

**DOCKETED**

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**Request for Information for Long Duration Energy Storage  
Demonstration Solicitation**

*Additional submitted attachment is included below.*



**CALIFORNIA ENERGY COMMISSION**

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## **Request for Information**

### **Long Duration Energy Storage Demonstration Solicitation**

### **Docket # 23-ERDD-08**

### **Due Date: February 16, 2024**

#### **Purpose of Request**

The California Energy Commission (CEC) is seeking information for a potential future grant funding opportunity (GFO) that will focus on research and demonstration to advance non-Lithium-ion (non-Li) long-duration energy storage (LDES) technologies aimed at helping California meet its clean energy and climate goals. The purpose of the Request for Information (RFI) is to help define critical demonstration and system capacity needs in non-Li LDES and identify high-impact use cases that a future GFO should target to maximize the benefits of government investments in energy storage.

#### **Background**

As California accelerates the deployment of renewable energy sources to meet decarbonization goals, the electricity grid will continue to evolve to accommodate more renewable energy and the importance of LDES will continue to grow to help maintain grid reliability. Hence, the CEC is pursuing the demonstration and deployment of emerging LDES technologies that use alternatives to commercial lithium-ion (Li-ion) technologies. These non-Li technologies can help California achieve its ambitious goal of deploying 19.5 gigawatts (GWs) of energy storage by 2035 and 52 GWs by 2045. To meet this challenging objective, the CEC is collaborating with industry partners to diversify the state's energy storage portfolio. In the fiscal year 2022-2023 and 2023-2024, the CEC received \$140 million in general funds and \$190 million in Greenhouse Gas Reduction Funds (GGRF), respectively to support this effort through the LDES program. The CEC used initial LDES program funds to award grant agreements that will deploy five distinctive non-Li LDES technologies. For future competitiveness, non-Li technology systems must be 20-40 megawatt-hours (MWh) in size today and aim to scale up to 200-400 MWh or more in the next 3-6 years.

The anticipated GFO will fund approximately \$70 million for multiple non-Li LDES demonstration projects in California with the goal of supporting a diverse portfolio of energy storage systems that offer essential capacity and grid services to the electrical grid and lead to fostering diversity and competition in the California storage market.

## Request for Information

The following questions are designed to elicit information that will help CEC structure the planned solicitation. While there is no requirement to respond to all RFI questions, stakeholders are encouraged to respond to questions they feel most suit their focus, knowledge, and expertise.

LDES System Demonstration – questions aimed more for technology developers, but open to all respondents:

1. According to the California legislation that authorized the LDES program, all demonstration projects must have a system capacity of a minimum of 1 MW for at least 8 hours<sup>1</sup>. Given this requirement and the current state of your non-Li LDES, which of the following system sizes could you deliver in the next 18 months to 2 years? Additionally, which system size would help your technology reach the 200-400 MWh system size in the next 3-6 years?
  - System size of 8-10 MWh
  - System size of 10-20 MWh
  - System size of 20-30 MWh

Zelos Energy has been performing on a CEC program for Zn-MnO<sub>2</sub> technology that is ready for pilot production, scale up and deployment. Within the next 18 months, Zelos could deliver a BESS in the 8-10MWh range with our Zn-MnO<sub>2</sub> technology. Further, we feel that learnings from implementing a system of this scale would translate to reaching 200-400MWh systems within 3-6 years.

Zelos Energy Ltd - Demonstration Alkaline Battery LDES Delivery Horizon by Generation and System Size			
System Size (MWh)	Generation I	Generation II	Generation III
Battery type	AA format alkaline rechargeable	Prismatic alkaline rechargeable	Prismatic alkaline rechargeable with gel electrolyte and hyper-conductive manganese
8-10	12-16 mo	20-24 mo	32-36 mo
10-20	14-18 mo	24-30 mo	36-42 mo
20-30	16-20 mo	30-36 mo	42-48 mo
200-400	Not recommended	48-60 mo	60-72 mo

2. What would be the range of the estimated project costs in a direct current (DC) configuration for demonstrating each of the three different system sizes listed in question 1 for your non-Li LDES system as a function of the location of deployment? Additionally, what would be the life expectancy of the demonstrated project? Would it be considered pre-commercial or commercial, and have an expected life of 10-20 years or longer? Please explain.

