partnerships, in 2016 the CEC issued the EPIC Challenge solicitation which emphasized the importance of diverse project teams that included local governments, project developers, community-based organizations, and technology developers to develop concepts for advanced energy communities. One such project was led by the ZNE Alliance and the City of Lancaster, who developed plans for a first-of-its-kind virtual power plant that integrates residential homes, commercial businesses, schools, and city facilities into a single point of control. This integration allows for the dynamic control of the generation and use of electricity in order to maximize use of clean energy resources, while keeping costs low and maintaining reliability. In 2019, ZNE Alliance received follow-on funding to conduct the build-out of this plan – this project offers a glimpse of how future communities can effectively deploy clean energy technologies and meet climate goals, while lowering operating costs. The ZNE Alliance has taken the lessons learned from its EPIC projects and applied them to other communities. They were recently chosen by Marin Clean Energy to execute the deployment of energy storage systems throughout its service territory to increase local resiliency while also providing a network of flexible, local assets that can ultimately be aggregated and dispatched.

EPIC has accelerated the technological learning necessary for new technologies and related services to scale widely. Technological learning, also known as "learning-by-doing" or

"learning-through-implementation," is critical to the widespread diffusion of new energy technologies. When new technologies move into the demonstration stage, technology developers must deal with a whole new set of challenges and engage with downstream actors, such as permitting agencies, contractors, and customers, that lack familiarity with the technology but have crucial roles in its adoption, installation and operation. Studies have found that much of the technological learning, especially among downstream actors, remains local. The CEC conducts numerous activities to ensure this technological learning is shared broadly. In addition to the knowledge dissemination activities, the CEC, through targeted solicitation scopes and other efforts, has taken steps to ensure the necessary technological learning reaches a wide range of geographic locations, market segments, and community types across the state. The results of these efforts are:

- EPIC projects have engaged over 582 entities including 500 for-profit business, 20 non-profits, 22 government entities, 31 universities, and 9 utilities (water and electric)
- EPIC funding has been dispersed to more than 650 project sites across the state. Figure 3 below shows the geographic dispersion of EPIC project sites.

Figure 3. Geographic Dispersion of EPIC Project Sites



EPIC has improved the effectiveness of codes and standards. Codes and standards are valuable tools to enable widespread diffusion of new technologies and advanced data-driven practices. Policymakers adopt regulatory codes and standards to set baselines of energy efficiency performance of buildings and appliances. Research to improve efficiency and performance provides policymakers the data necessary build on these continued improvements on them helps move those baselines. These codes and standards which can bring significant benefits to electric ratepayers. For example, between 1999 and 2008, the CEC invested $27.6 million in Public Interest Energy Research (PIER) Electric research funds that directly contributed to changes to California's Building and Appliance Energy Efficiency Regulations (Title 24 and Title 20, respectively). These changes are estimated to result **in more than $10 billion** in net savings for California ratepayers between 2005 and 2025.[45]

EPIC is conducting foundational research to build on this legacy. A few examples and preliminary estimates from recently completed projects that helped inform building or appliance efficiency standards are listed in Table 11. If adopted into standards, these projects are conservatively estimated to save **over $1 billion in annual energy costs**.

Table 11. Estimated Energy Cost Saving from Potential Codes and Standard Updates

Project	Building Component/ Market Sector	Annual Energy Cost Saving if Adopted into Standards
Sealed and Insulated Attic Performance in New California Homes Using Vapor and Air Permeable Insulation	Building Envelope/ New Residential Construction	$29 million[46]
Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	HVAC/ New Residential Construction	$7.4 million[47]

[45] Stokes, Erik. 2016. *Public Interest Energy Research 2015 Annual Report.* CEC Publication Number: CEC-500-2016-032-CFM.
[46] Table 21, page 144, indicates 108,033 new single-family homes in 2017, average electric rate is $0.1994/kWh per the U.S. Energy Information Agency, and assume 1352 kWh saved /home https://ww2.energy.ca.gov/2019publications/CEC-500-2019-039/CEC-500-2019-039.pdf
[47] Final report for CEC project EPC-15-019 estimated annual energy savings for all Climate Zones. Roughly 110,000 homes were built in California in 2019. Based on the distribution of new housing developments in the state, the energy savings associated with installing the LDSB-GSHP technology would be roughly 37.3 GWh.

Reinventing Residential Demand Response: Breaking Through the Barriers with Gamification and Devices	Residential Demand Response	$3.5 million[48]
Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls	HVAC/ New Commercial Buildings	$<1 million[49]
Value Proposition for Cost-Effective, DR-Enabling, Non-residential Lighting System Retrofits in California Buildings	Lighting/ New Commercial Buildings	$700 million[50]

In addition to regulatory codes and standards, industry or market-driven standards can also bring significant benefits to ratepayers. Businesses and institutions regularly rely on ASHRAE standards and other voluntary, market-driven standards in their purchasing and procurement practices to ensure performance, quality, and safety. In addition, market-driven standards are an effective tool to enable interoperability among different devices and equipment from different vendors. For example, CEC under PIER Electric funded the development of a new industry standard, Open Automated Demand Response (OpenADR), to facilitate the market for DR-enable devices. In 2012, DR-enable devices using OpenADR avoided 260 megawatts of peak load and saved California electric ratepayers an estimated $16.5 million that year alone.[51] As of early 2020, over **187 products have been certified to the OpenADR 2.0 standard**.[52] As California looks to unlock more load flexibility to cost-effectively integrate high penetrations of renewable energy, OpenADR is likely to play a significant role. Under EPIC, the CEC has been developing and validating a broader set of applications and end-uses, including electric vehicles,

[48] Assumptions: 14 million households in California, 1 million households have connected devices and assume 140,000 participate. Average savings is $25.48/household. OhmConnect provided comments/recommendations to Commission Electric Rule 24/32 and the CAISO ESDER phase 3.
[49] Savings figure is from the related 2019 Title 24 CASE report for "Occupant Sensor Ventilation Control Requirements" shown below. The first year of savings is 2020 and should be ongoing. The CASE report with this table can be found on page 115.
http://title24stakeholders.com/wp-content/uploads/2019/01/T24-2019-CASE-Study-Results-Reports-Proposal-Based-on-ASHRAE-90.1-_Final_with_Attachments.pdf
[50] Assumes 5090.7 GWh/yr saved for commercial buildings from Table ES-3: The Potential Shed and Shimmy DR Resources and NLC Energy Savings that Would Be Achievable by Universal Installation of NLCs in California Office and Retail Buildings, by Building Type and IOU Service Territory. Assumes average commercial rate of $0.154/kWh.
[51] Ibid.
[52] OpenADR certified product database developed by the OpenADR Alliance.
https://products.openadr.org/

utilizing the OpenADR standard, including charge management with BMW, residential customers with OhmConnect, and, commercial customers with UC Berkeley.

Appendix C and Appendix D detail how specific EPIC projects have improved the effectiveness of regulatory and market-driven codes and standards respectively. For each project, Appendix C identifies the project title, EPIC investment topic/energy application or device, whether the project has 1) identified updates need to codes and standards to improve energy performance, 2) advanced tools or technologies that streamline compliance with regulatory codes or standards, and 3) identified updates needed to codes or standards or related planning activities to improve health and safety, and lastly, identifies the pertinent code or standard. For each project, Appendix D identifies the project title and recipient, EPIC investment topic/energy application or device, whether the project has 1) informed updates to device and equipment standards that improve interoperability, 2) identified codes and standard updates to improve health and safety, and 3) identified code and standard updates to improve energy performance, and lastly, identifies the pertinent code or standard.

Table 12 summarizes the results of Appendix C and Appendix D.

Table 12. Number of EPIC Projects that have Improved the Effectiveness of Electricity-related Codes and Standards

Investment Topic	Regulatory Codes and Standards	Market-driven (Voluntary) Codes and Standards
Resiliency and Safety	7	1
Building Decarbonization	13	6
Grid Decarbonization and Decentralization	4	1
Industrial and Agricultural Innovation	1	1
Transportation Electrification	2	2
Total	27	11

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iii. Through EPIC, CEC Has Successfully Scaled-up Efforts to Disseminate New Knowledge and Results of Funded RD&D to Accelerate Development and Adoption of New Scientific and Technological Advancements and Inform State and Local Policymakers.

One of the key benefits of public research programs such as EPIC is the knowledge generated and made available to the public. This is a key difference between public and private research. Private sector companies are not motivated to publicly share research learning as that would damage their competitive advantage. Generating and distributing knowledge helps accelerate development and adoption of new scientific and technological advancements by ensuring future activities build on the successes and failures of previous efforts. In addition, the knowledge and project results can inform state and local policymakers of the technical and commercial readiness of new technology solutions for meeting near-term policy goals. Since the first EPIC projects began, the CEC has been scaling up its activities and tools to ensure the knowledge generated from these projects reaches the broad range of stakeholders that are key to successful commercialization of new technologies capable of supporting California's multiple energy and climate change policy goals.

The CEC has hosted numerous in-person events and webinars to ensure the results of EPIC projects are effectively disseminated. The CEC conducts these events to bring together a wide range of stakeholders including policymakers, technology adopters, entrepreneurs, local governments, researchers, trade organization, advocacy organizations and others to discuss clean energy research, results and challenges and how new technology solutions can be deployed in an efficient manner that helps achieve multiple energy and climate goals. Highlights of these events and webinars include the following:

- The annual EPIC symposium. In 2019, an estimated **800 in-person attendees** participated in the symposium. This represent roughly an 800 percent increase from the first symposium in 2015.[53]
- Between 2018 and 2019, the CEC presented a series of **10 webinars** that highlighted the results of energy-related research contributing to the Fourth Climate Change

[53] Doughman, Pamela. 2020. Electric Program Investment Charge 2019 Annual Report. CEC. Publication Number: CEC-500-2020-009. https://ww2.energy.ca.gov/2020publications/CEC-500-2020-009/CEC-500-2020-009.pdf

Assessment.[54] These results were particularly timely given such efforts as the Commission's order instituting rulemaking on adaptation (R.18-04-019).[55]

- Topical Forums and Workshops. CEC kicked off a series of technical forums in February 2020, with the first forum focusing on empowering resilient communities through advanced energy technologies and receiving much positive feedback. The forum drew over 200 attendees and overall received positive feedback, including that from Sarah Golden, Senior Energy Analyst at GreenBiz Group who reflected, "the day left me hopeful about the suite of technological solutions available and reeling over the complexities of bringing them to scale."[56]

EPIC project information and results have been effectively disseminated through online sources. The CEC has taken a number of steps to ensure information on EPIC projects, including project results, are accessible to the public online.

