

## QUESTIONS AND ANSWERS

PLEASE REFER TO THE GENERAL FAQs SECTION OF ARPA-E'S WEBSITE ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)) FOR ANSWERS TO MANY GENERAL QUESTIONS ABOUT ARPA-E AND ARPA-E'S FUNDING OPPORTUNITY ANNOUNCEMENTS. ADDITIONAL QUESTIONS SPECIFIC TO THIS FOA ONLY ARE INCLUDED BELOW. PLEASE REVIEW ALL EXISTING GENERAL FAQs AND FOA-SPECIFIC QUESTIONS BEFORE SUBMITTING NEW QUESTIONS TO ARPA-E.

### I. Full Application Phase Questions:

**Q1. If I have submitted a proposal to the ARPA-E OPEN 2018 FOA with an approach that is relevant to the performance metrics in the DAYS FOA, should I withdraw that application and submit it to DAYS?**

**ANSWER:** Please refer to Section III.C.2 (Responsiveness Criteria) of the DAYS FOA. Section III.C.2 states that "submissions that are not scientifically distinct from applications submitted in response to other currently issued ARPA-E FOAs" may be deemed nonresponsive and may not be reviewed or considered. If your application in response to the DAYS FOA technical performance metrics (specified in Section I.B.3 of the DAYS FOA) will not be scientifically distinct from your submission to OPEN 2018, ARPA-E strongly recommends that you/similar applicants withdraw your submission from OPEN 2018 and submit it in response to the DAYS FOA.

In order to withdraw from OPEN 2018, provide written confirmation to the ARPA-E Contracting Officer via email ([ARPA-E-CO@hq.doe.gov](mailto:ARPA-E-CO@hq.doe.gov)) of your intention to withdraw your submission from further consideration. Include the FOA name and number and the Control Number for your submission in the body of the email, as well as the name and email address of the person authorizing the withdrawal.

**Q2. I have submitted a proposal relevant to the performance metrics in the DAYS FOA to the OPEN 2018 FOA. Can I submit the same idea to the DAYS FOA?**

**ANSWER:** See ARPA-E's response to Q1 above.

**Q3: If my Concept Paper to the ARPA-E OPEN 2018 FOA with an approach relevant to the performance metrics in the DAYS FOA is not encouraged for writing a full application can I submit an application to the DAYS FOA using the same approach proposed to OPEN 2018?**

**ANSWER:** See ARPA-E's response to Q1 above. Assuming the submission is withdrawn from the OPEN 2018 FOA, it can be submitted to and considered under another ARPA-E FOA, such as the DAYS FOA.

**Q4: I submitted a concept paper to the ARPA-E OPEN 2018 FOA with an approach relevant to the performance metrics in the DAYS FOA. If my concept paper to OPEN 2018 is encouraged, and I submit a full application to the OPEN 2018 FOA, and it is not selected for an award, will there be an opportunity to submit to the DAYS FOA?**

**ANSWER:** No, the submission deadline for full applications for the DAYS FOA (July 2, 2018) is prior to the expected notification deadline of selection decisions for OPEN 2018.

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### **Q5. Could you let me know if concentrated solar power (CSP) stored thermally in molten salts is an approach of interest for the DAYS FOA?**

**ANSWER:** ARPA-E will not provide pre-submission assessments of a project team's specific concepts. In general, please refer to Section III.C.3 (Submissions Specifically not of Interest) of the DAYS FOA. Section III.C.3 states that submissions that propose "technologies that are not charged solely by electricity, and produce electricity as the sole output" are specifically not of interest for this FOA and "may be deemed nonresponsive and may not be merit reviewed or considered." Thermal storage systems charged using electricity may be responsive, but storage systems charged thermally would not be responsive.

