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Michaels Energy comments on the LDES Demonstration RFI

Additional submitted attachment is included below.

February 13, 2024

California Energy Commission
715 P Street
Sacramento, CA 95814

REFERENCE:
Docket No. 23-ERDD-08: RFI for Long Duration Energy Storage

Dear Commission Members and Staff:

Michaels Energy appreciates the opportunity to comment on the CEC's RFI for Long Duration Energy Storage. Michaels manufactures thermal energy storage (TES) systems in California for use in chilled storage applications. When TES-equipped facilities are synchronized in response to a demand response signal, Michaels' proprietary thermal energy storage system can yield utility-scale energy storage for eight to ten hours of demand response. Our solution utilizes food-safe materials, and unlike Li-ion batteries, does not present a fire hazard or even require a grid connection. Our LDES solution is scalable without requiring additional land or complex permitting, because the system is installed inside the chilled facility.

When used for cold storage, these systems allow energy-intense refrigeration equipment to be shut down during times of high electrical grid stress. Chilling equipment can be re-started during off-peak hours when electricity is more affordable, and the chilling systems run more efficiently. During peak periods when chilling equipment is shut down, the pre-cooled PCMs undergo phase transitions that absorb substantial amounts of thermal energy while holding temperatures constant. This provides stable temperatures within refrigerated spaces for extended periods—over 8 hours—without the need for energy-intensive cooling equipment. Essentially, adding thermal energy storage allows refrigeration systems to act as a long-duration battery, providing a cost-effective, behind-the-meter solution for demand and energy management.

Michaels responds to the RFI's questions in the following pages.

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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. 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*

   In the next 18 months, we can provide initial demonstration sites for thermal energy storage with phase change materials (TES with PCMs) systems that can remove 10-20 MWh of grid demand over a period of 8 to 10 hours. Each megawatt-hour of system capacity requires approximately 20,000 square feet of refrigerated space, so larger systems can be constructed in larger refrigerated warehouse spaces.

   Over the next three to six years, our distributed energy storage capacity would scale to the 200-400 MWh system size by installing TES with PCMs systems in additional refrigerated warehouse spaces. For example, we could reach 400 MWh in that timeframe by installing TES with PCMs systems in 40 refrigerated warehouse spaces that are approximately 200,000 square feet each.

   Scaling vertically (larger system sizes in larger buildings) is our preferred option, but TES with PCMs can also be scaled horizontally by deploying smaller systems in a broad range of spaces, such as walk-in coolers or grocery refrigerated cases. In either case, systems can be sized to provide 8 to 10-hour load reductions.

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.*

While many sources of long-term energy storage work by saving electrical energy directly and could therefore be stored in a DC configuration, TES with PCMs stores energy in the form of latent heat through crystallization of a brine solution. Storing this energy requires running refrigeration equipment, typically alternating current (AC) powered, during off-peak periods to recrystallize the phase change material.

For a 10 MWh system, the cost for installing TES with PCMs in a 200,000 sq. ft. refrigerated cold storage warehouse would be approximately $1.5M and have a life expectancy of 20 years per the designed specifications.

For a 20 MWh system, the cost for installing TES with PCMs in a 400,000 sq. ft. refrigerated cold storage warehouse would be approximately $3M and have a life expectancy of 20 years per the designed specifications.

For a 30 MWh system, the cost for installing TES with PCMs in a 600,000 sq. ft. refrigerated storage would be approximately $4.5M and have a life expectancy of 20 years per the designed specifications.

There are cold storage warehouses in California up to 900,000 square feet. We estimate there is about 1.5GW of refrigerated storage load in California.

PCMs are a brine-based material that has been used for load shifting in commercial and industrial buildings and refrigerated cold storage for over 30 years. PCM thermal energy storage is a commercial technology that is available to the market immediately. Our product is manufactured in California which will accelerate the shipping and installation process.

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?*

   For all system sizes, we recommend an approach like the DEBA program in California, with 20% installed cost match from the customer. This assumes a 30% IRA tax credit and a 50% incentive from the CEC. This would incentivize adoption and be an accelerator to achieve 400 MWh in 6 years.

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?*

   We believe a 40% IRA tax credit is one of the incentives for a TES LDES system. This is 30% for the IRA approved energy storage technology and a 10% adder for being manufactured domestically. The 40% tax credit would apply uniformly to all three of the system sizes listed in Question 1. To support adoption, California will need to provide additional incentives.

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.*

   TES behind the meter already meets this standard, with 100% round trip efficiency and without the associated losses of a round trip AC/DC conversion. It opens a more economical and faster way to provide storage and resiliency to Load Serving Entities (LSEs). The overall capital cost of an 8-to-10-hour TES system is around $150 per kWh, which is less than half of the current cost of Li-ion systems. The Levelized Cost of Energy (LCOE) for TES for 20 years is between $20-$50/MWh, which is also much less expensive than $200/MWh for Li-ion battery technologies.

   TES installations can provide energy savings and dispatchable loads or can be used for permanent load shifting. By stacking existing grants and incentives (IRA tax credit, tax deductions, utility rebates) alongside the lower costs and bill savings, these projects can have attractive financial performance for customers (paybacks in under 2 years).

   Compared to electrochemical batteries, thermal energy storage has lower costs, improved overall system efficiency, and is made with materials that are recyclable and even environmentally friendly. This supports California quickly diversifying away from Li-ion battery technologies in the next 5 years as the primary storage medium on the grid.

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?*

    A system size of 30 MWh would be needed to persuade us to at least partially automate the majority of our LDES system manufacturing capability to deliver a future order of that size in that window.