- The CEC's online searchable R&D project database, the Energy Innovation Showcase, has been viewed over **120,000 times** by more than **9,000 people** through December 2019.[57]
- EPIC Final Project Reports on the CEC website have been **viewed more than 6,800 times** as of December 2019.[58]
- Through December 2019, results from EPIC-funded projects have been published in more than **230 academic publications** with more than **1,300 citations**.[59]

EPIC projects have advanced tools and resources to make complex information and data more accessible, scalable and at lower cost to operationalize. These tools and resources, which can include online analytical tools, guidebooks, and training materials, transfer knowledge

[54] Orta, Jason. 2019. Electric Program Investment Charge 2018 Annual Report. CEC. Publication Number: CEC-500-2019-017-CMF. https://ww2.energy.ca.gov/2019publications/CEC-500-2019-017/CEC-500-2019-017-CMF.pdf
[55] Ibid.
[56] https://www.greenbiz.com/article/4-conversations-we-should-have-about-energy-resilience
[57] The Energy Innovation Showcase is a publicly available database which includes information on every project funded under the CEC's EPIC program. Available at: http://innovation.energy.ca.gov/
[58] Doughman, Pamela. 2020. Electric Program Investment Charge 2019 Annual Report. CEC. Publication Number: CEC-500-2020-009. https://ww2.energy.ca.gov/2020publications/CEC-500-2020-009/CEC-500-2020-009.pdf
[59] Ibid.

from EPIC projects to the public. These tools and resources can help reduce project development and planning costs associated with deploying technologies. For example, StorageVet® is an open-source tool that estimates the value of potential energy storage installations based on location, operation, size, and technical capabilities. Also, the CEC EPIC program is funding improvements to GridLAB-D to improve modeling performance of very large-scale deployment of distributed energy resources on electrical distribution systems. The funding will create a California specific version of GridLAB-D as well as develop new features and functionality to make it more intuitive so it can be used by a broader set of users including developers, utilities, and state agencies, including the Commission, which anticipates using the tool for tariff development.

Appendix E provides a detailed list of tools and resources advanced through EPIC. For each tool or resource, Appendix E identifies the EPIC investment topic, the tool or resource, and information on the tool or resource and its use. Table 13 summarizes the results of Appendix E.

Table 13. Tools and Resources Advanced through EPIC

Investment Topic	Tools and Resources	Cumulative Usage Metrics through 2019 (where available)
Entrepreneurial Ecosystem	2	12,300+ views
Resiliency and Safety	1	126,300+ views
Building Decarbonization	8	612,900+ views
Grid Decarbonization and Decentralization	10	1,600+ views
Industrial and Agricultural Innovation	4	1,700+ views
Transportation Electrification	2	10,000+ views (1+ per vehicle)
Total	27	764,800+ views

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iv. EPIC Has Provided Benefits to Underrepresented Groups, Including Diverse Businesses and Disadvantaged and Low-Income Communities and Tribal Nations.

The CEC's efforts to advance equity and diversity in EPIC began in November 2013 when then-CEC Chair Robert B. Weisenmiller, in a letter to Commission President Michael Peevey, announced the CEC's commitment to advance diversity and equity in EPIC. Since that initial letter, the CEC's administration of EPIC-related diversity and equity activities has been guided by additional policy direction, most notably the SB 350 Barriers Study, AB 865, and AB 523.

The CEC has increased awareness and made EPIC more accessible to diverse businesses and vulnerable communities including disadvantaged communities, low-income communities and tribal nations. To strengthen diversity of applicants for EPIC funding opportunities and encourage proposals for projects in and benefitting low-income and disadvantaged communities, the CEC engages in a broad range of outreach activities, including public workshops, webinars, event tabling, communications, and community engagement. Appendix F includes information on the CEC's outreach activities to strengthen diversity applications and encourage proposals in and benefiting low-income and disadvantaged communities.

Highlights of the CEC's outreach activities include the following:

- From 2014 to 2019, CEC staff have participated **in nearly 100 outreach and community events** including the Small Business Workshop & Business Exchange, the Commission Small Business Expo, Women in Cleantech Networking event, and the Disabled Veteran Business Alliance's Keeping the Promise Conference and Expo;
- Conducting two public workshops focused on equity as part of the public process to develop the 2018-20 EPIC Investment Plan;
- Creating and publishing a "How to Apply for Research Funding" video, which provides potential new applicants a quick four-minute overview of the first steps of applying for EPIC funding opportunities; and
- Creating and distributing funding materials translated for non-English speakers, including opportunity postcards and relevant materials in Spanish, Chinese, Tagalog, Korean, and Japanese.

The CEC has exceeded the EPIC funding requirements of AB 523 and the SB 350 Barriers Study. One of the recommendations of the SB 350 Barriers Study was that 25 percent of EPIC technology demonstration and deployment funds administered by the CEC go towards projects located in and benefitting disadvantaged communities.[60] AB 523 codified that recommendation into law and added a new funding requirement that at least ten percent of EPIC technology demonstration and deployment funds go to projects in and benefitting low-income communities.[61] Even prior to these minimum funding targets, the CEC had taken steps to ensure the benefits of EPIC reaches the state's most vulnerable communities and populations. This included increasing awareness and participation, discussed previously, as well as encouraging technology developers to seek projects in and benefiting disadvantaged communities by either awarding preference points or having a funding set-aside for projects in and benefitting disadvantaged- and low-income communities. See Table 14 for a list of past, current and planned CEC EPIC solicitations (i.e., Grant Funding Opportunities or GFO) with set asides for disadvantaged, low-income or tribal communities. Through these efforts, the CEC has exceeded the funding requirements set forth and highlighted below:

- Approximately **29 percent** of technology demonstration and deployment funds have gone to projects **located in disadvantaged communities.**
- Approximately **36 percent** of technology demonstration and deployment funds have gone to projects **located in low-income communities**.
- Although not a requirement, **about 2.6 percen**t of technology demonstration and deployment funds have gone to projects **located in Native American Tribal communities** (Blue Lake Rancheria and Chemehuevi).
- Collectively, **about 65 percent** of the CEC EPIC technology demonstration and deployment funds have gone to project located in vulnerable communities.

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[60] Scavo, Jordan, Suzanne Korosec, Esteban Guerrero, Bill Pennington, and Pamela Doughman. 2016. Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-income customers and Small Business Contracting Opportunities in Disadvantaged Communities. CEC. Publication Number: CEC-300-2016-009-CMF; p. 82.
[61] Pub. Resources Code, sec. 25711.6, as enacted by AB 523.

Table 14. Funding Opportunities with Set-Asides or Preference Points for Project Located in and Benefitting Underrepresented Communities

Funding Opportunity	Status	Community Type(s)
Validating Capability of Second-life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications (GFO-19-310)	Active	Low-income communities, Disadvantaged communities
Advancing Envelope Technologies for Single Family Residential Buildings, Low-rise Multifamily Buildings, and Mobile Homes (GFO-19-307)	Closed	Low-income communities, Disadvantaged communities
Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies (GFO-19-306):	Active	Tribal communities, Low-income communities, Disadvantaged communities
Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals (GFO-19-305)	Closed	Low-income communities, Disadvantaged communities
Advanced Refrigeration and Heat Pumps for the Industrial Sector (GFO-19-304)	Closed	Low-income communities, Disadvantaged communities
Geothermal Energy Overcoming Technology Hurdles and Enabling Recovery of the Mineral Lithium (Geothermal) (GFO-19-303)	Closed	Low-income communities, Disadvantaged communities
Advance to Next-Generation Wind Energy Technology (Next Wind) (GFO-19-302)	Closed	Low-income communities, Disadvantaged communities
Advancing Next-Generation Heating, Cooling and Water Heating Systems (GFO-19-301)	Closed	Low-income communities, Disadvantaged communities
Developing Lessons Learned, Best Practices, Training Materials and Guidebooks for Customer Side of the Meter Energy Storage (GFO-18-305)	Closed	Low-income communities, Disadvantaged communities
Bringing Rapid Innovation Development to Green Energy (BRIDGE) - Energy Storage (GFO-18-304)	Closed	Low-income communities, Disadvantaged communities
Cost Reductions, Advanced Technology for Solar Modules (CREATE Solar) (GFO-18-303)	Closed	Disadvantaged communities
Programmatic Approach to Existing Buildings Research, Development and Demonstration Program (GFO-17-304)	Closed	Disadvantaged communities
Demonstrate Business Case for Advanced Microgrids in Support of California's Energy and GHG Policies (GFO-17-302)	Closed	Tribal communities, disadvantaged communities

Advance the resilience and environmental performance of California's electricity system (GFO-16-311)	Closed	Disadvantaged communities
Improving Performance and Cost Effectiveness of Wind Energy Technologies (GFO-16-310)	Closed	Disadvantaged communities
Solar+: Taking the Next Steps to Enable Solar as a Grid Asset (GFO-16-309)	Closed	Disadvantaged communities
Advancing Cutting-Edge Technologies and Strategies to Reduce Energy Use and Costs in the Industrial, Agriculture and Water Sectors (GFO-16-305)	Closed	Disadvantaged communities
Emerging Energy Efficient Technology Demonstrations (EEETD) (GFO-16-304)	Closed	Disadvantaged communities
Advanced Vehicle-Grid Integration Research and Demonstration (GFO-16-303)	Closed	Disadvantaged communities
Advance Breakthrough and Piezoelectric-Based Systems Development to Increase Market penetration of Distributed Renewable Generation (GFO-16-302)	Closed	Disadvantaged communities
Improving Performance and Cost Effectiveness of Small Hydro, Geothermal and Wind Energy Technologies (GFO-16-301)	Closed	Disadvantaged communities
Development, Demonstration and Deployment of Environmentally and Economically Sustainable Biomass-to-Energy Systems for the Forest and Food Waste Sectors (GFO-15-325)	Closed	Disadvantaged communities
Innovative Water and Energy Efficiency Demonstrations for the Commercial, Industrial or Water/Wastewater Sectors (GFO-15-323)	Closed	Disadvantaged communities
Advancing Water and Energy Efficient Strategies and Technologies in California (GFO-15-317)	Closed	Disadvantaged communities
The EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities (GFO-15-312)	Closed	Disadvantaged communities
Reducing Costs for Communities and Businesses Through Integrated Demand-Side Management and Zero Net Energy Demonstrations (GFO-15-308)	Closed	Disadvantaged communities
Sustainable Energy Entrepreneur Development (SEED) Initiative (RFP-15-305)	Closed	Disadvantaged communities
Investing in California Communities through Building Energy Efficiency Workforce Development (GFO-15-302)	Closed	Disadvantaged communities
Demonstrating Clean Energy Solutions that Support California's Industries, the Environment, and the Electrical Grid (PON-14-307)	Closed	Disadvantaged communities

EPIC has increased the diversity of clean energy entrepreneurship across the state. The CEC, through EPIC, has built-up the state's capacity to foster and support clean energy entrepreneurship. This includes increasing the diversity of clean energy entrepreneurship. In a recent editorial, Greenlining Institute cited research that identified entrepreneurship as one possible solution to close the racial wealth gap. In designing and managing the programs that make up the Entrepreneurial Ecosystem, the CEC has taken specific actions, where allowable, to increase the business and geographic diversity of clean energy entrepreneurship including: ensuring entrepreneurs in every part of the state have access to incubator services; and setting a minimum funding target in CalSEED for underrepresented groups such as minority-, women- and LGBT-owned businesses, and businesses in a disadvantaged community or rural part of the state. Some of the results of this are highlighted below[62]:

