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Voya Energy Submission

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:

Richard Wang, richard@voya.energy, 626-318-0963

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

Voya Energy Inc.

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?

Voya Energy is pioneering a next-generation clean energy platform built around a metal-based fuel system that enables firm, zero-emission electricity delivery—anywhere, anytime, and at any scale. The platform integrates two core innovations:

1. Fuel-Grade Metal Production: A novel, cost-effective process to produce metal pellets using a low-temperature, inert-anode cell powered by clean electricity. This method drastically reduces emissions compared to traditional metal smelting and enables the creation of an energy-dense, clean, metal fuel.

2. Metal-Air Generator System (Genset): A high-efficiency, modular generator that converts metal fuel electrochemically into electricity on demand without combustion and with zero emissions. Voya's proprietary design overcomes historical barriers in metal-air batteries—particularly metal corrosion and byproduct buildup—through advanced electrolyte design and precision metering of metal input.

Together, these technologies enable energy to be stored as solid metal fuel and transported using existing infrastructure. The system outcompetes diesel generators on cost of delivered electricity, power density, ease of deployment, and environmental performance (Nox, CO₂, noise).

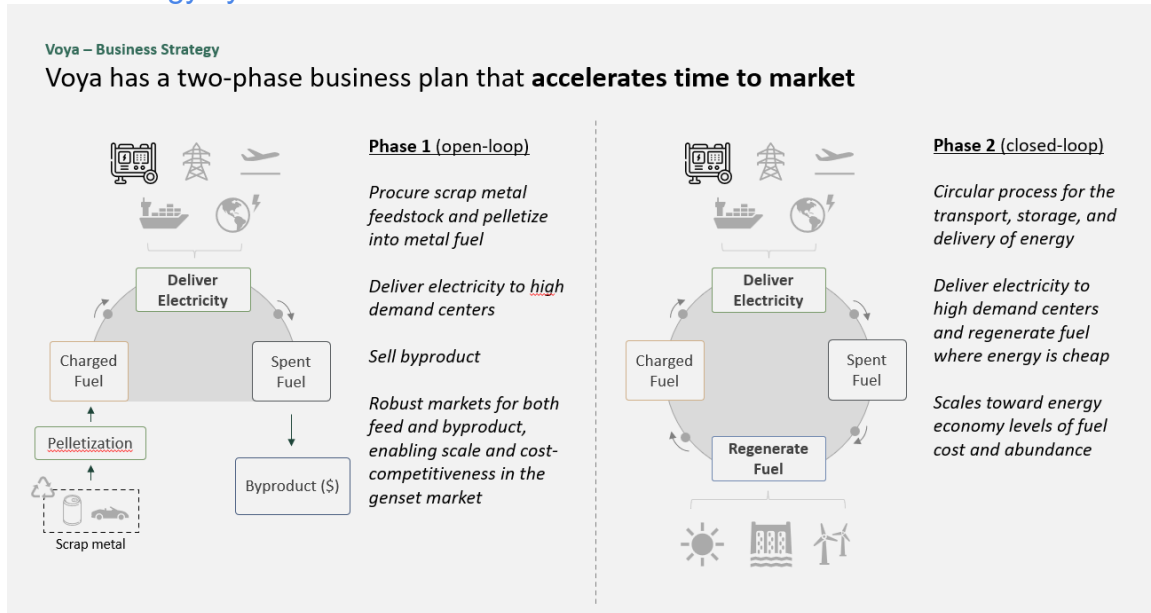
This concept aims to replace diesel generators—which are widely used for backup, off-grid, and mobile power applications—with a clean, scalable alternative. It also lays the foundation for a circular metal fuel economy, where metal is charged using surplus renewable electricity and discharged where and when firm power is needed. The goals are to:

- Ensure reliable power in hard-to-electrify sectors such as remote communities, construction sites, emergency response zones, and military operations.
- Reduce emissions and air pollution from distributed generation
- Enhance California's grid resiliency by deploying dispatchable, modular clean energy that:
 - Provide backup power during outages and public safety shutoffs.
 - Deliver zero-emission peaking capacity (e.g., demand response) to help avoid grid overloads.
 - Serve as prime or peaker power for commercial and industrial (C&I) users at lower cost and with faster interconnection
 - Enable California to support emerging and electricity demanding industries (ex. data centers)
- Support grid decarbonization by importing clean electricity into California and reducing peak demand stress.
- Promote a circular economy through the regeneration and reuse of metal fuel and its byproducts.