Zelos Energy Ltd - Demonstration Alkaline Battery LDES  
 Estimated Total Project Costs According to System Size and Location

System Size (MWh)	Prepared Site	Unprepared Site	Remote Site
Battery type	Urban, easy access, no improvements needed, no infrastructure work required for connections	Urban, easy access, site improvements needed, infrastructure work required for connections	Non-urban, remote, site improvements needed, infrastructure work required for connections, workers quarters not available
8-10	Facility: \$2M NRE system: \$750k System build: \$8M Site prep: \$250k  Total: \$11M	Facility: \$2M NRE system: \$750k System build: \$8M Site prep: \$1M  Total: \$12M	Facility: \$2M NRE system: \$750k System build: \$8M Site prep: \$2M Extra logistics: \$500k  Total: \$13.5M
10-20	Facility: \$2M NRE system: \$1M System build: \$15M Site prep: \$500k  Total: \$18.5M	Facility: \$2M NRE system: \$1M System build: \$15M Site prep: \$2M  Total: \$20M	Facility: \$2M NRE system: \$1M System build: \$15M Site prep: \$3M Extra logistics: \$1M  Total: \$22M
20-30	Facility: \$3M NRE system: \$1.5M System build: \$22M Site prep: \$1M  Total: \$27.5M	Facility: \$3M NRE system: \$1.5M System build: \$22M Site prep: \$3M  Total: \$29.5M	Facility: \$3M NRE system: \$1.5M System build: \$22M Site prep: \$4M Extra logistics: \$3M  Total: \$33.5M
200-400	Facility: \$30M NRE system: \$5M System build: \$180M Site prep: \$10M  Total: \$225M	Facility: \$30M NRE system: \$5M System build: \$180M Site prep: \$25M  Total: \$240M	Facility: \$30M NRE system: \$5M System build: \$180M Site prep: \$40M Extra logistics: \$10M  Total: \$265M

All systems in the above table would be commercial systems with an expected life of roughly 10 years.

- For the system sizes listed in question 1, what is the maximum amount of match funding that a technology provider and selected end customer can contribute towards one of the proposed future grants - 20%, 30%, 40%, or higher?

Zelos Energy has contributed funding towards the goals on the current CEC EPIC program, award EPC-019-042. We believe that up to 40%-50% matching funding could be contributed is the right partner can be identified.

Realistically, it would be easier to design the small demonstration projects (<10MWh) with a 15-25% match. The larger projects with a pre-demonstrated technology could run at higher matches, up to 60%, but 50% is standard.

Zelos Energy Ltd - Demonstration Alkaline Battery LDES Delivery Horizon by Generation and System Size			
System Size (MWh)	Min Match %	Max Match %	Target Match %
8-10 (1 <sup>st</sup> demonstration)	15	25	20
10-20 (1 <sup>st</sup> or 2 <sup>nd</sup> demonstration)	25	35	30
20-30 (2 <sup>nd</sup> + demonstration)	35	45	40
200-400 (3 <sup>rd</sup> + demonstration)	40	60	50

4. What type of incentives can be leveraged to make a LDES system demonstration more attractive from a financial standpoint? What will be the maximum amount of incentive that a technology provider and selected end user could obtain for the system sizes listed in question 1?

Zelos Energy believes taking the risk out of the project for the end user and demonstrator is the most critical help the CEC can provide. One way this can be provided is financial backstop to make the end user “whole” if the system does not perform as planned. Examples of such help include:

- Help with the financing of a performance bond
- Help with the financing of a warranty on the system
- Help with energy costs if renewable system cannot be fully harvested
- Help with program delays if they are caused by legitimate reasons out of the control of Zelos or the partner.
- Etc.

