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AFFORDABLE Net Zero & Regenerative Homes and Buildings NOW

The proposed ADUs and microhomes are designed to be built in DACs by DAC members. The potential impact on housing affordability makes this one of the most important sets of innovations in building NZE and Regenerative housing accessible and affordable to all.

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:

   Mark Isaacs
   mark@wonderwindow.net
   228 363 2529

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

   GS Research LLC

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 concept brings 19th century lightweight wood frame construction into the 21st century to yield AFFORDABLE Regenerative new construction that addresses California grid stability & building decarbonization, with low embodied and operational energy.

   Net Positive Energy ADUs address California's housing affordability crisis with microhomes as low as $25,000 DIY and $50,000 contractor built. The ratepayers' EPIC funds are well spent in bringing these results to scale in California, spreading NZE & Regenerative performance to new multi-family, hotel, and light commercial new construction.

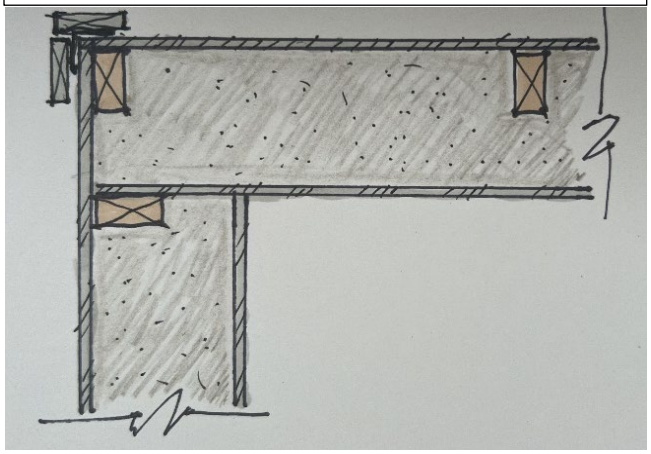
4. In accordance with Senate Bill 96[i], please describe how the proposed concept will "lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals." For example, what technical and/or market barriers or customer pain points 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 past is prologue to a future where Net Zero and Regenerative buildings are the norm. A CalTestBed-funded validation at Berkeley Labs' FLEXLAB gave confidence in building a 672sf home in Chico using Version 1.0 of the window-integrated envelope with only 7 rooftop solar panels providing 2.8kw with a small' 5kwh battery.

   The home has produced one Megawatt Hour more than it consumed since February 2025. The owner reports maintaining interior comfort without turning on the high SEER mini-split heat pump air conditioning until

outside temperatures hit 100 degrees F. The home cost $172,000 hard costs with soft costs and land bringing the total over $300,000.

Above: a 3 glazing layer unit is sealed by the fold-down lip front and back. Two such units friction-fit into a framed opening to create an R6.6 fixed window. The exposed grey foam acts as a gasket sealing against trim inside and out, caulked at the perimeter to provide a water-&-air-tight seal. Emergency egress & ventilation are provided by doors with screens.



Lessons learned from this Version 1.0 home have resulted in a pending patent for easier-and-cheaper-to-build R6-R9 windows, with an R7 2248 window costing $290. Two additional patents pending deliver an affordable approach to R30-R45 walls and R45-R60 ceilings.

Version 2.0 of the windows now require repeat of the National Fenestration Ratings Council (NFRC) thermal/optical and North American Fenestration Standard air/water/structure (NAFS a/k/a WDMA 101/AAMA 101/CSA 101) testing by Intertek Fresno with QA/QC review & Listings by the International Codes Council-Evaluation Services (ICC-ES) of La Brea, CA.

The recent wall innovations require ASTM E72 racking resistance testing by Intertek Fresno with ICC-ES review and Listing.

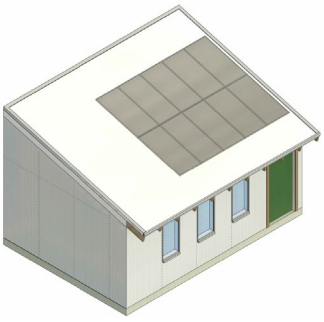
The proposed Version 2.0 R&D would also use modeling and measured and verified 120sf microhomes built in representative CA climate zones to prove the affordable cost of regenerative construction, and seed impact in Disadvantaged

Communities (DACs). This should lead to applications in stacked flats, townhomes, carriage homes, wood frame hotels, etc.

