ENabling Extreme Real-time Grid Integration of Solar Energy (ENERGISE)

Informational Webinar

May 19, 2016

Questions to Energise@ee.doe.gov

energy.gov/sunshot

None of the information presented here is legally binding. The content included in this presentation is intended only to summarize the contents of funding opportunity DE-FOA-0001495. Any content within this presentation that appears discrepant from the Funding Opportunity Announcement (FOA) language is superseded by the FOA language. All Applicants are strongly encouraged to carefully read the FOA guidelines and adhere to them. Neither the U.S. Department of Energy (DOE) nor the employees associated with DOE working on this presentation shall be held liable for errors committed by Applicants based on potentially incorrect or inaccurate information presented herein.

About This Presentation

- We will not be recording this webinar
- Slides and script will be posted to EERE Exchange after our webinar
- All questions submitted during this presentation will be answered in written form and posted to EERE Exchange

Agenda

- Systems Integration: ENERGISE introduction and overview
- ENERGISE Target Metrics to be met by all awardees
- ENERGISE Scope of Work
- Concept Paper and Full Application Details
- EERE-Exchange Question Review

ENabling Extreme Real-time Grid Integration of Solar Energy (ENERGISE)

SunShot Funding Opportunity Announcement (FOA)

Currently Open

FOA Issue Date:	May 2, 2016
Informational Webinar:	May 19, 2016
Submission Deadline for Concept Papers:	June 17, 2016 (5 PM ET)
Submission Deadline for Full Applications:	August 26, 2016 (5 PM ET)
Expected Submission Deadline for Replies to Reviewer Comments:	October 14, 2016 (5 PM ET)
Expected Date for EERE Selection Notification:	December 9, 2016
Expected Timeframe for Award Negotiations:	60-90 days

https://eere-exchange.energy.gov/#FoaId736ccdfb-d65d-49bb-9156-8ce9788802a7

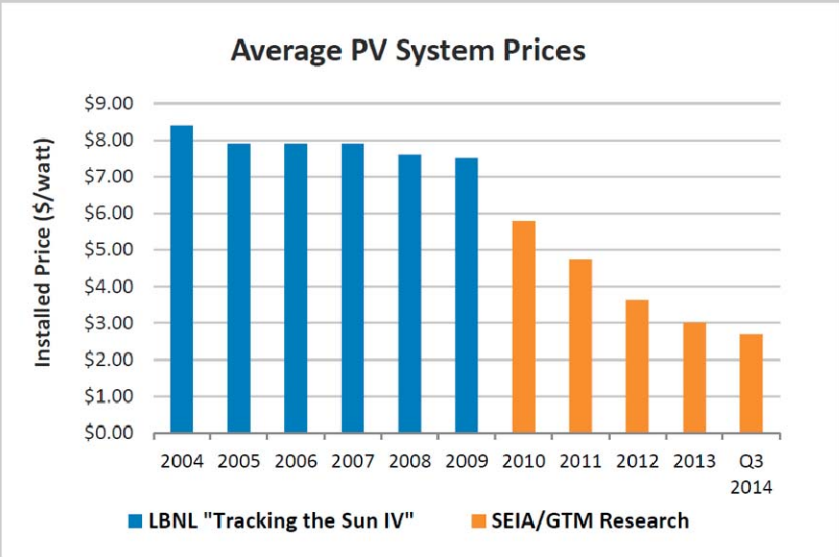
Exponential Growth of Solar Capacity in the U.S.

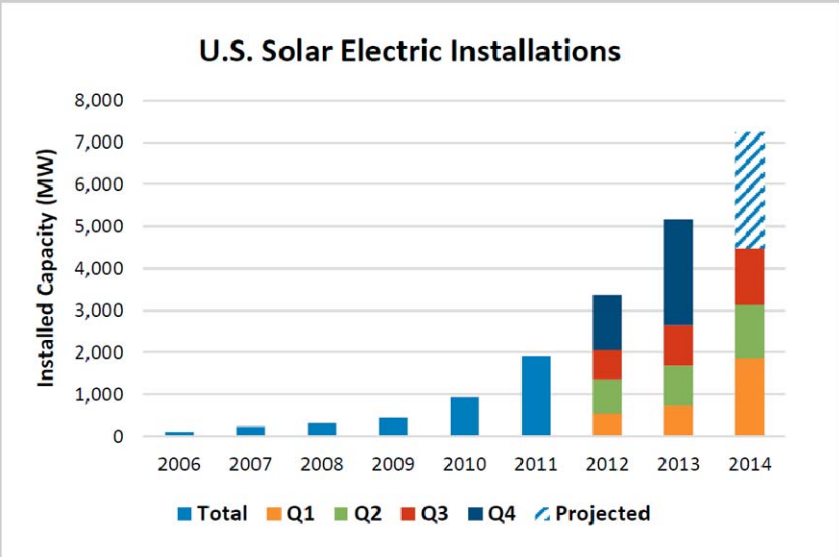
Installed cost of solar system rapidly decreasing, mostly connected to the distribution grid (~60%)