### **Q6. My question is about the table of performance metrics on page 11 of the DAYS FOA, specifically item 5. It says "only electricity in/ only electricity out."**

**Would this exclude power-to-gas (P2G) technologies, since they also have a continuous requirement for water and CO2? A typical P2G process actually consumes some water and CO2 for every kWh it stores. Would this "non-electricity input" cause a P2G proposal to be rejected as non-responsive?**

**ANSWER:** ARPA-E will not provide pre-submission assessments of a project team's specific concepts. In general, please refer to Section III.C.3 (Submissions Specifically not of Interest) of the DAYS FOA. Section III.C.3 states that submissions that propose "technologies that are not charged solely by electricity, and produce electricity as the sole output" are specifically not of interest for this FOA and "may be deemed nonresponsive and may not be merit reviewed or considered." Therefore, P2G systems that produce chemicals but not electricity as the output would not be responsive.

### **Q7. The FOA states that, "This program will only consider storage systems that are charged solely by electricity and produce electricity on discharge."**

**Would a geothermal storage system that makes dual use of the "electrically charged" thermal store for "electric discharge" "with secondary heat recovery for other uses" be an acceptable technology to propose?**

**ANSWER:** ARPA-E will not provide pre-submission assessments of a project team's specific concepts. In general, please refer to Section III.C.3 (Submissions Specifically not of Interest) of the DAYS FOA. Section III.C.3 states that submissions that propose "technologies that are not charged solely by electricity, and produce electricity as the sole output" are specifically not of interest for this FOA and "may be deemed nonresponsive and may not be merit reviewed or considered." Therefore, systems that provide thermal energy as the output would not be responsive.

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**Q 8.a. I recently created a new battery storage invention that could be very useful for the DAYS Program. My idea is not yet patent protected. Does ARPA-E protect IP in projects like DAYS?**

**8.b. Can I send ARPA-E my ideas and tell me if it is worth applying to the program?**

**8.c. Does ARPA-E provide grant writing assistance?**

**ANSWER:** 8.a. Please refer to sections VI.B.7 (Intellectual Property And Data Management Plan), VIII.E (Marking of Confidential Information), VIII.F (Title to Subject Inventions), and VIII.G (Government Rights in Subject Inventions) of the DAYS FOA. Keep in mind that any subsequent award will include a Patent Rights Clause which will include a definition of "subject invention" which is any invention *conceived or first actually reduced to practice* in the performance of work under the award. Subject inventions must be reported to the Government. The above cited sections of the FOA provided more information about Government rights in subject inventions.

8.b. ARPA-E will not provide pre-submission assessments of a project team's specific concepts. Applicants are encouraged to review Section IV.A (Application Process Overview) of the FOA for the NOI and Full Application review processes. "Compliance Criteria", "Responsiveness Criteria", and "Submissions Specifically Not of Interest" are found in Section III.C of the FOA. .

8.c. No, ARPA-E does not provide grant writing assistance.

**Q9. I have one quick question about the Notice of Intent. Should I include just information ( bullet points) listed in FOA or do we need to format it as concept paper + the bullet points?**

**ANSWER:** For Guidance on preparing and submitting the Notice of Intent please refer to the Required Documents Checklist, Section IV.A.2 (Notices of Intent), and Section IV.C (Content of Notices of Intent) of the DAYS FOA.

**Q10. I had a question about the Duration Addition to Electricity Storage (DAYS) FOA question: DE-FOA-0001906 and the info in Table 1, line 4 and "section 3. Submissions Specifically not of Interest." In those places the FOA states "Technologies may make use of below ground storage (e.g., a sub-surface tank), but technologies that rely on site-specific geologic structures are specifically not of interest."**

**We understand that this is meant to eliminate the use of unusual or very specific subsurface features like mines and caverns. However, is it mean to eliminate all technologies that make any use of the subsurface beyond tanks?**

**ANSWER:** To be responsive to the DAYS FOA, applicants must clearly demonstrate that an electricity storage system that relies on sub-surface technology can be sited independent of local geological or geographical attributes.