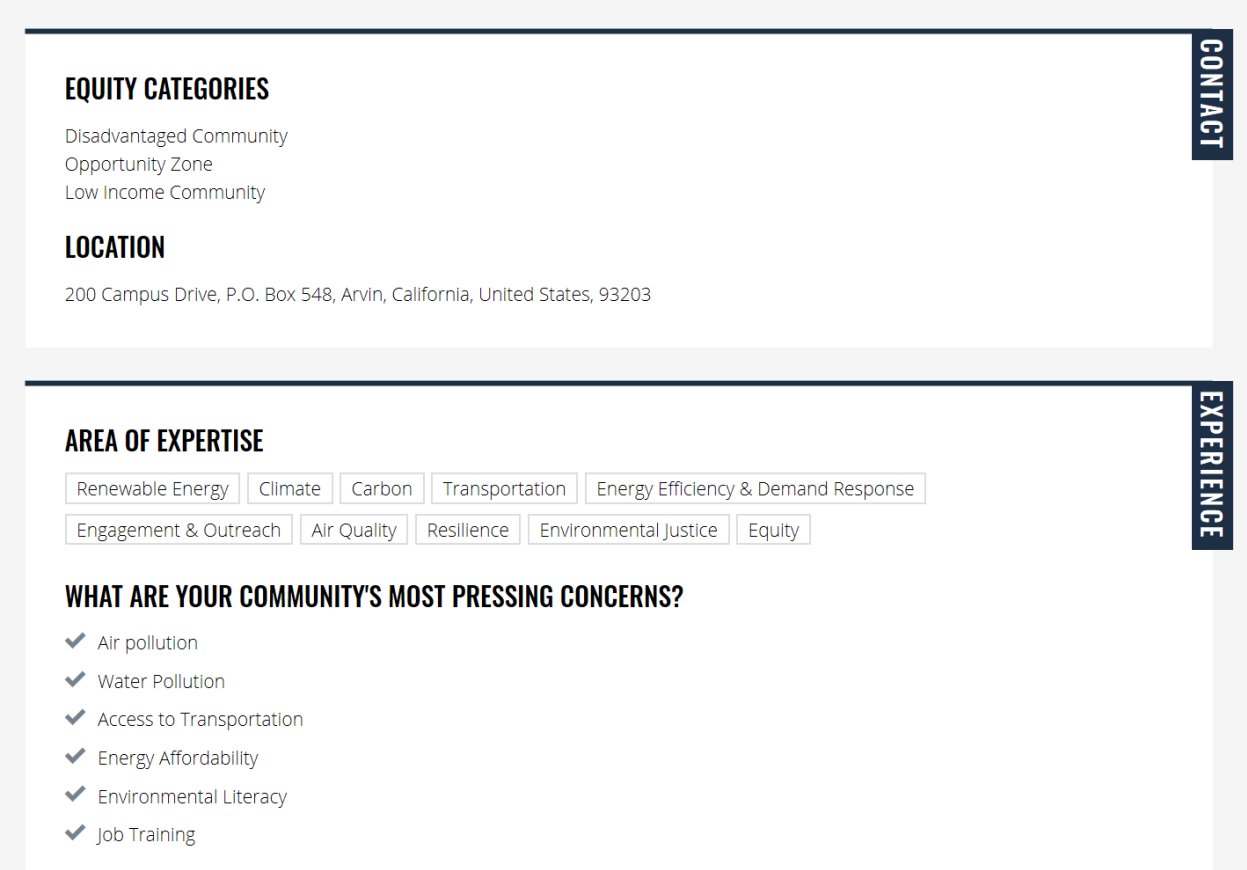
- **$1.4 million** in CalSEED funding has been awarded to start-up companies operating in **disadvantaged communities**;
- $**1.4 million and $2.4 million** in CalSEED funding has been awarded to start-up companies led by **women and underrepresented minorities,** respectively; and
- The organizations that make up Entrepreneurial Ecosystem have successfully used their EPIC awards to secure federal funding to expand entrepreneurial assistance for underrepresented geographic locations and businesses.

CEC has developed more sophisticated approaches and tools to ensure EPIC benefits disadvantaged- and low-income communities. As described previously, the CEC has undertaken numerous efforts to ensure EPIC provides benefits to California's vulnerable communities. These efforts have helped EPIC meet policy goals and objectives for equity. However, the CEC recognizes more needs to be done to bring benefits to these communities and in 2019 launched two new efforts. In response to AB 523, the CEC conducted a public process to develop scoring criteria to better assess the potential for proposed demonstration and deployment projects to benefit disadvantaged- and low-income communities. Over the course of the process, which included two public workshops, the CEC received 12 sets of comments that helped shape the final scoring criteria that will be used in EPIC solicitations.

[62] Current results from the CalSEED dashboard. See https://calseed.fund/.

In addition to the AB 523 scoring criteria, the CEC also created a new professional networking platform to, in part, help vulnerable communities more easily identify relevant funding opportunities, describe their priorities in clean energy projects, and find technology solution providers to partner with on potential projects. Figure 4 provides an example of how communities can describe their priorities on Empower Innovation. As of March 31, 2020, 12 organizations representing vulnerable communities have signed up on Empower Innovation. The CEC is planning a series of events in 2020 through 2021 to continue to onboard organization and members representing vulnerable communities onto the Empower Innovation platform.

Figure 4. City of Arvin's profile page on Empower Innovation.



b. EPIC Is Providing Value and the Potential for Future Value.

As described in other sections of this brief, the CEC believes EPIC has proven its value as well as the potential for future value. The CEC believes the program's unique structure and design established in D.12-05-037 has set up the program to provide long-term value.

i. EPIC Played a Crucial Role at a Time When the Clean Energy Sector Was at a Critical Crossroads.

The CEC initiated the first EPIC awards in 2014. At the time, the economy was still coming out of the recession and, as mentioned earlier, private investors had largely withdrawn from the clean energy innovation sector. The CEC developed a twofold strategy to maximize EPIC's effect, reflecting the policy and economic environment at the time.

The first part of the CEC EPIC strategy was to address deployment-specific gaps to accelerate the scale-up of key emerging technologies vital to creating a modernized grid and meeting state policy targets for 2020. The 2009 federal stimulus package directed a significant one-time funding plus-up into clean energy innovation. However, the decline in private investment a few years later threatened to keep much of this innovation form moving out of the laboratory. The CEC filled this gap by targeting much of the early EPIC funding opportunities to demonstration projects such as microgrids, energy storage, and low-carbon buildings. As demonstrated by several of the EPIC-funded microgrids, these technologies are already playing a beneficial and critical role in California's electricity system.

The second part of the CEC's EPIC strategy was to develop and implement a new model for supporting breakthrough clean energy technology innovation that could also meet the requirements of the private sector. As part of this new model, called the Entrepreneurial Ecosystem, the CEC has been able to put the infrastructure in place to efficiently and effectively mobilize the state's world-class universities, national laboratories, technology companies, private-public partnerships, and entrepreneurial spirit around clean energy. This second phase has stimulated higher risk/higher reward product development by startups and has invigorated the early stage of the Innovation Pipeline with exciting new products that are ready for deployment. With this new model in place, the CEC, under EPIC, is effectively mobilizing these clean energy ventures around the big technological challenges that must be addressed to realize a resilient, equitable and carbon-neutral electricity sector. For example, a recent funding opportunity to advance non-lithium energy storage technologies received **29 proposals that exceeded the CEC's threshold for funding**.[63]

[63] CEC Notice of Proposed Award for GFO-19-305 available at: https://www.energy.ca.gov/media/3565

ii. Ongoing EPIC Projects and Planned Investments Have Breakthrough Potential.

As noted above, realizing the full impact of clean energy innovations can take several decades. Nevertheless, the CEC continues to push innovation through its implementation of the 2018-2020 CEC EPIC Investment Plan. Table 15 summarizes the breakthrough topics in each investment area that have recently started or are currently being planned. These ongoing and planned investments build upon lessons learned from previously funded research and set bold targets for both technology performance and scale of application. These examples show the strength of EPIC's potential to continue to impact clean energy technology development and demonstration.

Table 15. Examples of Projects and Planned Investments with Breakthrough Potential

Investment Area	Breakthrough Topics Being Supported by EPIC in 2020
Entrepreneurial Ecosystem	• CalTestBed, the nation's largest clean energy testbed network, will provide start-up companies with access to the state's premier testing facilities at over 30 laboratories at UC campuses and LBNL. This will provide start-ups with validated performance data that will facilitate investments in the technologies.
Resiliency and Safety	• Mobile solar plus storage systems that can replace mobile diesel generators typically used in emergency response (e.g., wildfires) to power emergency medical tents and field communication systems. • Improved wildfire behavior modeling and risk-assessment of energy infrastructure. • Energy storage technologies with 100+ hour duration at a cost less than $10 kW/h. (Projects ongoing)
Building Decarbonization	• A design-build competition focused on all-electric, zero-net-carbon mixed-use multifamily buildings located in disadvantaged communities. • Portable electric heat pumps units that can be directly installed by customers without expensive professional installation. These units have performance that exceed mini-split systems and are ideal for renters and multi-family residents. • Technology advancements to electric heat pumps that don't require costly panel upgrades and have load flexibility functionality

	• Skinny triple pane windows that can double efficiency and can fit into the form factor of existing double pane windows. • Prefabricated facades that enable higher envelope efficiency at a lower installed cost.
Grid Decarbonization and Decentralization	• Four first-of-their-kind demonstrations of community-scale Virtual Power Plant concepts. These projects will provide a glimpse of the future electricity system. • Technology advancements that can increase the technical potential and capacity factor of both in-state high-elevation onshore and offshore wind resources. • Advancements in emerging thin-film PV technologies that can increase the technical potential of solar generation and significantly reduce the installed costs of distributed PV systems. • Foundational environmental research to assess potential environmental impacts and mitigation strategies from offshore wind developments. • Load Flexibility Hub in planned to facilitate technology development in a policy rich, collaborative research environment. • Develop and deploy technologies for recovery of lithium from California's geothermal brine to make geothermal more cost competitive and provide a domestic lithium supply.
Industrial and Agricultural Innovation	• With $3 million in EPIC support, Lawrence Berkeley National Lab was selected to lead the U.S. Department of Energy's $100 million Energy-Water Desalination Hub. The Hub will kick-off in Summer 2020. • Industrial heat pump technology advancements capable of capturing low-grade waste heat to meet thermal requirements for industrial processes, replacing natural gas currently used for industrial process heating. • Improving industrial refrigeration efficiency.
Transportation Electrification	• Advanced component technologies to enable next-generation lithium batteries that can provide 400-mile EV range, reduce thermal runaway, and reduce demand for rare-earth materials such as cobalt. (projects ongoing)

	• Establishing a Research Hub to accelerate the development and deployment of transformative electrification infrastructure for California's heavy-duty electric vehicle market. (planned investment).

iii. Based on CEC Implementation, EPIC Impact and Benefits Metrics Are in Line with Those Used by Other Public RD&D Programs.

Comparing EPIC's benefits and impacts with similar or past Research, Development and Demonstration programs is challenging. There is only a handful of publicly funded RD&D programs for energy and even among these few programs, there are key differences in scope and maturity. For example, the U.S Department of Energy's (DOE) ARPA-E program targets investments primarily at the applied research stage for high risk, high reward technologies; while the New York State Energy Research and Development Authority's (NYSERDA) program targets investments towards demonstration stage. EPIC has a broad scope, covering applied research all the way to the demonstration stage and even the early-adoption stage. Despite the differences in scope, there are several metrics that are consistently used across RD&D programs. The consulting firm Industrial Economics, Inc., under contract to the CEC, interviewed one or more individuals at five R&D programs at the federal and state level to benchmark EPIC to other programs. Table 16, adapted from the work of Industrial Economics, Inc., shows how CEC EPIC metrics compare with other public RD&D programs.

Table 16. Comparison of Impact Metrics from Public RD&D Programs

R&D Program	Follow-on Funding	Publications	Intellectual Property/ Patents	Partnerships	Technology Commercial-ization	Sales/ Revenue
CEC EPIC	X	X	X	X	X	X
DOE ARPA-E	X	X	X	X		
DOE EERE[64]	X		X	X	X	
DOE SBIR[65]	X	X	X			X
MassCEC[66]	X		X	X		
NYSERDA					X	X

[64] DOE's Office of Energy Efficiency and Renewable Energy (EERE).
[65] DOE's Small Business Innovation Research (SBIR) program.
[66] Massachusetts Clean Energy Center (MassCEC).

c. EPIC Funding Should Be Continued.

