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Factory-Installed Solar & Battery (FISS)

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:

Vamsi Kumar Kotla, CEO, vkk@remo.homes, (323) 708-4094

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

ReMo Homes

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?

Background

Currently, the cost of residential solar installations in California ranges approximately from $3 to $4 per watt, and the cost of battery storage ranges approximately from $1500 to $2000 per kWh. These costs are far higher than other states and decidedly higher than places like Australia and China, where installed costs are as low as $1.50/W and less than $1000/kWh. Bringing down these costs for ratepayers is urgent given the exigencies of climate change, and California's related goal of carbon neutrality by 2045 anticipated, coupled with the sunsetting of IRA and other incentives for solar and batteries. California will

struggle to reach its 2045 if distributed generation and home electrification are difficult to justify economically.

A significant reason for expensive solar and battery installed costs is the relatively high proportion of soft costs, which can reach three-fifths or more of overall costs. With factory-installed solar and storage on factory-built modular homes (built to meet or exceed 2025 Title 24 standards), installed cost can potentially be reduced by up to 50% while saving time as well. This pathway is backed by research by the U.S. DOE's Solar Energy Technologies Office (SETO).

Concept Overview

The Factory-Installed Solar and Storage (FISS) concept proposes integrating solar photovoltaic panels and battery energy storage directly into new homes at the offsite construction stage. By making clean energy a built-in standard rather than an add-on scope or retrofit, FISS reduces installation costs and time, streamlines permitting, and can help equip more homes for California's decarbonized energy future.

FISS aligns with all five EPIC 5 Investment Plan Strategic Goals. It would:

- advance **building decarbonization** through on-site renewable generation and storage powering electrified loads;

- support **distributed energy resource (DER) integration** through physical integration of distributed generation in homes in a more cost-effective and scalable way as well as with grid-interactive controls that allow the FISS to operate in concert with the grid;
- facilitate **transportation electrification** by enabling more widespread and reliable solar-powered EV charging;
- contribute to California's goal of **100% net-zero carbon emissions**;
- and enhance **climate resilience** by providing an integrated source of backup power during outages caused by wildfires, extreme heat, or grid disruptions.

Funding Need

EPIC funds will further the development of this concept to address key barriers, including high upfront costs and long construction timelines for homebuyers, lack of standardized design and permitting frameworks, and limited access for low- and moderate-income households. Funding would support pilot projects with builders (including modular/prefabricated housing providers) and utilities to refine and validate design, manufacturing/installation, controls, and interconnection

approaches; development of scalable financing and deployment models that respond to current developer and homebuyer needs; and demonstration of measurable benefits such as reduced greenhouse gas emissions, increased energy affordability, improved grid reliability, and greater community resilience.

This concept represents a distinctly worthwhile investment as it directly supports state climate targets and all five EPIC goals while also positioning California as a national leader in clean, future-aligned, and attainable factory-built housing.

4. In accordance with Senate Bill 96[1], 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)?

California's Title 24 (2025) code requirements mandate solar (or other renewable generation behind-the-meter) for many residential buildings and highly encourages battery storage. FISS can allow homes to meet or exceed these requirements more cost-effectively by reducing soft costs (such as labor, permitting, and interconnection) through factory efficiency and automation as well as streamlined approvals. It also saves hard costs by sourcing components directly from manufacturers or distributors at volume, instead of owners having to pay retail when adding solar on a project-by-project basis.

The FISS concept for modular homes integrates solar PV and battery storage directly at the factory, delivering cost-effective, resilient, grid-flexible, and zero-carbon-ready housing. Solar PV can be rooftop and/or building-integrated PV (BIPV). By embedding clean energy systems before homes are set and assembled on their sites, modular homes with FISS become a scalable solution to advance California's statutory energy goals under Senate Bill 96.

Barriers Addressed

[1] 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.

