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EPIC 4 Transportation Electrification Scoping Workshop

Solicitation Concepts for 2021-2025 Initiatives

Energy Research and Development Division

Date: May 31, 2023

Agenda

Time	Item
2:00 pm	Welcome and Introduction • Housekeeping • Diversity Survey • EPIC Program Background
2:10 pm	EPIC 4 Transportation Electrification Initiatives and Proposed Funding Concepts • Background and Goals • Possible Project Focus • Questions for Feedback
3:25 pm	Q&A / Public Comment
3:55 pm	Closing Remarks
4:00 pm	Adjourn

Housekeeping

- Workshop is being recorded
- Workshop Event Webpage: https://www.energy.ca.gov/events
- Closed captioning is enabled
- Virtual Participation through Zoom
  - Q&A after each concept
  - Q&A/public comment period after the main presentation
  - Raise Hand or Q&A Box feature
- Written Comments to Docket # 20-EPIC-01: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-EPIC-01
- **Deadline: June 13, 2023, by 5:00 p.m.**

Commitment to Diversity

The CEC adopted a resolution strengthening its commitment to diversity in our funding programs. The CEC continues to encourage disadvantaged and underrepresented businesses and communities to engage in and benefit from our many programs.

To meet this commitment, CEC staff conducts outreach efforts and activities to:

- Engage with disadvantaged and underrepresented groups throughout the state;
- Notify potential new applicants about the CEC's funding opportunities;
- Assist applicants to understand how to apply for funding from CEC's programs;
- Survey participants to measure progress in diversity outreach efforts

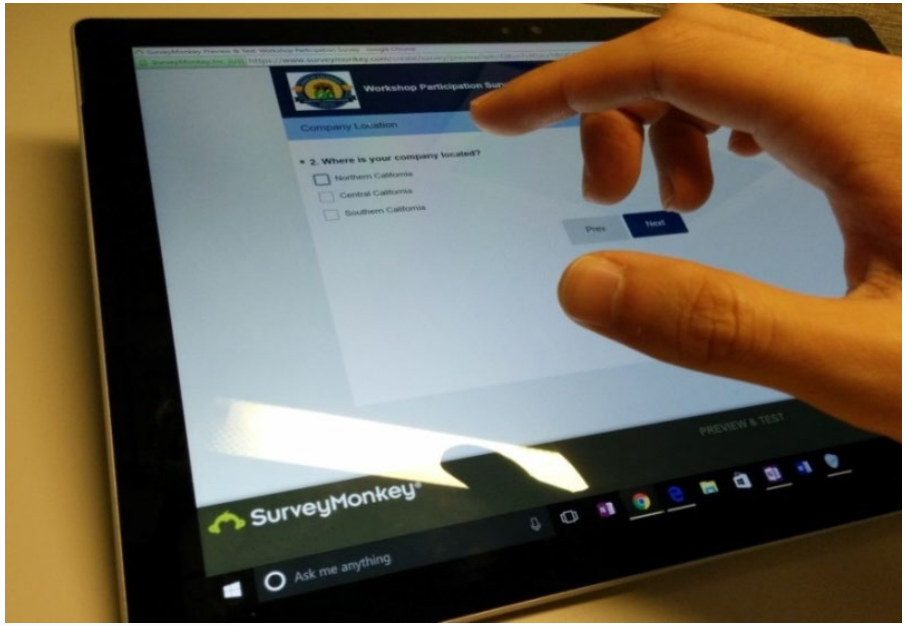
Diversity Survey

1 Minute Survey

The information supplied will be used for public reporting purposes to display anonymous overall attendance of diverse groups.

Please use this link:
https://forms.office.com/g/BjMNrECc75

Thanks!



Find a Partner on EmpowerInnovation.net

Empower Innovation strives to accelerate your clean tech journey with easy access to funding opportunities from the CEC and other funding providers, curated resources and events, and connections to people and organizations.

FIND A PARTNER	RESOURCES & TOOLS
Announce your interest in this funding opportunity and message other interested parties to find potential partners.	Browse the collection of resources for clean tech innovators including Resource Libraries, Funding Sources, Tools, and Databases.

