FY12 DOE CSP Program Update to Industry
September 2012

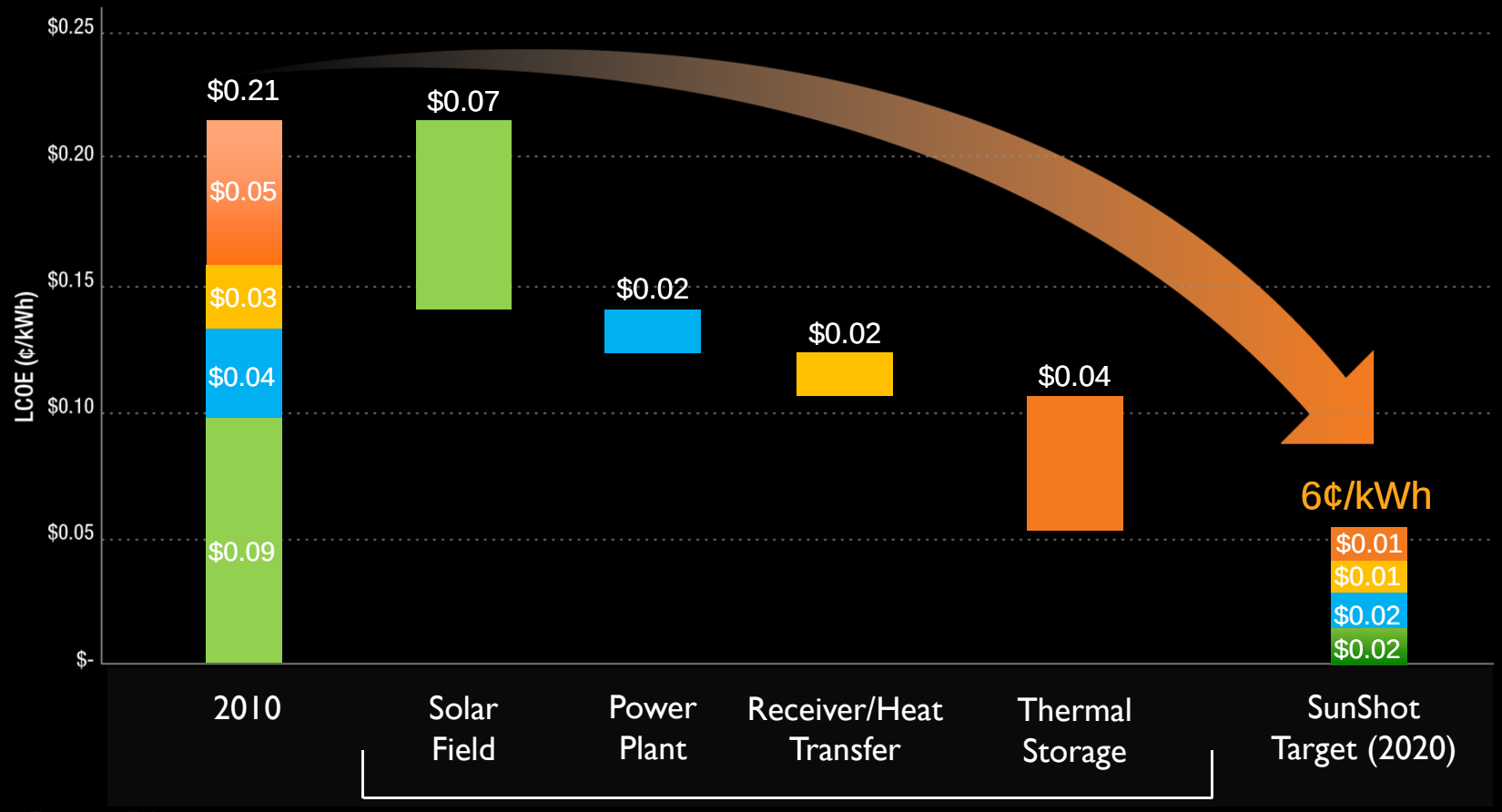
SunShot
U.S. Department of Energy

Outline

- SunShot Goals
- FY12 Funding Opportunities and Outcomes
- Competitive Funding of the DOE National Laboratories
- Summary
- Q&A

SunShot CSP Goal

The DOE SunShot Initiative is a collaborative national endeavor to make solar energy cost competitive with other forms of energy, without subsidies, by the end of the decade.