(< $2/W for utility–scale system)

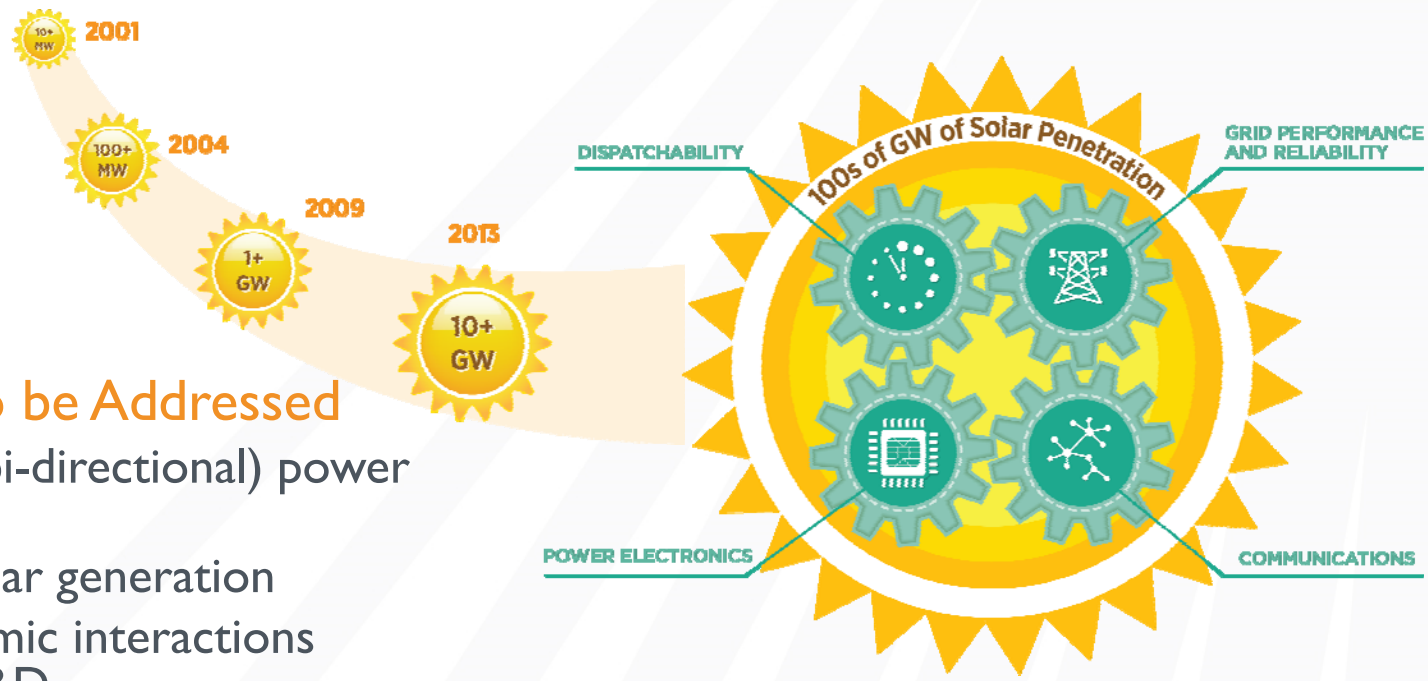
Installed solar generation capacity rapid increasing

(>20 GW cumulative by end of 2014)