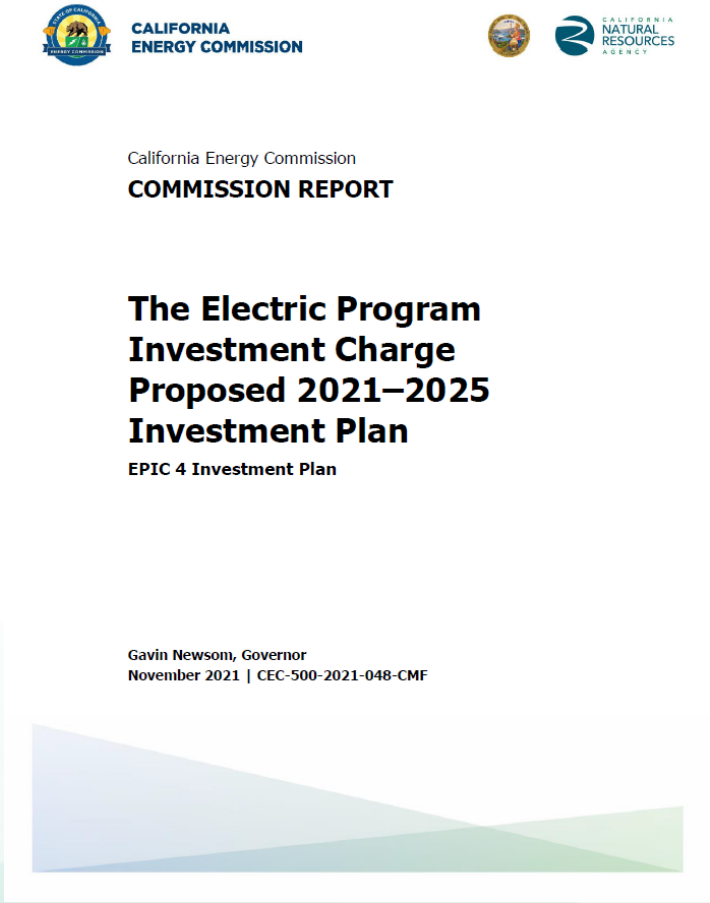
Link to funding opportunities:
https://www.empowerinnovation.net/en/custom/funding/directory

For questions related to the Empower Innovation platform:
https://www.empowerinnovation.net/en/contact_us

EmpowerInnovation.net

EPIC Program Background

- Established by the CPUC in 2011 to fund research leading to technological breakthroughs supporting California's clean energy goals.
- Invests in pre-commercial technology innovation, complementing other state activities including standards, regulations, and incentives for commercial technology.
- ~$130 million annual budget, funded by an investor-owned utility electricity consumption surcharge.
- Provide electricity ratepayer benefits including improving safety, reliability, affordability, environmental sustainability, and equity.


CALIFORNIA ENERGY COMMISSION

California Energy Commission

COMMISSION REPORT

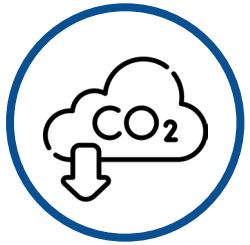
The Electric Program Investment Charge Proposed 2021–2025 Investment Plan

EPIC 4 Investment Plan

Gavin Newsom, Governor

November 2021 | CEC-500-2021-048-CMF

Policy Drivers

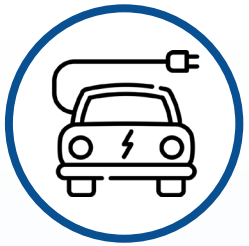


SB 100, 2018: Meet 100% of electricity retail sales and state agency electricity needs with renewable and zero-carbon resources by 2045.

AB 1279, 2022: Achieve net zero GHG emissions by 2045.

EO N-79-20:

- All new in-state passenger vehicle sales to be zero-emission by 2035;
- All medium- and heavy-duty vehicles to be zero-emission by 2045 where feasible and by 2035 for drayage trucks;
- All off-road vehicles and equipment to be zero-emission by 2035 where feasible.



AB 2127: requires CEC to biennially assess EV charging infrastructure needed to meet state goals. Inaugural report predicts 1.2 million chargers needed by 2030 to support 8 million EVs.

AB 2061: requires CEC to establish EV charger uptime recordkeeping and reporting standards for state or ratepayer-funded chargers.