- **High Costs:** Factory integration and bulk procurement reduce system costs by **up to 50%%** by 2030 against installed cost baselines of $3–4/W for solar and $1500–2000/kWh for storage.
- **Permitting Delays:** Standardized factory-built designs and pre-approved interconnection packages can cut approval timelines by **50% or more**.
- **Reliability:** Integrated storage provides **8–12 hours of backup power** for critical loads during outages, supporting resilience in wildfire- and heat-prone regions and enabling grid flexibility.
- **Equity:** Deploying FISS modular homes in affordable housing markets and Tribal areas could yield **$500–$800 in annual bill savings** for low- and moderate-income and other marginalized households.

Breakthroughs and Data Contributions

- **Cost-Reduction Optimization:** Refinement of design innovations and process improvements to yield significant installed cost savings.
- **Cost-Benefit Analysis:** Verified lifecycle savings, emissions reductions, and resilience metrics.
- **Grid Integration:** Field data on modular communities providing load shifting, peak demand reduction, and microgrid capabilities.
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- **Equity Outcomes:** Demonstrated reduction in energy burden for disadvantaged communities.

Beneficiaries

- **Consumers (Homeowners and Residents):** Affordable, resilient, and energy-independent homes.
- **Utilities:** Streamlined DER integration and improved grid flexibility.
- **Builders/Manufacturers:** Standardized, code-compliant clean energy designs.
- **Policy Makers:** Data to shape incentives and regulations for factory-built clean energy housing. Progress toward existing policy goals.

By embedding solar and storage into modular homes at the factory, FISS can deliver scalable technological breakthroughs in cost, resilience, and equity—positioning California to lead in clean, resilient housing solutions.

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 innovation at scale? How will the innovation lead to ratepayer benefits in alignment with EPIC's guiding principles to improve safety,[2] reliability,[3] affordability,[4] environmental sustainability,[5] and equity?[6]

- **Affordability:** Bring down the average installed cost of solar PV and battery storage in homes by as much as 50% (from around $3–4/W for solar and $1500–2000/kWh for batteries).
- **Safety and Reliability:** Improve worker safety by dramatically reducing in-field time on roofs. Precisely and traceably install solar PV panels, balance-of-system components, and batteries in a quality-assured and controlled factory environment.
- **Environmental Sustainability:** Solar PV and batteries can lessen pressure on the grid, especially during the peaks of the "duck curves," reduce the need for the grid to bring non-renewable peaker plants online, and provide other grid services that support a greening grid. Behind-the-meter power generation and storage also minimizes conversion and transmission losses, increasing overall efficiency. Scalable, cost-effective, and flexible distributed generation and storage helps meet the state's 2045 carbon neutrality goal

If successful, the FISS concept for modular homes will provide transformative benefits for California's ratepayers, housing sector, and energy system, in alignment with EPIC's guiding principles.

Cost Reductions & Affordability

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[2] EPIC innovations should improve the safety of operation of California's electric system in the face of climate change, wildfire, and emerging challenges.
[3] EPIC innovations should increase the reliability of California's electric system while continuing to decarbonize California's electric power supply.
[4] 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.
[5] 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.
[6] 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.

- Lower solar PV and battery storage system costs by **up to 50%** compared to separate on-site installation through factory integration, streamlined processes, and bulk procurement.
- Enable embedded mortgage financing, eliminating large upfront costs or less-favorable separate financing for homeowners.
- Deliver **$500–$800 in annual bill savings per household**. At scale, deployment in **100,000 modular homes** could save ratepayers **$50–$80 million annually** (this does not directly account for the value of grid services, which can also provide indirect savings to ratepayers by reducing utilities' capital and operational costs).