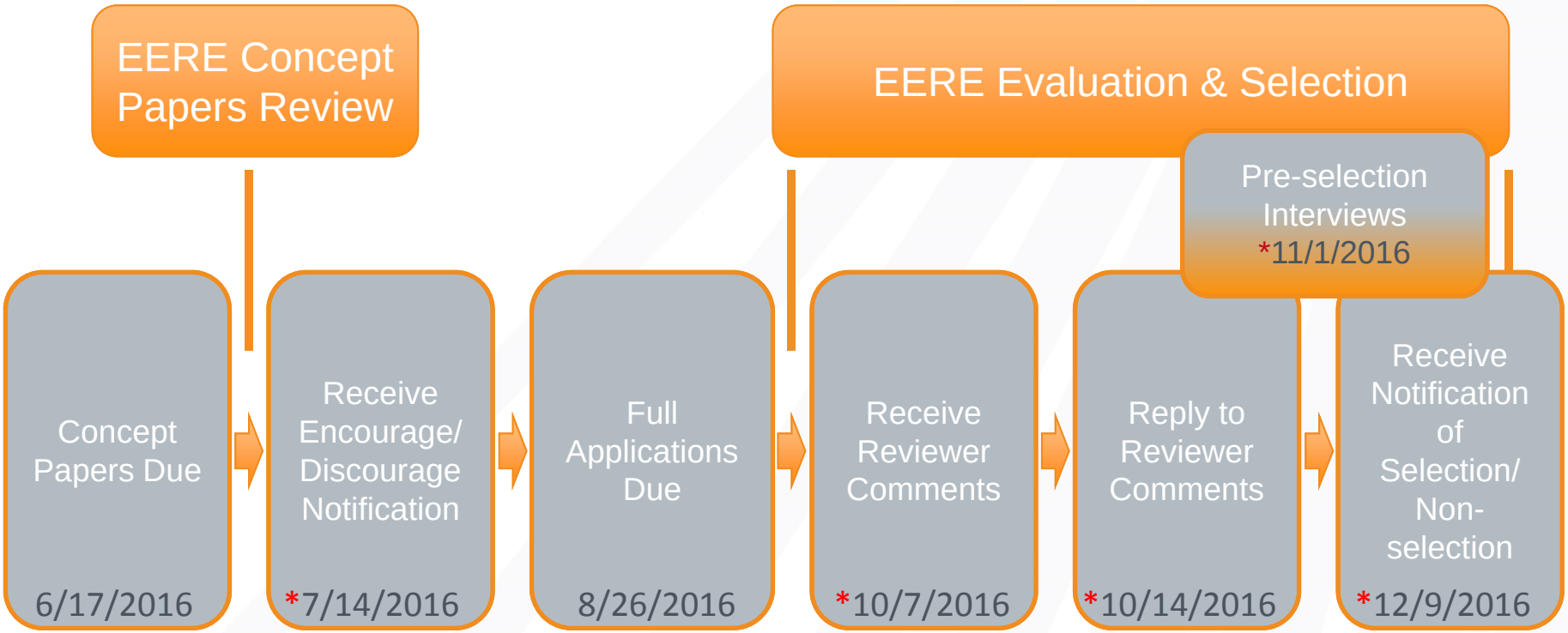
SunShot Systems Integration Vision



- Challenges to be Addressed
  - Two-way (bi-directional) power flows
  - Variable solar generation
  - More dynamic interactions between T&D
  - Lack of visibility & control
  - Integration of information and communication technologies for PV system monitoring and control

SunShot U.S. Department of Energy

FOA Timeline



* Expected

ENERGISE FOA Details

- Period of Performance: Up to three years
- DOE Funds Available (subject to appropriations) : $25 Million
- Cost Share Requirements:
  - Topic Area 1 – 50%
  - Topic Area 2 – 20%
- Minimum Award Amount:
  - Topic Area 1 - $500,000
  - Topic Area 2 - $500,000
- Maximum Award Amount:
  - Topic Area 1 - $4,000,000
  - Topic Area 2 - $2,000,000
- Approximate Number of Awards: 10 – 15*

* Topic areas 1 & 2 combined

ENERGISE FOA – Main Objectives

- The main objectives of this ENERGISE FOA are to:
  1. Topic Area 1: Seek near-term (2020), commercially-ready and highly scalable distribution system planning and real-time operation solutions that seamlessly interconnect and integrate high penetration (>50% of distribution peak load) solar generation in existing grid architecture (e.g. centralized generation, transmission, and distribution) in a cost-effective, secure, and reliable manner.
  2. Topic Area 2: Seek long-term (2030), transformative and highly scalable technologies that plug into distribution system planning and real-time operation solutions for advanced grid architectures (e.g. distributed generation, dynamic network topology, microgrid, and potentially distribution level energy market) to enable extremely high penetration (> 100% of distribution peak load) solar generation in a cost-effective, secure, and reliable manner.

