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Electric Program Investment Charge 2026â€“2030 (EPIC 5) Research Concept Proposal

Additional submitted attachment is included below.

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:

   Orly Hasidim
   orly@universal-devices.com
   818-489-7672

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

   NuCore^{AI}.

   Universal Devices has open-sourced and MIT-licensed all assets related to this proposal, and contributed them to the non-profit organization NuCore^{AI} Foundation (https://nucore.ai) .

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?

NuCore^{AI} is an open, AI-enhanced building and smart home management platform developed and contributed by Universal Devices and governed by the non-profit NuCore^{AI} Foundation. It addresses long-standing fragmentation in smart energy and automation by unifying diverse protocols, devices, and standards under a single, plugin-based, natural language-driven interface.

Purpose and Objectives:

- Eliminate Vendor Lock-In and Protocol Silos: Facilitate seamless communication across all devices by leveraging their native protocols, while maintaining full compatibility with standardized devices. This approach avoids protocol fragmentation and mitigates reliance on proprietary ecosystems.

- Ensure Compatibility with Existing Infrastructure: Support integration with customers' current devices and systems, maximizing investment protection and minimizing disruption.

- Support Grid Optimization Through Data-Driven Insights: Leverage anonymized device and usage data that is collected with privacy safeguards, for advanced analytics, enabling utilities and grid operators to enhance demand forecasting, improve reliability, and design more responsive demand flexible programs.

- Deliver Intuitive Optimization for End Users: Empower customers to optimize energy usage, comfort, and cost without requiring expertise in complex technologies, device configurations, or dynamic tariff structures.

- Accelerate Development Through Plugin Frameworks: Enable manufacturers and developers to define and generate plugin skeletons in minutes, reducing development cycles from months to days.

- Disrupt the Cycle of Fragmented Standards: Provide a unified and extensible framework that overcomes the limitations of siloed ecosystems and the burden of continually evolving specifications.

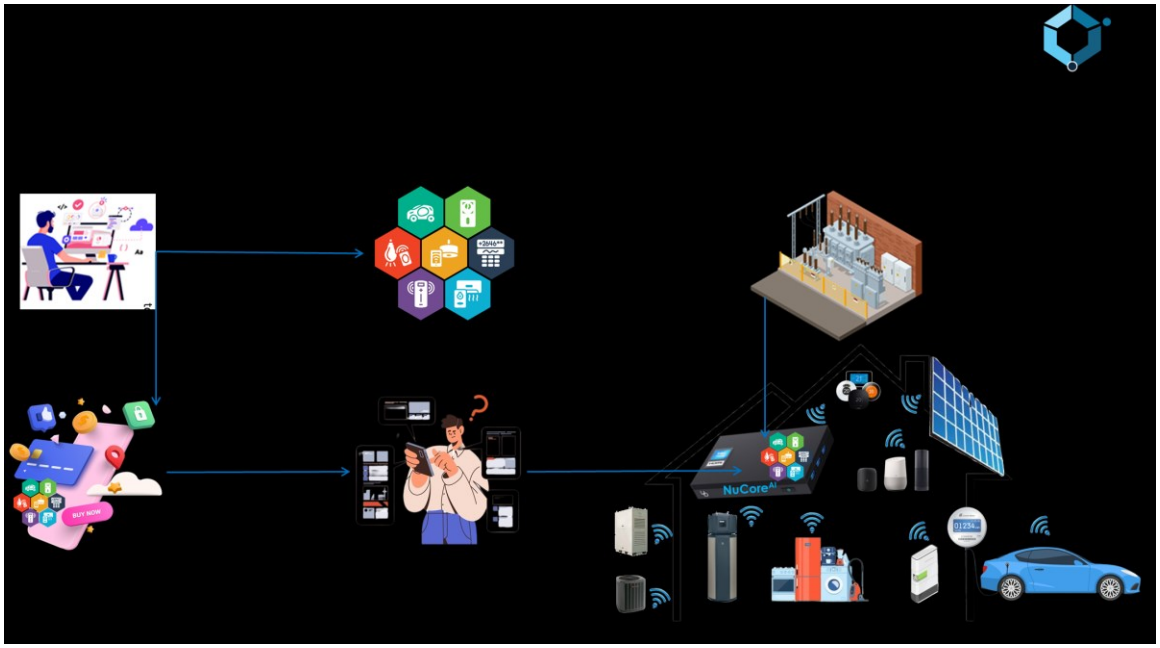
Why EPIC Funds Are Needed:

- Support the continued open-source development of the platform, accelerating plugin creation for DERs, grid-responsive devices, and utility integration.