5. Considering that California is aggressively planning to procure energy storage and has already approved over 8 GWs of Li-ion systems, when do you anticipate your non-Li system will be able to compete with Li-ion systems in terms of price and performance for a future commercial solicitation if the price range is \$350-\$450 per kilowatt-hour (kWh) delivered in a DC configuration? Please explain.

Zelos Energy internal company forecasts indicate we will deliver our Gen II products at roughly \$65-80 per kWh at the pack level, and with significantly less additional infrastructure requirements at the system level when compared to lithium, we believe our system cost will be roughly \$80-\$100/kWh at the cell level.

The economics of battery systems which we plan to produce from our initial pilot line, however, will be closer to \$500/kWh given the low throughput of this manufacturing line. We expect cost reductions to come rapidly with scale, and the timing of this will be dependent on Zelos opening a larger facility. Cell level costs below \$100/kWh is a very attainable target within 2-4 years. At scale,

battery materials compose about 80% of cell level costs. With Zelos using Zinc and Manganese, which are very inexpensive compared to the metals used in Lithium systems, we expect our cost to be low and remain low. Overtime, as battery material scarcity intensifies and continues to plague lithium manufacturers, Zelos will enjoy an even greater comparative cost advantage, which will be passed down to the ratepayers.

For BESS systems, a better metric may be the Levelized Cost of Storage (LCOS) in \$/kWh/Cycle, which considers the initial capital cost and maintenance over the system's life to compare different technologies. The best models account for parasitic load (like HVAC) and inefficiencies (self-discharge). Since Zn-MnO<sub>2</sub> requires only minimal maintenance (as compared to Flow battery technologies, or electroplating technologies), needs only a basic BMS (compared to Lithium), no fire mitigation and prevention systems (compared to Lithium), Zelos solution can yield a very low LCOS of ~\$0.05/kWh/cycle when produced at scale.

One last item to consider is the end-of-life scenarios of the ESS, and particularly the cells. Though it may not be a troubling issue for a 1MWh installation, it becomes a massive issue both in terms of economic and environmental issues for a 400MWh installation. Fast forward to 2045 (with 52GWh in service in CA alone) and you may have an economic and environmental timebomb.

Zelos designed its product for minimal lifetime impact. The selection of the battery materials was made to ensure a circular lifecycle. Zelos' cells can be safely and economically recycled. One such avenue is to crush the batteries, extract the plastic shell and metal current collector (using magnets and a float in a water bath) yielding a water solution of zinc and manganese, a very effective non-chemical fertilizer. Manganese zinc solutions are recommended for use on (but not limited to) the following crops for correction of manganese and zinc deficiencies: citrus, corn, cotton, deciduous fruit and nut trees, beans and peas, onions, sugarbeets, and small grains.

<https://brandt.co/media/7788/brandt-manganese-zinc-powder-label.pdf>

We strongly recommend the CEC (and all other agencies) to evaluate the end-of-life profile of the technologies they support. At the moment, there is no economically or environmentally viable way to recycle lithium batteries. These cells end up in a dangerous waste storage facility somewhere or in an incinerator. Most of these materials are thereby lost forever.

6. What demonstration system size would be needed to persuade you to at least partially automate the majority of your LDES system manufacturing capability to deliver a future order in the range of 200-400 MWh in a 12-24-month delivery window?
  - a. What is the largest system on a kWh basis you have fielded and have been operating to date?

We are in the final stages of negotiations for a 6MWh international project, over 2 x 3MWh phases. Since we do not have local manufacturing, we may be forced to outsource the cell manufacturing to a large Japanese supplier of alkaline batteries.

- b. What is the largest system on a kWh basis that you have a firm order to deliver in the

next 12-18 months?

Zelos Energy could deliver an 8-10MWh LDES system but for that it would have to establish a semi-automated production facility which would take 12 months. The design and construction of the LDES would be done in parallel, with staged system testing. The cells would be shipped separate of the LDES containers and inserted on site, which is rather customary.