EPIC funding is essential to accelerate the development and validation of this platform within California. Specifically, funds will enable Voya to:

- Conduct pilot deployments of the metal genset with California utilities, public agencies, and critical infrastructure providers.
- Advance system engineering, fuel design, cost reduction, and manufacturability.

- De-risk early commercialization by generating independent performance and reliability data.
- Expand public-private partnerships, including engagement with underserved communities and disaster-preparedness agencies.
- Position California as a global leader in the emerging metal fuel sector, while creating jobs and advancing workforce development in advanced energy systems.



The figure above demonstrates the multi-phase approach to de-risk the deployment of this solution. Initial metal fuel will be sourced from readily available scrap metal.

While Voya is venture-backed and actively attracting private capital, EPIC support is vital to bridging the “valley of death” between lab-scale innovation and large-scale impact. It enables alignment of public-sector priorities with breakthrough energy technologies that serve California ratepayers.

4. In accordance with Senate Bill 96¹, 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

¹ See section (a) (1) of Public Resources Code 25711.5 at: https://leginfo.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC§ionNum=25711.5.

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)?

Voya Energy's concept addresses several critical technological and market barriers that impede California's statutory energy goals. California aims to achieve 100% clean electricity by focusing on energy storage, renewables integration, energy efficiency, EV-grid integration, and forecasting renewables. Additionally, California is looking to reduce the cost of building electrification by targeting various parts of the grid infrastructure including expense areas such as electrical panel upgrades and service expansion.

The key barriers addressed by the Voya solution are:

1. Long interconnect times and slow-moving grid infrastructure
 - a. Barrier: Meeting California's growing energy needs and its clean energy goals will require significant growth in grid infrastructure. Unfortunately, grid expansion is severely bottlenecked, bureaucratic and slow moving. This challenge is especially pronounced in remote regions.
 - b. Breakthrough: California needs a faster mode of energy transportation that supports the grid and in some cases, is an alternative to the grid. Metal fuel is that opportunity to cost effectively, efficiently move energy. Voya's metal fuel platform enables long-duration, high-density energy storage and geographic decoupling of generation and use. It provides clean, dispatchable power, without relying on long lead-time infrastructure like transmission or traditional batteries.
2. No bridge power alternatives
 - a. Barrier: Access to sufficient energy is a major factor for businesses looking to set up operations in California. In particular, data centers turn to bridge power options before connection to the grid is established. Unfortunately, the primary option for bridge power remains expensive, inefficient, polluting diesel generators. The use of diesel generators here sets California back on emission goals.
 - b. Breakthrough: Access to cost effective and clean bridge power is critical to achieving California's energy goals. Across numerous industries; manufacturers, EV chargers, data centers, critical infrastructure - the story is the same. More energy is needed, faster as businesses wait for the grid. Voya Energy's metal fuel generator can meet that bridge power need, with no emissions.