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**Q11. Would ARPA-E consider long duration energy storage that converts electrical energy into a chemical energy storage vessel that is dedicated and only capable of running air conditioning?**

**ANSWER:** Refer to Section III.C.3 (Submissions Specifically not of Interest) of the DAYS FOA. Storage systems must produce electricity as the output; a storage system that produces thermal energy as the sole output (which appears to be implied by the question) would be deemed nonresponsive.

**Q12a. The FOA specifies that the minimum final, full scale system size should be >100kW based on peak electrical output. Is that the size that must be demonstrated within this funding phase or is the program open to us demonstrating proof-of-concept at a smaller scale provided that technoeconomic analysis shows viability at [at least] that scale?**

**ANSWER:** Prototype electricity storage systems or subsystems developed through the DAYS funding opportunity are not required to meet the 100 kW minimum capacity threshold. Smaller, proof-of-concept demonstrations, at the system and/or component level, are suitable for funding. However, final system design and technoeconomic analysis for a long-duration electricity storage system ultimately deployed at scale should be based on a system with a minimum capacity of 100 kW.

**12b. The FOA specifies that Sections 1-5 (Innovation and Impact, Proposed Work, Team Organization and Capabilities, Technology to Market, and Budget) of the full application should be 12 pages max. Is the 12 page limit for each of the 5 sections or for the total of the 5 sections combined?**

**ANSWER:** Twelve is the maximum total number of combined pages for Sections 1-5 of the DAYS full application.

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**Q13. I would like to ask for a clarification on Equation 1 of DOE-FOA-0001906, reproduced below:**

$$LCOS = \left[ \underbrace{\left( \frac{1}{\eta_{RTE}} - 1 \right) P_c \sum_{t=1}^T \frac{1}{(1+r)^t}}_{\text{electricity}} + \underbrace{\sum_{t=1}^T \frac{O\&M(t)}{(1+r)^t}}_{\text{O\&M}} + \underbrace{\left( \frac{C_E}{\eta_D} + \frac{C_P}{d} \right)}_{\text{energy power}} \right] * \left[ \sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} \right]^{-1}$$

As written, there are four components of LCOS: electricity, O&M, energy, and power. However, the component of the equation for electricity cost does not appear to account for the fact that electricity must be paid for each cycle; the numerator in the first summation is one, which implies that only one cycle occurs each year. However, if the system is cycled more than once per year, then equation 1 results in a lower LCOS than the system actually has. Below are two possible ways to rewrite the equation that I believe will fix this problem:

$$(1) LCOS = \left[ \left( \frac{1}{\eta_{RTE}} - 1 \right) P_c \sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} + \sum_{t=1}^T \frac{O\&M(t)}{(1+r)^t} + \left( \frac{C_E}{\eta_D} + \frac{C_P}{d} \right) \right] * \left[ \sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} \right]^{-1}$$

$$(2) LCOS = \left( \frac{1}{\eta_{RTE}} - 1 \right) P_c + \left[ \sum_{t=1}^T \frac{O\&M(t)}{(1+r)^t} + \left( \frac{C_E}{\eta_D} + \frac{C_P}{d} \right) \right] * \left[ \sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} \right]^{-1}$$

**Can you please confirm that my analysis is correct, or illustrate where I have made a mistake?**

**ANSWER:** The omission of  $n_c(t)$  in the numerator of the discounted cost of electricity for charging term is indeed an error in the reproduction of the LCOS equation. This has been corrected by DE-FOA-0001906, Modification 02. Figures 3 and 4 derived from the LCOS equation are correct as written.

**Q14. I am unable to reproduce the LCOS in Figure 3 using the information in the technical document. Would ARPA-e be willing to share a representative detailed calculation that shows how this is calculated?**

**ANSWER:** Equation 1 in the DAYS FOA has been corrected to reflect the per-cycle cost of charging the storage system (see response to Q13 above). Using the corrected Equation 1, the LCOS for a given system at a specified number of annual equivalent cycles can be determined.

