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Proposed research concept for EPIC5

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:

   Aubryn Cooperman, Aubryn.Cooperman@nrel.gov, 303-384-7618

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

   National Renewable Energy Laboratory

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 CEC should consider funding research that focuses on efficient utilization of port facilities for floating offshore wind, including novel wet storage concepts. Wet storage refers to the practice of storing floating platforms near shore prior to installation. This provides a crucial buffer in the sequence of platform assembly, turbine integration, and on-site installation and reduces the chance that delays in one stage will cascade throughout the project timeline. Decoupling these stages also provides more flexibility in scheduling equipment such as vessels or cranes to optimize their utilization and minimize downtime.

   The lack of specialized shallow-water moorings for floating offshore wind turbine assemblies and platforms at California ports presents a significant bottleneck in floating offshore wind development due to insufficient space in high-value port facilities under development. EPIC funding could address the need for compact, efficient, temporary

mooring systems that maximize storage capacity within limited port spaces. Enabling safe, high-capacity wet storage in shallow waters would support rapid deployment, minimize downtime, and enhance port throughput, directly advancing California's offshore wind goals and fostering critical innovation in port infrastructure.

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)?

   As an emerging industry, floating offshore wind is primarily at the demonstration and precommercial stages, with most efforts focused on deep-water mooring system design. Efficient deployment at commercial scale requires temporary mooring systems that can compactly secure floating wind turbines in very shallow water. Industry resources are concentrated on developing mooring systems for deployment in relatively deep waters, typically 50–1,300 meters, with little attention to shallow-water temporary mooring solutions suitable for 15- to 20-meter depths found within or near harbors. Mooring systems in shallow water are challenged by snap loading, where the mooring line tension drops to zero before rapidly increasing. Snap loading is expected to negatively impact fatigue life and can potentially damage mooring connector components. The performance and requirements for temporary mooring systems in depths shallower than 50 m remains an unexplored area of research. As commercial-scale deployment becomes imminent, the need for large-scale assembly, staging, pre-commissioning, and efficient deployment processes will become critical.

   California ports that will support floating offshore wind developments are aware that wet storage will be essential. However, they face several uncertainties, including whether their available harbor space and water depth can support adequate wet storage, what type of temporary mooring system—including anchor types, mooring line materials, buoys, etc.—is best suited to their specific conditions, and how many turbines or floating platforms their site can accommodate. Ports and developers also lack clarity on the costs of wet storage systems and the operational requirements for hook-up and disconnection. These unknowns create challenges for estimating port throughput efficiency, operational timelines, and overall infrastructure and project planning.

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]

Novel solutions for port utilization including wet storage would reduce the amount of high-value quayside and upland space that is required per gigawatt of floating offshore wind deployment. Shifting activities such as pre-commissioning to wet storage could reduce the demand for quayside facilities by approximately one week per turbine, or nearly 16 months for a 1-GW plant composed of 15-MW turbines. Without wet storage, the demand for port sites to meet California's offshore wind deployment targets could be doubled, vastly increasing port development costs.

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

Innovations in floating offshore wind ports would need to meet several technical, performance, and cost goals. Systems deployed in the water should be designed to endure 100-year extreme wave and wind conditions within or near a floating offshore wind port. Harbor equipment such as mooring lines should be designed to have safe and efficient hook-up and disconnection operation procedures. An initial cost target for novel solutions could be a 50% reduction in costs relative to the "do nothing" approach of allowing heavy-lift equipment to remain idle when quayside space is occupied by a floating platform that is not undergoing assembly or turbine integration.

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.

- NOWRDC-funded "Demonstration of Shallow-Water Mooring Components for FOWTs (ShallowFloat)"
- CEC-funded "Comprehensive Shared-Mooring Solutions to Minimize the Cost, Risk, and Footprint of GW-Scale Floating Wind Farms"
- International Energy Agency Wind Technology Collaboration Program Task 49 "Integrated Design on Floating wind Arrays"
- NREL Technical Report "The Impacts of Developing a Port Network for Floating Offshore Wind Energy on the West Coast of the United States"

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.

The proposed concept supports EPIC's goal (d) Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas by enabling efficient assembly and installation of floating offshore wind turbines. Without dedicated solutions for maximizing the efficient utilization of port facilities, deployment of offshore wind will face severe operational bottlenecks. California's target of 25 GW of offshore wind by 2045 represents a substantial contribution towards the goal of net-zero carbon emissions. The proposed research could enable offshore wind to be deployed at a rate that achieves the state target.

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