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CA Solar Canal Initiative_USC Dornsife Public Exchange

Advancing Solar Canals: A Deployment Framework for Californiaâ€™s Energy-Water Infrastructure
(see attachment for full details)

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:

   Name: Doug Messer, Sr. Project Manager
   Email: messerd@usc.edu
   Phone: 213.821.9658

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

   University of Southern California Public Exchange

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?

   Advancing Solar Canals: A Deployment Framework for California's Energy-Water Infrastructure

   The proposed concept is to develop a practical, research-based framework for evaluating when and where solar canal projects make sense in California—based on the diverse conditions, constraints, and opportunities that exist across the state. Solar canals—solar photovoltaic (PV) systems built over water canals—offer a promising dual-benefit approach to clean energy and water conservation. With over 4,000 miles of canals statewide, California has abundant potential for deployment, but not all segments are technically, economically, or

operationally suitable. This research will produce a public-facing report and decision-support tools to help utilities, water agencies, regulators, and developers assess feasibility across canal types, ownership models, and geographies. Beyond prescribing specific project sites, the framework will clarify conditions under which solar canals can be viable, cost-effective, and publicly beneficial—and where they may not be. As many of California's canals traverse historically under-resourced communities, the project will also include a community benefits framework to support equitable participation in future deployments.

The research would be led by the California Solar Canal Initiative (CSCI)—a public-private-academic partnership led by the University of Southern California (USC) Dornsife Public Exchange and independent advisory firm Solar AquaGrid, with a research team comprising faculty from six California universities, including USC, UC Berkeley, UC Irvine, UC Merced, San Jose State University, and UC Law SF. The CSCI team is uniquely positioned to carry out this effort as its team includes researchers who conducted the initial feasibility analysis on solar over canals in California (UC Merced) and the strategic advisory firm that assembled and coordinates the three implementing partners of Project Nexus—the state's first solar canal demonstration project currently underway in the Central Valley. CSCI brings together interdisciplinary expertise in energy systems, water infrastructure, policy, engineering, and community engagement, and has established relationships with utilities, water agencies, and state decision-makers.

EPIC funds are essential to CSCI because it is a pre-commercial, cross-sector innovation that falls outside the scope of traditional research, philanthropic, or private investment funding. As a novel multi-benefit approach that intersects energy, water, and land systems, solar canal deployment requires early-stage, public-interest research to reduce uncertainty, clarify utility integration pathways, and define where it can deliver the greatest value. Because investor-owned utilities will be directly impacted by, and potentially benefit from, the distributed generation and grid support opportunities solar canals offer—especially in agricultural and transmission-constrained regions—EPIC is uniquely positioned to support the foundational research and framework development needed to inform future utility planning and infrastructure coordination.

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 proposed concept will support technological advancement not by inventing new hardware, but by enabling the deployment of existing technologies on existing infrastructure—solar PV and canals—in a new, integrated way. While California has funded a pilot project (Project Nexus at Turlock Irrigation District), there is no framework to guide how and where this model should be applied statewide. As a result, adoption is constrained not by technology limitations but by uncertainty around feasibility, cost-effectiveness, permitting, and community benefit. This initiative addresses those barriers by developing a public-facing deployment framework and supporting tools to guide decision-making across diverse canal, utility, water agency, and electricity contexts. By reducing risk and clarifying value, the project aims to stimulate a new category of distributed clean energy development that also delivers significant water conservation, land conservation, and community resilience benefits.

From a technical perspective, the initiative will build on insights from Project Nexus and emerging research to define performance benchmarks and contextual factors such as canal type, solar potential, energy yield, and cooling effects. This includes identifying conditions where solar canals provide at least higher generation efficiency than ground-mounted PV and where co-benefits like reduced evaporation and maintenance, and land conservation significantly improve project economics.

From a market and cost perspective, this initiative will conduct a *total value analysis* to understand the full range of benefits solar canal projects can offer. While construction costs may be higher than conventional ground-mounted solar due to the engineering complexities of the varied sites, solar canals also provide significant co-benefits—particularly water savings from reduced evaporation—that can offset those costs when properly accounted for. This initiative will help quantify and, where appropriate, monetize those benefits. Doing so could strengthen the investment case for solar canals by capturing avoided energy use from water pumping, improved water reliability, and land-use savings—factors that directly support the CEC's goals of accelerating clean energy deployment, improving system efficiency, and maximizing ratepayer value. By providing energy agencies, water managers, and developers with a more complete economic picture, this analysis will reduce uncertainty, enable smarter infrastructure investments, and advance California's integrated climate and energy resilience strategies—especially in water-stressed and under-resourced regions like the Central Valley.

The project also addresses critical information and planning gaps by producing publicly available tools and methodologies that water agencies, utilities, community choice aggregators (CCAs), and regional planners can use to evaluate project viability. These tools will help end-users assess not just

technical fit, but also regulatory complexity, land and water policy implications, and alignment with infrastructure and grid needs.

