SunShot
U.S. Department of Energy

Generation 3 Concentrating Solar Power Systems Funding Opportunity Announcement Informational Webinar

energy.gov/sunshot

September 19, 2017

Solar Energy Technologies Office
Concentrating Solar Power

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-0001697. 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content within this presentation that appears discrepant from the Funding Opportunity Announcement (FOA) language is superseded by the FOA language.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.

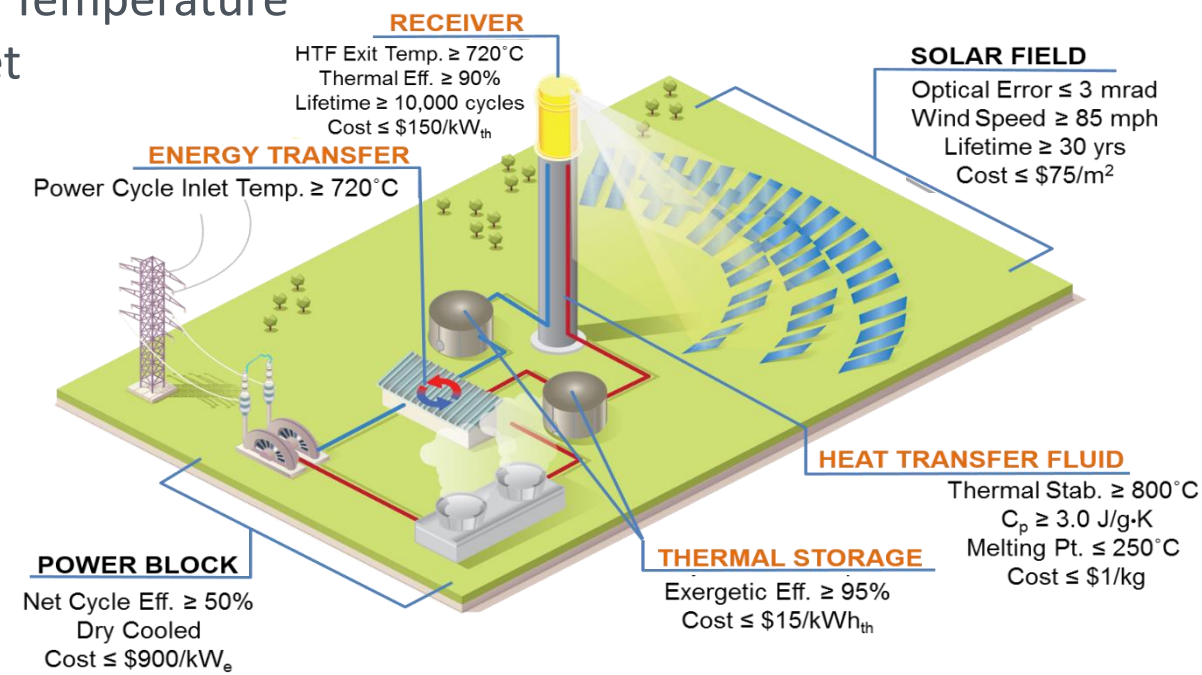
Agenda

- Gen3 CSP Initiative Overview
- Gen3 CSP Systems Funding Opportunity Announcement
  - Objectives
  - Requested scope of proposed research and development
  - Anticipated project structure
- Concept Paper Information
- Application, Review, and Selection Timeline
- Questions