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**Q15. I am evaluating the ARPA-E DAYS FOA number 0001906 and I noticed that formula [1] of the FOA document (page 12) doesn't appear to give the results described in the footnote at the bottom of Table 1 (page 11). ... Please could you confirm the correct formula.**

**ANSWER:** See response to Q13 above.

**Q16. Can you please tell me if after the Notice of Intent is submitted, if we would receive a reply shortly afterwards encouraging or discouraging us to submit a Full Application? The Full Application deadline is about 2 weeks after the Notice of Intent deadline, and requires quite a high amount of materials development, so I am unclear if ARPA triggers a recommendation to the applicant in time to prepare the materials required for the Full Application, or if the expectation is that the applicant would begin working on the Full Application before getting feedback about the competitiveness / eligibility of the project described in the Letter of Intent. After reviewing the information you provided, it seems we have a very short window to create a large body of materials, including a full project scope, costings, Gantt charts, etc – am I perhaps not understanding the process correctly?**

- **Notice of Intent Deadline: 6/15/2018 5:00 PM ET**
- **Full Application Submission Deadline: 7/2/2018 5:00 PM ET**

**ANSWER:** ARPA-E will not provide any response to Notices of Intent it receives. Refer to the DE-FOA-0001906 Section IV (Application and Submission Information) and Section V (Application Review Information) for details concerning the application and evaluation process for this FOA.

**Q17. We are a small business dedicated to solving energy storage. We have a great concept and outstanding team with a national lab (FFRDC) and leading university. We would like to understand how to receive the first year cost share waiver of 0%, ...**

**ANSWER:** Refer to FOA Section III.B.3 and General FAQ 4.7 for pertinent cost sharing requirements.

**Q18. I have a question about this FOA. Please see new version FOA. Page 10, Table 1, ID 6. It is described to be minimum 100 kw system size. I am wondering whether it should be 100 kWh system size other than 100 kw system size.**

**ANSWER:** See the response to Q12a above, for context on the meaning of the 100 kW system size in Table 1. As written in the FOA, the minimum system size for ultimate deployment (not for actual demonstration through the DAYS program) is 100 kW (not kWh). The minimum number of kWh is not fixed, because systems with a range of durations may be supported by the DAYS program, and the FOA fixes the power level.

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**Q19.** This question corresponds to the following requirement for the energy storage system:

*The technologies in this program need to be suitable for siting throughout the entire United States. Technologies may make use of below ground storage (e.g., a sub-surface tank), but may not rely on site-specific geologic structures. Can you clarify the phrases "site-specific geologic structures" and "throughout the United States"?*

Do "site-specific geologic structures" refer to singular structures or do they refer to structures that exist in many places around the U.S? For instance, salt caverns (formations) exist in many places, but could be considered site-specific geologic structures as they do not cover the entirety of the U.S.

We are considering submitting an offshore solution. Does such a solution automatically disqualify because it can not be sited throughout the interior of the United States.

**ANSWER:** See the response to Q10 above, which provides additional context on the question of siting. Approaches that require the use of offshore resources are excluded, because they are not "suitable for siting throughout the entire United States," as specified in Table 1 of the FOA.

**Q20.** The process that we have been developing appears to meet all the criteria requested by the Financial Assistance Funding Opportunity Announcement except that the LCOS is greater than \$0.05/kWh. Will ARPA-E be interested in proposals for processes that have LCOS values greater than the target \$0.05/kWh?

**ANSWER:** The DAYS program will focus on approaches that describe innovative technologies and a project plan that can demonstrate a pathway to an LCOS of \$0.05/kWh.

**Q21.** In order to ensure accurate interpretation of the duty cycles specified in Figure 2B, would ARPA-e be willing to post either the spreadsheet supporting the figure or a table providing storage duration, system cycles and marginal cycles (for Category 1 and Category 2), particularly for durations from 10 to 30 hours as the scale is difficult to read toward the left side of the chart?