A CBECCS model of a 120sf microhome with 2kw rooftop solar plus a 5kwh battery using the window-integrated envelope has a Time-of-Day Value ("EDR2") **87% lower than the code-compliant Standard Model**. This 120sf microhome design has been cost estimated at an AFFORDABLE $25,000 DIY and $50,000 contractor built.

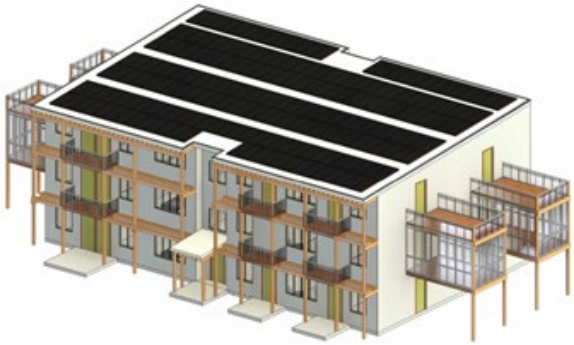
Over forty years after 24" centered "Optimum Value Engineered" framing was introduced, most US new homes still get framed 16" on-center, which automatically has a third more thermally radiating framing members than 24" spaced construction. Market transformation requires widely disseminated and easily accessed You Tube videos and in-person demonstrations that show ease of assembly with clear cost-, material- and energy-efficiency.

The research aims to show that grid-stabilizing Net Zero and Regenerative performance can be delivered at LESS FIRST COST than conventional code-compliant construction across California climate zones. The solution uses bio-based natural forest products up-cycled in fire-resistant low-embodied energy, high recycled content borate-treated cellulose dense pack insulation, fiber-cement cladding, and ground contact heavy timber R30 insulated foundations, replacing high-embodied-energy, hard-to-insulate concrete slabs.



Past R&D with Oak Ridge National Labs applied the window-integrated envelopes to ADUs, stacked flats, townhouses, and 4-story hotels modeling Near and Net Zero Energy performance in hot humid Houston, temperate New York, and cold Minneapolis. The proposed work would enable Version 2.0 updates of those energy and CAD models, with those Green Template designs, updated costs and related

continuing education leading to adoption as 21st century Best Framing Practices.



Architects, engineers, builders, and real estate developers will derive satisfaction in cost-controlled, predictably priced construction that reliably delivers Wildfire Resistive Net Zero & Regenerative Energy performance across California.

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]

   Ratepayer benefits come in improved safety, reliability, affordability, and environmental sustainability as highly anticipated outcomes:

   A $390 window becomes $100 more affordable at $290 for a 2248 R6.7 window twice the thermal resistance of Energy Star. An R5.6 2248 window is likely to prove optimal for California targeting the same $225-250 price range of R3.3 Energy Star windows, a 70% thermal resistance improvement at no extra cost.

   For LESS FIRST COST than conventional 2x4, 16" centered stud construction, we will deliver wildfire resistant envelope construction with enhanced passive survivability and comfort, and AFFORDABLE Net Positive Energy performance: Regenerative by Design.

With ADUs and microhomes the fastest growing segment of the California housing market with 25-40,000 units expected per year for the foreseeable future, with continuing exponential growth projected, having them be Net Energy Producers like the Chico home with 50% of its supply exported back to the grid at peak or part-peak times, at an **87% improvement over the CBECCS Time-of-Day-Value ("EDR2") code-compliant Standard Model: new Regenerative construction becomes grid stabilizing with increasing impact targeting 120-200,000 new multi-family, single-family, hotel, assisted living, and light commercial units built annually in California.**

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

   Metrics:

   - Net Energy Use Intensity (EUI) in BTU/sf/year annually and Time-of-Day-Value ("EDR2") from CBECCS code compliance models of the ADUs and other selected prototypes.
   - Actual energy performance from utility bill info of monitored built prototypes as well as measured interior temperature as a comfort indicator.
   - Cost of construction, both modeled & actual for several sites across the state.
   - NAFS and NFRC window testing results related to resistance to 90-120 mph winds, or more, and window thermal conductance/resistance, % Visible Light Transmission, Solar Heat Gain Coefficient, and Condensation Resistance Rating of windows
   - ASTM E72 structural racking resistance test results.

