Request for Information: Planning and Operation Models and Data Analytics for Solar Grid Integration

DATE: July 26, 2019

SUBJECT: Request for Information (RFI) – DE-FOA-0002157

Purpose

The U.S. Department of Energy Solar Energy Technologies Office (SETO) is issuing this request for information (RFI) to solicit feedback from industry, academia, research laboratories, government agencies, and other stakeholders. This RFI will inform SETO’s strategic planning on research related to the integration of distributed solar energy resources. Specifically, this RFI will inform strategies relating to the modeling, monitoring, predicting, and controlling of solar photovoltaic (PV) systems. As the penetration of solar PV on the grid grows, these activities will become more important as grid operators consider how solar adoption impacts grid planning and operations technologies.

This is solely a request for information and not a funding opportunity announcement (FOA). No funding applications are being accepted in response to this RFI.

**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.

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.

**Proprietary Information**

Because information received in response to this RFI may be used to structure future programs and FOAsand/or otherwise be made available to the public, **respondents are strongly advised to NOT include any information in their responses that might be considered business sensitive, proprietary, or otherwise confidential.** If, however, a respondent chooses to submit businesssensitive, proprietary, or otherwise confidential information, it must be clearly and conspicuouslymarked as such in the response.

Responses containing confidential, proprietary, or privileged information must be conspicuously marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Federal Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

If your response contains confidential, proprietary, or privileged information, you must include a cover sheet marked as follows identifying the specific pages containing confidential, proprietary, or privileged information:

**Notice of Restriction on Disclosure and Use of Data:**

Pages [List Applicable Pages] of this response may contain confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for the purposes described in this RFI [Enter RFI Number]. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source.

In addition, (1) the header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure” and (2) every line and paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

**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.

Introduction

# The SETO Systems Integration (SI) subprogram supports early-stage research and development that advances the reliable, resilient, secure and affordable integration of solar energy onto the U.S. electric grid. For more in-depth discussion of SI subprogram research areas, please visit the Systems Integration section of SETO’s website here: <https://www.energy.gov/eere/solar/systems-integration>.

In the past 40 years, solar energy has grown from a niche technology powering satellites in space to a technology that powers homes and businesses in every state. According to the U.S. Energy Information Administration (EIA), solar supplied nearly 2.3% of U.S. electricity demand in 2018,[[1]](#footnote-2) and in some states, solar represented up to 19% of total annual electricity generation.[[2]](#footnote-3) There are over 2 million solar installations across the U.S.[[3]](#footnote-4)

This growth has been driven in part by a dramatic decline in costs, especially in the past decade. Since 2010, solar costs have declined 70% to 80%, making solar one of the most economical ways to add new electricity generation to the grid. From 2011 to 2018, cumulative installed solar power capacity increased from just 1.2 gigawatts (GW) to 60 GW for utility-scale, commercial, and residential solar systems in the United States.[[4]](#footnote-5) The EIA estimates that in 2019, 18% of new utility-scale capacity additions will come from solar energy[[5]](#footnote-6) and that solar will grow to account for 5% of U.S. electricity by 2030.[[6]](#footnote-7) If the price of solar electricity and/or energy storage continue to decline as projected, that percentage could be much higher.[[7]](#footnote-8)

In 2017, SETO announced that the industry had achieved the SunShot 2020 goal three years earlier than expected. The average unsubsidized cost of utility-scale solar reached 6 cents per kilowatt-hour (kWh) and continues to decrease. The achievement of this goal and increased solar deployment have created a need for research well beyond the challenge of technology costs. At the same time, grid modernization efforts, deployment of energy storage, digitization of the grid, and concerns about cybersecurity have changed the energy landscape. Integrating solar with long-term energy storage, improving operational tools for solar on the grid, and enhancing photovoltaic (PV) systems’ cybersecurity are areas of growing priority for SETO. These areas represent ways that solar technologies can play a greater role in ensuring that energy is readily available and secure across the U.S.

SETO works to ensure that the early-stage technologies developed through federal funding are relevant to the private sector. This is accomplished through partnerships to facilitate the exchange of information between industry and research communities, as well as across scientific disciplines. SETO also funds technologies that have the potential to be rapidly commercialized but are too risky for private investment. In all, these efforts help to support American leadership in the solar industry.

SETO collaborates and coordinates its systems integration research activities with other DOE technology offices through the Grid Modernization Initiative.[[8]](#footnote-9) These research are aligned with the major technology areas identified in the Grid Modernization Multi-Year Program Plan,[[9]](#footnote-10) including grid reliability and resilience, energy storage, sensors and measurements, cybersecurity, and grid services.