Safety & Reliability Improvements

- Provide **8–12 hours of backup power** for critical loads, improving safety during outages and reducing reliance on dirty diesel generators.
- Improve worker safety by dramatically reducing in-field time on roofs. Precisely and traceably install solar PV panels, balance-of-system components, and batteries in a quality-assured and controlled factory installation environment.
- Lessen pressure on the grid. For example, through coordinated smart controls, **100,000 FISS homes** could shift **400–600 MW of peak demand**, strengthening grid reliability and reducing utility infrastructure costs.
- Enhance resilience in wildfire- and heat-prone communities, protecting vulnerable households.

Environmental & Equity Benefits

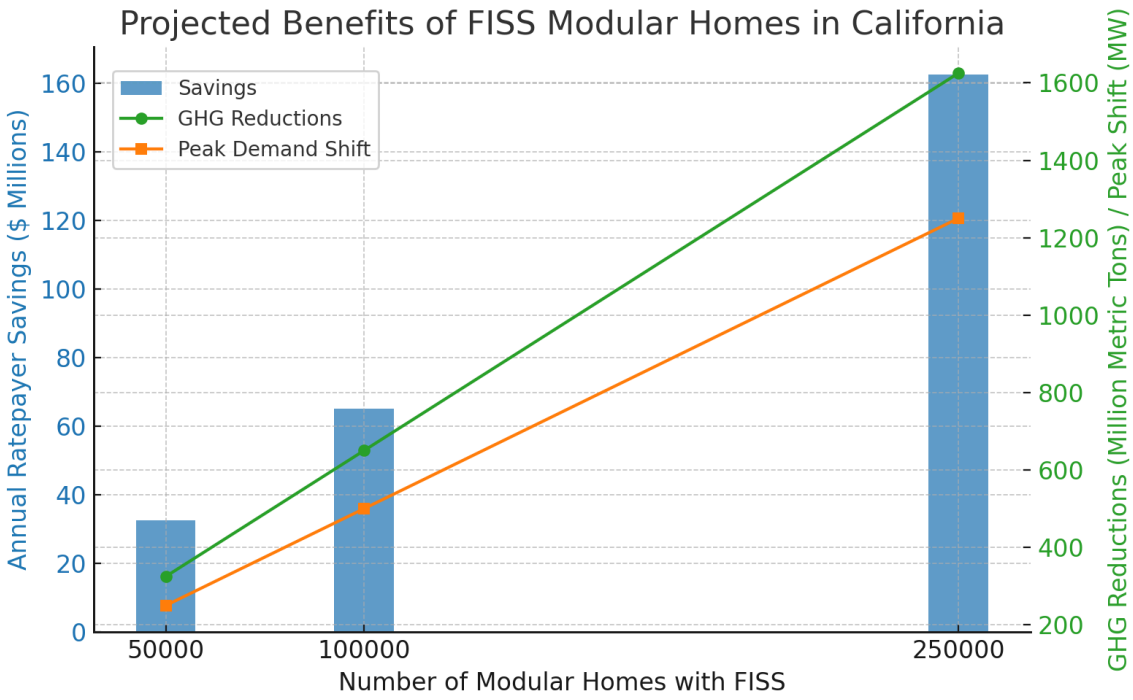
- Avoid **0.5–0.8 million metric tons of CO_2 emissions annually** with 100,000 homes equipped with 5 kW PV and 10 kWh storage each.
- Reduce the need for the grid to bring dirtier fossil-fueled peaker plants online. Provide other grid services that support a greening grid.
- With behind-the-meter power generation and storage, minimize conversion and transmission losses, increasing overall efficiency.
- Target deployments in disadvantaged communities, including Tribal communities, reducing household energy burdens by up to **25%** and advancing environmental justice.
- Position modular homes as a scalable solution to cost-efficiently meet Title 24 net-zero requirements and advance the state's 2045 carbon neutrality goal..

Innovation at Scale

Widespread adoption of FISS in modular housing could establish solar-plus-storage as a **default standard** for new construction, transforming

California's housing stock into a distributed, resilient, zero-carbon energy resource.

