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Iron + Sodium Battery Manufacturer Perspective

Additional submitted attachment is included below.

California Energy Commission RFI

Inlyte Energy is scaling proven long duration batteries for daily cycling, made from iron + sodium. Inlyte Energy's iron + sodium battery is in the class of sodium metal halide batteries, also known as ZEBRA batteries. Originally developed for electric vehicles in the 1980s and '90s by some of Inlyte Energy's current team members, sodium metal halide batteries conventionally use nickel and have been commercialized for a wide range of applications, demonstrating safety and reliability. By re-imagining the sodium metal halide battery for grid storage, Inlyte Energy is commercializing next-generation batteries made with iron that will have substantially lower cost for grid storage.

Batteries are known for long development cycles and the iron + sodium has a big head start. The sodium metal halide battery has undergone 40 years of development, beginning in the '80s and '90s with commercialization in the 2000s. It has been deployed in cars, buses, submarines, and some stationary storage at commercial- and utility-scales. This class of sodium batteries is known for its safety and durability, high cycle capability, and tolerance to high temperature environments.

Inlyte Energy is revolutionizing the sodium metal halide battery to address critical grid storage applications through a three-fold approach: 1) Replacing expensive nickel with low-cost iron; 2) New cell and battery pack designs; 3) Scalable and automated low cost manufacturing innovations. Inlyte Energy's iron + sodium battery has the potential to be one-fourth (1/4) the cost of current lithium-ion batteries. The battery uses abundant materials that avoid foreign supply chains.

Inlyte Energy's battery modules are completely self-contained and operate under all conditions — even extreme heat and cold — without the need for air conditioning. Made with no flammable materials, iron + sodium batteries eliminate fire risk with 20 year lifetime and 10,000 cycles. With similar efficiency to lithium-ion batteries, even higher at the plant level in hot climates, Inlyte Energy's solution is an ideal medium-long duration battery for daily cycling (6-12 hour discharge).

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 hours1. 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

Based on Inlyte's current manufacturing capacity in the UK, we could deliver a system of 8-10MWh in the next 18 months to 2 years. However, within 18 months of notice of an award, Inlyte would be able to deliver any of those sizes, subject to incremental investments in manufacturing. Inlyte is focusing on incremental manufacturing investments to support a U.S. based production strategy.

Any of these sizes would be supportive to reach the 200-400MWh system size in the next 3-6 years. These scales are not materially different for Inlyte in the development of our technology. More important is to find the right fit with a customer and application.

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.

The precise project costs may vary significantly by specific customer, location, and application. For this demonstration, we would consider the project "pre-commercial" for projects deployed prior to 2027. Therefore, the direct financial benefits of the project would be greatly outweighed by the applied R&D value of the demonstration. As a result, we would expect the project life to be less than a commercial project. We would target 3-5 years of operation initially, followed by a go/ no go decision to proceed with a longer demonstration.

The underlying battery technology platform (sodium metal halide) that Inlyte is using has a long track record of performance and reliability. Inlyte is building an iron + sodium battery that builds upon the principles of the sodium nickel chloride battery that was initially developed 40 years ago. We expect initial commercial cells and modules to have a life of at least 10 years with a target of 20+ years under a daily cycling regime.

Here are the expected all-in project costs of the 3 different size ranges, for a pre-commercial energy storage system utilizing Inlyte's battery technology.

- System size of 8-10 MWh - $10-14M
- System size of 10-20 MWh - $14-22M
- System size of 20-30 MWh - $22-28M

3. 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?

The answer to this question depends on the maturity of the technology and CEC's goals in this funding opportunity.

If the project is deemed "pre-commercial" (projects deployed prior to 2027 for Inlyte), Inlyte would be able to provide a match of 20-30%. For projects deemed "commercial" (deployed after 2027), a larger size and a higher match share of 40-50% would be possible, because the end-user will have access to warranties and performance guarantees to insure their project value. We expect that this is a general condition of most technology providers working to develop new technologies.

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?

For commercial projects, IRA tax incentives may be typically utilized to receive 30% investment tax credit, with potential to achieve higher levels up to 70% in special cases. If DOE has an appropriate cost-sharing opportunity, there may be an opportunity to get 50% cost share. The tax incentives will only be applicable to the non-cost shared portion. A strong scenario would be 50% DOE cost share + 30-40% IRA incentive (65-70% financial incentive overall) federally. However, this requires exceptional coordination in project timing and meeting the respective requirements of multiple grants.

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.

Inlyte's first factory is planned for 2027 production and we are projected to provide a cost at or below $350-450/kWh level for the DC system. From a materials cost standpoint, Inlyte's models indicate a cost of ¼ the magnitude per unit energy as compared to present-day lithium ion. As a result, we believe that all-in DC costs can be below $350-450/kWh with all packaging and management systems inclusive.