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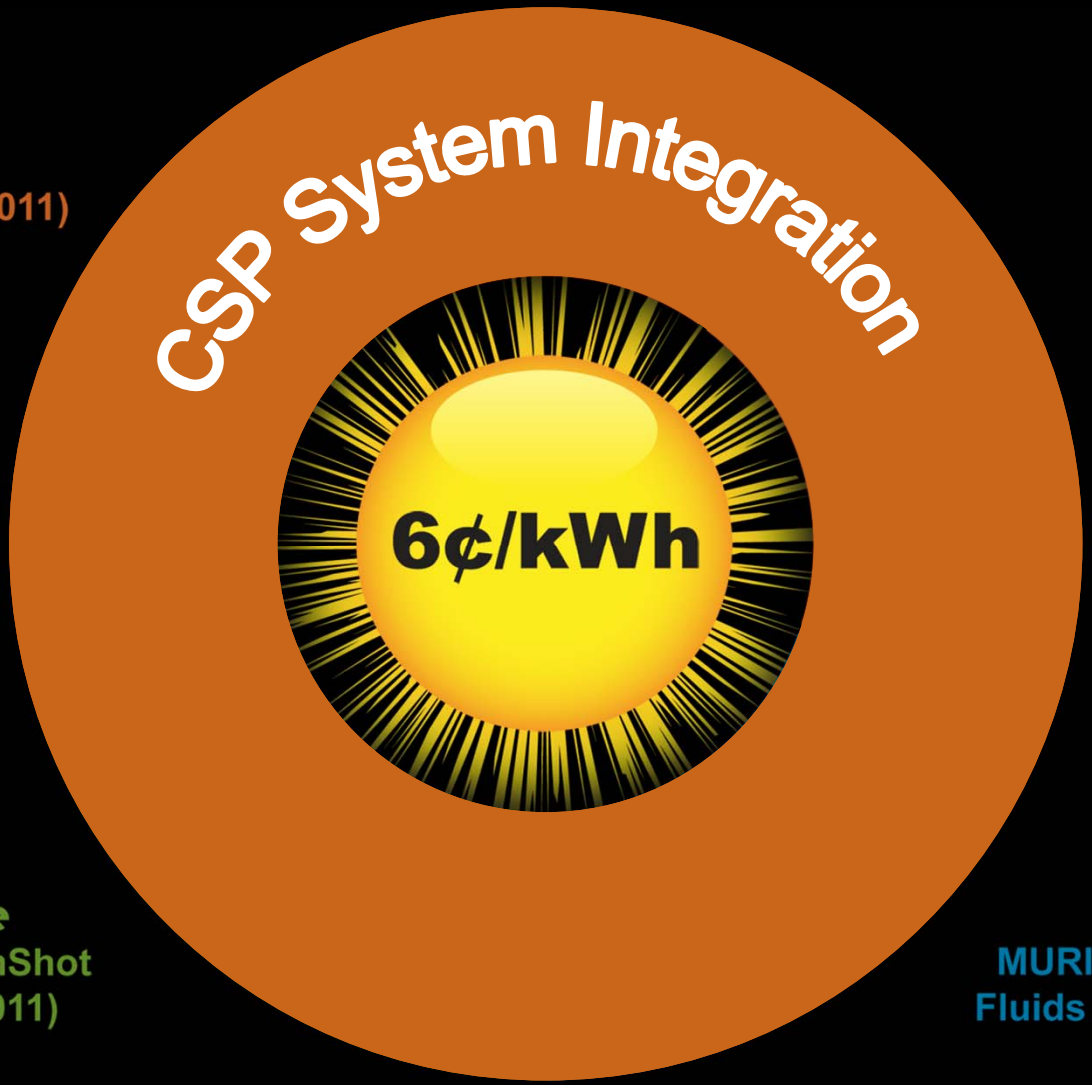
DOE CSP SunShot Strategy



CSP
SunShot (2011)

arpa • e
HEATS & SunShot
Awards (2011)

MURI HOT
Fluids (2012)

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SunShot CSP FOA Selections

- Goal: To innovate and develop next-generation CSP technologies for low-cost collectors, high-temperature receivers and high-efficiency dry-cooled power cycles to meet the aggressive technical targets of SunShot.

- Investment: Up to $55 million over 3 years in 21 projects at companies, universities and national laboratories.