Previous EPIC Investments in Transportation Research

EPIC 1 (2014-16)

Early smart charging and V2G research with LD vehicles

EPIC 2 (2016-18)

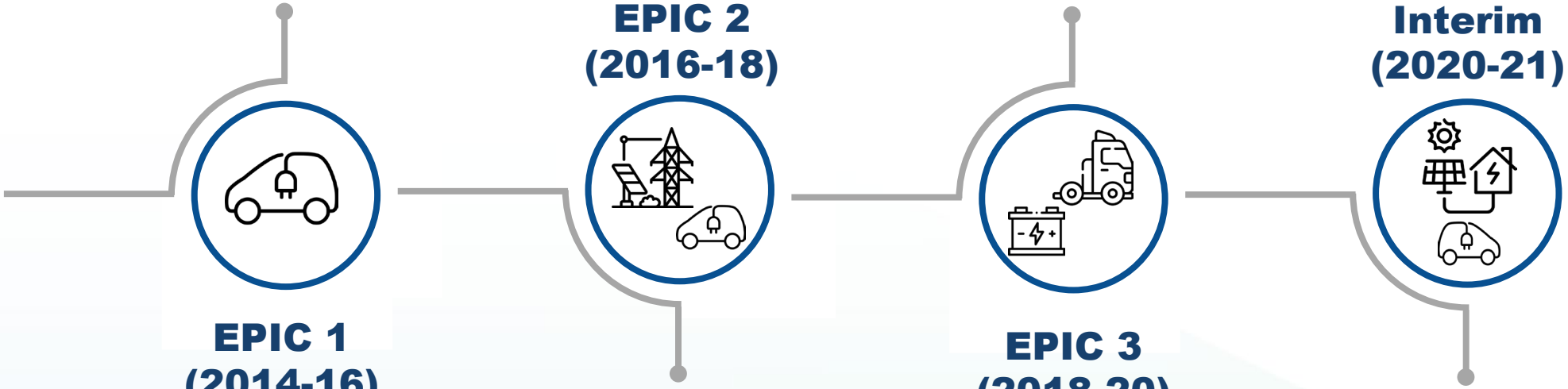
Smart charging pilots with transit fleets; High-power and bidirectional LD charging supported by stationary storage

EPIC 3 (2018-20)

MDHD fleet electrification supported by DERs; Public access MDHD charging infrastructure pilots; EV battery recycling research

EPIC Interim (2020-21)

V2B pilots with EVs providing resilient backup power to commercial buildings and site loads



EPIC 4 Transportation Electrification Initiative and Topics

The 2021-2025 Investment Plan (EPIC 4) includes **~$50M** for four topics under the Transportation Electrification initiative:

- **Topic 20:** Efficient Transportation Electrification and Charging Technologies
- **Topic 21:** Technology Enablers for Using Electric Vehicles as Distributed Energy Resources
- **Topic 22:** Integrating Distributed Energy Resources for Grid-Supportive Vehicle Charging
- **Topic 23:** Lithium-Ion Battery Reuse and Recycling Technologies

EPIC 4 Transportation Electrification Proposed Solicitation Concepts

Staff are scoping Topics 20-23 into the following proposed Solicitation Funding Concepts:

- **Concept 1:** Efficient Electric Vehicle Mobility and Charging Systems (EV-MACS)
- **Concept 2:** Technology Enablers for Using Electric Vehicles as Distributed Energy Resources (PEVs as DERs)
- **Concept 3:** Grid-Supportive Electrification of Emerging Transportation Segments
- **Concept 4:** Electric Vehicle Battery Reuse and Recycling

Concept 1
Efficient Electric Vehicle Mobility and Charging Systems (EV-MACS)

Background:

- AB 2127 predicts light-duty vehicles will produce a 5,500 MW peak load and medium- and heavy-duty vehicles will produce a 2,000 MW peak load in 2030.
- AC onboard charging equipment efficiency losses up to 15% and DC offboard charging equipment losses up to 10%.
- EV system efficiency losses up to 40% when performing mobility services.
- Efficiency improvements can complement load flexibility to mitigate load growth.

Goal:

- Develop energy saving solutions for EVs and charging equipment to lessen burden on electric grid as state transitions to zero-emission vehicles.
- Reduce peak load with efficient charging equipment and improve reliability and uptime of charging infrastructure by reducing time required to charge.
- Lower total cost of ownership and increase range and capacity for grid services with efficient EV mobility systems.

Concept 1
Possible Project Focus

- Possible efficiency improvement categories:
  - Established charging solutions (Level 2 AC onboard charging, DC fast charging).
  - Emerging charging solutions (wireless, automated, mobile, extreme fast charging, DC-coupled architectures).
  - EV system solutions (traction inverter, motor, thermal management, regenerative braking, cabin climate control, possible extension to tires).
- Open to all vehicle types.
- Target technology between early development and pre-commercial product.
- Leverage developed target metrics where applicable (ex. electric drive system targets set by DOE).