- Advance AI tooling that maps natural language to real-world automation and energy use cases that are vital for equitable adoption across California's diverse communities.

- Foster industry-wide collaboration through a neutral, nonprofit foundation with no membership fees or vendor lock-in, ensuring regulatory alignment and long-term sustainability.

This investment will catalyze a new era of accessible, intelligent, and standards-agnostic demand-side energy management across homes and buildings.



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 NuCore^{AI} platform and foundation directly advance California's statutory energy goals by overcoming key *technical, market, and user adoption barriers* that have historically hindered the widespread deployment of clean energy technologies in buildings and homes.

Barriers Addressed:

1. Protocol and Standards Fragmentation (Technical Barrier)

- Problem: Diverse device protocols (Z-Wave, Zigbee, Matter, BACnet, etc.), in addition to myriads of WiFi based proprietary protocols (Tesla, Ecobee, Nest, etc.) and endless standard revisions create integration and interoperability challenges.

- Solution: NuCore^{AI} uses a plugin-based architecture that enables native communication across devices regardless of protocol. This reduces engineering overhead, accelerates innovation, and makes it easier for DERs, grid-interactive appliances, and legacy systems to participate in clean energy programs. Furthermore, it addresses one of the most important barriers for demand flexibility: requiring installation of new equipment.

2. Lack of Unified Customer Interface (User Barrier)

- Problem: End-users are overwhelmed by incompatible devices, apps, differing and incomprehensible tariff structures, and unintended device behavior especially when optimizing for energy savings.

- Solution: The AI-backed natural language interface allows customers to optimize their environment using plain English, eliminating the need for technical knowledge. This significantly lowers the barrier to participation in demand flexibility, TOU optimization, and electrification.

3. Slow Manufacturer Adoption (Market Barrier)

- Problem: Manufacturers are frequently burdened with developing custom integrations for each protocol, standard, or utility program. This

results in high development costs, extended lead times, limited scalability, and ultimately hinders widespread adoption.

- Solution: NuCore^{AI} offers a unified, protocol-agnostic platform that dramatically simplifies and accelerates integration. By allowing manufacturers to retain their native communication protocols and equipping them with streamlined tooling, NuCore^{AI} reduces integration efforts from months to days. This accelerates time-to-market and enables scalable, efficient participation in utility programs and energy optimization initiatives.

  Furthermore, as long as manufacturers expose publicly accessible and official APIs, regardless of the format, third-party developers can create plugins on their behalf, alleviating the integration burden entirely.

  To further incentivize participation, developers can monetize their plugins through the NuCore^{AI} Plugin Store, fostering a vibrant marketplace that drives innovation and accelerates ecosystem growth.

4. Innovation Gridlock from Standard Overload

- Problem: Constantly evolving standards create delays and uncertainty.

- Solution: By decoupling innovation from rigid standards, NuCore^{AI} breaks the cycle and enables a more adaptive ecosystem, governed by an independent non-profit that ensures openness, trust, and regulatory alignment.

Targets and Outcomes for Broader Acceptance:

- **Cost Target for Deployment:**
  - *On-prem*: Less than $200 per home (based on low-cost implementer hardware).

  - *Cloud-based*: SaaS pricing based on actual usage, reducing upfront capital costs.

- **Performance Goals:**

- Broad Device Support: Achieve support for 1,000+ device types through plugins within 12 months**.**
- High AI Accuracy & Speed: Deliver **>**90% accuracy in natural language automation for routine energy and comfort tasks, with processing speeds exceeding 20 tokens per second**.**
- Rapid Plugin Generation: Enable skeleton plugin creation in under 30 minutes per device profile for manufacturers and developers.