ENERGISE Solution Features

- For the near-term (2020) topic area, the proposed planning and operation solutions should be able to
  - monitor and control in real time a distribution system (or subsystem) consisting of at least ten (10) distribution feeders and ten thousand (10,000) active nodes with 50% or more PV penetration relative to the peak load.
  - In addition, the solutions should be able to dynamically respond to simple feeder switching events under radial network topology to ensure that the system operates in a reliable manner.
- For the long-term (2030) topic area, the proposed planning and operation solutions should be able to
  - monitor and control a coupled sub-transmission and distribution system consisting of at least one thousand (1,000) distribution feeders and one million (1,000,000) active nodes with greater than 100% PV penetration relative to the peak load.
  - In addition, the solutions should be able to dynamically and adaptively respond to complex feeder switching events under radial, mesh, or hybrid network topologies to ensure that the system operates in a reliable manner.

ENERGISE Solution High Level System Requirements

Requirements	Baseline (2015)	Near Term (2020)	Long Term (2030)
Distribution level solar penetration 1) Relative to peak load, 2) Relative to day time minimum load (DML), 3) By annual energy production	< 15% except for few cases	> 50%	> 100%
	< 100% except for few cases	> 125%	> 250%
	< 5% except for few cases	> 20%	40 – 80%
Interconnection Review and Approval Time	10-60 days (<50kW) >10-90 days (50kW to 2MW)	< 1 day (residential) < 5 days (commercial/utility)	in real time (residential) < 1 day (commercial/utility)
Reliability	SAIDI/SAIFI ANSI 84.1 IEEE, NERC	SAIDI/SAIFI ANSI 84.1 IEEE, NERC	SAIDI/SAIFI ANSI 84.1 IEEE, NERC

ENERGISE Solution High Level System Requirements (continued)

Requirements	Baseline (2015)	Near Term (2020)	Long Term (2030)
Distribution Network Scalability	~10s active nodes	~10,000s active nodes	~1,000,000s active nodes
Observability, Predictability & Visualization	Almost none	• >80% coverage, • Real-time visualization, • Day-ahead, hour-ahead forecast	• >99% coverage, • Real-time visualization, • Day-ahead, hour-ahead forecast, 5-minute forecast
Controllability & Optimization	• Limited to legacy devices (LTC, CAP, VR) • Non-optimal	• Coordinated hierarchical control of legacy devices, PV inverters, ES & other DER controllers • Optimized for operation	• Coordinated hierarchical control of legacy devices, PV inverters, ES, other DER controllers, & emerging smart controllers • Optimized for operation & emerging distribution energy market

ENERGISE Detailed Technical Requirements & Performance Metrics

	Requirement		Performance Metrics	
			Near-term	Long-term
Platform	Openness	Support application development and implementation by different 3rd parties without the need for any legacy system and database translators or transformations	Desired	Required
	Security	Secure API	Required	Required
	Interoperability	Device level – IEC 61850	Required	Required
		Enterprise level – IEC 61968 (CIM)	Required	Required
	Scalability	Network size by substations	> 3	> 10

ENERGISE Detailed Technical Requirements & Performance Metrics (cont.)

	Requirement		Performance Metrics	
			Near-term	Long-term
Platform	Scalability	Network size by microgrid	> 3	> 10
		Network size by feeders	> 10	> 1,000
		Network size by active nodes	> 10,000	> 1 million
	Database	Synchronization of data among systems-of-records' databases	Up to 3 systems	> 10 systems
		Availability	Scheduled	On-demand
	Computation cycle	Real-time operation	< 1 minute	< 1 minute
		Operational Planning	< 5 minutes	< 5 minutes
Device	Measurement & metadata	Locational Information	Required	Required
		Timestamps	Required	Required

ENERGISE Detailed Technical Requirements & Performance Metrics (cont.)