A larger, more automated factory would be required to deliver an LDES in the 200-400MWh. Such facility would require 12 months to design/plan, and 12 months to commission. It would be able to produce 30-50 MWh per month.

We have not yet fielded and operated a complete system, though we are finalizing an order for 6MWh LDES currently.

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<sup>1</sup> Assembly Bill (AB) 205 (2022) [https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB205](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB205)

Demonstration Sites – questions targeting site hosts and adopters, but open to all respondents:

7. How can funded LDES projects better prioritize benefits for under-resourced (low-income and disadvantaged) communities and Tribes? Should benefits to under-resourced communities and Tribes be strict requirements in the solicitation or incentivized through solicitation scoring criteria bonus points? Should match fund requirements be reduced or potentially eliminated? What are the potential barriers to the funding and development of successful LDES projects in under-resourced and tribal communities? Please explain. Specific examples are welcomed.

According to our research, disadvantaged communities are very sensitive to the following:

- **High initial acquisition costs**
  - These communities are more prone to purchasing a less expensive product that has acceptable performance, rather than an expensive product that has high performance, even if the overall economics of the latter are better. Focus should be on a reduced initial investment to help those communities get a leg up with the renewable program or grid reliability program.
- **Complex operation requiring highly specialized equipment/labor**
- **Site safety / community safety**
  - Since they operate with limited resources, often in remote areas (tribes), and sometimes rely on their local food production; these communities are especially vulnerable to a battery fire, chemical spill, hydrogen release/explosion, plain flooding (damaging and release of toxic metals in the environment), etc.
  - Toxicity to humans should always be considered even when a product is buried inside a unit. It is not infrequent to see teenagers break-in or product be stored unattended before being commissioned or after decommission. Exposure to toxic substances is more likely in disadvantaged communities.
- **End of life issues**
  - Systems that are simple to dispose of should be easier to manage for disadvantaged communities.
- **UPS Features**
  - Zelos' product has a special "Emergency Mode" where the capacity of the BESS can be raised to 400% of label a few times per year. This is a very important feature in regions where fuel supply interruptions, power supply interruptions, technical expertise delays, and/or inclement weather can be expected.

Zelos Energy believes to prioritize benefits for under-resourced communities the CEC should have these benefits be strict requirements in the solicitation, with these benefits being incentivized through bonus points following as a secondary pathway. Match funding requirements do not need to be reduced, though doing so would give applicants additional flexibility in delivering projects to these communities, which would likely add to their overall benefit.

8. Should demonstration projects be required to be located in Tier 2 or 3 High Fire-Threat District areas (as defined by the CPUC<sup>2</sup>)? Or should these siting locations be incentivized

through solicitation scoring criteria bonus points? Please explain.

Zelos Energy believes that locating demonstration projects in Tier 2 / 3 high fire-threat district areas would position the CEC grants to provide maximum value to California ratepayers and community members, provided the funded deployments are based on safe, non-flammable technology, such as an alkaline-based chemistry. We believe that requiring these demonstrations to be located in such areas would be a benefit to California given non-lithium-based technologies would inherently provide significant value to these areas and allow them to install LDES capacity which might otherwise be unattainable. If not listed as a requirement on this solicitation, we believe incentivizing demonstration project installations in these areas via scoring criteria bonus points would be beneficial.

9. Do demonstration projects provide more value in certain service territories (i.e. investor-owned utilities, publicly-owned utilities, community choice aggregators, rural electric cooperatives, and electric service providers)? If so, why?

Demonstration projects provide value in all service territories, but given a driver of demand for LDES technology is the desire to replace fossil-fuel generated base load capacity with that of renewables, it may be appropriate to pair the LDES with solar or wind generation capacity which would in turn help optimize the operation of one of these systems.