Data and Scientific Gaps Addressed:

- **Semantic Mapping Gaps:**

  AI-driven classification and semantic understanding tools address a critical gap by translating unstructured user input, device metadata, and utility signals into actionable automation and optimization. For example, a user can simply say, “make it warmer” without specifying the device, command, or parameter. Similarly, a request like “optimize my charging and HVAC so I don’t pay too much when prices go over $0.75” lacks explicit references to a specific EV, thermostat, or utility tariff.

- NuCore^{AI}’s AI engine bridges this ambiguity by inferring intent and establishing semantic correlations between the user’s request, their plugin ecosystem, and the capabilities of their devices, and thus enabling intuitive, intelligent control without requiring technical knowledge.

- **DER Interoperability Models:**

  By aggregating anonymized plugin data, the platform can help utilities, regulators, and researchers analyze DER behavior, predict load shifts, and simulate demand flexibility scenarios.

- **Beneficiaries:**
  - **Consumers** gain access to simplified energy management and increased participation in incentive programs.
  - **Developers** monetize their effort

- **Manufacturers** reduce integration costs and broaden market access.
- **Utilities and researchers** gain scalable tools for modeling customer behavior and DER performance across heterogeneous ecosystems.
- **CEC and policymakers** benefit from faster adoption of demand flexibility and electrification goals aligned with SB 100 and SB 49.

In conclusion, NuCore^{AI} represents a technological and market breakthrough by turning today's fragmented, vendor-centric energy landscape into an open, intelligent, and participatory ecosystem. It directly accelerates the adoption of clean energy technologies and supports California's climate and energy goals through scalable, equitable, and adaptive infrastructure.

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, the NuCore^{AI} platform and foundation will fundamentally transform how buildings and homes participate in California's clean energy future: reducing costs, improving performance, and enabling equitable access to advanced energy management. Even if partially successful, the outcomes will still offer substantial benefits across multiple EPIC priority areas.

   Anticipated Outcomes:

   1. Reduced Costs for Consumers and Implementers

   - **Lower Technology Costs:**

   Open-source, MIT-licensed platform removes licensing fees and reduces hardware costs by fostering competition on low-cost, local deployments (<$200/home).

- **Reduced Integration Costs:**

Manufacturers can auto-generate plugins skeletons from natural language, avoiding expensive custom integrations or third-party middleware. Developers can develop plugins based on publicly available APIs by manufacturers.

- **Minimized Operational Costs:**

Can integrate existing devices rather than forcing customers to buy new devices.

2. Increased Performance and Adoption

- **Faster Time-to-Deployment:**

New devices and DERs can be added to the platform in hours rather than months, accelerating innovation cycles.

- **Improved Automation Accuracy:**

AI interface ensures >90% accuracy in parsing and executing natural language automation commands, improving user trust and engagement.

- **Scalable Architecture:**

Plugin ecosystem can grow to support tens of thousands of device **profiles**, creating a robust and future-proof foundation.

Potential at Scale:

- **Statewide Deployment Potential:**

Can scale across millions of homes and buildings, regardless of hardware and existing devices.

- **Utility Program Integration:**

Seamless plugin integration with smart thermostats, EV chargers, water heaters, and storage unlocks greater demand flexibility and load shifting.

- **Grid Responsiveness:**

Real-time integration with dynamic pricing and grid signals ensures demand-side resources can be orchestrated at scale with minimal friction.

Ratepayer Benefits Aligned with EPIC Principles:

EPIC Principle	NuCore^{AI} Impact
Affordability	Lowers upfront and ongoing costs for both customers and service providers by using free, open-source software and affordable hardware.
Reliability	Enables real-time, AI-optimized control of DERs and load shifting to support grid stability.
Safety	Reduces manual intervention and risk-prone configurations by enabling automation through a trusted, neutral platform.
Environmental Sustainability	Promotes widespread adoption of DERs and electrification technologies through interoperability and automation.
Equity	Designed to work on any device, cloud or local, without vendor lock-in, ensuring underserved communities can access and benefit from advanced energy tools.