**ANSWER:** ARPA-E does not believe it is necessary to provide additional information on the duty cycles in Figure 2B at this time. Figure 3 and Figure 4 in the FOA provide guidance on the system lifetime costs of interest for a range of durations, including from 10 to 30 hours. Applicants should also review the Full Application Template for a description of the system attributes that ARPA-E will use to make project selections.

**Q22.** Would concepts that utilize electricity to charge but discharge by offsetting an end-service that would otherwise be using electricity during that discharge period be responsive to the DAYS FOA?

**ANSWER:** See responses to Q5-Q7 and Q11 above.

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**Q23. In the response to Q13 of the DAYS FAQ, ARPA-E states “The omission of  $nc(t)$  in the numerator of the discounted cost of electricity for charging term is indeed an error in the reproduction of the LCOS equation. This has been corrected by DE-FOA0001906, Modification 02.” As shown in the attached file LCOS equation analysis (omitted), the equation in Modification 2 does not address the error in the O&M term. Is there a plan to address this issue? In the same response, ARPA-E states “Figures 3 and 4 derived from the LCOS equation are correct as written.” As shown in the attached file “Figure 2-5 analysis.pdf” (omitted), Figure 4 is not correct as written. Is there a plan to address this issue?**

**ANSWER:** Equation [1] in DE-FOA-0001906, Modification 02 is correct as written. The referenced LCOS analysis submitted as part of the question (omitted here) assumes units of \$/kWh-cycle for the O&M cost term. As stated in the FOA, the units of O&M in Equation [1] are \$/kWh, and therefore must be divided by the number of cycles to arrive at the LCOS with units of \$/kWh-cycle. Figures 3 and 4 are also correct as displayed.

**Q24. The FOA Specifies that the minimum final full scale size should be > 100kW. To this end, What TRL component/system is expected to be developed through the DAYS funding?**

**ANSWER:** Please refer to section I.B.2 of the FOA for information regarding expected component and system development targets. As stated in the FOA, “For this program, ARPA-E is open to smaller projects seeking to develop transformational advances in one or more components used in a complete system, with proof of concept demonstrated at the subscale component level. ARPA-E is also open to larger projects, seeking proof of concept for fullscale components, and/or a complete sub-scale system.”

**Q25. I am hoping to get some guidance or extra explanation about the Figure 5 in the DAYS FOA. It shows a "Storage Media Capital Cost" for NH3 in Graph A at about 0.45 \$/L, 0.15 \$/kWh. Unfortunately, I don't understand how "storage media capital cost" applies to NH3 because the NH3 is the storage medium and it doesn't have any portion that stays behind when it is used. I understand that there is considerable capital equipment for its synthesis, but the text makes me think that is not what the plot means. I would think that this refers to a container cost, but Graph B has that. Can you provide some additional explanation so I can understand what capital the plot refers to?**

**ANSWER:** The Storage Media Capital Costs in Figure 5 are meant to provide an approximate value of the cost of the energy storage medium itself. In the case of ammonia, the value shown is the approximate value of ammonia made via the Haber-Bosch process; in other words, the cost of ammonia that is shown is for its "charged" form. If the "discharge" of ammonia is assumed to involve conversion to N<sub>2</sub> and H<sub>2</sub>O with release into the atmosphere (and not into a closed container that would prevent the need for separation of N<sub>2</sub> and H<sub>2</sub>O from air during each charge, which would obviously

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reduce efficiency), one could also consider the cost of ammonia as an energy storage media to be nearly zero. Applicants should describe the energy storage media in both the charged and discharged form in their applications, as described in the required information for the Technical Volume.

**Q26. Our technology has been demonstrated at pilot scale and at pre-commercial sub-system scale. An initial deployment is likely to require a portion of viability gap funding in addition to private funding, in order to tip the balance of the business case. Is such funding within the scope of this call if it can be shown to drive a technology toward the stated targets?**

**ANSWER:** ARPA-E will not provide pre-submission assessments of a project team's specific concepts. In general, please refer to Section III.C.3 (Submissions Specifically not of Interest) of the DAYS FOA. Section III.C.3 states that submissions that propose "demonstration projects that do not include a significant degree of technical risk" are specifically not of interest for this FOA and "may be deemed nonresponsive and may not be merit reviewed or considered." As stated in Section I.B.2 of the FOA, "a second phase to the DAYS program is envisioned, with a goal of building one or more prototype systems that are placed in field use...ARPA-E expects to finalize and publicize its plans for a second phase to the DAYS program in 2021."