10. Is there any preference for behind-the-meter or front-of-the-meter demonstrations for the system size ranges listed in question 1? If so, why?
  - a. For a behind-the-meter installation, does your LDES technology have any advantages to the utility regarding the utility interconnection agreement?
  - b. If you are considering a front-of-the-meter configuration, have you applied for a CAISO reservation? If so, when would that reservation become effective?

Zelos Energy has no preference regarding where our demonstration project would be placed relative to the meter as our BESS technology is appropriate for both scenarios.

11. Are you considering a project for which the interconnection agreement is already approved?

California Environmental Quality Act (CEQA):

12. What would be the typical footprint range needed to deploy certain LDES systems for the three system size ranges listed in question 1?

Zelos Energy can deploy an 8MWh BESS in a containerized system that fits within 6 standard-sized 20foot shipping containers (20' long x 8' wide x 8' 6" high), with no additional spacing requirements. Thus, the footprint for an 8MWh BESS using our technology would be roughly 6x the footprint of one container and would scale linearly with added capacity.

13. When a GFO is posted, proposals are generally due to the CEC within 8 to 12 weeks, and the CEQA process is generally required for the CEC to award grant funding to a project. The CEC has learned from the initial LDES projects that the LDES systems have a greater footprint than systems exempted from CEQA. Therefore, an environmental impact report or negative declaration is normally required for the potential projects, as are other actions required by CEQA. For the system size ranges listed in question 1, how long would it take to complete the CEQA process (and the National Environmental Policy Act (NEPA) if applicable) for your LDES system, and approximately how much would these processes

cost?

14. Is it reasonable to require that all GFO applicants complete discretionary permitting and CEQA through their local public agency before submitting a proposal for a project in the sizes defined in question 1? Please explain.

Zelos Energy recommends that completion of discretionary permitting not be required before proposal submission. Completion of permitting can and should be a requirement for receipt of funding but requiring completion for proposal submission is a strict requirement.

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<sup>2</sup> [California Public Utilities Commission Fire-Threat Maps and Fire-Safety Rulemaking](https://www.cpuc.ca.gov/industries-and-topics/wildfires/fire-threat-maps-and-fire-safety-rulemaking)

<https://www.cpuc.ca.gov/industries-and-topics/wildfires/fire-threat-maps-and-fire-safety-rulemaking>

15. If the timeline and costs are not feasible, what preliminary CEQA studies or information would you recommend be completed before proposals are submitted to the CEC? Additionally, how long would it take to complete the preliminary CEQA studies or information for your proposed LDES technology for the system size ranges listed in question 1?
16. What environmental process would be required if your project were not subject to CEQA? Additionally, how long would it take to complete the environmental process for your proposed LDES technology for the system size ranges listed in question 1?

Greenhouse Gas (GHG) Reductions:

17. As stated in the "Background" section of this RFI, the funds are provided by GGRF, and therefore, CEC is required to track GHG reductions provided by the installed systems.
  - a. What combination of LDES and renewables is needed to maximize the GHG reductions from a project?
  - b. Is there a difference in what your technology can provide in GHG reductions if installed in a behind-the-meter or front-of-the-meter configuration?

Others

18. What lessons have you learned from the LDES projects you have demonstrated, deployed, or operated to date? What major technical, economic, or policy barriers have affected the demonstration, deployment, or operation of LDES systems in the last two to four years? What are some potential solutions to these barriers? How can future funding from this GFO help solve these barriers?
19. Are there any additional comments or input you want the CEC to consider as they develop this future GFO?

In our internal models, we use 3 major axes when evaluating ESS. Beyond Performance and Economics – which most people are focused on – we measure Environmental and Safety as well as Strategic Supply Issues. It is understood that ESS will be a critical component of a green energy transition and it is important that environmental, safety, and strategic supply issues be considered as well to ensure the long-term viability of these new systems. The scale of the required deployments from 7GW to 52GW by 2045 will exponentially amplify any issue or shortfall in those categories.