In conclusion, NuCore^{AI} has the potential to significantly reduce technology and ratepayer costs while increasing participation in California's clean energy goals. It offers a scalable, flexible, and inclusive foundation for energy automation that aligns precisely with EPIC's mission to deliver safe, affordable, equitable, and sustainable energy innovation to all Californians.

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

   To assess the success and impact of the NuCore^{AI} research concept, a combination of quantitative and qualitative metrics will be used. These metrics are designed to evaluate platform adoption, cost-effectiveness, technical performance, customer experience, and alignment with California's clean energy and equity goals.

Quantitative Metrics

Metric	Target / Indicator	Purpose
Deployment Cost per Site	<$200 for on-premise deployments	Demonstrates affordability and scalability
Plugin Development Time	<2 hours per new device profile	Validates ease of integration for manufacturers
Automation Accuracy	>90% success in parsing and executing user commands	Measures effectiveness of natural language AI
Device/Plugin Coverage	>1,000 supported device types in first 12 months	Assesses platform extensibility
User Adoption	Number of active users and organizations deploying NuCore^{AI}	Indicates market traction and ecosystem growth
Load Flexibility Enabled	kW/MWh of flexible load integrated across participants	Measures demand-side impact for grid support
Ratepayer Cost Reduction	% reduction in bill or automation service costs vs. status quo	Quantifies financial value to end users

Qualitative Metrics

Indicator	Evaluation Focus
Customer Feedback	User satisfaction, usability, and perceived value of AI interface and automation capabilities
Developer Feedback	Experience with plugin creation tools, documentation quality, and onboarding process
Utility and Regulator Input	Integration success, regulatory alignment, and usefulness of anonymized plugin metadata for demand flexibility modeling

Indicator	Evaluation Focus
Equity Outcomes	Accessibility and deployment in disadvantaged or underserved communities, based on location and demographics
Standards Impact	Reduction in vendor-specific implementations or duplicated efforts in standards development

Continuous Monitoring and Evaluation

All metrics will be tracked throughout pilot deployments and early rollouts using:

- Built-in telemetry (with user consent) for usage and automation performance
- Surveys and focus groups for qualitative feedback
- Plugin store analytics to monitor ecosystem growth
- Energy data (where available) to track demand response and savings outcomes

In conclusion, these metrics ensure a comprehensive evaluation of NuCore^{AI} impact, measuring not only technical performance and cost reduction but also customer experience, equity, and system-level benefits to the grid and the State of California.

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.
The NuCore^{AI} research concept is grounded in industry trends, field experience, and publicly recognized challenges in energy automation, grid integration, and smart building technologies. Below are references that support the **cost targets, technical potential, market barriers, and equity benefits** described in this proposal.

1. Market and Technical Barriers

- **CEC Smart Home Roadmap (2021)** – Highlights fragmentation in device protocols and lack of consumer-friendly automation interfaces as a barrier to clean energy adoption.
Source: California Energy Commission, "California's Smart Home Roadmap," https://www.energy.ca.gov

- **NREL Grid-Interactive Efficient Buildings (GEB) Technical Report** – Emphasizes need for unified platforms and open standards to achieve grid integration at scale.
Source: NREL, "Grid-Interactive Efficient Buildings," NREL/TP-5500-78542, 2021

2. Open Source and Cost Targets

- **Experience from Universal Devices, Inc.** – Over 20 years of commercial deployment experience with affordable local energy management controllers has demonstrated that costs under $200/home are achievable with open-source software and commodity hardware.
Internal reference: Universal Devices Inc. field deployments and product data

- **OpenADR and Transactive Energy Pilots** – Past CEC-funded pilots (e.g., OpenADR 2.0a/b and TE initiatives) show that proprietary integration, new equipment installations, and rigid standards lead to high implementation costs and slow device onboarding, validating NuCore^{AI} plugin-based, adaptive architecture.
Source: CEC EPIC Project Data – e.g., EPIC-15-066 and EPIC-17-042

3. Natural Language Interface and AI Automation

- **DOE Buildings-to-Grid Integration Roadmap** – Calls for intuitive automation interfaces, including AI-driven tools, to simplify consumer participation and support dynamic tariffs.
Source: U.S. Department of Energy, “Buildings-to-Grid Integration Roadmap,” 2020

- **MIT-licensed AI integration** within NuCore^{AI} leverages current advancements in transformer-based models (e.g., GPT/Qwen) to **map user input to device-level actions**, closing the usability gap for non-technical users.