3. Expensive peak power pricing
 - a. Barrier: To meet California's energy needs, the cost of electricity needs to be competitive, especially the cost of clean electricity. During peak demand, the price of electricity rises and businesses rely on dirty fuels to supplement power to reduce costs (ex. diesel, natural gas, etc.)
 - b. Breakthrough: Voya Energy provides an alternative to fossil fuels for companies looking to manage peak pricing with on-site power generation. Voya's solution provides clean, behind the meter power during peak demands on the grid.
4. Poor Alternatives to Diesel in Distributed & Off-Grid Use Cases
 - a. Barrier: Diesel generators remain dominant in backup, remote, and mobile power due to their portability, ramp rate, and high energy density. Existing clean alternatives (batteries, hydrogen, fuel cells) often fall short in cost, safety, logistics, or performance.
 - b. Breakthrough: Voya's metal genset matches or exceeds diesel on:
 - i. **Energy density**: ~22 kWh/L vs. 10.7 kWh/L for diesel, 0.3 kWh/L for lithium-ion
 - ii. **Ramp rate**: Full power in milliseconds
 - iii. **Cost**: Delivered electricity cost beats diesel at first pilot scale; further reductions expected via circular model and byproduct value
 - iv. **Zero emissions**: No CO₂, NO_x, or particulate output
 - v. **Load Mgmt**: can manage various intermittent load profiles
5. Corrosion and Efficiency Limitations in Metal-Air Systems
 - a. Barrier: Historically, metal-air systems suffered from rapid corrosion and inefficient fuel utilization
 - b. Breakthrough: Voya has discovered proprietary electrolytes that reduce metal corrosion by 99% compared to the best published results, and a system design that meters fuel use precisely, preventing passivation and increasing reliability.
6. High Cost and Complexity of Clean Fuel Production
 - a. Barrier: Existing metal production uses a carbon-intensive process, which is incompatible with producing clean metal.
 - b. Breakthrough: Voya's bench-scale electrolysis method uses non-consumable inert anodes and low-cost metallic electrodes to enable clean, modular, and affordable metal fuel production—at up to 20% lower cost and with zero process emissions.

The specific cost & performance targets that need to be met for increased industry and consumer acceptance are defined below.

Metric	Target	Adoption Impact
System efficiency	>60%	This system efficiency would be double that for diesel and would significantly reduce the LCOE for the Voya Energy Solution
System Cost (\$/kW)	<\$500	This price point would increase adoption amongst customers as it reduces the upfront capital cost
LCOE (\$/kWh)	< \$0.3	Achieving a highly competitive cost of electricity would prove to customers that the Voya Solution is the most economic solution
metal Fuel (\$/lb)	\$0.5	Sourcing cheap metal fuel feedstock for phase 1 of the business before circularity is achieved

Voya's research will fill major gaps in:

- Secondary scrap metal fuel economics
- Cost of manufacturing fuel-grade metal utilizing inert anode technology
- Metal air technology
- Voya Energy's performance across geographies, use cases, and load profiles
- Clean fuel delivery logistics, including refueling models and supply chain optimization
- Market-specific requirements for a variety of backup, mobile, and remote power applications—including defense, utilities, data centers, and C&I

These research findings will benefit a variety of stakeholders including:

- California utilities and grid operators needing options for flexible, firm clean bridge power
- Public agencies planning for resilience, disaster response, or emergency backup power
- Corporations that require mobile or backup power across a variety of applications, bringing more development and economic growth to California
- US Military that's seeing power solutions that offer supply chain resilience and better fuel logistics
- Disadvantaged and rural communities lacking access to affordable, reliable energy

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,² reliability,³ affordability,⁴ environmental sustainability,⁵ and equity?⁶

If successful, Voya Energy's metal fuel energy platform will establish a transformative new tool in California's clean energy arsenal—one that delivers firm, zero-emission electricity on demand, at lower cost than incumbent diesel generators, and in applications where other clean technologies cannot compete.

The project targets significant improvements in the value proposition Voya Energy's solution for clean distributed energy:

- Cost of Delivered Electricity: <\$0.30 / kWh target with the intent to reduce costs further in a closed-loop model
- CapEx / System Cost: <\$500/kW target, competitive with diesel and fuel cell alternatives
- Fuel Storage & Logistics: Safe, energy-dense, and shelf-stable metal pellets; no pressurized gases or hazardous chemicals
- Efficiency: >60% discharge efficiency; lower parasitic losses than fuel cells or engines
- Utilization: Near-complete metal consumption due to corrosion-mitigation design and precise metering

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.