Solar Integration Challenges in Distribution Planning and Operation

SETO’s systems integration research focuses on using solar energy for greater grid resilience and improved reliability. This will be accomplished through advancements that enable effective operations with increasing penetration of solar energy; advanced dynamic photovoltaics (PV) models and adaptive distribution protection; interconnecting and integrating solar with energy storage and synergistic technologies to provide grid services; researching advanced inverter controls and sensors; and supporting processes for standardizing interconnection, interoperability, and cybersecurity for PV. The goal is to advance the knowledge base as well as the ability to integrate increasing amounts of solar generation into electric transmission and distribution systems in a cost-effective, secure, resilient, and reliable manner. SETO’s existing R&D funding includes, but is not limited to, [FY2019 Funding Opportunity](https://www.energy.gov/eere/solar/funding-opportunity-announcement-solar-energy-technologies-office-fiscal-year-2019), [Advanced Systems Integration for Solar Technologies (ASSIST)](https://www.energy.gov/eere/solar/funding-opportunity-announcement-advanced-systems-integration-solar-technologies-assist), and [Enabling Extreme Real-Time Grid Integration of Solar Energy (ENERGISE)](https://www.energy.gov/eere/solar/funding-opportunity-announcement-enabling-extreme-real-time-grid-integration-solar-energy).

In order to better understand the challenges associated with the planning and operation of grid-tied solar PV, SETO hosted a workshop on May 16-17, 2019, in Washington, D.C. At the event, subject matter experts and SETO-funded researchers discussed state-of-the-art systems integration technologies that enable the reliable operation of higher penetrations of solar energy onto the grid. [Presentations](//update) focused on distribution network data and modeling, real-time and forecasted data, numerical algorithms for distribution systems steady-state and dynamics analysis, and systems and platforms for grid analysis and co-optimization. The second day of the workshop consisted of breakout sessions and a brainstorming session on future challenges in data, modeling, steady-state and dynamic analysis for distribution networks, and other issues related to integrated planning and grid operations with distributed solar energy resources.

SETO is seeking additional feedback on these topics from industry, academia, research laboratories, government agencies, and other stakeholders. The main focus is enabling high penetration of distributed behind-the-meter (BTM) and small-scale solar generation and decrease its curtailment through better data acquisition and its numerical analysis. The sample questions are given as follows. Responders are welcome to answer all or subsets of the questions.

Categories and Questions

**Category 1: Real Time and Forecasted Data Acquisition and Ingestion for High Penetration of PV**

1. Real-time data
2. How can measurement data be best integrated into EMS/DMS/DERMS environments to increase situational awareness[[10]](#footnote-11) for BTM? What are the challenges in augmenting the SCADA[[11]](#footnote-12) data with synchrophasor, smart-meter, PV inverter and line sensor data to enable high penetration of BTM and decrease its curtailment?
3. Do you plan to update/investigate your communication architecture to address cybersecurity issues and challenges for BTM solar? If so, which components are the most important?
4. What measurement rates and resolutions are required for your real-time and operational planning applications? What are your critical data bandwidth constraints?
5. What is the optimal model for ownership, transport, and use of BTM data? How could certain models impede or leverage the use of real-time BTM data in utility operations?
6. Forecasted data
7. What are the challenges posed to load forecasting by behind-the-meter PV? What is the readiness and capability of forecast vendors to deal with those challenges?
8. How do you use or plan to use solar generation forecasting in your planning and operations?
9. What metrics are needed for determining the value of improved forecasting?
10. Operational Planning Data for Transmission Contingency Studies
	1. What data gathering and integration gaps remain for performing contingency analysis (stability, protection, etc.) under high inverter-based resource performance studies? Are DER with legacy and IEEE 1547-2018 capabilities able to be sufficiently modeled in transmission reliability studies?
	2. What are the data or modeling capability gaps for addressing the challenges associated with developing the IEEE P2800 standard?