**Q27. Is January 1, 2019 an acceptable start date to use for the application?**

**ANSWER:** Refer to FOA Section II.A.

**Q28. We are two small businesses with technologies that have been developed over the past 20 years toward this goal. How do we negotiate/get some cost share relief on this DE-FOA-0001906 DAYS effort?**

**ANSWER:** As set forth in the FOA at Footnote Note 24, minimum cost share requirements are governed by the Energy Policy Act of 2005 (Pub.L. 109-58, sec. 988). Reduced cost share requirements for small business are addressed at FOA Section III.B.3.

**Who would be a good contact in a Federal Lab to interface with before the submittal deadline?**

**ANSWER:** Prospective applicants are responsible for assembling the teams they judge necessary to participate in this FOA.

**Q29. I have some questions on the LCOS equation/calculation.**

**1) With  $T=20$  years, can you please define what  $t$  (small  $t$ ) period is? Does  $t=1$  year?**

**ANSWER:**  $t$  in Equation [1] of the FOA is the discrete time step used for discounting future costs and energy production. It is assumed to occur on an annual basis.

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**2) For the LCOS equation, is rated power omitted by design, or should it be in the equation?**

**ANSWER:** The rated power is not explicitly shown, but it is built into the duration at rated power variable ( $d$ ), where  $d$  is the ratio of usable energy to rated power.

**Q30. Is there an overall total budget limit for ARPA E DAYS call in the letter of intent the PIs are submitting this week?**

**ANSWER:** Refer to FOA Section II.A.

**Q31. There are potentially conflicting statements in the FAQ sections about the need for a Concept Paper. Is a Concept Paper required to make a compliant "Notice of Intent"?**

**ANSWER:** There is no concept paper phase as part of the DAYS FOA. The application process for DE-FOA-0001906 (DAYS) is set forth in Section IV.A.

**Q32. In the FOA for the DAYS program, it says that (Section III.C.3)**

**"Approaches seeking incremental improvements to other storage technologies already under development, including electrochemical (e.g., flow batteries), chemical (e.g., hydrogen), mechanical (e.g., compressed air), and other storage technology classes" are not of interest.**

**Can you please clarify if ALL incarnations of the stated examples (e.g. compressed air, hydrogen, flow batteries) are ruled not of interest? If not, can you clarify what APRA-E has in mind for "technologies under development" (to which the proposed concept should not be an incremental improvement) for these examples?**

**ANSWER:** As stated in Section 1.A of DE-FOA-0001906, Modification 02, "ARPA-E supports high-risk, potentially transformative research that has the potential to create fundamentally new learning curves." The text referenced in the question above does not rule out any of the listed technology classes. Rather, it emphasizes that ARPA-E is not interested in *incremental* improvements to any existing storage technologies as part of the DAYS FOA.

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**Q33. I have a question regarding the latest LCOS formula updated in Mod 2 of Funding Opportunity No. DE-FOA-0001906. As written, the formula has a component to account for the cost of electricity. Why is the cost of electricity included in the cost of storage? Per my current understanding, even if a system could be built and operated for no cost, the “cost” of storage per this formula would still be \$0.025/kWh-cycle. Thus, if I constrain the provided formula to \$0.05/kWh-cycle or less, I only have \$0.025/kWh-cycle to work with, since the other \$0.025 is fixed by the cost of the input electricity. Figure 1 on page 13 of the FOA appears to correctly show this potential discrepancy, illustrating the input (charge) of \$0.025/kWh is separate from the targeted \$0.05/kWh-cycle for LCOS, providing a total LCOE of \$0.075. Should the formula for LCOS provided in Mod 2 actually be constrained to \$0.075/kWh-cycle in lieu of \$0.05/kWh-cycle given that it includes the purchase price of the input electricity?**