	Requirement		Performance Metrics	
			Near-term	Long-term
Device	Measurement & metadata	Time resolution for planning	1 minute	1 minute
		Time resolution for operation & control	1 second	1 second
Communication	Performance	Availability	Support real-time operations	
		Latency	Support real-time operations	
		Scalability	Support 1 million nodes	
Control	Response time	Local level	< 10 seconds	< 10 seconds
		Network level	< 30 seconds	< 30 seconds
		System level	< 1 minute	< 1 minute
		Enterprise level	< 5 minutes	< 5 minutes
Analytics	Distribution system state estimation (DSSE)	Observability (using both available sensors & SW techniques)	> 75%	> 99%

ENERGISE Detailed Technical Requirements & Performance Metrics (cont.)

	Requirement		Performance Metrics	
			Near-term	Long-term
Analytics	Feeder topology recognition	Switch and branch status	> 10	> 100
		Real-time probabilistic feeder topology recognition	Desired solution time < 60 seconds	Required solution time < 60 seconds
	Distribution power flow (PF)	True multi-phase models	Capability to analyze all feeders off a single substation	Capability to analyze all feeders off multiple substations
	QSTS	Circuit reduction by size & simulation time	90%	90%
	Distribution optimal power flow (OPF)	Multi- objective optimization	Technical objectives such as Volt/Var	Techno-economic objectives including economic dispatch

ENERGISE Detailed Technical Requirements & Performance Metrics (cont.)

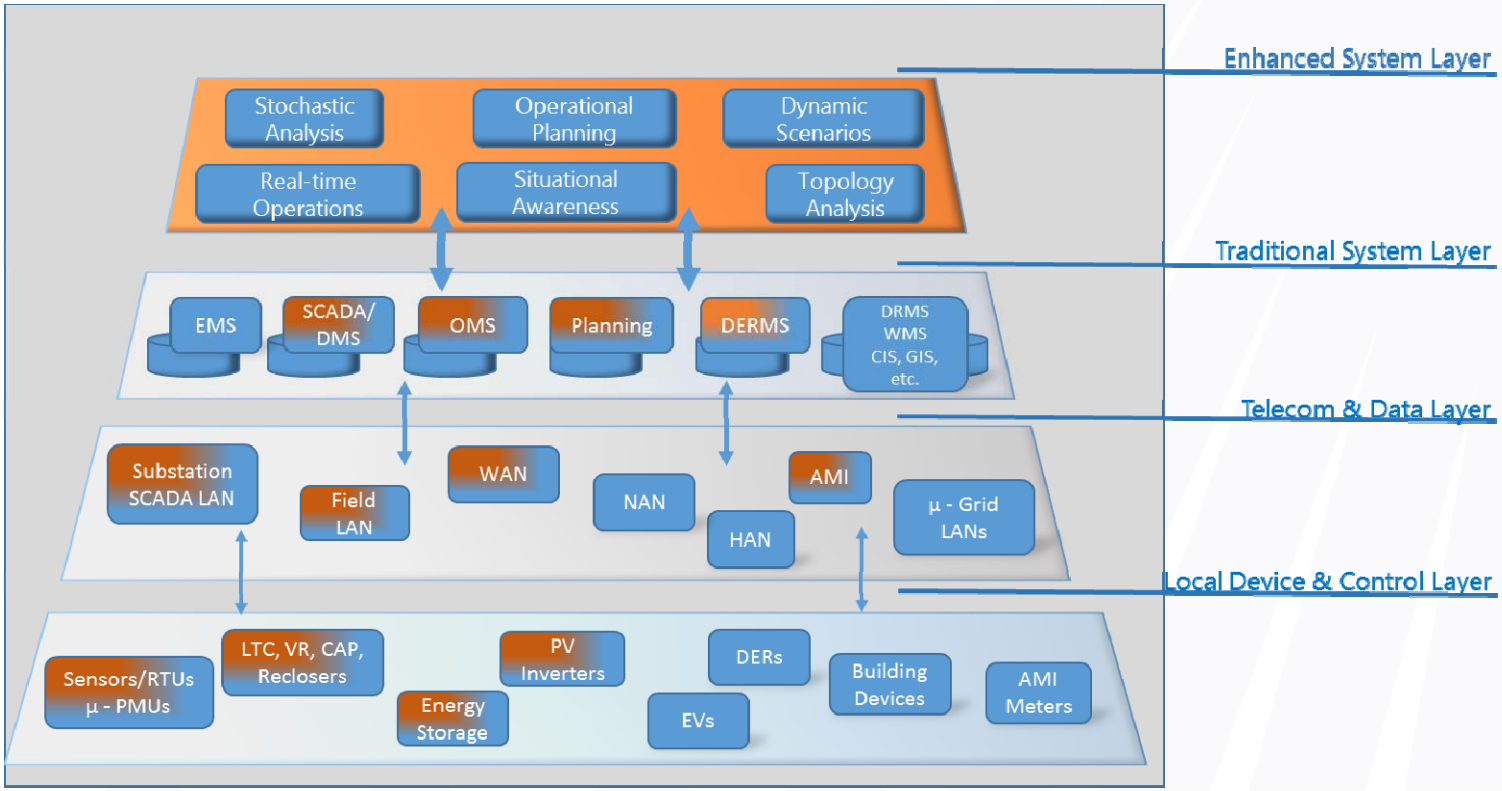
	Requirement		Performance Metrics	
			Near-term	Long-term
Analytics	Stochastics Analysis	Predictive controls	Required for operational planning	Required for real-time operational planning
		Prescriptive controls	for long-term planning	for operational planning

