

**DOCKETED**

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*Comment Received From: Mark R Thompson*  
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**Form Energy Comments on EPIC 2026-2030 (EPIC 5) Research  
Concept Proposal**

See attachment

*Additional submitted attachment is included below.*



## **Electric Program Investment Charge 2026–2030 (EPIC 5) Research Concept Proposal Form**

The California Energy Commission (CEC) is currently soliciting research concept ideas and other input for the Electric Program Investment Charge 2026–2030 (EPIC 5) Investment Plan. For those who would like to submit an idea for consideration, please complete this form and submit it to the CEC by **August 8, 2025**. More information about EPIC 5 is available below.

To submit the form, please visit the e-commenting link:  
<https://efiling.energy.ca.gov/EComment/ECommentSelectProceeding.aspx> and select the Docket **25-EPIC-01**. Enter your contact information and then use the “choose file” button at the bottom of the page to upload and submit the completed form. Thank you in advance for your input.

1. Please provide the name, email, and phone number of the best person to contact should the CEC have additional questions regarding the research concept:

Mark Thompson, Senior Director, State Affairs, [mthompson@formenergy.com](mailto:mthompson@formenergy.com),  
503-706-0434

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

Form Energy, Inc.

3. Please provide a brief description of the proposed concept that you would like the CEC to consider as part of the EPIC 5 Investment Plan. What is the purpose of the concept, and what would it seek to do? Why are EPIC funds needed to support the concept?

**Proposed Topic:** *Decarbonizing Domestic Metals Production by Electrically Purifying Low-Grade Feedstocks*

Form Energy proposes that the CEC establish a new funding topic to advance new electrochemical approaches to transform low-grade, domestically-abundant metal feedstocks (e.g. scrap and ores) into high-purity metals to decarbonize metal production, support the security of existing California manufacturers, and enhance the electric grid.

## **Innovation Need**

The U.S. and California import most high purity critical metals that are essential for economic security, including the security of California's existing aerospace, automotive and energy industries. These critical metals include light metals such as aluminum, titanium, and lithium among others, as well as critical materials for energy<sup>1</sup> like copper and electrical steel. Conventional production of these metals is highly energy and emissions intensive, and imports are both costly and increasingly exposed to trade risks. Similarly, conventional approaches to recycle and upgrade these materials from domestic sources are highly polluting and frequently impact community health.<sup>2</sup> Additionally, certain limitations exist around the ability to use recycled and upgraded metals for primary industrial or manufacturing purposes. Thus, most domestically-available scrap materials are exported to be purified or used internationally. This is causing the US and California to lose economic value and jobs that could be onshored if new ways existed to purify these metals. For example, California annually exports \$4.5 billion worth of ferrous and non-ferrous metal (~5.5 million tons of material), value that could be retained in-state.<sup>3</sup>

Metals processing is among the most difficult to decarbonize industrial sectors.<sup>4</sup> However, advances in electrochemistry have created new highly-efficient, low-cost, rampable methods of purifying domestically-abundant metal feedstocks using variable electricity. This innovation, coupled with growing amounts of intermittent renewable electricity in California's electric grid, make it possible to produce high purity metals from low-grade feedstocks in a manner that supports electric grid reliability and decarbonization. This makes it possible to increase economic growth and security, decrease emissions, and also lower electric sector costs by coupling flexible industrial load with intermittent electricity generation.

## **Research Opportunity**

This research topic will support the commercialization of new approaches to decarbonizing metals production by electrochemically purifying critical metals from domestically available low-grade feedstocks. Research will advance technologies that have the potential to overcome historical barriers to the

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<sup>1</sup> Congressional Research Service, Critical Mineral Resources: National Policy and Critical Minerals List, June 17, 2025, available at [https://www.congress.gov/crs\\_external\\_products/R/PDF/R47982/R47982.8.pdf](https://www.congress.gov/crs_external_products/R/PDF/R47982/R47982.8.pdf)

<sup>2</sup> California Air Resources Board, 2022 Scoping Plan for Achieving Carbon Neutrality, p. 168, available at <https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf>

<sup>3</sup> Calrecycle, State of Disposal and Recycling in California 2022, available at <https://calrecycle.ca.gov/stateofreport/>

<sup>4</sup> CPUC, Energy Division Staff Proposal Identifying Strategic Objectives and Criteria to Guide Electric Program Investment Charge (EPIC) Program (CPUC Staff Proposal on Strategic Objectives), p. 22, available at <https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M558/K340/558340127.PDF>

domestic development of this industry. It will support technologies that have low energy intensity and low cost, can economically ramp up and down to balance intermittent electricity supplies, and can enhance the value of existing California feedstocks and industries. Research activities will include support to advance technologies from proof of concept to prototypes, and from prototypes to pilot-scale demonstrations. Priority will be given to approaches with the most potential to decarbonize and enhance the value of existing California supply chains.