Many of the benefits of continuing the program have been discussed already. The most important benefit of continuing the program is to continue to fill the critical funding gap to bring breakthrough innovation to the market for customer value, while achieving California's long-term energy policy goals and mandates. As shown in Table 1, not continuing EPIC would reduce state funding at the Applied Research and Prototype stages to almost zero and significantly reduce state funding at the Demonstration stage.

i. Continuing EPIC Is Critical to California's Energy Innovation Economy.

In addition to providing public funding at critical stages, continuing EPIC would also provide certainty to the private sector that the public sector is willing to share the financial risk to bring new technologies to market as well as provide the technical validation and due diligence that most private investment firms have traditionally lacked. Under normal circumstance, not continuing the program would significantly slow clean energy innovation. However, given the current federal position on clean energy innovation as well as the unprecedented economic circumstances caused by the COVID-19 pandemic, not continuing EPIC at this time could set clean energy innovation in California back several years as private sector investors would likely withdraw again from cleantech.

ii. EPIC Has Benefited from Continuous Improvement and Refinement Over the Past Several Years.

Another benefit to continuing the program is that programs like EPIC take time to scale, and through continuous iteration become more effective - for both the CEC as an Administrator and for the research community. Over the course of EPIC, the Commission along with the four Administrators have participated in several proceedings to further refine the program requirements, resolve program challenges and identify improvement areas for administration. Furthermore, effective coordination among multiple Administrators takes time to build. Beginning over again with a new program with new requirements would take significant time and resources.

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iii. R&D Is Critical to Bringing About Technology Solutions to Meet the Statutory Goals of SB 100.

EPIC provides critical RD&D for advancing the key existing and emerging energy technology areas that can support SB 100 and mid-century decarbonization goals, among other priority state objectives. EPIC supports a range of technology areas that will be important to SB 100 implementation, including solar; onshore wind; offshore wind; geothermal; bioenergy; hydropower; energy storage; hydrogen; and demand flexibility. Mid-century decarbonization targets will require an expected generation of approximately 350 TWh per year of renewable and zero-carbon sources by 2045. While renewable energy resources are making up an increasing share of the electricity mix, anticipated generation needs will require significant additional capacity. As of 2018, renewable energy technologies – solar, wind, geothermal, bioenergy, and hydropower resources – accounted for an estimated 42 percent of the California power mix – 90 TWh[67] – underscoring the scale of the challenge ahead and the need for sustained public investment. According to E3,[68] advancements needed to meet mid-century decarbonization targets include (1) scaling up and deploying existing technologies (e.g., renewables and energy efficiency in buildings and industry); (2) enabling market transformation (e.g., through zero emission vehicles and methane capture); and (3) achieving one or more reach technologies (e.g., zero emission trucks and industrial electrification). The EPIC Program is well-positioned to continue supporting progress across this spectrum of technology innovation.

Finally, EPIC is inextricably linked with California's energy policy. By design, EPIC informs and influences the two public energy agencies and provides insights that illuminate future regulatory action. Questions that are on the horizon for agencies like the Commission, CEC and CAISO include, but certainly not limited to:

a. How much load flexibility can be derived from buildings and what are the technologies to harness that potential?
b. What strategies can mitigate the grid impact of medium- and heavy-duty transportation electrification? The state is moving well ahead of the rest of the

[67] E3, 2018: Deep Decarbonization in a High Renewable Future. Prepared for CEC. CEC-500-2018-012.
[68] Mahone, Amber, Zachary Subin, Jenya Kahn-Lang, Douglas Allen, Vivian Li, Gerrit De Moor, Nancy Ryan, Snuller Price. 2018. Deep Decarbonization in a High Renewables Future: Updated Results from the California PATHWAYS Model. CEC. Publication Number: CEC-500-2018-012.

country in electrifying transportation, which will result in substantial impacts to the grid.

c. What industrial processes can be electrified? To meet the state's greenhouse gas emission goals, industrial processes that rely on natural gas will need to be electrified. Current technology is either not available or cost prohibitive to electrify industrial processes.
d. Can lithium extraction in the Salton Sea be extracted in new, novel ways to bring down the cost of battery manufacturing?
e. What energy storage technologies will enable the state to better utilize existing and future renewable resources and provide long duration (e.g., days) of backup power for grid outages?

As shown in Table 15 above, the CEC EPIC program already has a number of research projects, both recently started and currently being planned, that targets technology advancements to address these critical issues.

iv. The CEC Sees No Reason Why Program Funding Should Not Be Continued.

As previously stated, EPIC fills an important gap in the California energy policy that would be left unfilled if program funding is not continued.

While California can achieve its SB 100 goals[69] for renewable and zero-carbon resources with existing technologies, continued investment and innovation in renewable and carbon-free electricity and enabling technologies can accelerate technology performance and cost improvements that can make progress easier and faster, while also minimizing incremental costs to electric ratepayers. EPIC-funded clean energy technology innovation plays a critical role in advancing an electricity system powered by renewable and carbon-free electricity and in meeting complementary state objectives for grid reliability, energy affordability, environmental quality, public health, and economic development. Through EPIC, the State is working with innovators

[69] Among other provisions, SB 100 provides that it is the policy of the state that eligible renewable energy resources and zero-carbon resources supply 100 percent of all retail sales of electricity to California end-use customers and 100 percent of electricity procured to serve all state agencies by December 31, 2045. (Pub. Util. Code, sec. 454.53, subd. (a).)

to advance a range of promising technologies. This broad approach is necessitated by the scale of the challenge; mid-century decarbonization targets will require an expected generation of approximately 350 TWh per year of renewable and zero-carbon sources by 2045.[70] While renewable energy resources are making up an increasing share of the electricity mix, anticipated generation needs will require significant additional capacity. As noted earlier, as of 2018, renewable energy technologies – solar, wind, geothermal, bioenergy, and hydropower resources – accounted for an estimated 42 percent of the California power mix (90 TWh).[71] Additionally there will be challenges to integrating the renewables on the grid and ensuring a balanced and safe system, while moving to more time of day or weather-impacted generation.

2. <u>If EPIC Program Funding Authorization Is Renewed:</u>

a. <u>The Current Funding Levels Should Be Continued.</u>

As stated earlier, the CEC recommends ongoing funding for the EPIC program at no less than current funding levels.[72] EPIC program research is essential to support the state's clean energy mandates. EPIC-funded research and development gives California the best opportunity to achieve these mandates at lower costs and possibly even ahead of schedule. As noted in the CEC's 2018 Integrated Energy Policy Report Update, additional research is needed to further the state's decarbonization efforts including in energy efficiency, electrification of buildings, improving renewable power generation, expanding the diversity of renewable energy systems and integrated solutions, and electric vehicle deployment.[73] The CEC believes that anything less than current funding levels could impact the ability to further the state's decarbonization efforts. Additionally, without the emphasis that EPIC has placed on affordable solutions for low income and disadvantaged communities, the state's decarbonization transition risks leaving behind the most vulnerable communities.

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[70] E3, 2018: Deep Decarbonization in a High Renewable Future. Prepared for CEC. CEC-500-2018-012.
[71] CEC, Total System Electric Generation. Available at: https://ww2.energy.ca.gov/almanac/electricity_data/total_system_power.html
[72] Opening Comments of the California Energy Commission to Order Instituting Rulemaking 19-10-005, December 2, 2019, p. 2.
[73] CEC staff. 2018. 2018 Integrated Energy Policy Report Update, Volume II. CEC. Publication Number 100-2018-001-V2-CMF. p. 51. Available from CEC's website at https://ww2.energy.ca.gov/2018_energypolicy/

b. The Program Should Be Authorized Through At Least 2031.

As state earlier in this brief and noted in the CEC's prehearing conference statement, the CEC recommends renewing the EPIC program from 2021 to 2031.[74]

c. The Investment Cycles for the Program Should Be Changed from 3-Year to 5-Year Cycles to Enable an Expanded Research Planning Horizon for Technology Development and New Investment Plans.

As noted in the CEC's prehearing conference statement, the CEC recommends the program be renewed at least through 2030 and recommends two 5-year investment cycles within that period, rather than the current 3-year investment cycles. The longer duration will enable an expanded research planning horizon for technology development, reduce the administrative effort involved in developing and approving new investment plans, and retain the flexibility in implementation to respond to evolving needs. The CEC will continue to seek stakeholder input during the development of investment plans and solicitations to ensure that research is nimble and able to adapt to changing needs and market situations.

If Commission approves one year of bridge funding, as discussed below and recommended jointly by the EPIC Administrator, the new, successor EPIC program should begin on January 1, 2022, and end on December 31, 2031. During the one-year period of bridge funding, the Administrators would continue to implement the EPIC program under the current program rules and prepare investment plans for the new, successor EPIC program under the program rules as updated under Phase 2 of the proceeding

d. The CEC Does Not See a Need at this Time to Change the Relative Shares of Funding Among Administrators.

The CEC does not see a need to change the relative shares of funding among Administrators. As noted earlier in the brief, the CEC values having all four Administrators as part of the EPIC program. The administrator structure expedites coordination and communication of promising research results to accelerate adoption and realization of ratepayer benefits.

[74] Prehearing Conference Statement of the California Energy Commission, January 10, 2020, p. 2.

e. The Commission Should Adjust Program Funding Annually for Inflation Based on the Projected California Consumer Price Index for Urban Wage Earners and Clerical Workers.

The CEC recommends that the Commission continue to apply inflation adjustments for the EPIC program. The CEC recommends the Commission pre-approve annual increases in program funding based on inflation adjustments that are tied to the projected California Consumer Price Index for Urban Wage Earner and Clerical Workers (CPI-W), as published by the California Department of Finance.

In the past, inflation adjustments were calculated and approved as part of the Commission's decisions approving the Triennial Investment Plans. The timing of these Commission decisions may not align well with the state budget cycle and, as a result, the CEC's use of additional funding from inflation adjustments may be delayed. The California Department of Finance typically will not approve changes to the CEC's annual budget to reflect increased funding from inflation adjustments until the Commission has first approved such funding increases in an adopted decision. If inflation adjustment decisions are not made early enough in the state budget cycle, the CEC must wait for the next state budget cycle to request an adjustment in its annual budget, and this could put the CEC out of sync with the Commission decision by about a year. Pre-approved annual increases will resolve this time delay and enable the CEC and Commission to be in sync.

f. Allowable Administrative Expenses for the EPIC Program Should Be Increased from the Current Cap of 10 Percent to 15 percent.

The CEC recommends increasing the administrative cap for the EPIC program. In the Commission Staff Proposal for Phase 2 Scoping of the EPIC program, Commission staff recommended that up to 15% of EPIC funds be set aside for administrative costs. However, the administrative cap was established as 10% by the Commission in D.12-05-037, noting that administrative costs need to be minimized to the greatest extent practicable without compromising programmatic oversight and functions and efficacy. The decision also noted that "it is difficult to identify a rationale that would justify departing from our general practice and precedent of a 10% administrative cap for the energy efficiency, CSI, and SGIP programs."