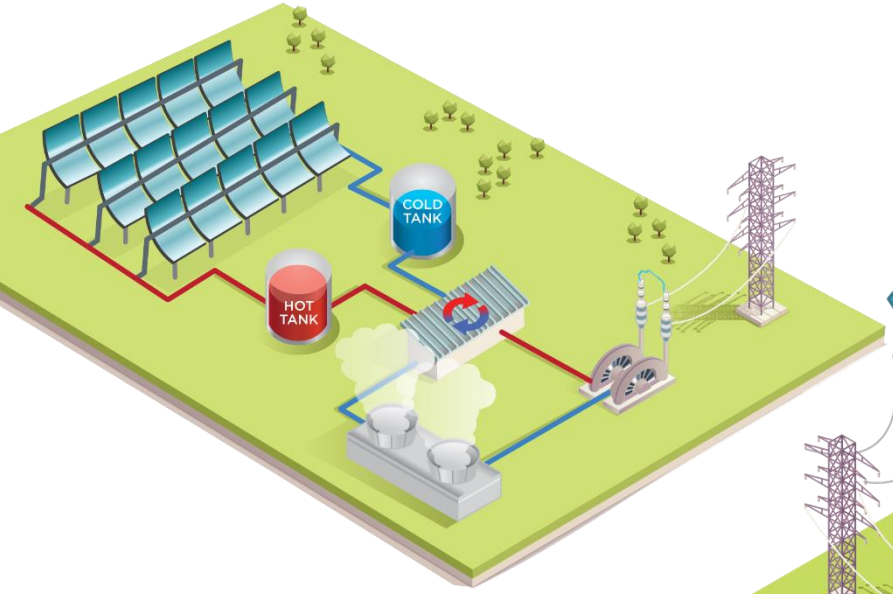
Gen3 CSP Initiative Overview

The Gen 3 CSP Initiative aims to decrease the cost of CSP electricity by increasing efficiency through higher temperature operation:

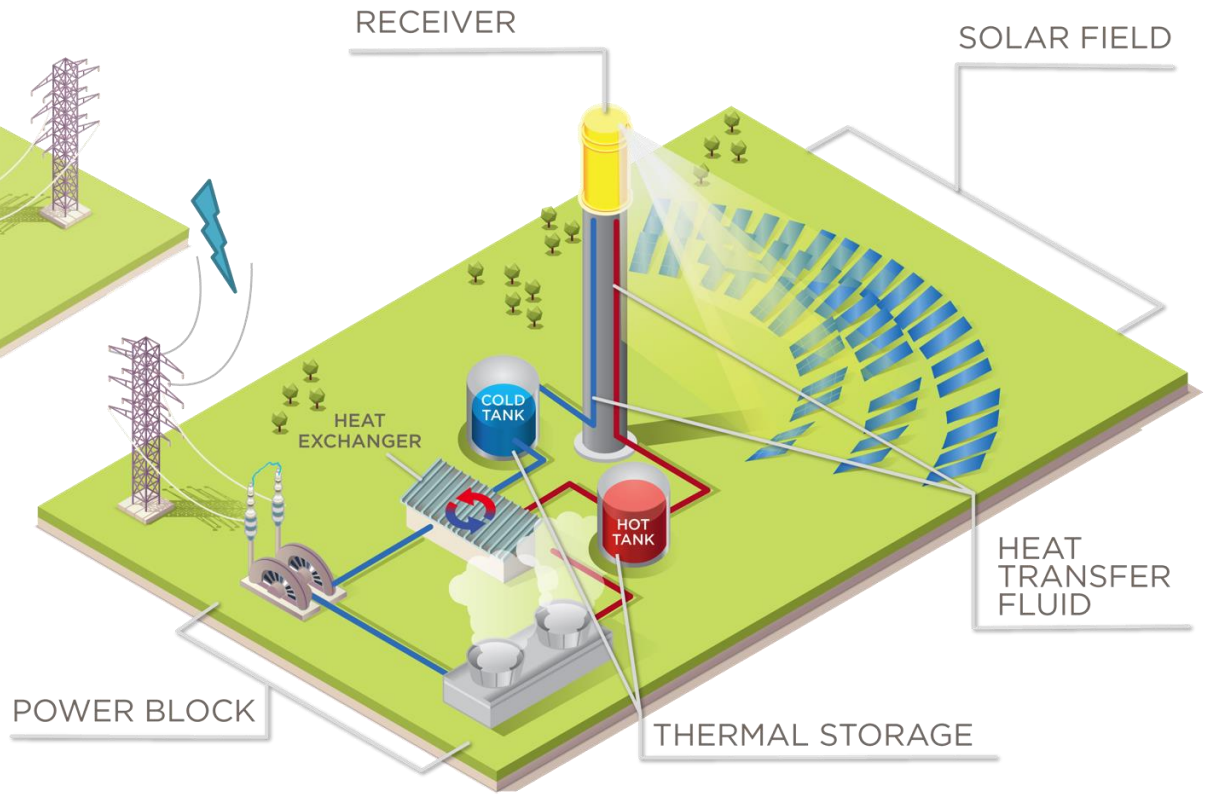
- Develop thermal systems to deliver heat to advanced power cycles (e.g. supercritical CO_2 power cycles) that can offer high efficiency at temperatures above current CSP thermal systems
- Develop Reliable High Temperature CSP Systems that meet SunShot targets