### **EPIC Funding Need**

This research topic focuses on a broad opportunity that has not yet been addressed in prior EPIC Investment Plans or other California programs. Previous EPIC Investment Plans have focused on related but more narrowly defined opportunities (e.g. economically recovering lithium from geothermal brine<sup>5</sup>). However, no prior EPIC Plans have supported the broader class of critical metals that are just as crucial to California's energy sector and broader economy, and that can directly help integrate renewable energy resources. This new research topic will address the CPUC's new EPIC strategic goal of "achieving 100 percent net-zero carbon and the coordinated role of gas," and will support CPUC Staff-proposed Strategic Objective 5: "Innovative Approaches for Difficult-to-Decarbonize Sectors," which includes metal processors. This topic will support early stage technology development (TRL 2-6) that benefits most from RD&D funding.

4. In accordance with Senate Bill 96<sup>6</sup>, please describe how the proposed concept will "lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals." For example, what technical and/or market barriers or customer pain points would the proposed concept address that would lead to increased adoption of clean energy technology or innovation? Where possible, please provide specific cost and performance targets that need to be met for increased industry and consumer acceptance. For scientific analysis and tools, provide more information on what data and information gaps the proposed concept would help fill, and which specific parties or end users would benefit from the results, and for what purpose(s)?

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<sup>5</sup> CEC, Electric Program Investment Charge 2021-2025 Investment Plan (EPIC 4), Topic 2b , p. 35.

<sup>6</sup> See section (a) (1) of Public Resources Code 25711.5 at:

[https://leginfo.ca.gov/faces/codes\\_displaySection.xhtml?lawCode=PRC&sectionNum=25711.5](https://leginfo.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC&sectionNum=25711.5).

This research topic will address several barriers to the achievement of California's energy goals and that have historically prevented domestic investments in decarbonized critical metal purification.

### **Barriers to California Achieving its Energy Goals**

- Need for Secure, Low Cost, Domestic Supply Chains: The growth and competitiveness of California's energy industry is highly dependent on having stable supplies of low-cost, high purity critical metals that are not subject to trade risks. These metals are used as inputs to everything from power plants, transmission lines, heat pumps, and solar and wind farms. They are also critical inputs to the automotive industry and electric vehicle manufacturing, as well as the success of California's aerospace industry, a large energy consumer. This project will address these barriers by creating new pathways to increase lower-cost, domestic supply of high purity metals that are direct inputs for these industries.
- Need to Enable Flexible Electrified Industrial Loads and Minimize Renewable Energy Curtailment: Economic development and electric reliability can be in conflict if new industrial loads are inflexible. Conventional approaches to purifying critical metals require constant, high electric demand at all hours, which has the potential to exacerbate electric grid reliability risks and add to electric system costs. This research will support new electrochemical approaches that are designed to be flexible and aligned to times with high levels of renewable electricity. This flexibility has the potential to reduce renewable energy curtailment, improve electric reliability, and lower electric system costs.

### **Market Barriers to Domestic Processes to Purify Metals with Electricity**

- High Energy Intensity: Conventional approaches to purifying or creating usable critical metals are highly energy intensive, which can be a barrier to using electricity as an energy source and can lead industry to pursue foreign locations that have access to cheaper or subsidized energy. This research will support approaches that have significantly lower energy intensity, which will make electricity a more competitive fuel source, and will enable the use of more variable energy sources to feed new and existing industries.
- Inability to Leverage Low Grade Feed Stocks: Conventional approaches to purifying critical metals are often highly polluting, which often does not align with federal regulations, state goals, and community preferences to avoid local pollution impacts. This leads to the export or disregard of low-grade materials, rather than domestic metals processing. This research will support new ways to use low-cost intermittent renewable electricity to purify low-grade scrap and other material streams that have high value to the California economy.

5. Please describe the anticipated outcomes if this research concept is successful, either fully or partially. For example, to what extent would the research reduce technology or ratepayer costs and/or increase performance to improve the overall value proposition of the technology? What is the potential of the innovation at scale? How will the innovation lead to ratepayer benefits in alignment with EPIC's guiding principles to improve safety,<sup>7</sup> reliability,<sup>8</sup> affordability,<sup>9</sup> environmental sustainability,<sup>10</sup> and equity?<sup>11</sup>

This research has the potential to achieve the following outcomes:

- Lower Energy Consumption: It may be possible to achieve a 25-75% reduction in energy required to produce each ton of high purity metal, depending on the metal.
- Electrified Industrial Load: The metals processing industry will have new pathways to electrify load by leveraging advances in electrochemistry.
- Improved Clean Energy Integration and Load Flexibility: New electrified industrial processes can be developed that are flexible and can cost-effectively ramp up and down to align with the availability of low-cost, clean energy resources.
- Decarbonized Industry and Reduced Pollutants: By electrifying load and aligning it with the availability of clean energy sources, this research will further the EPIC strategic goal of addressing a hard to decarbonize industrial sector that is the source of significant pollution, both directly and indirectly in California supply chains.
- Economic Growth and Security: The research has the potential to increase and retain the value of low-grade material streams within California rather than exporting them.

