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Offshore Data Centers Powered by Ocean Renewable Energy

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:

   Leah Sirkis, Leah.Sirkis@nrel.gov, 267-697-9825

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?

   CEC should consider funding research into the design and feasibility of offshore data centers powered by ocean energy such as offshore wind or hybrid power plants that integrate wind systems with wave energy, solar, and battery storage systems. As AI and other data-centric technologies grow, the U.S needs larger and more powerful data centers, which also requires more energy. Positioning data centers offshore can significantly improve efficiency by using ocean water for cooling, which is a large component of data center energy demand. The still-large energy demand could be met by ocean renewable energy sources, a largely untapped resource in the United States. Powering offshore datacenters with collocated renewable sources can save on capital expenditures such as costly export cables or transmission upgrades, indirectly reducing costs to ratepayers. Incorporating hybrid power plant elements and storage will help regulate power production to meet the datacenter's demand profile. California is uniquely positioned to benefit from this concept for four reasons:

1. California has a large coastline and access to cold ocean waters
2. California's largest population centers are situated along the coast
3. California is committed to developing ocean renewable energy sources such as floating offshore wind
4. California is home to 32 of the top 50 AI companies and hosts many other technology industries dependent on data centers

This concept is being explored around the world – pilot data centers powered by offshore wind have already been built off the coast of Shanghai, China[1] - but it has not yet been picked up by industry in California, despite California's ideal conditions. Studies are needed to better quantify the challenges and advantages of this concept off the coast of California before it is ready to be adopted by industry. The scale of benefits and challenges for this concept are very site-dependent due to the nature of the technologies considered; therefore, studies focused on the techno-economics, type(s) of ocean energy used, offshore data center design, and reliability for California specifically should be supported by EPIC to add confidence in investment of this concept for the technology industry.

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)?

The growth of data centers to support AI adoption represents the largest source of new electricity demand and as such a major risk to state energy and greenhouse gas emissions targets. Supporting new data centers with renewable energy sources is crucial to mitigating this risk. Directly designing data centers offshore to reduce energy demand through more efficient cooling and to provide emissions-free power through onsite renewable generation has the potential to fully decouple AI capability growth from emissions. However, there are numerous unexplored technical unknowns and uncertainties with realizing offshore data centers integrated with offshore energy systems.

On a high level, an initial feasibility study is needed to generally understand and compare costs, environmental impacts, and other design challenges of offshore data centers to traditional data centers and ocean energy sources before this concept can be further developed. Part of this feasibility study may include design exploration. As a burgeoning technology, offshore data centers have not yet converged on a specific design, and design constraints may vary for different locations. Exploration and development of offshore data center designs is necessary to quantify and mitigate potential risks, environmental impacts, and costs. Research is also needed to understand and design an ocean renewable energy power plant to fit the power levels and reliability requirements of

data centers while also meeting site-specific design requirements. The proposed research will do formative investigation into these technical questions and shed light on the feasibility and potential of this important opportunity for sustainable data centers.

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]

The proposed research concept has the potential to advance technology that will lead to reduced water usage, improved efficiency and running costs of data centers, and lowered costs of ocean energy such as offshore wind. Large data centers use up to 5 million gallons of water per day[2], which strains the freshwater sources of areas with limited freshwater access. Offshore ocean data centers are expected to virtually eliminate freshwater usage. Ratepayers will benefit from reduced drought risks and lower water costs.

Data centers are also very energy intensive. Up to 40% of data center energy consumption comes from cooling systems[3], which could be significantly reduced with the use of ocean water to cool data centers. By reducing the strain on the energy grid, ratepayers could benefit from lower electricity costs.

Using ocean renewable energy sources will eliminate emissions from data centers, providing the benefit of increased environmental sustainability. Although ocean renewable energy sources may not produce constant energy output, hybrid plants with multiple ocean energy sources, along with battery energy storage, can be considered to ensure a reliable stream of energy to power the data center. By co-siting offshore data centers and ocean renewable energy plants, expenses and time related to permitting, siting, manufacturing, and installing export cables can be eliminated, along with grid upgrades. Though most ratepayers will not be directly using the energy produced, co-locating offshore data centers and offshore renewables enables sustainable power to be delivered to critical infrastructure without increasing the load on the grid. Thus, rate payers receive the benefits of California leading the datacenter innovation race without suffering the rate impacts from increased demand on the grid.

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

To ensure feasibility of this concept and a clear benefit to ratepayers, various metrics could be considered:

Energy Efficiency: An offshore data center system should use less energy than a traditional data center of the same capacity.

Emissions intensity: Greenhouse gas emissions per unit of computing effort, accounting for all energy sources including backup generation and storage.

Cost Performance: Change in levelized cost of energy (LCOE) relative to traditional data center energy costs. Overall data center cost (including capital expenditure, operations, and maintenance costs) should be at or below traditional data center costs

Environmental Impact: A successful concept should mitigate or minimize negative environmental impacts

Individual quantitative metrics are important to measuring feasibility of a project, but overall feasibility should be evaluated based on a holistic view of all metrics.

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.

[1]https://www.scientificamerican.com/article/china-powers-ai-boom-with-undersea-data-centers/
[2] https://www.eesi.org/articles/view/data-centers-and-water-consumption
[3] https://www.nrel.gov/news/detail/program/2025/reducing-data-center-peak-cooling-demand-and-energy-costs-with-underground-thermal-energy-storage
https://news.microsoft.com/source/features/sustainability/project-natick-underwater-datacenter/

8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:[vii]
    1. Transportation Electrification
    2. Distributed Energy Resource Integration
    3. Building Decarbonization
    4. Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas
    5. Climate Adaptation

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

The proposed concept supports goal (d) Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas by improving efficiency of data centers while lowering the costs of ocean renewable energy, thus increasing viability of these energy sources. As power-hungry data centers proliferate, action must be taken to reduce power consumption and increase renewable energy generation; this concept combines both approaches to help achieve 100% net-zero carbon emissions.

The proposed research concept also supports (b) Distributed Energy Resource Integration by investigating hybrid offshore power plants that combine several distributed

marine renewable energy resources such as wind, wave energy, and solar. Through control co-design, this research concept will develop strategies for optimal dispatch, load balancing, and resilience in offshore energy hubs supporting data centers off-grid. This approach enables offshore renewable energy resources to operate as a unified system to improve reliability, smooth power production variability, and reduce curtailment.

[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

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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