While the early years of the EPIC program may have been more similar to these programs, the EPIC program has evolved into a much more sophisticated program with greater administrative burdens. Some of the requirements that have added administrative functions to the program include:

- Continually Responding to the Needs of the State: The EPIC program is not like a rebate program. EPIC staff must keep current on and help inform the evolving and progressive policy changes in the state, while at the same time understanding technology gaps that need to be filled to meet these policy changes. This involves a substantial amount of time and effort to understand the technology landscape and the capabilities and limitations of these technologies. It also requires understanding the time and cost to achieve the desired technological innovations, so that staff can develop solicitations that push innovation but are achievable within the time and funding constraints of the program. This is achieved by our experts keeping abreast of cutting edge developments, engaging with established and start up technology developers, conducting independent analysis, and engaging with peers in other R&D programs at the federal, state and academic levels.
- Increasing Outreach to Low Income and Disadvantaged Communities: It has taken and will continue to take a substantial effort to meet the needs of the low income and disadvantaged communities. This requires active listening and relationship building with a diverse set of communities that have a diverse set of needs – one community does not represent all communities. The CEC has implemented a substantial outreach effort and process changes in response to multiple legislative requirements to help the most vulnerable communities benefit from emerging clean energy technologies.[75] The CEC has increased outreach to these communities, including conducting two public workshops in the state in 2019 in and for low income and disadvantages communities and another for California Native American Tribes to hear the needs of these communities and inform them about the EPIC program. The CEC developed a web-based platform to connect these communities with clean energy technology developers. The CEC developed new scoring criteria with public input to better assess

[75] SB 350 and AB 523.

the potential benefits of projects to low income and disadvantaged communities and developed grant funding opportunities focused on the needs of these communities. There is much more to be done to shape solicitations to address the unique challenges that the communities face, which requires ongoing outreach among the communities and creative thought to structure grants that focus on these needs.

- Annual Reporting to the Legislature: EPIC annual reports are required to be provided to the legislature on an annual basis.[76] These reports provide a substantial amount of information on the developments of ongoing projects and the results from individual completed projects. The report also provides a synthesis of research results from portfolios of projects. These reports have expanded from early reports of less than 100 pages to current reports of over 1100 pages and require a substantial amount of staff time to develop.
- Annual EPIC Symposium: The success of the EPIC program has resulted in these annual public events growing substantially from approximately 100 attendees in the first symposium to 800 attendees in 2019, making this the preeminent clean energy technology R&D event in the state. CEC staff have been responsible for all aspects of planning the events, including establishing relevant themes, sourcing venues, identifying and organizing speakers, and managing on-site activities. An important factor in the success of the symposium, is the effort required to shape the structure of the symposium to have the greatest impact. Staff organize the event to bring in senior thought leaders from finance, government, and end users to talk about the challenges and opportunities in the industry. The symposium includes pitch sessions, where technology developers can pitch their new developments to investors and end users, and staff work with the presenters to focus content on the highest relevance to the audience. CEC staff intentionally design the symposium to be much more than a simple delivery of research findings and instead design sessions to be informative to energy users as well as policy makers.
- Outreach Workshops: The Commission added additional workshops (in Northern and Southern California) for the purpose of providing training about EPIC, and related

[76] Pub. Resources Code, sec. 25711.5, subd. (f).

technical support, to Disadvantaged Communities and interested community-based organization. These workshops were required in D.18-10-052, Ordering Paragraph 11, and are additional to two annual workshops required by D.12-05-037, Ordering Paragraph 15.

- Additional Technical Working Groups: The CEC has engaged in several task forces to inform the research and also share research results. Examples include the Forest Working Group, Wildfire Working Group, Microgrid Working Group, Rule 21 Working Group, and the Vehicle-Grid Integration Working Group. This enhances the value of the research but requires additional administrative investment to be effective.
- The Policy + Innovation Coordination Group (PICG): This is the most recent addition to the EPIC program. The PICG has required more administrative time from the Administrators to create the group and will continue to require more effort to support the identification of three to five Policy + Innovation Partnership Areas (PIPA) as required by D.18-10-052. PIPAs are topics of specific focus for coordination among the Administrators and the Commission. Each PIPA will require additional focused coordination meetings as well as public workshops. Ultimately, the PIPAs may also result in new research topics.

These new requirements are in addition to the administrative functions identified in D.12-05-037, which include developing investment plans, conducting market analysis to properly scope funding opportunities, evaluating and scoring proposals (which are growing in number), selecting projects for funding, developing agreements, managing the progress of projects and investments, and reporting on results. The CEC follows this direction and includes these expenditures under administrative funds rather than project funds. Also included in the CEC's administration funds are technical assistance agreements that augment our staffing, such as proposal review and small grant administration. For these reasons, the CEC believes that an increase to the administrative cap is warranted.

The CEC reviewed available information for other energy R&D programs to assess the typical administrative budget relative to program funding and found the EPIC program to be below average.

Table 17 provides examples of the administrative budget of similar programs.

Table 17. Program and Administrative Budget of Research Entities

Research Entity	Total Allocation (Research and Admin)	Program Administration	% of Allocation
DOE OE[77]	$68,087	$13,824	20%
DOE EERE[78]	$831,348	$128,669	15%
NYSERDA[79]	$250,842	$34,541	14%
SWRI[80]	$554,723	$221,647	40%
GTI[81]	$87,203	$32,688	37%

3. The Commission Should Approve Bridge Funding in Phase 1 of the Proceeding to Support the Administrators' Ongoing Implementation of the Program while the Commission Considers the Remaining Programmatic Issues During Phase 2 of the Proceeding.

The CEC recommends that the Commission approve bridge funding as requested in the joint Administrator proposal.[82] The bridge funding would help support the Administrators' ongoing implementation of the EPIC program while the Commission considers the remaining programmatic issues during Phase 2 of the proceeding. If there is a gap period between the current EPIC program and the successor program, there will be a gap in RD&D projects that support the program objectives. The EPIC Administrators cannot afford to lose momentum. The uncertainty in transitioning to a successor EPIC program may also diminish broader participation by the research community, technology investors, and other stakeholders, and the Administrators

[77] Department of Energy (DOE) FY 2020 Congressional Budget Request, March 2019. Volume 3, Part 1. FY19 Enacted budget for Office of Electricity (OE), Washington Headquarters. p 59.
[78] Department of Energy (DOE) FY 2020 Congressional Budget Request, March 2019. Volume 3, Part 2. FY19 Enacted budget for Office of Energy Efficiency and Renewable Energy (EERE), Washington Headquarters. p. 257.
[79] New York State Energy Research and Development Authority (NYSERDA) Fiscal Year 2018-19 Budget and Financial Plan. Market Development / Innovation & Research Expenses. p. 12.
[80] Southwest Research Institute (SWRI) Annual Report 2018 (for fiscal year ending September 2018). p. 24.
[81] Gas Technology Institute (GTI) and Subsidiaries Consolidated Financial Report with Additional Information, December 31, 2016. GTI Budget. p. 45.
[82] Joint EPIC Administrators' Bridge Funding Proposal by Southern California Edison Company (U 338-E), Pacific Gas and Electric Company (U 39-E), San Diego Gas and Electric Company (U 902-E), and California Energy Commission, January 31, 2020. (Joint Administrator's Bridge Funding Proposal).

may lose continuity in their workforce for managing ongoing RD&D and programmatic transitions.

Approval of bridge funding would additionally signal a sustained commitment to RD&D and help move the marketplace and effectuate change at this crucial time in our economy as the state endures the COVID-19 pandemic. As was noted in the Joint Administrator's Bridge Funding Proposal, it is the sustained commitment to RD&D that helps move the marketplace and effectuate change; however, bridge funding, may not be enough to send the right signal to the research community, technology investors, and other stakeholders, unless it is also coupled with a clear indication that there will be a long-term commitment to RD&D.[83]

During the one-year period of bridge funding, the EPIC Administrators would continue to implement the EPIC program under the current program rules as outlined in previous Commission decision approving and directing execution of the EPIC program. This would help the Administrators maintain the critical momentum needed to ensure a smooth transition to the successor EPIC program. Additionally, during the one-year period of bridge funding the Administrators would do the work to plan and prepare investment plans for the successor EPIC program under the program rules as updated under Phase 2 of the proceeding.

a. <u>One Year of Bridge Funding for Both Project and Program Administration Should Be Approved for Each Administrator, Proportionate to 33 Percent or Approximately 1/3 of Each Administrator's Three-Year Budget Plan.</u>

The CEC recommends that one year of bridge funding (including both project and program administration funding) proportionate to 33 percent or approximately 1/3 of each Administrator's three-year budget plan, as specified on page 38 of D.18-01-008. As discussed in the Joint Administrator's Bridge Funding Proposal, bridge funding should be defined as an extension of EPIC III funding levels and rules to enable a seamless transition to a new RD&D program. More specifically, bridge funding should be separate, distinct and in addition to, any future Commission-approved funding for the subsequent EPIC program or its successor program.[84] The CEC believes that bridge funding will be sufficient so long as a decision on the successor program is made by the end of 2021.

[83] Joint Administrator's Bridge Funding Proposal, p. 2.
[84] Joint Administrator's Bridge Funding Proposal, p. 2.

Consistent with the Joint Administrator's Bridge Funding Proposal, the CEC recommends that the bridge funding be used to focus on RD&D in the following three overarching areas:

- Reliability, Resiliency and Safety to better understand climate impacts and prepare for potential impacts with adaptation methods focused on a more distributed and flexible grid;
- Decarbonization to advance clean energy technologies and their integration to support a zero-carbon future.
- Equity and Affordability to provide clean and affordable energy options to disadvantaged and low-income communities and support environmental social justice.[85]

The CEC would prioritize the bridge funding for RD&D initiatives that support addressing each of these overarching research areas. The RD&D initiatives would be based on EPIC III gaps and lessons learned.

b. <u>The Commission Should Adopt the Joint Proposal Submitted by the EPIC Administrators on January 31, 2020, at the Request of the Assigned ALJ.</u>

The CEC recommends that the Commission adopt the Joint Administrator's Bridge Funding Proposal, as submitted on January 31, 2020.

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[85] Joint Administrator's Bridge Funding Proposal, pp. 4 – 5.

III. CONCLUSION

For the reason discussed above, the CEC strongly recommends that the EPIC program be renewed through at least 2031 and funded at no less than the current funding level, adjusted annually for inflation. The EPIC program directly benefits California electric ratepayers, gives the state the best opportunity to realize its energy policy goals and mandates, and is a critical driver of innovation-driven economic development in the state. The CEC believes that the EPIC program has provided substantial value to the state in terms of supporting the development of new clean energy technologies that provide benefit to the electric ratepayers. The CEC EPIC program has catalyzed a robust clean energy ecosystem in the state, and EPIC renewal will continue this world-class ecosystem.

The CEC also recommends that the investment cycles for the EPIC program be changed from 3-year cycles to 5-year cycles to enable an expanded research planning horizon for technology development and new investment plans and retain flexibility in implementation to respond to evolving needs. It also recommends that allowable administrative expenses be increased from the current cap of 10 percent of an Administrator's budget to a cap of 15 percent of an Administrator's budget to reflect the Administrators' added workload, which has increased over time as the program has developed and new administrative requirements have been added.

Lastly, to avoid any disruption to the EPIC program or its administration, the CEC recommends that the Commission approve one year of bridge funding in Phase 1 of the proceeding to support the Administrators' ongoing implementation of the program while the Commission considers the remaining programmatic issues during Phase 2 of the proceeding. Approval of bridge funding will additionally signal a sustained commitment to RD&D and help move the marketplace and effectuate change at this crucial time in our economy as the state endures the COVID-19 pandemic. If Commission approves one year of bridge funding, the CEC recommends that the new, successor EPIC program begin on January 1, 2022, and end on December 31, 2031. During the one-year period of bridge funding, the CEC will continue to implement the EPIC program under the current program rules and prepare an investment plan for the new, successor EPIC program under the program rules as updated under Phase 2 of the proceeding.