**Category 2: Distribution Network Analysis** **for High Penetration of PV**

1. Distribution State Estimation
2. In order to obtain full observability for distribution networks, how can the measurement data be augmented with virtual, derived, pseudo, or other methods?
3. How do you handle data with disparate time-scales that is not GPS-synchronized in distribution network analysis?
4. Do you plan to deploy distribution state estimation in your distribution operations? What use cases will be the most challenging and how are you addressing them?
5. Quasi-Static Time Series (QSTS) Simulations
6. How can QSTS simulations be extended beyond static, worst-case hosting capacity analysis?
7. Is there a need for dynamic hosting capacity analysis tools? How would you utilize them?
8. Optimization
	1. Do you plan to use optimization for your distribution operations beyond VVR/CVR[[12]](#footnote-13)? If so, what would be your priorities?
	2. What kind of multiple objective functions would be important for you? Is it critical to model financial incentives for DER support to distribution networks?
	3. What challenges remain for analyzing how energy storage may be incorporated into the optimization algorithms?
9. Data Based Analytics
	1. What are the challenges in deploying data based artificial intelligence (AI) algorithms to operations and operational planning with high penetration of BTM?
	2. What are the priority AI applications to further develop AI for operations and operational planning?
	3. If network model based planning and operations analysis were to be augmented with data based analysis, which tools would be most beneficial?
	4. If data based AI algorithms were available, what data sets would be readily available? What are the challenges in integrating and ingesting those data sets?
10. Integrated Transmission-Distribution-Communication (TDC) systems Co-Simulation
	1. Current TDC integrated analysis is more or less iterative transmission and distribution analysis. There are information losses during the process. What are the technical challenges to analyze the systems as one whole big system?
	2. Do you see a need for tools that would integrate micro-grids and transmission network models?
	3. What are the cybersecurity features needed in co-simulation environment and how can they be integrated in co-simulation tools?
	4. How can simulation tools study power systems operating modes with little or no communications?
	5. How can co-simulation tools model and simulate all hazards at scale to improve or identify pathways to enhance resilience?

**Category 3: Power System Stability for High Penetration of PV**

1. Transient Stability
	1. Is there a need for a generic PV inverter electro-magnetic transient (EMT) model to study EMT phenomena versus a proprietary "black-box" EMT model? Is it possible to develop one that is both generic and accurate?
	2. What are the other gaps in existing models/tools to achieve accurate real time transient stability analysis/simulation for large-scale high renewable penetration systems?
	3. How do you model your distribution networks for long-term and short-term planning, with positive sequence, negative sequence or zero sequence transient analysis?
2. Frequency Stability
	1. Moving toward a grid with higher power electronic based resources, how should frequency regulation and detailed inverter controls be modeled in grid studies?
3. Voltage Stability
	1. Is voltage collapse a critical issue for distribution network with high PV penetration?
	2. What are the gaps in modeling voltage control stability?
4. Protection
	1. What are the gaps for transmission and distribution system protection for a grid with high penetration of inverter based resources (e.g. solar PV, energy storage, type III and IV wind)?

**Request for Information Response Guidelines**

To respond, please email your response to SETO.RFI.SI@ee.doe.gov no later than 12:00pm (ET) on August 30, 2019. Responses to this RFI must be submitted electronically and 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 ten (10) pages in length, 12 point font, 1 inch margins. Only electronic responses will be accepted.

Please identify answers by responding to a specific question or topic if applicable. Respondents may answer as many or as few questions as desired at their discretion.

EERE will not respond to individual submissions or publicly publish 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.

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.
1. U.S. Energy Information Administration. *Electric Power Monthly with Data for November 2018.* <https://www.eia.gov/electricity/monthly/current_month/epm.pdf>. January 2019. [↑](#footnote-ref-2)
2. https://www.seia.org/states-map [↑](#footnote-ref-3)
3. Solar Energy Industries Association. *Solar Means Business Report.* <https://www.seia.org/research-resources/solar-means-business-2017>. 2017. [↑](#footnote-ref-4)
4. Solar Energy Industries Association. <http://www.seia.org/>. [↑](#footnote-ref-5)
5. U.S. Energy Information Administration. “Today in Energy.” <https://www.eia.gov/todayinenergy/detail.php?id=37952>. January 10, 2019. [↑](#footnote-ref-6)
6. U.S. Energy Information Administration. *International Energy Outlook 2017*. [https://www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf](https://www.eia.gov/outlooks/ieo/pdf/0484%282017%29.pdf). [↑](#footnote-ref-7)
7. U.S. Department of Energy Solar Energy Technologies Office. SunShot 2030. <https://www.energy.gov/eere/solar/sunshot-2030>. [↑](#footnote-ref-8)
8. U.S. Department of Energy Grid Modernization Initiative. <https://www.energy.gov/grid-modernization-initiative>. [↑](#footnote-ref-9)
9. U.S. Department of Energy Grid Modernization Multiyear Program Plan. <https://energy.gov/downloads/grid-modernization-multi-year-program-plan-mypp>. [↑](#footnote-ref-10)
10. https://eioc.pnnl.gov/research/sitawareness.stm [↑](#footnote-ref-11)
11. https://www.webopedia.com/TERM/S/SCADA.html [↑](#footnote-ref-12)
12. https://etap.com/product/volt-var-optimization-control [↑](#footnote-ref-13)