By advancing affordability, reliability, resilience, sustainability, and equity, FISS aligns directly with EPIC's guiding principles and has the potential to deliver measurable statewide benefits for decades:



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

Quantitative Metrics

- **Installed Cost Reductions:** Achieving a target of around 50% installed cost reduction for solar PV and batter storage in California (from around $3–4/W for solar and $1500–2000/kWh for batteries).
- **Ratepayer Bill Savings:** Average annual household savings of **$500–$800**; aggregate savings for deployed units.
- **Resilience Outcomes:** Hours of backup power provided (target: **8–12 hours** for critical loads).

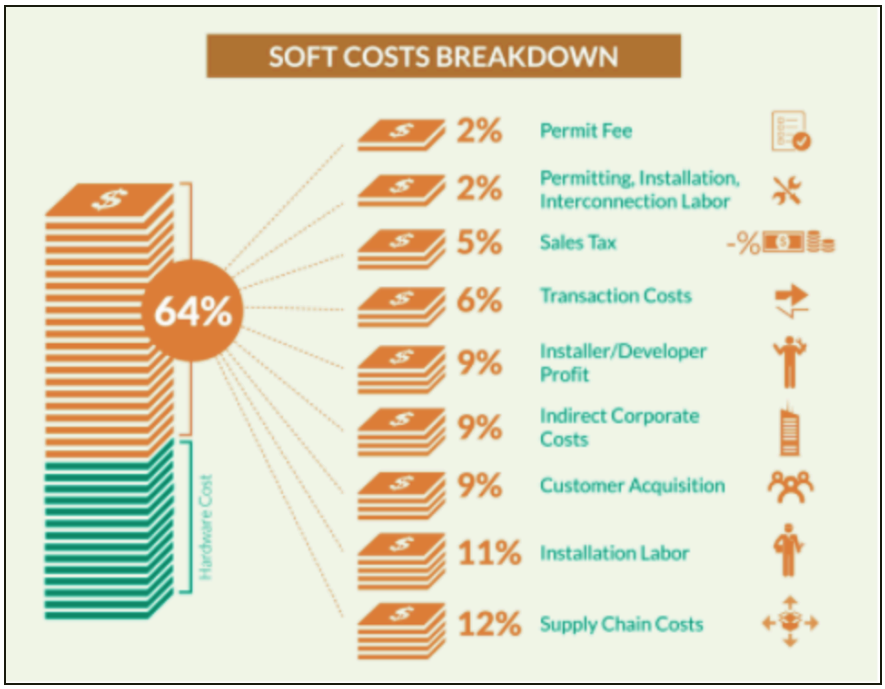
- **Grid Benefits:** Peak demand reduction (targeting **4–6 kW per home**) and aggregate MW shifted; load-shifting and demand-response participation rates.
- **Environmental Impact:** Annual greenhouse gas (GHG) reductions, targeting **0.5–0.8 million metric tons CO_2 avoided per 100,000 homes**.
- **Equity and Access:** Percentage of installations in low- and moderate-income and Tribal communities; percentage reduction in household energy burden.

Qualitative Metrics

- **Customer Satisfaction:** Homeowner feedback on affordability, reliability, and ease of use (goal of **>90% satisfaction**).
- **Deployment Scalability:** Builder and developer feedback on ease of adoption, permitting efficiency, and Title 24 compliance.
- **Community Resilience:** Case studies on performance during grid outages, wildfire events, and extreme heat conditions.
- **Market Transformation:** Evidence of replication in the housing industry and adoption of factory-installed clean energy as a standard practice.

Together, these metrics will demonstrate whether FISS modular homes improve affordability, reliability, safety, sustainability, and equity, providing actionable insights for utilities, policymakers, builders, and consumers.

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.



8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:[7]
    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.

This concept supports aspects of all five EPIC 5 Investment Plan Strategic Goals. (Please see “Concept Overview” under Question 3.)

[7] 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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