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Advanced Thermal Energy Storage

Additional submitted attachment is included below.

CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

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:

Micah Sweeney, msweeney@epri.com, (865) 218-8158

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

Electric Power Research Institute, Inc. (EPRI)

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?

The Advanced Thermal Energy Storage (ATES) Integration concept addresses critical gaps in California's building decarbonization pathway by developing scalable, cost-effective TES solutions that simultaneously reduce peak demand, enhance grid flexibility, and provide equitable access to clean energy benefits. Building on proven CEC-funded TES demonstrations (Ice Bear systems achieving 95% HVAC peak reduction, Viking Cold achieving 30% demand cuts, and emerging Stasis/Harvest Thermal solutions), this concept advances next-generation thermal storage technologies optimized for disadvantaged communities (DACs) and multi-family housing electrification.

The concept integrates three complementary TES applications: (1) dual-mode phase change material (PCM) systems for seasonal heating/cooling optimization, (2) community-scale thermal microgrids serving affordable housing clusters, and (3) hybrid TES-heat pump systems that enable right-sized electrical infrastructure during electrification retrofits. This multi-scale approach directly supports California's 6 million heat pump goal while providing measurable contributions to the state's 7 GW load-shift target.

EPIC funding is essential because current TES technologies face market barriers including high upfront costs, limited contractor familiarity, and insufficient integration with DAC-focused programs. Private investment alone cannot overcome these systemic barriers or ensure equitable deployment in communities bearing disproportionate energy burdens.

4. In accordance with Senate Bill 96[i], 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)?

Technical Barriers:

- Lack of dual-mode (heating/cooling) TES systems suitable to meet California's electrification goals without major infrastructure investments to meet winter peaks.
- Integration challenges between TES controls and utility demand response programs

Market Barriers:

- Split incentives in multi-family housing preventing TES adoption
- Contractor workforce lacking TES installation and maintenance expertise
- Regulatory gaps preventing TES from receiving full Resource Adequacy credit
- Limited financing mechanisms for community-scale thermal infrastructure
- Energy burden disparities leaving DACs unable to access TES benefits[5][6]

Equity Barriers:

- TES deployment concentrated in affluent communities with single-family homes

- Lack of community-based ownership models for thermal storage assets
- Insufficient coordination between TES deployment and existing weatherization programs serving low-income households[7][8]

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,[ii] reliability,[iii] affordability,[iv] environmental sustainability,[v] and equity?[vi]

- Field demonstration of TES for heating/cooling seasons, establishing thermal performance and system efficiency under California climate as well as cost-effectiveness under California economic conditions.
- Assess market impacts and aggregate load shift capacity from deployment in California buildings
- Evaluate impact to distribution system upgrade costs for electrification retrofits
- Quantify availability for utility dispatch during critical peak periods
- Demonstration sites located in CalEnviroScreen top-quartile communities
- Reduction in energy burden for participating DAC households
- Quantify impact to participating households on thermal comfort and air quality

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

The results of the proposed project will deliver a decarbonized heating and cooling solution with TES for a disadvantaged community, reducing local fossil fuel use while minimizing the electrical infrastructure upgrades required. Success will be determined by the amount of heating load that can be decarbonized, which will be assessed using site energy consumption in electrical (kWH) and thermal (Btu and/or therms) units as appropriate. In addition, the total electrical demand (in kW) from heating/cooling equipment that can be made flexible. In particular, a focus on reducing peak cooling demand compared to baseline and reducing peak heating demand compared to all-electric. The avoided cost of upgrading electrical service for electrification of heating will also be assessed. The results of the project will directly enable a more safe, reliable, affordable, environmentally sustainable, and equitable heating solution that can be scaled without costly grid infrastructure upgrades.

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.

EPRI recently validated thermal performance through laboratory testing of a TES technology that would likely be used in the proposed project. Results were published in an EPRI Technical Brief 3002028656 and presented at the 2024 ASHRAE Annual Conference (citation below). The technology provider has been supported by recent NYSERDA and DOE SBIR grants, and is completing installation at a field demonstration site in Massachusetts whose preliminary results are expected by early 2026.

M. J. Grieve, M. Sweeney, M. K. Over and A. K. Dyall, "Tunable Thermal Energy Storage (TES) to Enable Decarbonization of Space Conditioning in Commercial Buildings," presented at the 2024 ASHRAE Annual Conf., Indianapolis, IN. June 2024. IN-24-C031

8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:[vii]
    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

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

Building Decarbonization: The ATES concept directly enables the state's 3% annual building electrification retrofit rate by addressing electrical infrastructure constraints. Dual-mode TES systems allow right-sizing of heat pumps and electrical infrastructure, reducing retrofit costs while maintaining performance. Community-scale thermal microgrids support comprehensive decarbonization of affordable housing clusters, directly reducing GHG use by displacing gas.

Distributed Energy Resource Integration: Advanced TES functions as a dispatchable grid asset, providing both energy arbitrage and ancillary services. Integration with CAISO's Flexible Ramping Product enables TES to contribute to grid stability during renewable ramping events.

Achieving 100% Net-Zero Carbon Emissions: The concept's thermal microgrids eliminate natural gas use in targeted communities. Integration with existing DAC programs ensures benefits flow to communities most impacted by climate change.

Equity and DAC Benefits: The concept prioritizes deployment in communities identified through CalEnviroScreen and DACAG guidance, ensuring direct benefits to households experiencing high energy burdens.

Climate Adaptation: Thermal storage provides critical resilience during extreme weather events.

The ATES concept represents a strategic investment in California's equitable clean energy transition, transforming thermal storage from a niche technology into a cornerstone of building decarbonization while ensuring benefits reach the communities most in need of relief from energy burdens and climate impacts.

About EPIC

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

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

To learn more about EPIC, visit: https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program

EPIC 5 documents and event notices will be posted to: https://www.energy.ca.gov/proceeding/electric-program-investment-charge-2026-2030-investment-plan-epic-5

Subscribe to the EPIC mailing list to stay informed about future opportunities to inform the development of EPIC 5: https://public.govdelivery.com/accounts/CNRA/signup/31897

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i See section (a) (1) of Public Resources Code 25711.5 at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC&sectionNum=25711.5.

ii EPIC innovations should improve the safety of operation of California's electric system in the face of climate change, wildfire, and emerging challenges.

iii EPIC innovations should increase the reliability of California's electric system while continuing to decarbonize California's electric power supply.

iv 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.

v 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.

vi 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.

vii 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