Finally, the initiative will develop a community benefits framework to support equitable participation in future solar canal deployments—especially in under-resourced communities across the Central Valley, where a majority of the state's canals are located. By embedding benefit-sharing and engagement strategies into the framework and identifying specific community use cases, the project will ensure that technological breakthroughs contribute directly to the resilience, wellbeing, and clean energy access of the communities most impacted by climate and infrastructure inequities.

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]

   If successful, this research will result in a first-of-its-kind deployment framework and decision-support tools that enable informed, cost-effective, and community-aligned development of solar canals across California. Even partial success—such as clearly identifying where solar canals are not viable—would reduce development risk, prevent costly missteps, and streamline clean energy planning efforts. According to a 2021 UC Merced study, if implemented at scale across the 4,000 miles of canals in California, solar canals could generate up to 13 GW of clean electricity (roughly one-sixth of California's SB 100 goal), conserve 63 billion gallons of water annually, and preserve up to 50,000 acres of land—all while leveraging existing infrastructure.

   The initiative will improve the overall value proposition of solar canal deployment by quantifying both the direct and indirect benefits—such as reduced evaporation, avoided land acquisition, and the potential to co-locate clean energy generation with existing water and grid infrastructure. These findings can reduce soft costs, increase project confidence, and support innovative financing models that account for water and land-use savings, thus making these projects more economically viable for utilities and developers.

   Aligned with EPIC's guiding principles, the anticipated ratepayer benefits include:

- Affordability: By monetizing water savings and other co-benefits, the research supports more cost-effective solar deployment strategies that reduce overall project costs over time.
- Reliability: Solar canals can distribute clean energy generation closer to where it's used—particularly in agricultural and rural areas—reducing transmission constraints and increasing local energy resilience.
- Environmental Sustainability: Projects can reduce water loss, preserve natural and agricultural lands, lower greenhouse gas emissions, and promote multi-benefit infrastructure investments.
- Equity: The initiative includes a dedicated community benefits framework to ensure that under-resourced communities—many of which are traversed by California's canal network—are engaged early and positioned to benefit from future deployments through local job creation, infrastructure upgrades, and improved energy and water resilience.
- Safety: Co-locating solar with managed canal corridors reduces exposure to wildfire-prone terrain and supports safer, more climate-resilient energy system operations.

Ultimately, this initiative would give California the tools to responsibly scale an emerging infrastructure model that simultaneously addresses energy, water, land, and equity challenges—delivering long-term value to ratepayers and the state.

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

The impacts of this research will be evaluated using a mix of quantitative and qualitative indicators that reflect the initiative's goal: to develop a practical, decision-support framework that helps determine when and where solar canal deployment makes sense, and how to maximize its public value. These indicators are structured around the core components of the framework: technical feasibility, policy and regulatory context, market and cost considerations, and community benefit. Importantly, these core components will be informed by direct dialogue and input from canal operators across the state as part of the research scope.

Technical Feasibility

- Estimated solar generation potential (GWh/year) based on canal characteristics and solar access
- Modeled water savings from reduced evaporation (gallons/year)
- Land preserved compared to ground-mounted solar (acres)
- GHG emissions avoided ($MTCO_2e$/year)
- Operational and maintenance considerations documented from the Project Nexus pilot
- Identification of feasible interconnection conditions and resource adequacy implications

- Summary of safety, infrastructure access, and environmental considerations (e.g., impacts on wildlife or canal operations)

Policy and Regulatory Context

- Number of regulatory or permitting barriers mapped and clarified
- Pathways identified for streamlining interagency permitting and approvals
- Number of regulatory engagement sessions held with state and local agencies

Market and Cost Considerations

- Modeled cost per kWh for solar canal systems, including installation and O&M costs
- Valuation of water savings, land-use savings, and other co-benefits to offset higher installation costs
- Development of financial models reflecting different ownership and deployment structures (e.g., public agency, public-private partnership, utility-led)
- Identification of monetizable benefit streams to improve overall project viability and attract investment

Community Benefit and Equity

- Number of under-resourced or frontline communities assessed using CalEnviroScreen and GIS tools
- Number of community interviews, workshops, or stakeholder sessions conducted
- Equity indicators, such as potential for improved clean energy access, cleaner air, water security, and workforce opportunities
- Qualitative feedback from communities on relevance, interest, and perceived value of solar canal deployment

Together, these indicators will help determine whether the research reduces uncertainty, improves decision-making, and supports the responsible, equitable expansion of solar canal infrastructure—aligned with EPIC's guiding principles.

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.

Technical Potential and Co-Benefits

- McKuin et al., Nature Sustainability (2021) – *Energy and Water Co-Benefits from Covering Canals with Solar Panels*
- CPUC 2022 Resource Adequacy Report
- CAISO Net Qualifying Capacity Reports (2022-2025)

- California SB 100 Joint Agency Report (2021)
- California's Water Supply Strategy. Governor Newsom's Administration, 2022
- California's Water and Energy Systems are Inextricably Linked. Public Policy Institute of California, December 2022.

