Technical Research Opportunities for 50-Year Photovoltaic System Service Life

DATE: 09/01/2021
SUBJECT: Request for Information (RFI)

Description

The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Solar Energy Technologies Office (SETO) is requesting information on the possible areas of technical research that would enable improvements in utility-scale photovoltaic (PV) systems to support PV plant service life of 50 years. Specifically, DOE seeks information related to advances in DC-side fault detection, balance of systems (BoS) component degradation, and energy-loss remediation.

Background

The cumulative installed capacity of PV systems in the U.S. has exceeded 100 GW_{DC}[1] and is expected to increase as much as 500-600 GW_{DC} by 2030 to be on track to meet the President's goal for a carbon-free power sector by 2035. To support this rapid acceleration of PV deployment, the DOE has set a goal for the levelized cost of electricity (LCOE) of $0.02/kWh by 2030.[2]

There are many combinations of quantitative targets that would result in utility-scale PV LCOE of $0.02/kWh, and achieving this aggressive goal will likely require improvements to balance of system hardware design, DC-side fault detection capabilities, and PV plant maintenance strategies. In addition to LCOE reduction goals, SETO supports research and development of PV systems that are hardened (damage resistant), or reduce recovery costs and assure the availability of electricity in the aftermath of extreme weather events (for example, wind events of greater than 100 kilometers per hour, hail storms, flooding or heavy snow), especially in under-resourced communities.

One potential area of opportunity to extend useful system life and overall durability is furthering the development of modular components that can be easily replaced, upgraded, or retrofitted to maintain system performance. Much like traditional power plants, it is expected

[1] SEIA Solar Market Insight Report, June 15, 2021: https://www.seia.org/us-solar-market-insight
[2] Goals of the Solar Energy Technologies Office, August 19, 2021: https://www.energy.gov/eere/solar/goals-solar-energy-technologies-office

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

that certain components will need to be replaced in a PV system due to normal operational wear and tear, manufacturing or installation defects, and extreme weather events.

Another area of opportunity for advancement is improved data acquisition and management strategies to monitor component integrity, troubleshoot root causes of degradation or failure, and gather relevant stressor data—particularly meteorological data, that need to be developed to ensure the LCOE goal is achieved. This data could enable improved learning rates for BoS maintenance management, and directly lower LCOE over time by informing operations and maintenance (O&M) personnel when and how to best implement component replacement, identifying reliability weaknesses for component designers and engineering, procurement and construction (EPC) firms, and quantifying the impact of manufacturing and installation quality to plant owners and independent engineers.

There may also be an opportunity to develop "smart" functionality within the DC electrical system that uses electrical signals and sensors to monitor electrical system health, predict BoS component degradation, and automatically bypass faults. This functionality could be used to improve O&M efficiency, reduce downtime after damaging weather events, validate component reliability predictions, predict imminent failures, and inform best practices for engineering, procurement, and construction.

Purpose

The purpose of this RFI is to solicit feedback from O&M service providers, the solar component manufacturing and EPC industries, PV system owners, academia, research laboratories, government agencies, and other stakeholders on available data and experiences regarding O&M costs and energy loss due to BoS component degradation, and areas of research needed for more efficient O&M and increases to energy production throughout a 50-year PV system service life.

Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA); therefore, EERE is not accepting applications at this time. EERE may issue a FOA in the future based on or related to the content and responses to this RFI; however, EERE may also elect not to issue a FOA. There is no guarantee that a FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if EERE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of EERE funded awards, will be subject to Congressional appropriations and direction.

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. EERE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. EERE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that EERE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind EERE to any further actions related to this topic.

Confidential Business Information

Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email two well-marked copies: one copy of the document marked "confidential" including all the information believed to be confidential, and one copy of the document marked "non-confidential" with the information believed to be confidential deleted. Submit these documents via email. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Evaluation and Administration by Federal and Non-Federal Personnel

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to EERE providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

Request for Information Questions

1. What is your experience with system O&M (e.g., how many PV systems do you have in your fleet, in how many climate zones, and the size of your installations)?

2. What operational lifetime or O&M issues were you seeing 5-10 years ago that you do not see today? How was it solved for and are there lessons we can learn for solving other system durability issues today?

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

3. Are there specific communities that would benefit more from hardened PV systems than others? If so, please explain how.
4. Insufficient data is publicly available on PV component field degradation and failure with regard to energy production loss and associated O&M costs. Based on your experience:
    a. Other than inverters, what are the top three BoS component failures that cause measurable energy loss in normal operations (i.e., not resulting from an extreme weather event)?
    b. What percentage of O&M costs and energy production losses do you expect are associated with the following extreme weather events:
        i. High wind (> 100 kph)
        ii. Hail
        iii. Flooding
        iv. Snow or ice
        v. Drought (including resulting wild fires)
    c. What are your recommendations for improving extreme weather robustness in the PV systems you service, own, or insure?

5. Which of the following have you observed to a degree that concerns you?
    a. Loose or missing bolts on the mounting structure
    b. Observable degradation of cabling jackets, zip ties, or other cable harness
    c. Corrosion (within module or structural components)
    d. Evidence of arcing or fire on junction boxes, cables or other power transmission components
    e. Tracker or racking mechanical malfunction
    f. Other observations of BoS degradation or failure

6. Which components (if any) would benefit from being modular (and easily replaced) or repairable? Conversely, what components cannot be replaced, but that you still expect to enable the system to generate energy at $0.02/kWh or below?

7. What key advantages and critical challenges do you foresee with industry adoption of a 'smart BoS' concept, in which the PV system is networked by component-level sensors and automated methods are used to identify, predict, and remediate energy loss from degradation and faults?

Request for Information Response Guidelines

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

Responses to this RFI must be submitted electronically to SETO.RFI.PV@ee.doe.gov no later than 5:00pm (ET) on September 30, 2021. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Responses must be provided as a Microsoft Word (.docx) attachment to the email, and no more than 3 pages in length, 12 point font, 1 inch margins. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if applicable. Respondents may answer as many or as few questions as they wish.

Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name;
- Company / institution contact;
- Contact's address, phone number, and e-mail address.

EERE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.