Concept 1
Questions and Feedback

- What level of funding would be necessary for this concept? Each category?
- Should CEC establish a baseline for efficiency improvements in each loss category or should that be a requirement of the applicant?
- Are there specific systems or loss categories that should be prioritized?
- Should there be a bidirectional requirement for any of the charging solution categories to improve roundtrip efficiency (L2 AC charging, high-power DC charging, or innovative charging solutions)?
- What project requirements would ensure technologies are successfully validated and ready for commercial adoption? Should projects focus on applied research or demonstrations?

Q&A – Concept 1

1. **Use the raise hand feature in Zoom:**
   - Zoom phone controls:
     - *6 – Toggle mute/unmute
     - *9 – Raise hand
   - Introduce yourself by stating your name and affiliation
   - Keep questions under 3 minutes to allow time for others

2. **Type questions in the Q&A Box in Zoom:**
   - Please provide name and affiliation.

Concept 2
Technology Enablers for Using Electric Vehicles as Distributed Energy Resources (PEVs as DERs)

Background:

- Barriers for broader commercialization of VGI technologies and programs include gaps in standards and evolving policy context.
- CPUC approved the PEV Submetering Protocol (D-22-08-024).
- AC V2G has potential to improve cost effectiveness, however, enabling standards are still under development.
- IOUs are conducting VGI pilots intended to scale adoption beyond laboratory research and small-scale demonstrations (D-20-12-029).
- Need to further advance enabling technologies to reduce cost of VGI solutions, improve customer usability, and support additional functions.

Goals:

- Develop technology enablers including low-cost submetering and bidirectional AC charging equipment to drive more widespread VGI and maximize benefits.
- Inform scale-up mechanisms including incentives, dynamic rate design, and resource forecasting.

Concept 2
Possible Project Focus

Low-cost EV Submeters

- Develop low-cost EV submeters that meet accuracy requirements and DC submeters for high-power charging and microgrid applications.
- Develop software and data analytics solutions that enable use of EV submeter/telematics data to inform charging/discharging management.
- Co-optimize and assess VGI value based on driver needs, battery state of charge, distribution system conditions, other flexible loads and DERs, and renewable generation.

V2G-enabling Equipment

- On-vehicle equipment to enable discharge of AC electricity from EV batteries to support building loads or export to the distribution system.
- Advanced grid interactive inverter functionalities such as multimode or hybrid inverters.
- Simple retrofit solutions that can enable bidirectional charging for existing EVs and chargers.

Battery Degradation Mitigation

- Battery solutions to quantify, monitor, and mitigate potential degradation impacts of V2G.

Concept 2
Questions and Feedback

- Are there other key enabling technology areas that should be considered?
- Are there technology gaps specific to AC bidirectional charging that could be addressed through additional research? Are there specific data collection requirements that could help inform future interconnection pathways?
- Should projects focus on applied research and technology development or would there also be value in demonstrations to collect and analyze real-world data?
- Should projects require OEM participation and in what capacity?
- How should this solicitation be timed to maximize value considering other ongoing activities in this space?

Q&A – Concept 2

1. **Use the raise hand feature in Zoom:**
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Concept 3
Grid-Supportive Electrification of Emerging Transportation Segments

Background:

- Need for accelerated and grid-supportive electrification of emerging transportation segments wherever feasible including:
  - On-road MDHD vehicles, such as drayage, delivery, and work trucks.
  - Off-road vehicles and equipment, such as in agriculture, construction, freight and cargo handling, rail, marine, and aviation.
- Diverse duty cycles may support various vehicle grid integration (VGI) use cases, but more research is needed to realize potential benefits.
- Active EPIC projects are demonstrating DER solutions to support MDHD charging.

Goals:

- Develop and demonstrate technologies and pathways that enable scalable, grid-supportive, and cost-effective electrification of emerging transportation segments.
- Address challenges including charging access at remote and/or capacity constrained sites and unique work environments.
- Inform charging needs assessments, load forecasting efforts, and potential grid impacts and benefits.