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.

Isaacs, Mark, Dr. Mahabir Bhandari, ORNL, & Je Burger, MS Polymer Institute, "Novel R7 Fixed Windows & R9 Daylight Transoms for Net Zero Energy Buildings", ASHRAE BUILDINGS XV Conference, December 2022. https://drive.google.com/drive/home

Kunwar, Dr. Niraj, Dr. Mahabir Bhandari, Mark Isaacs, John Ross, Matt Wong, Abigail Gauthier, CAD-Based Energy & Cost Models Prove Affordable Net Zero Energy Performance For WonderWindows + 24" On-Center Framing; June 2024, https://www.osti.gov/servlets/purl/2472701/

1000 Gretas Award Recognition

https://www.1000gretas.org/post/innovator-spotlight-mark-isaacs-wonderwindow-net-zero-energy-in-every-backyard?utm_medium=email&_hsenc=p2ANqtz-_WaAiZbAiIxOu-sR05VKMUPo8jkNTtc2_UFr_lrkVHZc1LRDjfR1d8PBBWNQanGhLl7ItCdSo4Gb18qsQN3Bq8hNUAQQ&_hsmi=367609791&utm_content=367609791&utm_source=hs_email

BUILD Review Award for Customer Service Excellence 2025
Leading Net Zero Window Systems Provider 2025 - USA
https://docs.google.com/document/d/1ofRzsJI0K__W_KbE8g_fgRELp8n9RcIc/edit

8. The EPIC 5 Investment Plan supports the five Strategic Goals:[vii]

Transportation Electrification
Net Zero Energy and Regenerative ADUs, microhomes & multifamily densify their neighborhoods (without looking 'dense'), distributing infrastructure cost over more households & serving more households with mass transit, bicycle lanes, & electric vehicle charging 40A circuits built into the new construction.

Distributed Energy Resource Integration
Green Template designs at all sizes of buildings have right-sized rooftop solar pre-specified, and already in the cost budget, bill of materials, and online 'shopping cart'. In the ADUs and micro-homes pre-assembled plug-n-play solar panels with integrated 5 kwh battery systems with built-in inverters and power center with 110V AC and USB low voltage plugs.

Building Decarbonization
CBECCs calculations of both the built 672sf Chico home (and its actual performance) and the 120sf microhome model deliver 87% improved ("EDR2") Time-of-Day performance over the Standard code-compliant Design at LESS FIRST COST. Net Zero or Regenerative energy performance, wildfire resistance and ultra-low embodied energy are designed in. All Green Template building types are fully electric and designed to have their energy needs met by rooftop solar with modest battery packs.

Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas
Gas is a bridge fuel to the future, needed for Combined Heat and Power tweaker turbines, and for powering existing buildings as they decarbonize in stages.

Close friends in Fairfield, CA have 20 solar panels on their roof but continue to use a gas furnace and gas hot water heater. They expect they will invest in heat pumps for space conditioning and water heating as their existing equipment reaches end-of-life and demands replacement.

Their anecdotal experience suggests that even under the best of conditions, residential decarbonization will happen in 2 or more stages, and may span over a decade or more, even when the will and practical resources are available and engaged.

In the meantime, our window-integrated envelopes and Green Template designs show how new construction can be built today with Net Zero *and Net Negative* Carbon Emissions, saving gas use for existing buildings.

Climate Adaptation

Adapting wood frame construction and bio-based materials for wildfire resistance without adding extra cost is a necessity when wildfires are the new reality. The white and light colors of the building exteriors decrease albedo temperatures. Their designed-in landscaping and trees provide shade and reduce urban heat island effect.

The R30 perimeter-insulated, ground-coupled foundation, the radiant barrier envelope, and thermal storage inside the envelope through waterbeds, etc. are likely to have a climate adaptation and grid stabilization effect beyond what we have measured to date. Bi-directional car charging can extend the energy storage required for climate adaptation. We expect demand curves to be shaved and shape-shifted at scale while maintaining comfort.

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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.

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