**ANSWER:** 5 cents/kWh-cycle is the correct target for the LCOS. The cost to charge the system is considered an operating expense and is represented by the term  $P_c(\eta_{RTE}^{-1} - 1)$  in the LCOS equation in DE-FOA-0001906, Modification 02, where  $P_c$  is the input electricity price (2.5 cents /kWh-cycle) and  $\eta_{RTE}$  is the AC round-trip efficiency. Therefore, the cost to charge is some fraction of the input electricity price that depends on the round-trip efficiency of the system.

**Q34. While I can calculate the LCOS for a 100kW system for 10, 50 and 100 hours individually, I don't know how to calculate the LCOS for a system designed for 100 hrs but will be used for any discharge case from 10-100 hours.**

**ANSWER:** The duty cycle shown in Figure 2B of DE-FOA-0001906, Modification 02, can be used to determine the number of equivalent full charge-discharge cycles per year for various system durations.

**Q35. We are working on the DAYS proposal. Our collaborators and we are actively discussing about the milestones with timeline and exchanging the portions of this proposal, but the deadline is approaching. Will it be possible to extend the deadline for about 15 days?**

**ANSWER:** ARPA-E is not presently contemplating an extension of the date and time for submission of Full Applications.

**Q36. What are the definitions of “AC system round trip efficiency” and “AC system...discharge efficiencies” as mentioned in the discussion near Equation 1? Are these terms synonymous with “AC system energy efficiency” and “AC System charge/Coulombic efficiency”, respectively?**

**ANSWER:** The AC system round-trip efficiency refers to an energy efficiency, and includes all energy losses, including any power conversion losses associated with AC interconnection, incurred when passing a unit of electricity in to and then out of the electricity storage system. The AC discharge efficiency also refers to an energy efficiency, and only accounts for energy losses incurred upon discharging of the storage system, again including any power conversion losses required to deliver AC power.

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**Q37. What is meant by “Number of cycles each marginal hour of the storage system performs per year” in the caption of Figure 2b?**

**Is this the assumed number of cycles of a given duration that would be required of a system each year (given that the system is capable of the required duration)?**

**ANSWER:** The marginal number of annual cycles as defined in Figure 2B is the ratio of energy discharged at a given “unit” of duration (i.e. a given range of state of charge) to the rated energy of that single unit of the electricity storage system per year. For example, a 1 MW / 100 MWh (100 h) system that discharges a total of 10 MWh of electricity between a state of charge of 39-40% over a year would have a marginal annual cycle count of 10 at 40 hours duration at rated power.

**Q38. Since we are the commercialization entity, for “Technology Transfer and Outreach Costs” can we seek a waiver on this provision and simply state that we are the commercialization entity?**

**ANSWER:** ARPA-E requires Applicants to spend at least 5% of ARPA-E funding on Technology Transfer and Outreach (TT&O) activities. Preparing technologies for an eventual transfer from lab to market is a key element of ARPA-E's mission, specifically called for in our statutory mandate from Congress. Applicants may request a waiver of this requirement, in whole or in part, by completing Item 6 of the Business Assurances and Disclosures Form, but any waiver request must be supported by a substantive reason or reasons for ARPA-E to grant the waiver.