Concept 3
Possible Project Focus

- Demonstrate VGI use cases with an eligible MDHD on-road or off-road vehicle or equipment application. Examples include but are not limited to:
  - Resilient backup power to site and/or community loads
  - Automated load management to avoid or defer system upgrades
  - Charge management solutions optimizing grid and operation needs
- Identify remote and/or capacity constrained sites with unique work environments and develop charging solutions tailored to vehicle operations.
- Modify vehicles and/or charging infrastructure to enable VGI use cases including but not limited to hardware or software to support bidirectional power flow, data transmission, and control systems.
- Further optimize performance and reduce cost of DER solutions (solar, storage, and managed charging) as an alternative to distribution grid upgrades needed to support EV charging.
- Target segments with high air pollution impacts and prioritize projects that benefit under-resourced communities.

Concept 3
Questions and Feedback

- Should requirements be set for communication standards (such as OCPP for charging management) to leverage automotive sector learnings and encourage interoperability and replicability?
- What project performance metrics should be targeted?
- What are the most promising emerging transportation segments, site types, and VGI use case combinations to target?
- How can this concept be timed and coordinated appropriately with other funding opportunities (e.g., to fund vehicle costs)?
- What amount of funding would be necessary for this concept?

Q&A – Concept 3

1. **Use the raise hand feature in Zoom:**
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2. **Type questions in the Q&A Box in Zoom:**
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Concept 4
Electric Vehicle Battery Reuse and Recycling

Background:

- Reusing EV batteries after end-of-life (EOL) can help transform them from a liability to a valuable resource.
- Recovering high-value materials through recycling can provide low-cost feedstocks for manufacturing new batteries.
- EV battery heterogeneity makes development of scalable processes for reuse and recycling challenging.
- Supply chain constraints and price volatility in battery materials create a market opportunity and growth potential for recycling and reuse.

Goals:

- Build on active project portfolio by continuing to develop scalable pathways to conserve critical battery materials and promote sustainability.
- Target flexible, economic, and scalable process improvements related to transportation, disassembly, diagnostics, sorting, recycling, and reuse.
- Build novel partnerships between utilities, OEMs, and technology developers.

Concept 4
EV Battery Reuse and Recycling

Current EPIC-funded Projects:

Reuse

- Demonstrating second-life storage systems for commercial and industrial behind-the-meter applications.
- Investing in low-rate initial production to support process optimization and cost reductions.
- Advancing technology enablers including a fast battery-grading tool and innovative battery management systems.
- Leveraging federal funds (pending award) to scale-up second-life storage demonstrations (3,000 kWh and 500 kWh system).

Recycle

- Developing lab-scale high value recycling processes including efficient sorting, separation, and direct regeneration of degraded cathode materials for various chemistries. (1 - 5 kg/day).
- Leveraging federal funds (pending award) to scale-up direct recycling demonstrations (towards 1 ton/day).

Concept 4
Possible Project Focus

Reuse

- Develop flexible battery management systems and power electronics to enable safe EV battery reuse with different form factors, state of health, manufacturers, and chemistry.
- Develop accurate data collection and sharing strategies across the battery value chain.
- Develop and support open access testing resources and standardization to address deployment barriers including fire safety.
- Reduce reconditioning costs and time related to sorting, grading, safety and reliability testing, and logistics.

Recycling

- Improve efficiency and lower environmental impact of processes that recover materials from the cathode, anode, and electrolyte.
- Develop solutions for future recycling challenges of emerging battery chemistries.
- Improve economics and efficiencies of de-energization, logistics, sorting, disassembly, and component separation through automation and battery design.
- Demonstrate batteries made with recycled content in real applications to validate performance.

Concept 4
Questions and Feedback

- Due to limited funding, what focus area should we prioritize?
- Transporting EOL batteries contributes to 40-60% of recycling costs. How can R&D contribute to lowering these costs?
- What are the challenges associated with battery reuse for residential storage and grid-scale storage solutions?
- How can R&D funding be effectively utilized to further scale-up direct cathode recycling?
- What project performance metrics should be targeted?
- What are the R&D opportunities for the following additional topics?
  - Specialized processes to safely dismantle batteries that have faced physical damage or deformation
  - Utilizing or recycling scraps from battery manufacturing processes

Q&A – Concept 4

1. **Use the raise hand feature in Zoom:**
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Q&A / Public Comment

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2. **Type questions in the Q&A Box in Zoom:**
   - Please provide name and affiliation.

Next Steps

CEC staff will compile and consider feedback in developing solicitations.

Submit written comments to Docket 20-EPIC-01

- Deadline: **Tuesday, June 13 at 5:00 pm**
- Comment page for this docket: https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=20-EPIC-01
- Or email docket@energy.ca.gov with subject “20-EPIC-01 and EPIC 4 Transportation Electrification”

Thank You!

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