Gen 3 CSP Systems Background



Generation 1:
Parabolic Trough using oil based HTF at 395°C



Generation 2:
Tower using molten nitrate salt HTF at 565°C

Advanced Power Cycles: sCO2

Science Principles

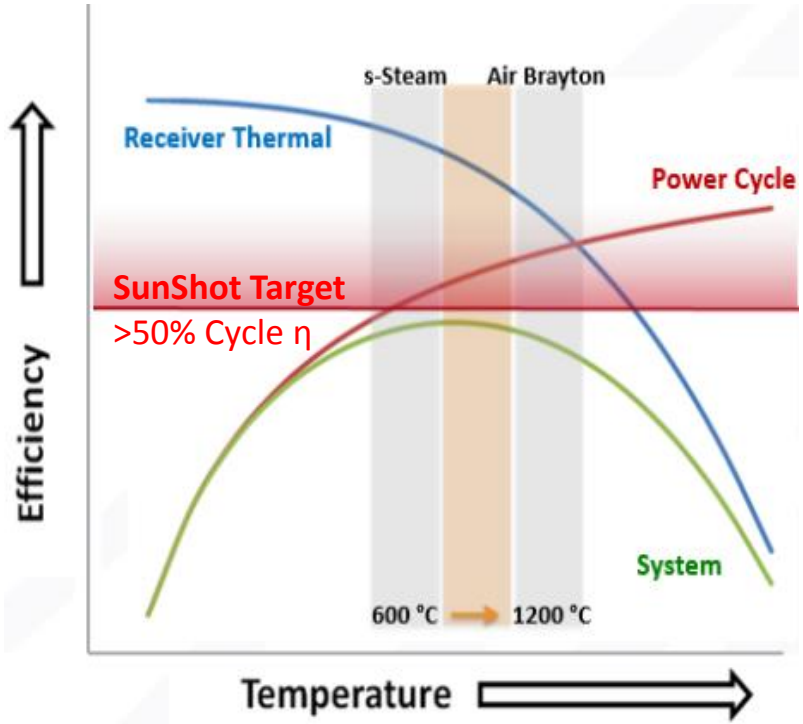
- Carnot vs. radiation optimum: 650 – 750°C
- Power Cycle Isothermal heat input higher η

sCO_2 Power Cycles

- Can achieve η > 50% operating at >700°C
- Scale from 50-500 MW and can scale to 10 MW with modest η decrease
- Suitable for dry cooling

Relevance and Opportunity for CSP

- Suitable for CSP Power Blocks <150 MW
- Higher efficiency critical to lower CSP costs
- Broad industry interest for Fossil, Nuclear and propulsion.



Gen 3 CSP Pathways and High Temperature Challenges

The 'Gen3 CSP' Roadmap identifies challenges for high temperature Generation 3 CSP Thermal Systems along three potential pathways: solid, liquid and gas HTF