**1. Performance and Economics**

- a. Initial CAPEX (which should consider the following)
  - i. BESS initial cost
  - ii. Inbound logistics (complicated for lithium batteries)
  - iii. Installation requirements including land use, site prep, fire suppression, retention basins, etc.
- b. LCOS (which should consider the following)
  - i. Calendar life
  - ii. Cycle life / total energy stored (adjusted for performance degradation overtime)
  - iii. Energy losses
    1. Roundtrip Efficiency

- 2. Self-Discharge Rate
- iv. Parasitic load
  - 1. HVAC, controls, lighting

- c. Ongoing operating costs
  - i. Firefighting and safety
  - ii. Maintenance and repairs

## **2. Environmental and Safety**

- a. Environmental Profile of Energy Storage System Itself
  - i. GHG content
  - ii. Energy footprint
  - iii. Water footprint
  - iv. Volatile Organic Compound footprint
  - v. Human toxicity
- b. Resources Access and Depletion
  - i. Key material availability
  - ii. Key material depletion rate
- c. Failure Modes and Safety
  - i. Fire risks / explosion risks
  - ii. Spill risks / contamination risks
  - iii. Other risks

## **3. Strategic Issues**

- a. US/US Ally Content of ESS
  - i. US content %
  - ii. US ally content %
- b. US/US Ally Content of required manufacturing equipment
  - i. US content %
  - ii. US ally content %

## How to Provide Information

Respondents to this RFI should not include any proprietary or confidential information. Comments may be submitted through 5:00 p.m. PST on February 16, 2024, using the [e-commenting feature for docket 23-ERDD-08](#), at <https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=23-ERDD-08>.

To use the e-commenting system, respondents will be asked for a full name, email address, comment title, and either a comment or an attached document (.doc, .docx, or .pdf format). After a challenge-response test is used by the system to ensure that responses are generated by a human user and not a robot, click on the "Agree & Submit Your Comment" button to submit the information to the CEC's Docket Unit.

Written comments, attachments, and associated contact information included within the documents and attachments will become part of the viewable public record and searchable on the internet.

Respondents to this RFI are encouraged to use the electronic filing system described above to submit information. If you are unable to submit electronically, a paper copy of your information may be sent to:

California Energy Commission  
Docket Unit, MS-4  
Re: Docket No. 23-ERDD-08  
715 P Street  
Sacramento, CA 95814-5512

Alternatively, you may email responses to [docket@energy.ca.gov](mailto:docket@energy.ca.gov) with the subject line "23-ERDD-08: RFI LDES".

**Public Advisor.** The CEC's Public Advisor assists the public with participation in CEC proceedings. To request assistance, interpreting services, or reasonable modifications and accommodations, call (916) 957-7910 or email [publicadvisor@energy.ca.gov](mailto:publicadvisor@energy.ca.gov) as soon as possible but at least five days in advance of the submission due date of the RFI Comments. The CEC will work diligently to meet all requests based on availability.

**Media Inquiries.** Email [mediaoffice@energy.ca.gov](mailto:mediaoffice@energy.ca.gov) or call (916) 654-4989.

**General Inquiries:** Email Hatice Gecol at [hatice.gecol@energy.ca.gov](mailto:hatice.gecol@energy.ca.gov) or call (916) 776-0688.

**Availability of Documents:** Documents for this RFI will be available at the CEC's [docket log for docket number 23-ERDD-08](#), at <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-ERDD-08>.

When new information is posted, an email will be sent to those subscribed to the Long Duration Energy Storage (LDES), Energy Research and Development, Electric Program Investment Charge (EPIC) Program, Distributed Generation, Decarbonization Topics, Energy System Infrastructure Planning, Tribal Program, and Disadvantaged Communities Advisory Group. To receive these notices or notices of other email subscription topics, visit [Subscriptions](#), at <https://www.energy.ca.gov/subscriptions>.

**Dated:** December 29, 2023 at Sacramento, California.

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Cammy Peterson  
Deputy Director  
Energy Research and Development Division

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