At this time the CEC does not see a need to change the relative share of program funding among the four EPIC Administrators.

The CEC appreciates the opportunity to provide input on the continuation and on-going need for the EPIC program. It looks forward to continuing its work with the Commission to implement the renewed EPIC program and building on the program's ability to shape California's clean energy market and enable the state to more effectively and efficiently meet its energy mandates.

Dated this 17th day of April 2020.

Respectfully submitted,

CALIFORNIA ENERGY COMMISSION

/S/

Gabriel Herrera

Allan Ward
Gabriel Herrera
Chief Counsel's Office
CALIFORNIA ENERGY COMMISSION
1516 9th Street, MS 14
Sacramento, CA 95814-5512
Telephone: (916) 654-3951
Facsimile: (916) 654-3843
Email: allan.ward@energy.ca.gov
Email: gabe.herrera@energy.ca.gov

APPENDIX A

LIST OF EPIC TECHNOLOGIES AND RELATED SERVICES BEING SOLD COMMERCIALLY

Company	Investment Topic	Company Description	Commercialized Technology	Webpage Address
All Power Labs	Resiliency and Safety	Manufacturer of biomass gasifier generators.	PP30 25kW Power Pallet	http://www.allpowerlabs.com/products/product-overview
Gridscape Solutions, Inc.	Resiliency and Safety	Developer of standards-compliant products and solutions for renewable microgrid and EV charging systems.	EnergyScope	http://grid-scape.com/renewable-microgrid/
Caban Systems	Resiliency and Safety	Provider of a vertically integrated platform for plug-and-play installation on any telecom site.	Enduro System	https://cabansystems.com/us/installation-and-maintenance
Universal Devices, Inc.	Building Decarbonization	Manufacturer of energy management and automation products.	Universal Devices ISY	https://www.universal-devices.com/shop
Conectric Networks, LLC	Building Decarbonization	Provider of a software-as-a-service energy management platform that turns hotels into smart internet-of-things networks.	Energy management software gateway and wireless sensors	https://conectric.com/
Enlighted Inc.	Building Decarbonization	Provider of a multi-sensor internet-of-things platform for commercial real estate, helping customers reach sustainability goals while saving money and increasing efficiency.	Energy Manager	https://www.enlightedinc.com/system-and-solutions/iot-system/energy-manager/

Asetek	Building Decarbonization	Provider of liquid cooling and thermal management systems for data centers, servers, workstations, gaming, and high-performance PCs.	AIO liquid coolers	https://www.asetek.com/technology
OhmConnect	Building Decarbonization	Provider of a real-time energy monitoring platform designed to increase energy efficiency.	OhmConnect	https://login.ohmconnect.com/login
Embertec	Building Decarbonization	Provider or smart plug load controllers to reduce plug-in device energy use when not in use.	Emberstrip 8PC+	https://shop.embertec.com/products/emberstrip-8pc
Ibis	Building Decarbonization	Provider of advanced plug load controllers to reduce energy use from large plug-in devices.	Dual Intelisocket InteliGateway InteliNetwork	https://ibisnetworks.com/ibis-system/
Advanced Microgrid Solutions	Grid Decarbonization and Decentralization	Developer of an AI software platform designed to enable optimized trading of complex energy assets.	SigmaOne software platform	https://www.advancedmicrogridsolutions.com/solution-california-iso
Glint Photonics, Inc.	Grid Decarbonization and Decentralization	Manufacturer of a self-tracking solar concentrator.	Hero™	https://www.glintphotonics.com/hero
Primus Power	Grid Decarbonization and Decentralization	Provider of low-cost, long-life, and safe long-duration energy storage systems designed to offer the use of renewable energy worldwide.	ENERGYPOD® 2	http://www.primuspower.com/en/product/
Clean Power Research, L.L.C.	Grid Decarbonization and Decentralization	Developer of a cloud-based software that engages customers in their energy options and integrates solar resources.	Energy Management Software	https://developers.cleanpower.com/

Kitu Systems	Grid Decarbonization and Decentralization	Developer of a smart energy automation platform that supports interconnection of solar PV, battery storage, electric vehicles and other distributed energy resources.	Kitu Convoy	https://www.kitu.io/convoy
Natel Energy	Grid Decarbonization and Decentralization	Provider of hydropower products to solve the problems inhibiting traditional hydropower.	Restoration Hydro Turbine	https://www.natelenergy.com/turbines/
Nevados	Grid Decarbonization and Decentralization	Developer of solar tracker technologies that increase cost-competitiveness, output, and range of applications.	Nevados All Terrain Tracker	https://nevados.co/products-services/
Eos Energy Storage	Grid Decarbonization and Decentralization	Developer of storage technologies for the electric utility and transportation industries.	Eos Aurora®	https://eosenergystorage.com/products-technology/
Sunfolding	Grid Decarbonization and Decentralization	Developer of efficient solar tracking technologies that maximize energy output.	Sunfolding T29™ Single-Axis Tracker	https://www.sunfolding.com/products
UniEnergy Technologies	Grid Decarbonization and Decentralization	Developer of megawatt-scale advanced vanadium redox flow battery energy storage solutions.	ReFlex battery storage units	http://www.uetechnologies.com/products
Amber Kinetics	Grid Decarbonization and Decentralization	Provider of flywheel energy storage services.	Amber Kinetics M32	https://www.amberkinetics.com/products/#1

Omega Grid	Grid Decarbonization and Decentralization	Provider of a peer to peer blockchain energy platform to distribute transactive energy.	Blockchain energy platform	https://www.omegagrid.com/community
Lightapp Technologies (now Zira)	Industrial and Agricultural Innovation	Provider of resource management services.	Energy Management Application	https://www.lightapp.com/product
Porifera, Inc.	Industrial and Agricultural Innovation	Developer of product concentration systems and wastewater treatment systems using forward osmosis.	Concentrator Recycler DPR Shield	http://www.porifera.com/products
Terzo Power Systems, LLC.	Industrial and Agricultural Innovation	Manufacturer of electronic pump system.	Hydrapulse	https://www.terzopower.com/
Carnot Compression	Industrial and Agricultural Innovation	Manufacturer and designer of centrifugal compressor.	CARNOT™ COMPRESSOR	https://carnotcompression.com/
Wexus Technologies, Incorporated	Industrial and Agricultural Innovation	Developer of a cloud-based, energy and water management software system that increases agricultural energy efficiency.	Wexus Energy Management Software	https://wexusapp.com/pricing/
Chirp Microsystem	Industrial and Agricultural Innovation	Developer of ultrasonic 3D-sensing systems that help in industrial automation and building air flow monitoring.	Chirp's MEMS ultrasonic technology	http://www.chirpmicro.com/technology.html
PowWow Energy	Industrial and Agricultural Innovation	Provider of a software-as-a-service to improve yield while reducing energy and water inputs.	PumpMonitor/Ranch Monitor/CropMonitor	https://powwow.io/pricing/
Charge Bliss, Inc.	Transportation Electrification	Developer of "mixed topography" or hybrid battery designs.	Smart Panel 3000	https://chargebliss.com/technologies/

ChargePoint	Transportation Electrification	Developer of EV charging network designed to transform transportation and energy use by helping people choose to drive electric.	Electric Vehicle Chargers	https://www.chargepoint.com/products/commercial/
Kisensum	Transportation Electrification	Developer of an energy management storage platform designed for energy distribution grid.	Electric Vehicle Energy Management	https://www.chargepoint.com/products/commercial/
Greenlots	Transportation Electrification	Developer of charging networks for electric vehicles.	EV Charging Stations	https://greenlots.com/solutions/grid-balancing/
Andromeda Power, LLC	Transportation Electrification	Developer of smart, bi-directional fast chargers built for electric vehicles.	ORCA Incisive - Strada	https://andromedapower.net/ap-shop/
Greenlight Labs	Transportation Electrification	Developer of a marketing and advertising platform intended to persuade customers to switch to electric vehicles.	MyGreenCar/ MyFleetBuy	https://www.greenlight-labs.com/overview

APPENDIX B

TECHNOLOGICAL CHALLENGES AND BARRIERS SUCCESSFULLY ADDRESSED BY EPIC PROJECTS FOR KEY PORTFOLIO TOPICS

The following key is used for Appendix B:

● - successfully demonstrated the research or technology in a real-world environment in real-world conditions.

◒ - successfully demonstrated the research or technology in a controlled or simulated environment such as a laboratory setting.

○ - project has the potential to address but is still in progress.

Key Portfolio Topic: Microgrids

Project Title	This project advanced technologies, tools or practices that reduce the capital costs required to design, install and commission a new microgrid system?	The microgrid successfully islanded in on the following scenarios: Emergency Grid Outage, Non-emergency outage, simulated outage?	This project quantified the value streams of a new microgrid installation to better assess the business case?
Demonstrating a Renewable-based Microgrid for a Critical Facility at the Blue Lake Rancheria	●	Emergency Outage	●
Renewable Microgrid for a Medical Center		Simulated Outage	●
City of Fremont Fire Stations Microgrid Project	●	Simulated Outage	●
Demonstrate a Utility-owned Renewable-based Community Microgrid at Borrego Springs	●	Emergency Outage	●
Las Positas College Microgrid	●	Simulated Outage	●

Key Portfolio Topic: Load Flexibility/Dynamic Efficiency

Project	This project advanced technologies, tools and/or practices that reduce the cost of engaging customers and providing DR resources to the grid?	The project reduced uncertainty about the actual performance of DR strategies and the value to the grid that is attributed to DR resources?	This project advanced technologies that improve the ability of automated end use devices to be coordinated and managed to provide response to signals from an aggregator, consumer, or utility?
Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems	●	●	●
Customer-centric Demand Management using Load Aggregation and Data Analytics	●	●	●
Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	●	●	●
Complete and Low-Cost Retail Automated Transactive Energy System	●	◒	●
Identifying Effective Demand Response Program Designs for Small Customer Classes	◒	●	
Empowering Prosumers to Access Wholesale Energy Products	●	●	●
Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings	●	●	●

Key Portfolio Topic: Low Carbon HVAC and Water Heating

Project	This project advanced technologies, tools and/or practices that reduce the installed cost of a new low carbon HVAC systems?	The project advanced a technology that increases energy efficiency and use of low or no GHG refrigerants by documenting energy and cost savings and benefits?	This project advanced a technology to streamline acceptance or use in codes and standards?
Customer-centric Approach to Scaling IDSM Retrofits		●	●
Low Cost, Large Diameter, Shallow Ground Loops for Ground Loops for Ground-Coupled Heat Pumps	●		●
Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	○	○	○
Develops and tests prototype anemometers to measure air flow. The technology could be incorporated into HVAC ducts or VAV equipment.	●		
Integrated Smart Ceiling Fans and Communicating Thermostats to Provide Energy Efficient Comfort.		●	●
Optimizing Energy Performance for Multi-Family Zero Net Energy Buildings.	●	●	●
Development and Testing of the Next Generation Residential Space Conditioning System for California		◒	

Key Portfolio Topic: Energy Storage

Project	This project advanced technologies, tools and/or practices that reduce the installed cost of a new energy storage system?	The project advanced a technology that reduces the energy storage market's demand for imported lithium or other rare-earth materials?	This project advanced a technology that improves the value proposition of energy storage?
Low- Cost Thermal Energy Storage for Dispatchable CSP	●	●	●
Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System	●	●	●
Demonstration of Community Scale Generation System at the Chemehuevi Community Center	●		●
Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits	●	●	●
A Transformative Flywheel R&D Project	●	●	●
Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems	●	●	●
Las Positas Microgrid (Unienergy Flow Battery)	●	●	●