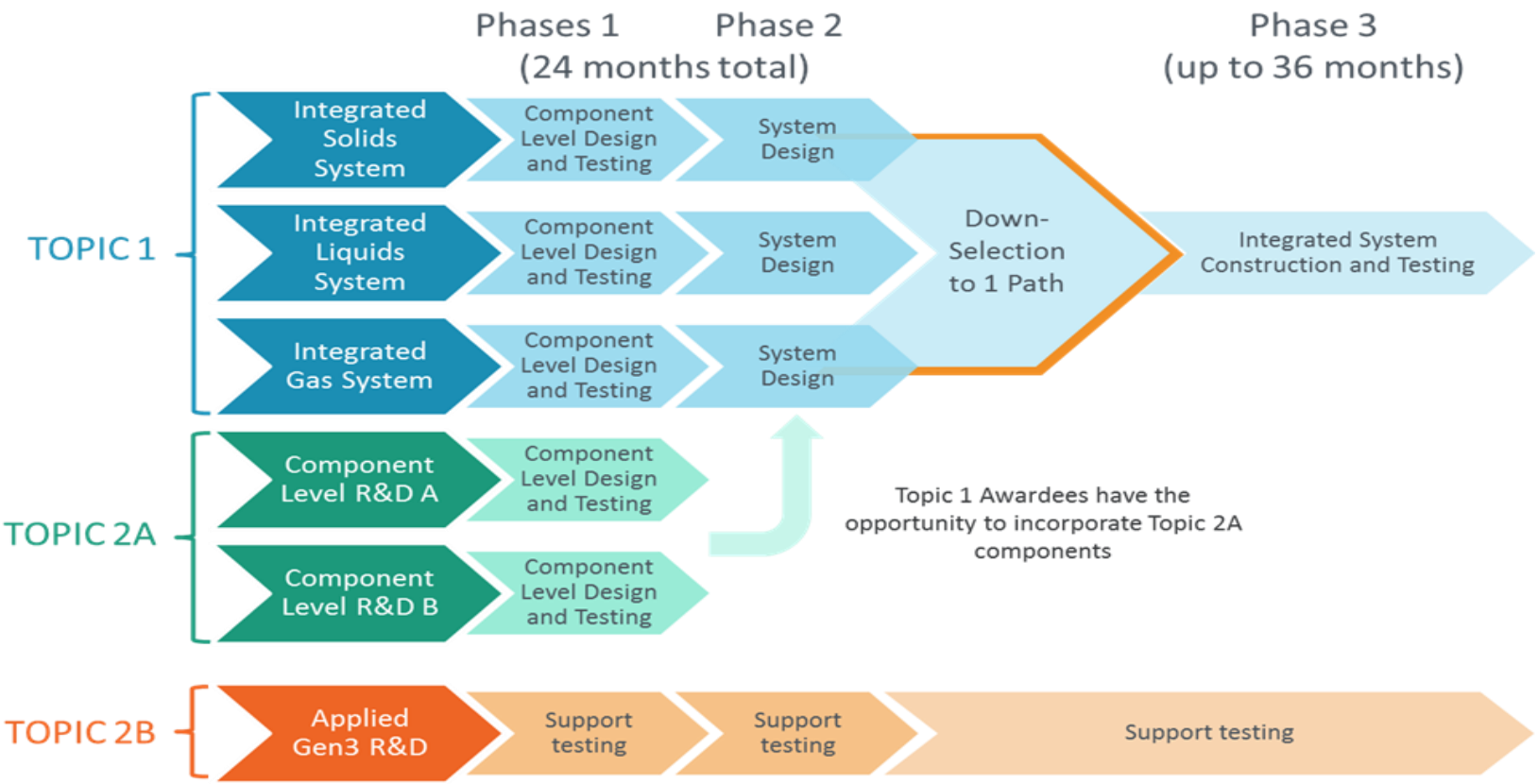
Gen3 CSP Roadmap: https://energy.gov/sites/prod/files/2017/04/f34/67464.pdf

Gen3 Concentrating Solar Power System; Innovation

Gen 3 CSP Systems FOA focus is on Gen 3 thermal systems:

- This FOA seeks an "integrated thermal system" encompassing only the integrated components inside the box labeled 'Innovation' to overcome current CSP system temperature limitations, while lowering capital costs and enabling the use of advanced turbines to achieving a higher overall system efficiency.
- FOA does not seek innovations in solar collectors or power cycles

Topic Areas and FOA Structure



Down selection to Phase 3

- Phase 3 objectives are to build and operate a test facility to demonstrate and retire risks for **one** selected pathway
- Down-selection merit review criteria
  - Evaluate the extent to which the critical concerns for a given technology have been adequately de-risked in Phase 1 / 2 , and in previous research to advance and succeed in Phase 3.
  - Evaluate the project management and technical capabilities of the awardees to accomplish the Phase 3 activities, using the Phase 1 / 2 results and other past research. The awardee's Phase 3 proposal should use the knowledge gained by the Topic Area 1 team during Phase 1, and potentially also incorporate knowledge, technologies, or members from Topic Area 2 awardees.
  - Evaluate the merit of the proposed Phase 3 integrated thermal system to reduce the cost of electricity and advance market adoption of the next generation of CSP systems.
  - Evaluate the extent to which the proposed activities will de-risk the critical concerns for the proposed technology in Phase 3.
  - Evaluate how the results of Phase 3 can be successfully implemented into a future CSP demonstration and adopted for commercial use.

Phase 3 – Integration Test Facility

- Characteristics and Requirements for Integration Facility
  - Test facility should accommodate 1-10 MWth output to an working fluid suitable for an advanced power cycle, at conditions necessary for stated efficiency
  - TES capability to conduct full day tests
  - Facility to include all components for integrated-subsystems
  - Facility must be designed to obtain confidence in the operation of a scale relevant to a commercial plant
  - Suggest operation at receiver exit temperatures ≥700 C; but lower temperatures acceptable if compelling TEA support ≤ 6 ¢/kWh target

Phase 3 – Integration Test Facility (continued)