- Time-to-Power: Milliseconds to full ramp; better than diesel, unlike many alternatives

These improvements will increase the value proposition that Voya Energy offers by providing firm, clean power, anywhere, anytime. Voya Energy will be cost-competitive with fossil-fuel solutions, even in markets where batteries and hydrogen are less practical due to storage, transport, or density limitations. If Voya Energy is successful, rate payers can see a direct impact. Customers of Voya will have the ability to offset peak power from the grid, reduce costs of having backup power, and operate businesses more effectively with a better energy solution.

At scale, the innovation has the potential to redefine how California stores, distributes, and deploys clean electricity:

- Massive Energy Storage Potential: Just 3% of the known global reserves for this metal could theoretically meet the world's total energy demand. California's scrap market for this metal alone could support gigawatt-hours of clean, dispatchable electricity storage. This creates the opportunity for California to store, move, and deploy clean electricity more efficiently. And, California can import clean energy from outside the state and transport seamlessly to points of use.
- Drop-in Diesel Replacement: Gensets are a \$10B+ market in the U.S. alone. Voya's system provides a plug-and-play alternative to diesel engines—immediately reducing emissions from backup, mobile, and remote power sectors.
- Grid Resilience: By providing dispatchable energy storage independent of transmission constraints, the system supports grid reliability and peak shaving—especially as climate-driven grid stress increases.

Alignment with EPIC guiding principles:

- Safety: Voya Energy is a non-toxic, non-flammable solid fuel that presents lower risk than diesel, hydrogen, or lithium-ion systems. No pressurized vessels, fire hazards, or thermal runaway. Additionally, Voya Energy offers resilience during demand surges or climate events protecting the grid.
- Reliability: The metal genset design ensures fast response, stable output, continuous power and no emissions—even in off-grid or emergency scenarios. With Voya's solution, California can provide more access to energy across the state.
- Affordability: Voya Energy provides a lower levelized cost of electricity (LCOE) vs. diesel. For backup power on the grid, this also translates into operating cost savings for ratepayers due to reduced fuel and maintenance needs. Additionally, the importing of electricity could open up

California to major reductions in energy as the grid is supplemented with clean fuel from across the country.

- Environmental Sustainability: The Voya solution has zero direct emissions, uses recycled metal, and eliminates combustion-related pollutants (CO₂ , NO_x, PM). Enables clean power in sectors currently underserved by renewables.
- Equity: Voya offers a resilient and affordable power solution for disadvantaged and remote communities facing high electricity costs, unreliable service, or limited infrastructure access. Portable design also supports equitable disaster response and recovery.

Broader Economic and Innovation Impacts

- Job Creation & Workforce Development: Advancing metal fuel manufacturing and system integration will create skilled jobs in clean energy hardware, materials science, and logistics.
- Technology Spillover: Innovations in corrosion-resistant electrolytes, low-cost electrolysis, and modular power electronics could benefit broader cleantech markets.

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

Voya Energy's proposed research concept incorporates a rigorous set of quantitative and qualitative metrics to evaluate both technical progress and broader impact. These indicators align with EPIC's focus on safety, affordability, reliability, sustainability, and equity, and will enable the CEC to track outcomes across pilot demonstrations and scale-up phases.

Category	Metric	Target / Baseline
System Performance	Ramp time to full load (seconds)	<1 second
	Electrical efficiency (%)	>60% (discharge cycle)
Cost	Cost of electricity (\$/kWh)	<\$0.30/kWh
	Capital cost (\$/kW)	<\$500/kW

Environmental	Greenhouse gas emissions (gCO ₂ /kWh)	0 gCO ₂ /kWh (scope 1 emissions)
	Pollutants reduced vs. diesel (NO _x , PM, VOCs)	100% reduction
Deployment	Number of field demonstrations	≥3 diverse pilot sites

All pilot deployments will include:

- Pre- and post-deployment assessments
- Operational data logging and real-time system telemetry
- Third-party validation of system performance
- Community and customer surveys to document experiential benefits and barriers

The metrics will be reviewed quarterly throughout the project lifecycle and summarized in annual reports to ensure transparency and continuous improvement

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 following references support the technical potential, cost and performance targets, market barriers, and equity impacts identified in Voya Energy's proposed concept. These references include primary research data, third-party analyses, and peer-reviewed publications, as well as findings from Voya's internal development efforts to date.