ENERGISE FOA – Required Scope of Work

Design:

- Create an ENERGISE conceptual prototype that includes part (only if applying to Topic 2) or all (both topics) of the following solution components and meets the respective performance metrics:
  - Device and Local Control Layer
  - Telecommunication and Data Layer
  - Traditional System Layer
  - Enhanced System Layer
- Each proposing team is **required** (Topic 1) or **encouraged** (Topic 2) to include at least one utility partner (or an equivalent electricity service provider) as an integral and active member, and
  - for Topic 1, the proposed ENERGISE solution should be accepted by the utility to be deployed at scale.
  - DOE expects the utility partner in the project team to be integrally involved in the fundamental design and development of the ENERGISE solution, and provide specific guidance on the desired operation of the solution with the utility grid.

High Level Concept of ENERGISE



Critical challenges for high penetration solar exist in these areas

ENERGISE FOA – Required Scope of Work (cont.)

Development and Validation Testing:

- Perform detailed development, implementation, and validation testing of the proposed ENERGISE solution prototypes.
  - The applicant should provide a detailed testing plan to demonstrate the effectiveness of the proposed technology in achieving the program objectives and technical performance targets.
  - Testing should include real hardware and software in addition to computer simulations. Testing and validation should use real world measurement data or high-fidelity synthesized data with sufficient granularity and duration.
  - Wherever possible, large scale hardware-in-the-loop testing is strongly desired to mimic the real world operation scenarios.
  - Test results should show that all of the performance targets of the proposed ENERGISE solution can be met or exceeded and as such form a critical milestone in this project.

ENERGISE FOA – Required Scope of Work (cont.)

Deployment and Demonstration:

- Field deployment and demonstration are **required** for Topic Area 1, and **optional but strongly encouraged** for Topic Area 2.
  - In the case Topic Area 2 applicants choose not to propose field deployment and demonstration, a medium to large scale hardware-in-the-loop lab demonstration is required.
- It is DOE's expectation that the field deployment will occur in a distribution system that is representative of those widely prevalent across the country, in either rural settings or densely populated urban environments, and anything in between.
  - All equipment and components proposed as part of the ENERGISE solution or proposed to be interacting with the developed ENERGISE solution should be actual equipment operating in real-world conditions without a proxy or a simulator in place of the actual equipment.
  - This is to ensure that the developed ENERGISE solution is installed and tested under the most commonly occurring conditions and therefore provides a pathway to facilitate large-scale deployment.

ENERGISE FOA – Required Scope of Work (cont.)

Deployment and Demonstration:

- Once the ENERGISE solution is installed, varying levels of continuous and dynamic visualization, control, and optimization should be verified to show that all of the performance targets can be met or exceeded after deployment of the ENERGISE solution, using actual performance data for at least 1 year.
- Considerable interaction with both the utility and the consumer is expected of the ENERGISE solution, and should be studied as part of the deployment.
  - The operational objectives for the proposed solution should include maximizing cost-effective utilization of installed solar systems, sensors, communication, and data infrastructures and should further consist of a well-defined set of value metrics that will appeal to a broad range of potential stakeholders.

ENERGISE FOA – Required Scope of Work (cont.)