Equity and Community Benefit Considerations

- Brás et al., Energy Research & Social Science (2024) – *People of the Sun: Local Resistance and Solar Energy (In)Justice in Southern Portugal*
- Fernandez-Bou et al. (2021) – *3 Challenges, 3 Errors, and 3 Solutions to Integrate Frontline Communities in Climate Change Policy and Research*

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 research concept supports multiple EPIC 5 Strategic Goals, with primary alignment to Distributed Energy Resource Integration and Climate Adaptation, and secondary relevance to Achieving 100 Percent Net-Zero Carbon Emissions and Building Decarbonization.

    1. Distributed Energy Resource Integration (Primary)

    This research supports distributed energy resource (DER) integration by enabling a novel siting and deployment model for solar generation that leverages California's existing canal infrastructure. Unlike conventional solar farms, canal-top solar arrays follow the linear path of water conveyance systems, creating opportunities to co-locate energy production with essential infrastructure over long distances. This linear configuration allows for deployment at a range of scales—from small canal segments that support localized distribution and agricultural loads, to larger spans that feed into the utility-scale grid. The proposed framework will help agencies and developers evaluate where canal solar best fits within California's DER landscape, how to overcome interconnection challenges, and how to align these projects with existing energy and water infrastructure investments. This approach supports EPIC's goal of accelerating the deployment of clean energy in ways that enhance system flexibility, reduce the need for new transmission, and optimize the use of existing assets.

2. Climate Adaptation (Primary)

This research supports climate adaptation by promoting integrated infrastructure strategies that enhance California's resilience to drought, land-use pressure, and air quality challenges. By identifying viable deployment conditions for solar canals, the framework advances solutions that reduce water loss via evaporation, thereby fortifying drought resilience. According to a 2022 report from the Governor's office, California faces losing up to 10 percent of its water supply by 2040—making the conservation potential of solar canals especially timely and critical. It also supports land conservation by co-locating solar arrays over existing canals rather than building on agricultural or natural habitats—conserving land for habitat conservation, housing, and economic development.

One potential opportunity of solar canal deployments is to reduce air pollution by supplying clean electricity that could replace diesel-powered irrigation pumps—common in parts of the Central Valley—thereby helping to lower NOx and particulate emissions in regions with the worst air quality in the state. Shading the canals with solar arrays also suppresses aquatic weed and algae growth, reducing maintenance-related emissions and significant chemical usage in the canal systems. This co-benefit alone is estimated to save up to $40,000 per mile in annual maintenance costs, with reductions in chemical inputs and labor.

Additionally, siting solar along canal corridors avoids wildfire-prone terrain, reducing exposure to fire-related damage and supporting safer, more resilient energy infrastructure. The proposed community benefits framework ensures that under-resourced and frontline communities—particularly in the Central Valley—are engaged, benefit from water and energy improvements, and strengthen local resilience. This approach supports California's integrated adaptation and resource management goals by advancing water and land conservation, reducing environmental impact, and enhancing system safety and community well-being.

3. Achieving 100 Percent Net-Zero Carbon Emissions (Secondary)

The research advances this goal by unlocking siting strategies that support the expansion of clean energy generation without the need for new land acquisition. By enabling energy generation along California's 4,000 miles of canals, the framework will help identify how this underutilized asset can contribute to reaching SB 100 targets while minimizing environmental and community disruption.

Previous research indicates that canal-based solar arrays could generate up to 13 gigawatts of renewable power annually—equivalent to one-sixth of California's current installed capacity and nearly half of the additional capacity required to meet the state's 2030 decarbonization benchmarks.

4. Building Decarbonization (Indirect)

While the research does not target building technologies directly, it supports the underlying clean electricity supply needed for decarbonized building systems. In particular, the framework may help rural and agricultural communities access local, renewable energy that can be used to power homes, irrigation pumps, water treatment, and municipal buildings.

In addition, California's water system currently consumes one-fifth of the state's electricity and nearly one-third of its natural gas for pumping, heating, and treating water. Reducing that footprint through canal-sited solar would indirectly support the decarbonization of building and industrial energy uses tied to water treatment and distribution.

5. Transportation Electrification (Indirect)

While the primary focus of this research is not on transportation systems, the proposed framework for solar canal deployment could support transportation electrification by identifying new opportunities to co-locate DERs along major transportation corridors. California's canal system—including segments that parallel Interstate 5—offers long, linear infrastructure pathways that may be suitable for hosting solar generation near highways and rural transit routes. By producing clean electricity along these corridors, solar canals could provide localized energy supply for future electric vehicle (EV) charging infrastructure, particularly in underserved or infrastructure-sparse areas of the Central Valley. This research could help lay the groundwork for integrated infrastructure planning that supports both clean energy and EV expansion across regions that currently lack adequate charging access—contributing to a more equitable, distributed, and resilient transportation electrification strategy over time.

In sum, this research will equip the state and its partners with the tools to evaluate and implement a new, dual-benefit infrastructure model that supports clean energy integration, strengthens climate resilience, and prioritizes equitable outcomes—consistent with the EPIC 5 Investment Plan's overarching goals.

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