Category	Item	Reference
Generator	Efficiency Target	Internal benchmarking on performance
	Cost Target	Benchmarked against public

		diesel genset data
Fuel	Cost of Delivered Electricity	Benchmarked against cost of electricity in California provided by PG&E
	Cost of metal Fuel	Midwest premium scrap cost discount based on type of scrap
Market	Size of Diesel Genset Market	Diesel Generator Marketplace Report by Green Strategies Inc.
	Grid Interconnect Delays	California Independent System Operator (CAISO), "2023 Interconnection Queue and Transmission Assessment
	Backup Power Regulatory Pressure	California Air Resources Board (CARB), "Zero-Emission Backup Power Rulemaking (2022–2024)
	Disadvantaged Community Power Gaps	CPUC Environmental & Social Justice Action Plan (2023); CEC EPIC Equity Guidelines

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.

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>

Voya Energy's proposed metal-fueled genset platform directly supports four of the five EPIC 5 Strategic Goals, with especially strong alignment to Net-Zero Emissions, Distributed Energy Resource Integration, and Climate Adaptation. The solution also offers indirect pathways to advance Building Decarbonization and future support for Transportation Electrification.

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

Voya's system provides a drop-in replacement for diesel and natural gas generators—key emitters in the distributed generation sector. By delivering firm, zero-emission electricity using clean, recyclable metal fuel, the platform advances California's net-zero targets in multiple ways:

- Zero-emission, combustion-free generation eliminates CO₂, NO_x, and PM emissions at the point of use.
- Circular metal fuel cycle enables closed-loop regeneration using surplus renewable electricity—effectively converting solar and wind into dispatchable fuel.
- Displaces gas in backup and off-grid roles, accelerating the transition away from natural gas peaker plants, microgrids, and emergency response assets.

This aligns with the state's commitment to decarbonizing all sectors of electricity generation—including currently hard-to-abate distributed and backup applications.

2. Distributed Energy Resource (DER) Integration

Voya's genset operates as a modular, grid-edge energy resource that supports local resilience, peak shaving, and flexible generation:

- Can be sited anywhere—from urban substations to rural microgrids—without transmission upgrades.
- Supports load balancing and black start capabilities in grid-isolated or islanded configurations.

- Pairs with renewables in microgrids and mobile units, offering firming and long-duration storage capacity.

Unlike traditional DERs (e.g., rooftop PV + batteries), Voya's fuel model allows energy to be transported where and when it is needed, unlocking DER functionality for locations with constrained infrastructure.

3. Climate Adaptation

Extreme heat, wildfires, and grid stress are intensifying across California. Voya's technology improves climate resilience by:

- Providing reliable backup power for critical infrastructure (e.g., water pumps, hospitals, emergency shelters).
- Reducing fire risk by replacing diesel with non-flammable, solid fuel that has no risk of pressurized leaks or spills.
- Enabling rapid deployment of mobile generators to disaster zones, construction sites, or off-grid installations.

By decentralizing clean generation and avoiding reliance on vulnerable transmission infrastructure, Voya's system offers a flexible tool for state and local governments to address climate-induced disruptions.

4. Building Decarbonization

While not a direct electrification retrofit, Voya's genset can enable electrification of off-grid and hard-to-reach buildings by providing portable, zero-emission power at sites where utility service upgrades are unavailable or prohibitively expensive.

Use cases include:

- Remote or temporary buildings (construction, mining, agriculture)
- Low-income multifamily or mobile home parks with grid constraints

- Disaster recovery housing

5. Transportation Electrification

While not focused on vehicle electrification directly, Voya's portable genset can support:

- EV charging in off-grid locations
- Backup power for charging depots
- Support for electric construction or military vehicles

Its ability to deliver clean, modular electricity makes it a useful infrastructure enabler for transportation electrification—especially in remote areas or mobile deployments.

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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