Key Portfolio Topic: Smart Industrial, Agricultural and Water Practices

Project	This project demonstrated optimized load management or provision of grid services?	The project advanced a technology that increases energy efficiency by documenting energy and cost savings and benefits?	This project advanced a technology to streamline acceptance or use in multiple applications in CA?
Wexus Energy and Water Management Mobile Software for the Agricultural Industry	●	●	●
Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption		●	●
Increased Energy Efficiency via Programmable Irrigation and Fertigation		●	●
Development of new technologies for agricultural loads to participate in renewables integration, RTP programs, and/or new Time of Use rates	●	●	●
Bringing Energy Efficiency Solutions to California's Water Sector With the Use of Customized Energy Management System and Supervisory Control and Data Acquisition System (EPC-14-062)	●	●	●
Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems (EPC-14-075)		●	●
Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants (EPC-06-026)	○	○	○

Facilitating On-farm Participation in Energy Demand Management Programs (EPC-16-027)	○	○	○
Advancing Demand Response in the Water Sector (EPC-16-062)	○	○	○

Key Portfolio Topic: Electric Vehicle-Grid Integration (VGI)

Project	This project demonstrated optimized load management or provision of grid services using plug-in electric vehicles (PEVs)	This project improved interoperability and harmonization of PEV, EV supply equipment (EVSE), and distributed energy resource (DER) communications standards and protocols	This project advanced understanding of VGI applications with medium- and/or heavy-duty vehicles or direct current fast chargers
Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	●	●	●
Smart Charging of Plug-in Electric Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	●		●
Next-Generation Grid Communication for Residential Plug-in Electric Vehicles	●	◒	
Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability	◒	◒	
Open Source Platform For Plug-in Electric Vehicle Smart Charging in California	●		

Grid Communication Interface for Smart Electric Vehicle Services Research and Development		◒	◒
Total Charge Management: Advanced Charge Management for Renewable Integration	●		
Open Vehicle-to-Building/Microgrid Integration Enabling Zero Net Energy and Improved Distribution Grid Services	○	○	
Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers	○		○
Development of Smart Charging Infrastructure Planning Tool (SCRIPT)	○		
Advanced Transit Bus VGI Project	○		○
Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Services and Renewable Power Penetration	○		
Intelligent Electric Vehicle Integration (INVENT)	○		
California E-Bus-to-Grid Integration Project	○		○

APPENDIX C

EPIC PROJECTS IMPROVING THE EFFECTIVENESS OF REGULATORY CODES AND STANDARDS

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
Modeling the Impact of Wildfires on California's Transmission and Distribution Grid (LBNL)	Resiliency and Safety (Wildfire)		✓	✓	IOU climate resilience planning as per Commission Adaptation Rulemaking (R.18-04-019).
Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency (Spatial Informatics Group, LLC)	Resiliency and Safety (Wildfire)		✓	✓	IOU climate resilience planning as per Commission Adaptation Rulemaking (R.18-04-019)
Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt (UC Berkeley)	Resiliency and Safety (Wildfire, flooding, heat, drought, declining snowpack)		✓	✓	IOU climate resilience planning as per Commission Adaptation Rulemaking (R.18-04-019)

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience (UC Berkeley)	Resiliency and Safety/ (Wildfire, flooding, heat, drought, declining snowpack)		✓	✓	IOU climate resilience planning as per Commission Adaptation Rulemaking (R.18-04-019)
City of Fremont Fire Stations Microgrid Project (Gridscape Solutions, Inc.)	Resiliency and Safety (Energy storage system)	✓	✓	✓	Commission Net Energy Metering
Enhancing Grid Resiliency through Improving Capabilities to Manage Communicating Energy Storage and Solar Systems	Resiliency and Safety (Energy storage system)	✓	✓		Commission Rule 21
Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems (UC Berkeley)	Resiliency and Safety (Hydropower production)	✓	✓	✓	Hydropower operational procedures (PG&E)

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
Unlocking Plug Load Energy Savings through Energy Reporting (LBNL)	Building Decarbonization (Plug Loads)	✓			Title 20, Title 24
Performance Specification and Verification of Building Control Sequences (LBNL)	Building Decarbonization (Plug Loads)			✓	Title 24
Integrated Smart Ceiling Fans and Communicating Thermostats to Provide Energy Efficient Comfort (UC Berkeley)	Building Decarbonization (HVAC)	✓			Title 24
CodeCycle	Building Decarbonization (Building energy efficiency)		✓		Title 24

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
New Generation of LED Lighting Solution (CLTC at UC Davis)	Building Decarbonization (Lighting)	✓		✓	Title 24
Optimizing Energy Performance for Multi-Family ZNE Buildings (Franklin Energy)	Building Decarbonization (HVAC, Lighting)	✓			Title 24
The Value Proposition for Cost Effective, DR-Enabling, Nonresidential Lighting Systems Retrofits in California Buildings. (LBNL)	Building Decarbonization (Lighting and Demand Response)	✓	✓		Title 24
Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps (UC Davis)	Building Decarbonization (Ground source heat pumps)	✓	✓	✓	Title 24
Workforce Instruction for Standards and Efficiency (WISE) (California Home-building Foundation)	Building Decarbonization (Building envelope)		✓		Title 24

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions (Taylor Engineering)	Building Decarbonization (HVAC)		✓		Title 24
Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC	Building Decarbonization (HVAC)			✓	Title 24/DSA (Division of State Architect)
Smart Ventilation for Advanced California Homes	Building Decarbonization (HVAC)			✓	Title 24
Empowering Proactive Consumers to Participate in Demand Response Programs (OhmConnect)	Building Decarbonization (Load flexibility)	✓	✓	✓	California ISO (proxy demand response)

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
Smart Inverter Inter-operability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage (SunSpec Alliance)	Grid Decarb and Decentralization (Smart Inverters)		✓	✓	Commission Rule 21
Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration (EPRI)	Grid Decarbonization and Decentralization (Smart Inverters)		✓		Commission Rule 21
Demonstration of Integrated Photovoltaic Systems and Smart Inverter Functionality Utilizing Advanced Distribution Sensors (LBNL)	Grid Decarbonization and Decentralization (Smart Inverters)		✓		Commission Rule 21

Project Title and Recipient	Investment Topic (Energy Application or Devices)	The project identified updates needed to codes and standards to improve energy performance?	The project advanced tools or technologies that streamline compliance with regulatory codes and standards?	The project identified updates needed to codes and standards or related planning activities to improve health and safety	Code or Standard
Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources (EPRI)	Grid Decarbonization and Decentralization (Smart Inverters)	✓			Commission Rule 21
Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal (Tomorrow Water)	Industrial and Agricultural Innovation (Groundwater)	✓	✓		Title 20 for perchlorate removal
Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability (EPRI)	Transportation Electrification (EV chargers)		✓		Commission DER inter-connection (electric vehicles)
Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services (EPRI)	Transportation Electrification (EV chargers)		✓		Commission DER inter-connection (electric vehicles)

APPENDIX D

EPIC PROJECTS IMPROVING THE EFFECTIVENESS OF MARKET-DRIVEN CODES AND STANDARDS

Project Title and Recipient	Investment Topic/ Energy Application or Device	This project informed updates to device and equipment standards that improve interoperability	This project identified codes and standards updates to improve health and/or safety	This project identified codes and standards updates to improve energy performance	Code or Standard
Enhancing Grid Resiliency through Improving Capabilities to Manage Communicating Energy Storage and Solar Systems	Resiliency and Safety (Energy storage system)	✓	✓		IEEE Standard 1547-2018 and DNP3
Mobile Efficiency for Plug Load Devices (Aggios, Inc.)	Building Decarbonization (Plug Loads)			✓	IEEE
Unlocking Plug Load Energy Savings through Energy Reporting (LBNL)	Building Decarbonization (Plug Loads)	✓			CTA-2047-A
Optimizing Energy Performance for Multi-Family ZNE Buildings Franklin Energy	Building Decarbonization (HVAC, Lighting)	✓			ASHRAE 216

Project Title and Recipient	Investment Topic/ Energy Application or Device	This project informed updates to device and equipment standards that improve interoperability	This project identified codes and standards updates to improve health and/or safety	This project identified codes and standards updates to improve energy performance	Code or Standard
Performance Specification and Verification of Building Control Sequences EPC-15-056 (LBNL)	Building Decarbonization (Plug Loads)			✓	ASHRAE 90.1
Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation (LBNL)	Building Decarbonization (Building envelope)		✓	✓	ASHRAE 90.1 and 189.1
Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions (Taylor Engineering)	Building Decarbonization (HVAC)	✓	✓	✓	ASHRAE Guideline 36-2018 Addendum
Certified Open-Source Software to Support the Interconnection Compliance of	Grid Decarbonization and Decentralization (Smart Inverters)	✓			IEEE 2030.5

Project Title and Recipient	Investment Topic/ Energy Application or Device	This project informed updates to device and equipment standards that improve interoperability	This project identified codes and standards updates to improve health and/or safety	This project identified codes and standards updates to improve energy performance	Code or Standard
Distributed Energy Resources (EPRI)					
Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	Industrial and Agricultural Innovation/ (Irrigation)			✓	CDFA SWEEP
Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability (EPRI)	Transportation Electrification (EV chargers)	✓			SAE-J series
Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services (EPRI)	Transportation Electrification (EV chargers)	✓			SAE-J series

APPENDIX E

TOOLS AND RESOURCES ADVANCED THROUGH EPIC

Investment Topic	Tools and Resources and Use in 2019
Entrepreneurial Ecosystem	• Empower Innovation (300+ organizations; 8,700+ views): https://www.empowerinnovation.net/. Access to funding and networking opportunities for clean energy in California. Though March 2020, membership has grown to 300+ organizations and 1,000+ members. • Founders Playbook (2,580+ users, 3,600+ views): http://playbooks.cyclotronroad.org/. A curated library of essential reading and example materials related to launching and growing a hardware-focused clean energy company.
Resilience and Safety	• Cal-Adapt (23,200+ users and 126,300+ views): https://cal-adapt.org/. Climate change data and visualization tools. In the Commission's Adaptation Rulemaking 18-04-019, D.19-10-054 directs IOUs to Cal-Adapt as a data source for climate change vulnerability assessment and adaptation planning. In collaboration with activities funded by a Strategic Growth Council grant and a CEC natural gas research grant, the Cal-Adapt EPIC development team holds quarterly webinars to introduce new tools and features and provide training to a variety of users, including electricity sector stakeholders. Most of the webinars are recorded and available on www.cal-adapt.org. On average, approximately 50 people attend each webinar.
Building Decarbonization	• High performance windows and facades: https://facades.lbl.gov/measurements-modeling. LBNL researchers have developed a suite of free, open-source software tools (WINDOW, THERM, OPTICS, and Radiance) that enable industry to evaluate the thermal and daylighting performance of window components and systems. • WISE (9,700+ users): https://www.wisewarehouse.org/. High performance building resources and training.