Value Analysis:

- Applicants should perform in-depth value analysis to show that there will be net benefits, that these benefits will be sustained if the ENERGISE solution is deployed at scale, and to show the pathway for deployment of the ENERGISE solution for levels of penetration of solar greater than 100% of peak load.
  - The sustainability of benefits at varying penetration levels of solar can be shown through a blend of results from deployment and from detailed modeling of deployment under very high solar penetration scenarios.
  - A clear and credible pathway should be shown to be achievable with a very high degree of confidence toward meeting the SunShot LCOE target of 6 cents/kWh at wholesale level and reaching grid parity at the retail level.
  - The assumptions, methodology, and calculations will be independently validated by DOE.

ENERGISE FOA – Required Scope of Work (cont.)

Value Analysis:

- All pre- and post-deployment benefit analyses should be performed for two cases:
  - a) to estimate benefits at the proposed location as baseline, and
  - b) to estimate benefits when the ENERGISE solution is deployed at a scale for high penetration of solar.

  The assumptions for these analyses should be clearly stated, justified, and buy-in should be demonstrated by stakeholders including the customer and the utility.
- The economic analysis should be done with actual grid, market, and component performance data as applicable, for a continuous period of at least 1 year.
- Economic modeling should be performed using stakeholder accepted methodologies and assumptions for both the year in which actual data is available, and future years' projections of net benefits under multiple scenarios.
- The pre-deployment analysis, as indicated in the Design activity above, will estimate the benefits that will be obtained upon implementation of the proposed solution whereas the post-deployment analysis in the Demonstration activity will calculate the benefits obtained using actual data obtained from the installation(s).

ENERGISE FOA – Required Scope of Work (cont.)

Value Analysis:

- Applicants should also identify additional value propositions (such as synergies between PV, EV, and building load management) resulting from real time control and operation of the system, by using a multi-stakeholder team approach that includes the utilities, regulators, PV manufacturers, other equipment manufacturers, and consumers in the design and development stage.

ENERGISE FOA – Required Scope of Work (cont.)

Cybersecurity and Interoperability:

- Applicants should describe their strategies and plans for establishing and maintaining interoperability, and the utilization of open standards wherever possible.
  - Applicants should consider interoperability within their solution (among devices and/or subsystems) and at the external interfaces with other utility and customer systems. Applicants shall indicate where they have chosen to utilize proprietary standards.
- Applicants should also describe their approach to establishing and maintaining cybersecurity throughout their solution, and at the interfaces to external components and systems.
  - In accordance with the cybersecurity technique of defense in depth, applicants shall not cede responsibility for cybersecurity to the external boundaries of their proposed solution, nor shall they propose that it be added on at some later stage. Discussion should include a defense in depth approach with respect to the layers depicted in figure above and within the layers relevant to the proposed solution, as well as appropriate and available standards.

ENERGISE FOA – Required Scope of Work (cont.)

Cybersecurity and Interoperability:

- Post award, Recipients will be required to submit an Interoperability Plan and a Cybersecurity Plan, detailing how they propose to implement and maintain these aspects of their solution.

Eligible Applicants (full details in FOA Section III.A)

- Individuals
  - U.S. citizens and lawful permanent residents
- Domestic entities
  - For- & not-for-profit, universities, national labs/FFRDCs
  - Can be held by foreign entity, but Applicant must be incorporated in U.S.
- Foreign entities
  - Waiver must be submitted for DOE approval
  - Can receive a minority of funding as sub-recipient
- Consortia
  - Can be a mix of domestic/foreign entities
  - Incorporated can apply as prime recipient
  - Unincorporated must designate a member as prime recipient
- Applicants can submit more than one concept paper
  - Each submission must be unique and distinct from the other(s)

Concept paper overview

- Provides early indicator of proposal relevance to FOA
  - Technical review criteria in FOA Section V.A.1
- For fairness, must conform to content requirements
  - Refer to FOA Section IV.C
- Encourage/Discourage notification sent to applicant
  - Notification will be sent approximately 3 weeks after concept paper due date
  - Applicants may submit a Full Application even if discouraged
- ***Concept papers are mandatory***
  - ***Only Applicants that submit a compliant Concept Paper are eligible to submit a Full Application.***

Concept Papers are due June 17, 2016 at 5pm ET

Concept Papers are mandatory

Submit Concept Papers in EERE-Exchange by

June17, 2016 5:00PM ET

https://eere-exchange/energy.gov/

Reminder: Only applicants that have submitted a compliant Concept Paper are eligible to submit a Full Application

Concept Paper Review Process

- Applicants will be provided review comments on their Concept Paper as well as an Encourage/Discourage decision.
- It is **expected** that Encourage/Discourage notifications will be released on July 14, 2016.
- Applicants will be provided approximately 2 months to prepare a Full Application.