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<sup>7</sup> EPIC innovations should improve the safety of operation of California's electric system in the face of climate change, wildfire, and emerging challenges.

<sup>8</sup> EPIC innovations should increase the reliability of California's electric system while continuing to decarbonize California's electric power supply.

<sup>9</sup> EPIC innovations should fund electric sector technologies and approaches that lower California electric rates and ratepayer costs and help enable the equitable adoption of clean energy technologies.

<sup>10</sup> EPIC innovations should continue to reduce greenhouse house gas emissions, criteria pollutant emissions, and the overall environmental impacts of California's electric system, including land and water use.

<sup>11</sup> EPIC innovations should increasingly support, benefit, and engage disadvantaged vulnerable California communities (DVC). (D.20-08-046, Ordering Paragraph 1.) DVCs consist of communities in the 25 percent highest scoring census tracts according to the most recent version of the California Communities Environmental Health Screening Tool (CalEnviroScreen), as well as all California tribal lands, census tracts with median household incomes less than 60 percent of state median income, and census tracts that score in the highest 5 percent of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

- Decreased Trade Exposure: This research has the potential to protect existing California industries that rely on high purity critical metal feedstocks from trade exposure (e.g. the metals, automotive, aerospace, and energy industries among them) by opening new pathways to source high purity primary metals from domestic sources.
6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.
- Energy Efficiency: kWh required per kg of metal produced compared to conventional approaches
  - Metal Purity: desired weight percent of target metal purity per total weight
  - Load Flexibility: Percentage of time the process must run to be cost-effective, and/or MW/min ability to ramp production in response to electricity price signals
  - Avoided Pollutants: avoided pollutants per kg of metal produced compared to conventional approaches (reduced emissions intensity)
  - Avoided Electric Costs: estimated avoided electric system costs from fully-scaled production of flexible loads compared to conventional approaches
7. Please provide references to any information provided in the form that supports the research concept's merits. This can include references to cost targets, technical potential, market barriers, equity benefits, etc.

Two prior ARPA-E programs validate the merits of this proposed research topic:

- Revolutionizing Ore to Steel to Impact Emissions (ROSIE)<sup>12</sup>
  - Modern Electro/Thermochemical Advances in Light Metals Systems (METALS)<sup>13</sup>
8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:<sup>14</sup>
- a. Transportation Electrification
  - b. Distributed Energy Resource Integration
  - c. Building Decarbonization
  - d. Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas
  - e. Climate Adaptation

<sup>12</sup> See <https://arpa-e.energy.gov/programs-and-initiatives/view-all-programs/rosie>

<sup>13</sup> See <https://arpa-e.energy.gov/programs-and-initiatives/view-all-programs/metals>

<sup>14</sup> In 2024 the CPUC adopted five Strategic Goals to guide development of the EPIC 5 Investment Plan. A description of the goals can be seen in Appendix A of CPUC Decision 24-03-007 available at: <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M527/K228/527228647.PDF>



Please describe in as much detail as possible how your proposed concept would support these goals.

This research topic primarily supports the EPIC Strategic Goal “Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinate Role of Gas,” and related CPUC Staff-proposed Strategic Objective 5 “Innovative Approaches for Difficult-to-Decarbonize Sectors.” This Goal and related Objective are intended to support RD&D with the potential to achieve the “last 10 percent” of California’s goal to be carbon neutral economy-wide by 2045. The CPUC has identified that a primary gap to achieving this goal is “the high cost and lack of electrification solutions for difficult-to-decarbonize” industries, and it identified metal processing and mining operations as being among these industries.<sup>15</sup>

This research proposal will create new pathways to decarbonize the domestic production of high purity critical metals using low-grade feedstocks available in California. These metals are necessary inputs for a wide range of California manufacturers and California’s clean energy industry, which currently face high trade risks. Additionally, by supporting innovations in electrochemistry that enable highly flexible industrial load, this research will make it possible to align the domestic purification of metals in a manner that supports electric grid reliability and cost-effectiveness. The net result will be improved economic development in California, more secure domestic industry, decarbonized critical metal production, and lower electric grid costs.

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<sup>15</sup> CPUC Staff Proposal on Strategic Objectives, p. 22-23

## About EPIC

The CEC is one of four EPIC administrators, funding research, development, and demonstrations of clean energy technologies and approaches that will benefit electricity ratepayers of California's three largest investor-owned electric utilities.

EPIC is funded by California utility customers under the auspices of the California Public Utilities Commission.

To learn more about EPIC, visit:

<https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program>

EPIC 5 documents and event notices will be posted to:

<https://www.energy.ca.gov/proceeding/electric-program-investment-charge-2026-2030-investment-plan-epic-5>

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