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?
b. What is the largest system on a kWh basis that you have a firm order to deliver in the next 12-18 months?
1 Assembly Bill (AB) 205 (2022)
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB205

All system sizes that CEC is mentioning will drive new partial automation. Inlyte's current pilot manufacturing plant has a capacity of 5MWh/year. Our current commercial manufacturing line design contemplates 500MWh/year with a high degree of automation. There are several phases of station-level automation that will be implemented to transition this manufacturing scale-up in the 2024-2027 timeframe as Inlyte scales to commercial production.

As a company, as of today Inlyte has not fielded stationary storage demonstrations nor does it have firm orders. However, Inlyte has selected its strategy and team (including the world experts in sodium metal halide battery technology who originally developed the technology and built factories for it) in order to scale-up rapidly. The company has just hired an experienced Chief Commercial Officer to perform business development including identifying pilot opportunities for 2025 and onwards.

As a technology class, energy storage systems based on sodium metal halide batteries have been demonstrated and are currently deployed commercially. According to the DOE Global Energy Storage database, at least 28 projects based on sodium nickel chloride have been deployed worldwide to-date and the largest operational system is 10MWh. This technology has demonstrated a strong technical track record. Inlyte is developing a low-cost stationary storage version of this technology by replacing expensive materials and innovating designs of cells and modules. 2025 and 2026 are dedicated to advancing the manufacturing automation and achieving integration readiness for a stationary 8 hour AC energy storage product.

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.

The funded LDES projects can be incentivized through bonus points in scoring and/or a reduction in match funding requirements. This would make these sites more attractive for the technology developers.

8. Should demonstration projects be required to be located in Tier 2 or 3 High Fire-Threat District areas (as defined by the CPUC2)? Or should these siting locations be incentivized through solicitation scoring criteria bonus points? Please explain.

Similar to answer 7, match points and/or relief in match funding requirements would be good ways to drive more projects to these areas. However, for pre-commercial projects this should be less of a weighting because most of the value is in the learning process, which is very portable to other customers if appropriately presented.

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?

Diversity of service territories, sites, applications, and technologies helps to provide more learning opportunities for everyone across the state.

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?

Front of meter installations will provide substantial advantage to the incumbent project developers because of the huge CAISO queue for interconnection. 1-10MW is a very small front of meter device and the CAISO integration provides a lot of potential for delays. 1MW behind the meter, on the other hand, limits the number of potential customers to larger industrial players. Multi-site behind the meter could provide the most opportunity to work with a larger number of customers in need. For example, 100kW per unit minimum with total deployment of 1MW/8 hour or more.

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

Not at this time.

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?

Inlyte's technology enables approximately 2MWh of storage for a 20 foot shipping container, which is approximately 160 square feet. The footprint of 10MWh would be approximately 1000 square feet, plus clearances and the footprint of 30MWh would be approximately 3 times larger, or 3000 square feet. The iron + sodium technology has energy density in excess of 100Wh/L, so it is substantially more energy dense than most LDES technologies.

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?

Because Inlyte's project would occupy less than 10,000 square feet across the size ranges contemplated by CEC, we believe that Inlyte's project could be exempted from CEQA.

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.

2 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

This requirement could create a challenge to provide a viable proposal in the contemplated 8-12 week response time.
It may limit the responses to mature projects and technologies, and that may not support CEC's goals.

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?

For maximum competitive response to the solicitation, it would be beneficial if the proposer could provide a discussion of the CEQA plan, rather than requiring studies to be completed during the short proposal preparation period.

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?

I would expect that the project would require typically permitting review, but the scope and duration is uncertain until a site host is identified.

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?

The answer to this question is highly site-specific. Typically, energy storage projects maximize their GHG value when the renewables are being curtailed during overgeneration conditions.

There is no clear rule of thumb that we are aware of that would categorically favor BTM or FTM installations.

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?

The related sodium nickel chloride technology has primarily been challenged by economics and manufacturing scale-up. Inlyte is addressing unit economics with the replacement of expensive nickel with low-cost iron and addressing the manufacturing cost with scaled up cells.

LDES was generally challenged economically by the lack of market signals, such as the blanket 4 hour resource adequacy capacity requirement. The migration to capacity value based on ELCC methods is increasing the assessed value of 6-10 hour duration LDES systems, which will increase in value in the future.

This GFO can support solving these challenges by guiding emergent technologies to a level of improved integration and manufacturing readiness. It can also support the refinement of use cases for end customers to deeply consider how to capture the value of LDES technologies and work to demonstrate that value during the project period.

19. Are there any additional comments or input you want the CEC to consider as they develop this future GFO?

When considering technology readiness level (TRL) of solutions, we ask that CEC consider the fundamental risk levels of battery cell technologies as well as the integration readiness of solutions. The latter is an area that CEC can help to drive relatively quickly, if the cell level is solidly developed. Lab-scale battery technologies will take much longer to mature if the cell has not been well-characterized. Therefore, cell-level readiness should be considered separately from integration readiness, a gap that can be closed more quickly and leverage many of the lessons learned from lithium ion. Inlyte's technology is innovating from a stable technology platform so the cell-level risk is low.