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.*

    No basis for response

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

    The commitment to Tier 2 or 3 High Fire-Threat Districts aligns with safety regulations and reflects responsible deployment, addressing California's wildfire risk. Incentivizing these sites with bonus points through solicitation scoring aligns with California's goals.

    Thermal energy storage using phase change materials is a safe behind-the-meter technology, and does not pose any fire hazard, unlike other storage technologies. Michaels Energy's TES system primarily consists of salt water and recyclable containers, so it can be safely used even in high fire-threat areas.

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?*

   A customized approach based on service territory characteristics will require further analysis. There will be variation across service territories due to the concentration of cold storage and food distribution centers across California. A strategic approach based on concentration of targeted behind-the-meter sites will be necessary.

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?*

    Thermal energy storage is a behind-the-meter DER, which has a few advantages over front-of-the-meter-technologies. It's a more economical and faster way to provide storage and resiliency to Load Serving Entities (LSEs). A typical site can be installed in 120 days, and the 20-year LCOE as mentioned above can be as low as $0.02-$0.05/kWh, which is much less expensive than Li-ion storage.

    a. *For a behind-the-meter installation, does your LDES technology have any advantages to the utility in regard to the utility interconnection agreement?*

       Thermal storage presents an advantage to the utility, because it doesn't require an interconnection agreement.

    b. *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?*

       Not applicable.

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

No interconnection agreement is required, because the thermal energy storage "batteries" are not connected to the grid.

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

    An average-sized behind-the-meter building freezer site is 200,000 sq. ft. for a 10 MWh system. No additional space is required beyond the building's existing footprint. The technology is installed inside the building and does not interfere with operations.

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?*

    Since this is a behind-the-meter storage technology that installs inside the existing building footprint, there is no need for an environmental impact report. This will provide California with a simpler and lower cost means to achieve the non-Li storage goals required for grid resiliency.

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.*

    Thermal Energy Storage does not require the complexity of permitting and CEQA environmental assessments of typical electrical batteries. Discretionary permitting for thermal energy storage projects is quite simple. An electrical permit may be required to install revenue-grade electrical metering but would not be required for the TES system itself. TES often does not require building modifications and is at most a simple retrofit. Michaels Energy's design is customer-installable and easy to scale.

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?*

    The recommendation for preliminary CEQA studies and information provides a proactive approach, fostering early project alignment of electrical battery systems with environmental regulations. For a TES system, CEQA studies are not required.

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?*

    We provide industry standard Material Safety Data Sheets to show the composition of the product to be installed, with any safety hazards identified before the installation. All of Michaels Energy's PCM systems are non-flammable and not hazardous to the environment. Material Safety Data Sheets are already prepared, so no additional time is required for this environmental process.

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?*

        The over-generation of renewables in the middle of the day is an opportunity for energy storage for a TES System. TES systems can be set to "charge" (to their lowest temperature) during the middle of the day, leveraging solar generation. In this case, the refrigeration equipment charges the system using clean, carbon free electricity. Alternatively, the system can charge overnight, using available clean wind power or other fuel sources, allowing the refrigeration systems to operate in more efficient external ambient conditions.

During the 4-9pm peak window, and into nighttime hours, the TES system can be leveraged to provide maximum GHG reduction and load shifting benefits by turning off refrigeration equipment.

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?*

Our technology is always installed behind the meter.

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?*

C&I (Commercial & Industrial) adoption of technology that benefits the grid is most often slowed down because of budgets and conflicting priorities for capital. Future funding from this GFO can help solve the conflicting priorities barrier through grants that ensure a simple payback period of less than 2 years.

One accelerator that can be provided is off balance sheet financing so that the monthly payment is an expense rather than capital expenditure. Only one utility in the country has decided to provide clients with off-balance sheet financing for 5, 10, or up to 15 years, and payments can be made directly on their utility bill.

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

We urge the CEC to include thermal energy storage systems as an eligible LDES demonstration project in its next GFO. Thermal energy storage "batteries" alleviate grid stress without requiring grid connections or posing a fire hazard, use much more sustainably sourced and disposed of materials, and they have four times the service life of lithium-ion batteries.

Our proposed solution would focus on field demonstrations of Michaels Energy's proprietary TES systems which employ PCMs to reduce both the energy requirements and demand of low and medium-temperature refrigeration systems. Target markets include businesses with commercial and industrial refrigeration systems. These large loads are typically coincident with existing grid peaks. We believe that when using TES, the best value is achieved behind the meter for these reasons:

- There's no interconnection requirement. TES serves load-shifting purposes without the costly and time-consuming permitting processes required by grid-connected batteries.
- The commercial sector's refrigeration needs have high energy use intensity, and TES can shift peak loads to coincide with times of maximal solar PV generation. These low-cost, high-return projects create permanent load shifting, and/or can be used for demand response.
- The loading order mandated by the State prioritizes reducing electrical demand through energy efficiency and demand response, which is aligned to the results this technology produces.
- TES can help meet state and local equity objectives and requirements because systems can be deployed in refrigerated warehouses within disadvantaged/underserved communities without affecting the local environment.

TES equipment also has resiliency benefits in refrigerated warehouses that may either have no backup power sources, or backup power sources (such as diesel) that cause or exacerbate air pollution issues in environmental justice communities.

From a materials perspective, Michaels Energy's TES systems are significantly more environmentally sustainable than almost any other battery solution. PCMs primarily consist of salt water and recyclable containers, making the materials substantially more environmentally friendly. The PCM form factors for this project have a useful life of 20 years, as compared to grid scale lithium-ion batteries which have a useful life of approximately five years.

Thank you for your consideration, and for the opportunity to contribute to the advancement of non-Lithium-ion LDES solutions for California.

MichaelsEnergy

Sincerely,

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