4. Equity and Open Governance

- **SB 100 & SB 49 Goals** – State policy requires inclusive, equitable energy solutions that serve all Californians, including low-income and disadvantaged communities.
Source: California Senate Bill 100 (2018), Senate Bill 49 (2021)

- NuCore[AI] **Foundation** – Designed as a vendor-neutral, nonprofit organization with no membership fees, ensuring that small manufacturers, community-based developers, and underserved communities can access and contribute to the platform without barriers.

5. Plugin Ecosystem and Innovation Acceleration

- **Android/iOS App Store Analogy** – The success of app-based ecosystems (with discoverable plugins) demonstrates the technical viability and rapid scalability of decentralized innovation, which NuCore.AI mirrors for devices and services.
Reference model: Apple App Store / Google Play architecture

- **OpenADR Use Cases for DERs** – CEC-funded projects show that DER orchestration requires ongoing updates to device models and semantics, something NuCore[AI] plugin model addresses immediately and dynamically.

In conclusion, these references reinforce that NuCore[AI] is not only technically and economically feasible but also well-aligned with California's policy mandates and innovation needs. The platform builds on proven models, addresses real barriers, and creates an equitable path toward intelligent, grid-responsive, and future-proof buildings.

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 NuCore[AI] platform supports three of the five EPIC 5 Strategic Goals: Distributed Energy Resource Integration, Building Decarbonization, and Achieving 100 Percent Net-Zero Carbon Emissions. It provides an open, AI-driven, plugin-based infrastructure that enables deep integration of DERs, real-time optimization of building loads, and democratized access to energy automation, all critical to California's clean energy transition.

b. Distributed Energy Resource (DER) Integration

- **Unified Platform for DERs:** NuCore^{AI} enables seamless integration of DERs (e.g., EV chargers, solar inverters, battery storage, smart thermostats, water heaters) through a plugin architecture that eliminates the need for protocol-specific customizations.

- **Real-Time Response to Grid Signals:** The platform supports automatic response to dynamic pricing, load shedding events, and OpenADR signals by translating utility inputs into real-world device actions using AI.

- **Scalable Orchestration:** With natural language automation and a growing library of interoperable plugins, NuCore^{AI} can coordinate DERs across thousands of sites, providing meaningful load flexibility and supporting CAISO grid operations.

c. Building Decarbonization

- **Automation of Electrified Systems:** Enables automation and optimization of heat pumps, electric HVAC systems, smart appliances, and water heaters: key decarbonization technologies.

- **Customer Empowerment:** Through intuitive interfaces, customers can easily automate their electric loads for comfort and efficiency without needing technical expertise.

- **Vendor-Agnostic Interoperability:** Supports legacy and new electrified equipment regardless of brand or protocol, speeding up the retrofit process for existing buildings.

d. Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas

- **Grid-Aligned Load Shifting:** By optimizing device schedules around renewable availability and carbon-intensity signals, NuCore^{AI} helps maximize the use of clean electricity and reduce peak loads.

- **Reduced Reliance on Peakers:** Broad-scale deployment of demand flexible loads reduces stress on the grid and decreases dependence on natural peaker plants.

- **Transitional Integration:** For mixed-fuel buildings, NuCore^{AI} can support hybrid strategies where gas systems are phased out

progressively, with coordination of both electric and gas-consuming devices during the transition.

NuCore^{AI} directly enables distributed intelligence, automation, and interoperability, the foundational elements of a resilient, carbon-free energy system. Its ability to unify thousands of DERs, electrified devices, and consumer interfaces under a single, open-source platform makes it a powerful enabler of EPIC 5 Strategic Goals and California's long-term energy vision.

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