Full Applications Overview

- Provides detailed information on the proposal
  - Technical review criteria in FOA Section V.A.2
- For fairness, must conform to content requirements
  - Refer to FOA Section IV.D
- Applicants will be provided with reviewer comments following evaluation of all eligible Full Applications
- Applicants will have approximately three business days to prepare a short Reply to Reviewer Comments
  - Refer to FOA Section IV.F for Content and Form of Replies to Reviewer Comments
- One or more applicants may be invited to participate in Pre-Selection Interviews
  - Refer to FOA Section V.D.2 for more details
- Expected date for Selection Notifications is Dec. 9, 2016

Full Applications are due Aug. 26, 2016 at 5pm ET

Submit Full Applications in EERE-Exchange by

August 26, 2016 5:00PM ET

https://eere-exchange/energy.gov/

Reminder: Only applicants that have submitted a compliant Concept Paper are eligible to submit a Full Application

Timeline

- May 19, 2016 – Informational Webinar
- **June 17, 2016 – Concept papers due (mandatory)**
- July 14, 2016 – Encourage/Discourage decisions for Concept Papers (expected date)
- **Aug. 26, 2016 – Full applications due**
- Dec. 9, 2016 – Selection notifications (expected date)
- Feb. 2017 – Awards made (expected date)

Some Key Points for Submission

- Follow the formatting criteria and page lengths stated in the FOA
- Triple check entries in Exchange
  - Submissions could be deemed non-compliant due to an incorrect entry and cannot be reviewed
- Make sure you hit the submit button
  - Any changes made after you hit submit will un-submit your application and you will need to hit the submit button again

Some Q&A Already Posted on EERE Exchange

Question	Answer
May institutions submit only one Concept Paper by the June 17 Concept Paper deadline, or are institutions permitted multiple Concept Paper submissions?	Applicants may submit more than one Concept Paper, however as found in in FOA, Section IV.C.1, Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.
If an institution is able to submit more than one Concept Paper, is there a date by which applicants should expect to learn from EERE whether or not they are discouraged or encouraged to submit a Full Application?	Applicants should receive 'encourage' or 'discourage' responses by 26 July 2016 to allow for 30 days to prepare a full application as cited in the FOA, section IV.D. Regardless of the date the applicant receives the Encourage/Discourage notification, the submission deadline for the Full Application remains the date and time stated on the FOA cover page.
Will it be possible to download the content of the webinar after it has aired?	Yes, the webinar slides will be available after 19 May 2016.
Could you please tell us which Technology Readiness Level is required?	*** CORRECTED ANSWER FOR QUESTION #5 ABOVE *** Table 4 of Section I.B cites the Technology Readiness or Maturity Level (TRL) to be "mid- to high-level, commercial-ready actual system" for Topic 1 and " early- to mid-level, engineering prototypes" for Topic 2. More specifically, for Topic 1, the solutions should be in the range of TRL 6 - Technology prototype demonstration in a relevant environment, and TRL 8 - actual technology system completed and qualified through test and demonstration. For Topic 2, the solutions should be in the range of TRL 2 - Technology concept and/or application formulated, and TRL 6 - Technology prototype demonstration in a relevant environment.
For the Open Source Software potential identification requirement of the Technical volume; is an acceptable answer that "there is no potential for open source software distribution"? Or, would a commercial license model be an acceptable "alternative software distribution method"?	As cited in the FOA, section IV.J: "Applications selected for negotiations will be required to submit an Open Source Software Distribution Plan (or an alternative software distribution plan that encourages wide adoption of the research findings) within 3 months of the award notification." Additional information on Open Source Software Plans is found in Appendix E of the FOA.
Is a U.S. Army post eligible as a participant in or sub-prime recipient of this award?	As cited in the FOA, section III.2: "Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a Subrecipient, but are not eligible to apply as a Prime Recipient."
Does "applicant" refer to the person submitting or the organization/entity submitting?	The 'applicant' is the person or entity represented by the signatory of the SF-424, Application for Federal Assistance and will be the person or entity receiving the award.

SunShot
U.S. Department of Energy

Questions can be emailed to
Energise@ee.doe.gov

Answers will be posted, along with this webinar and script at

https://eere-exchange.energy.gov/Default.aspx?Search=ENERGISE&SearchType=