**Q39. We have the following two questions:**

- 1. For one of the technical inventions we'll be proposing, we can use the LCOS equation and the equivalent annual cycles from Figure 3 and get below the Category 1 target of 5 cents/kWh in the 10-20 hour discharge duration range, but that specific technology embodiment does not get below the 5 cents/kWh cost target for discharge durations from ~30-100 hours. Will this solicitation consider projects that meet the lower end of the specified discharge duration range, but not the whole range?**
- 2. Shipping and installation costs are referenced in the technical overview document, however, they are not explicitly described/included in the LCOS equations. Should costs such as shipping and installation be included in the LCOS cost parameter inputs (i.e., C\_E or C\_P)?**

**ANSWER:** Regarding question 1, systems with the potential to meet the DAYS FOA metrics for durations of 10 to 20 hours are of interest. All proposed systems do not need to meet the metrics for durations up to 100 hours. Please also note the second bullet in the list after “Table 1: Technical performance metrics for the DAYS program” in the DAYS FOA, which states that “Approaches with the potential to achieve the technical performance metrics for durations *up to* the upper range...” are of interest (emphasis added). Regarding question 2, as stated in the FOA, shipping and installation costs do need to be included in accounting for capital costs. As stated in the full application template, page 4, in the “System Specifications” section of the table, if a simple assumption is used for these costs, it should be stated.

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### **Q40. Two questions on the Technical Volumes of the proposal:**

- 1. The LCOS equation is very sensitive to maintenance costs. However, the metrics table does not include a line item to describe this parameter. Would you recommend I add it to the template table that you provided?**
- 2. In the FOA you indicate interest in systems that are at least 100kW. We believe that our technology is better suited for much larger applications (>10MW). Would you rather see the analysis for the power indicated or the expected target?**

**ANSWER:** Regarding question 1, maintenance costs are included in the LCOS equation, and information from applicants on the maintenance costs for their systems is welcomed. Adding a row to the template table is an acceptable way to provide such information. Regarding question 2, the DAYS FOA specifies a minimum system size of 100 kW. Systems better suited for much higher power levels (e.g., 10s of MW, as is the case for many turbine-based technologies) do not need to have their cost analyzed at a scale of 100 kW.

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**Q41. I have a few questions in regard to the DAYS FOA.**

- As is written, I do not believe equation 1 in DE-FOA-0001906, modification 2, is dimensionally consistent. Distributing the summation at the end of the equation yields:

$$\begin{aligned}
 LCOS = & \underbrace{\left(\frac{1}{\eta_{RTE}} - 1\right) P_C}_{\frac{\$}{kWh}} + \underbrace{\left[ \sum_{t=1}^T \frac{O\&M(t)}{(1+r)^t} + \left(\frac{C_E}{\eta_D} + \frac{C_P}{d}\right) \right]}_{\frac{\$}{kWh}} * \underbrace{\left[ \sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} \right]^{-1}}_{\frac{1}{\text{cycle}}} \\
 & \underbrace{\hspace{15em}}_{\frac{\$}{kWh * cycle}}
 \end{aligned}$$

The resultant units of the first term are then \$/kWh, while the remaining three terms have units of \$/kWh-cycle. If this is correct, I'm not sure how to interpret it. There would necessarily be some unknown units associated with the constant modifying the round trip efficiency. Please advise if this dimensional analysis is correct, and how to interpret this discrepancy.

- Am I correct in assuming that if we want to use a chemical storage unit (e.g. an electrolyzer) would the capital cost of the electricity to chemical energy converter (e.g. electrolyzer) go into the  $C_e$  term?

**ANSWER:** Regarding question 1, see the response to Q33 above. The system needs to be charged each cycle, so the units of  $P_C$  are \$/kWh-cycle. Regarding question 2, the portion of the system that converts from electricity to stored energy is considered the power component. The portion of the system that stores the chemical energy (e.g., tanks) is the energy component.

**Q42. I have two questions:**

- The paragraph at the bottom of page 28 describes how individuals can apply for funding. It states "However, ARPA-E will only award funding to an entity formed by the Applicant." When do I need to form a small business in order to receive funding?

**ANSWER:** Any Applicant business entity must be formed prior to the obligation of funds by ARPA-E.

## QUESTIONS AND ANSWERS

2. My project will evaluate the lifecycle costs of .... I think it would best to have ... carry out the actual research because they have the equipment ... that would be used .... As a GOGO would ... have to be the Prime Recipient?

**ANSWER:** Refer to OPEN 2018 FAQ 28.