- Characteristics and Requirements for Integration Facility (Continued)
  - Incorporate solar heat flux, unless it is demonstrated that receiver does not need direct solar radiance input
  - Investigate component performance
  - Derisk material and corrosion concerns
  - Test one selected technology pathway at scale, for several thousand hours and include steady state, dynamic, transient load following, power ramp-up, ramp-down, and endurance testing, and other operating scenarios as necessary.
  - Clearly define scope and boundary

Teaming Guidelines

- **Coordinator**: responsible for defining the concept system and directs or coordinates all critical activities and the generation, exchange and evaluation of information throughout the program
- **Integrator:** Engineering design for the integrated test facility. Provides input to the system concept with respect to the practical integration and operation
- **CSP Developer:** Experienced with design, construction and operation of CSP facilities.
- **System Analyst:** Performs solar system design and evaluates the integrated performance of the solar field and power cycle to system concept over an annualized basis.
- **Component Developer:** Develops components or sub-systems suitable for integration in the multi-MW testing and which are scalable to full-scale plants.

Awards Overview

- Total federal funds available: $62,000,000
- Max award amount: $35,000,000
- Project period: 1 to 5 years
- Number of expected awards: 8-12
- Cost-share:
  - 20% of R&D activities
  - 50% of demonstration and commercial activities
  - Topic Area 2B only: cost share requirement is reduced from 20% to 10% where:
    - The Prime Recipient is a domestic institution of higher education; domestic nonprofit entity; FFRDC; or U.S. State, local, or tribal government entity; and
    - The Prime Recipient performs more than 50% of the project work, as measured by the Total Project Cost.

Cost-Share

Total Task Cost = Non-federal Share + Federal Share

$$\text{Cost Share} = \frac{\text{Non–federal Share}}{\text{Total Task Cost}} \times 100\%$$

Type of Task and Type of Recipient or Sub-recipient	Minimum cost-share	Requested Federal Funds (example)	Cost-share (min)	Total Budget for Task
R&D Task	20%	$1,000,000	$250.000	$1,250,000
Demonstration or Commercialization Task	50%	$300,000	$300,000	$600,000
Topic 2B Task performed by FFRDC or non-profit entity	10%	$900,000	$100,000	$1,000,000

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
- 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 Paper Content

- **Technology Description (3 pages max)**
  - The proposed technology, including basic operating principles and how it is unique and innovative;
  - The proposed technology's target level of performance (Applicants should provide technical data or other support to show how the proposed target could be met);
  - The current state-of-the-art in the relevant field and application, including key shortcomings, limitations, and challenges;
  - How the proposed technology will overcome the shortcomings, limitations, and challenges in the relevant field and application;
  - The potential impact that the proposed project would have on the relevant field and application;
  - The key technical risks/issues associated with the proposed technology development plan; and
  - The impact that EERE funding would have on the proposed project.
  - Applicants may provide graphs, charts, or other data to supplement their Technology Description.
- **Team Description (2 pages max)**
  - What skills and expertise the Principal Investigator (PI) and Project Team have that will allow them to successfully execute the project plan;
  - Applicant's prior experience demonstrates an ability to perform tasks of similar risk and complexity;
  - Previous project and program collaborations between PI and team members; and
  - Equipment and facilities necessary to accomplish the effort to which applicant has access and/or how applicant intends to obtain access to the necessary equipment and facilities.

Key Points

- 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

Concept papers due November 3, 2017 at 5pm ET

Concept papers are mandatory

Submit Concept Paper in EERE-Exchange by

November 3, 2017 5:00 PM ET

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

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

Concept Paper Review Criteria

- **Criterion 1: Impact of the Proposed Technology Relative to State of the Art (50%)**
  - This criterion involves consideration of the following factors:
    - Quality and accuracy of the description of the current state of the art technology;
    - If technical success is achieved, the ability of the proposed idea to significantly improve technical and economic performance relative to the state of the art; and
    - Quality of the rational for how the proposed technology will address the Areas of Interest defined in Section I.B of this FOA.

- **Criterion 2: Overall Scientific and Technical Merit (50%)**
  - This criterion involves consideration of the following factors:
    - The proposed technology is unique and innovative; and
    - The proposed technical approach is justified and without major flaws.

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 late November, 2017
- Full Applications will be due on January 19, 2018

Timeline

- Sep. 19– 1st informational webinar (Intro. & Concept papers)
- **Nov. 3– Concept papers due (mandatory)**
- **Jan. 19– Full applications due (mandatory)**
- **Mar. 2– Submission Deadlines for Merit Review Comments**
- May – Selection notifications (expected date)
- July – Awards made (expected date)

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Questions can be emailed to

Gen3CSP@ee.doe.gov