	• OhmConnect (EPIC project helped grow signups from 15,000 to 300,000 in 2017. In 2019, OhmConnect had 600,000 signups): https://www.ohmconnect.com/. Coordinates time-dependent energy-use reduction and energy savings across a large group of ratepayers. • Dr. Power (2,170+ users): https://corp.hea.com/dr-power. Advances energy efficiency by allowing residents to identify home appliances that use energy even when turned off. • Manage Your Power (1,100 sessions): https://manage-your-power.com/. Convenient way for businesses to connect with qualified service providers to upgrade facilities or identify energy-saving opportunities. • Radiance: A Validated Lighting Simulation Tool: https://www.radiance-online.org/. Radiance is used by architects and engineers to predict illumination, visual quality and appearance of innovative design spaces, and by researchers to evaluate new lighting and daylighting technologies. Through March 2020, more than 500 people have "liked" the Website hosting this online tool. • Commercial Building Energy Saver (CBES): http://cbes.lbl.gov/. CBES enables building owners, energy managers, and others to identify and implement deep energy retrofits and zero net energy strategies for small- and medium-sized commercial buildings. • Advanced Plug Load Controls and Management in the Educational Environment. This project developed training material and conducted training sessions in northern and southern California to identify which plug loads can be controlled and show participants how to operate the two plug-load controllers in this project. In total about 40-60 California Conservation Corps members participated in the training sessions.
Grid Decarbonization and Decentralization	• Powernet (11 users for pilot-scale deployment): https://powernet.stanford.edu/. Pilot-scale system for participating residents to buy and sell local energy generation and time-dependent local reduction in energy use. • Integrated Distributed Energy Resources Management System (iDERMS): https://intra.ece.ucr.edu/~nyu/research.html. Efficient, scalable, and decentralized resource dispatch and coordination platform that enables optimized operation of DERs. iDERMS leverages a data-driven approach and machine learning techniques to overcome barriers to large-scale operation of DERs. As an open-source platform, iDERMS ensures that future improvements can be made to the code base or segments can be taken and used in commercial applications.

	• StorageVET (1,600 users): https://www.storagevet.com/. Estimates the value of potential energy storage installations based on location, operation, size, and technical capabilities. • DER-VET (forthcoming) Open source microgrid valuation and optimization tool with a robust technical and economic analysis to aid in the design of microgrids and distributed energy resources (DERs). Through March 2020, more than 400 people have participated in monthly webinars (there have been 15 webinars so far). • E3 Solar + Storage Modeling Tool (forthcoming). Evaluated PV with energy storage and an array of advanced controls and dispatchable DER technologies for optimal dispatch with a wide range of customer programs and incentives. Nearly 300 people attended workshops in 2019 to learn about the Solar + Storage Tool. • Clean Power Research, Simulated 15-Minute Interval Data of CSI Data: https://www.californiadgstats.ca.gov/downloads/#_csi_15_id. Simulated dataset that was built on measured historical production data for 414 of 504 systems that were monitored under the California Solar Initiative (CSI) from January 1, 2011 through December 31, 2016 that contains solar PV production data by zip code at 15-minute intervals. This is a completed and continuous dataset, with gaps in the measured data and invalid data that were filled and replaced with simulated data reflecting the characteristics of the underlying systems. • GridLAB-D optimization (EPIC-funded upgrades coming soon): https://github.com/gridlab-d/gridlab-d. Building on the existing GridLAB-D open-source software, EPIC funded development of a user-friendly interface for distribution grid modeling, model manager and converter, and optimization of the GridLAB-D computation engine to improve the performance for very large-scale simulation studies, such as studies to address distribution planning questions for renewable integration, energy storage, and demand response. GridLAB-D has been downloaded more than 91,000 times. • Richmond Advanced Energy Community Project. Guidebooks produced by this project include: “City of Richmond, CA: Green Revolving Fund Guiding Document” (documenting the purpose, administrative issues, and steps a local government can take to establish a green revolving fund) and “City of Richmond Vehicle Action Plan” (including EV-related public and private funding opportunities at various levels). • Offshore Wind Energy Research Database: https://www.energy.ca.gov/event/workshop/2020-03/staff-workshop-research-and-development-opportunities-floating-offshore-wind. A global

	database of offshore wind energy research projects. The database includes more than 200 studies conducted since 2017. The database focuses on floating projects and supporting infrastructure, as well as site studies for fixed and floating offshore wind technologies. • Biositing Webtool: https://biositing.jbei.org/ A web-based biositing tool for quantifying biopower, biogas, and biomethane generation for a broad range of waste-to-energy deployment scenarios at the state and local scales.
Industrial and Agricultural Innovation	• Accelerating Drought Resilience (1,700+ users): https://droughtresilience.com/. Insights and resources from water and wastewater technology providers and adopters in Tulare County. Focuses on existing and emerging technologies that can provide near-term, cost-effective benefits and help make a community drought resilient. • Waste-to-Energy Matching and Biositing Tool: https://biositing.jbei.org/. Shows available biomass within a user-specified distance from a potential biomass facility. • In-conduit Hydropower Business Case Assessment Tool: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development/research-tools. A webinar in April 2019 attracted more than 200 attendees and a lot of interest (from around the world) in receiving the tool and guidebook. • Deep Sea Annotation Tool (prototype): https://www.deepseaannotations.com/. This prototype demonstrates that automated classification of ocean species from video is possible. The project represents significant advances in the field. With further development, this could lower the cost of underwater biological surveys for offshore renewable energy. The Monterey Bay Aquarium Research Institute is interested in the prototype.
Transportation Electrification	• MyFleetBuy (10,000 vehicles): https://mygreencar.com/fleet/. Web portal for consulting services to compare costs, fueling, and return-on-investment for fossil-fuel, hybrids, and electric vehicles to inform ground transportation fleet procurement and operation. • Smart Charging Infrastructure Planning Tool (SCRIPT) (forthcoming)

APPENDIX F

OUTREACH ACTIVITIES TO STRENGTHEN DIVERSITY OF APPLICANTS AND ENCOURAGE PROPOSALS IN AND BENEFITTING LOW-INCOME OR DISADVANTAGED COMMUNITIES

To strengthen diversity of applicants for EPIC funding opportunities and encourage proposals for projects in and benefitting low-income and disadvantaged communities, the CEC engages in a broad range of outreach activities, including public workshops, webinars, event tabling, communications, and community engagement. These activities are summarized in Appendix F for 2014-2019.

Year	Outreach Activities to Strengthen Diversity of Applicants and Encourage Proposals in and Benefitting Low-Income or Disadvantaged Communities
2014	• In 2014, CEC staff held four public outreach workshops held in Sacramento, Fresno, San Jose, and Gardena. These workshops explained the EPIC application process and highlighted the CEC's commitment to diversity in the EPIC Program. Staff shared information on EPIC with more than 10 women, minority, and disabled veteran groups, including: o The African American, Hispanic, and Asian chambers of commerce in California o The Association of Women in Water, Energy, and Environment
2015	• In 2015, the CEC launched a LinkedIn group page titled the "California Energy Commission's Research and Development Networking Hub." By the end of 2015, the online hub had 858 members. CEC staff took steps to promote funding opportunities in English and other languages on multiple media platforms. Staff printed and provided EPIC funding opportunity postcards and related materials in Spanish, Vietnamese, Mandarin, Tagalog, Korean, and Japanese. Staff hosted a workshop to share information and answer questions about the CEC's competitive EPIC project selection and funding process. The CEC posted step-by-step presentations and related

	materials, including audio recordings of "how to apply" workshops to the CEC's EPIC website page. Staff distributed EPIC information at 20 key expositions and conferences, including: o Sacramento (Asian, Black, Hispanic) Multi-Chamber of Commerce Networking Event o Southern California Minority Supplier Development Council o UCLA Luskin Center Conference to Advance Women in Technology o California Legislative Black Caucus Diversity Job Fair o Disabled Veteran Business Alliance's Keeping the Promise Conference and Expo.
2016	• In 2016, CEC staff enhanced the LinkedIn group page "California Energy Commission's Research and Development Networking Hub." In 2016, this open group had nearly 1,200 members. The group page provided a user-driven platform to help potential applicants - including disabled veteran-, women- and minority-owned businesses - connect and partner on proposals for solicitations funded through the EPIC Program. Also, CEC staff conducted on-site meetings with local minority leaders in several Bay Area cities, including a meeting with the Minority Business Development Association. The meetings served as opportunities to inform local leaders about R&D funding opportunities and open channels for future dialogue. Other outreach activities in 2016 included: o The CEC took steps to promote funding opportunities in other languages on multiple media platforms and provided funding materials translated for non-English speakers, including "opportunity postcards" and relevant materials in Spanish, Vietnamese, Chinese, Tagalog, Korean, and Japanese. o CEC staff hosted a workshop to gather information about the types of program changes that could yield increased participation from the private sector in the EPIC Program. The workshop helped CEC staff understand the potential barriers that may deter private sector companies from applying for grant funding opportunities and solicit ideas for promoting greater private sector participation. Nine panelists from various backgrounds shared ideas for improving the EPIC grant funding process.

	○ CEC staff distributed EPIC materials at more than 20 key expositions and conferences in 2016, including: ▪ California League of Food Processors Expo ▪ Commission Small Business Expo ▪ Silicon Valley Manufacturing Roundtable ▪ Women in Cleantech Networking Event ▪ Young Professionals in Energy event ▪ Greenlining Institute's 23rd Annual Economic Summit.
2017	• In 2017, CEC staff hosted a networking webinar as an opportunity for interested applicants, including disabled veteran-, women- and minority- owned businesses, to connect and partner on proposals for solicitations funded through the EPIC program. Also, staff continued to provide funding materials translated for non-English speakers, including opportunity postcards and relevant materials in Spanish, Chinese, Tagalog, Korean, and Japanese. The CEC promoted funding opportunities in English and other languages on multiple media platforms. CEC staff distributed EPIC materials at more than 35 key expositions, conferences and webinars in 2017, including the Small Business Workshop & Business Exchange, presented by the Sacramento Hispanic Chamber of Commerce, Sacramento Black Chamber of Commerce, and the Sacramento Rainbow Chamber of Commerce. CEC staff held public workshops to discuss and promote the incorporation of community-focused equity measures in EPIC research initiatives, including: ○ R&D Funding Opportunities for Disadvantaged /Low-Income Communities Workshop in Fresno ○ R&D Funding Opportunities for Disadvantaged /Low-Income Communities Workshop in Los Angeles ○ The SB 350 Workshop on Doubling Energy Efficiency at the California Energy Commission in Sacramento

	○ The EPIC Investment Plan Stakeholder Workshop at the Commission in San Francisco.
2018	• In 2018, the CEC held two public workshops on AB 523 implementation. The workshops solicited input on draft scoring criteria to assess the potential for proposed demonstration projects to benefit residents of low-income or disadvantaged communities. Furthermore, staff started efforts to engage communities throughout California, including more in-person discussions with community-based organizations and other community leaders. Also, the CEC EPIC program added the following new outreach tools: ○ Hosting online networking webinars for each EPIC funding opportunity as standard practice. These webinars provide opportunities for applicants to build teams and work together to develop effective project proposals. ○ Revamping the Energy Commission's research landing page to make it easier and more intuitive for first-time users to find information. ○ Creating and publishing a "How to Apply for Research Funding" video, which provides new applicants a quick four-minute overview of the first steps of applying for EPIC funding opportunities.
2019	• In 2019, the CEC participated in more than 10 outreach and community events, held two preapplication workshops on funding opportunities for low-income and disadvantaged communities, and issued a request for comments on proposed evaluation criteria for benefits and impacts to low-income and disadvantaged communities in EPIC grant funding opportunities. In addition, the EPIC symposium featured a panel discussion focused on low-income and disadvantaged communities.