Collectors

3M
Boston University
BrightSource
The University of Arizona
Thermata
JPL Jet Propulsion Laboratory
Penn State

Receivers

Argonne National Laboratory
OSU Oregon State University
San Diego State University
UC San Diego
NREL
Norwich Technologies
Sandia National Laboratories
BraytonEnergy

Power Cycles

MIT Massachusetts Institute of Technology
NREL
SRI
SLAC Stanford University
Pacific Northwest National Laboratory
SRI

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MURI FOA Selections

- Goal: To develop high operating temperature heat transfer fluids for CSP applications through fundamental materials discovery and demonstration.
- Investment: Up to $10 million over 5 years in 2 projects at universities.
- Over 40 different universities competed as 11 teams, of which two teams were selected…

Liquid Metals

Molten Salts

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National Laboratories Funding So Far…

< FY11	FY12
Funding focused on SNL and NREL only	Funding focused on SNL and NREL only
Based on pre-allocated $8.5M annual budget to each lab.	Funding was based on technical review.
The AOPs were little reviewed for technical content	The AOPs were rigorously reviewed by DOE HQ for technical content. Labs revised AOPs a few times to address review comments.
Less emphasis on intellectual outcomes such as patents, licenses, or journal publications	Greater emphasis on intellectual outcomes such as patents, licenses, and journal publications as part of the statement of work.

FY12 was a transition to the new process

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National Laboratories Funding (FY13+)

Goal: To leverage the expertise within the US DOE national laboratory system to develop innovative CSP components, systems, and analysis capabilities.

- Open competition to ALL DOE National Laboratories with the technical targets of the SunShot goal. 44 Full proposals came from NREL, SNL, ORNL, SRNL, PNNL, and LANL.
- Proposals were more descriptive with a 3-year plan and yearly outcomes and deliverables toward the 3-year objective.
- Proposals were peer-reviewed by an external panel of distinguished researchers from industry, non-DOE national labs and academia, including NAE members.
  - Industry reps from SolarReserve, BrightSource Energy, SENER, Rolls Royce and Bechtel. Abengoa was invited to participate but never responded to the invitation.
- Peer-review consisted of a merit review panel discussion as well as evaluation of oral presentations on a short listed subset of 23 proposals by an external peer-review panel. The PIs were able to rebut the reviewer comments directly with the reviewers.
- Core facilities at Sandia and NREL were evaluated by the external peer-review committee in the oral presentations.
- Funding decisions on technical activities were based on their intellectual merit.

CSP Lab Call Selections

- Investment: 12 projects at national laboratories.
- This is additional investment in the national laboratories on top of their awards through the competitive FOAs
- Takeaway: Lab funding is broad based, with technologies applicable to Dish, Trough and Tower Systems and spanning near-term to long-term research.

FY13–15 Laboratory Funded Projects

Title	Prime Lab	Topic	Description of Research
High-Temperature Solar Selective Coating Development for Power Tower Receivers	SNL	Receivers	SNL and NREL will be teaming to research solar selective coatings that are stable in air to temperatures in excess of 650°C
Direct s-CO2 Receiver Development	NREL	Receivers	NREL will be partnering with an industry member to look at direct supercritical CO_2 configurations.
Fundamental Corrosion Studies in High-Temperature Molten Salt Systems for Next Generation Concentrated Solar Power Systems	SRNL	TES	SRNL will partner with universities and industry to perform corrosion tests on a wide variety of alloys at temperatures up to 800°C.
Dish Stirling High Performance Thermal Storage	SNL	TES	SNL, with some materials help from NREL, will be building a prototype latent heat dish storage system capable of greater than 6 hours of storage.
Low-Cost Metal Hydride Thermal Energy Storage System for Concentrating Solar Power Systems	SRNL	TES	SRNL will be prototyping a metal hydride storage system for CSP applications.
Degradation Mechanisms and Development of Protective Coatings for TES and HTF Containment Materials	NREL	TES	NREL, with some help from universities and Sandia, will be investigating high temperature salt corrosion on various alloys and begin developing mitigation methods via surface passivation and coatings. Corrosion of supercritical CO2 will also be investigated over a variety of alloys and impurities.
High Efficiency Thermal Energy Storage System for CSP	ANL	TES	ANL, along with a private non-profit laboratory, will be prototyping a latent heat storage system using graphite foams.
Low-Cost Heliostat for Modular Systems	NREL	Collectors	NREL will be designing and prototyping a new heliostat.
Low-cost self-cleaning reflector coatings for concentrating solar power collectors	ORNL	Collectors	ORNL will be determining the optical properties of their anti-soiling coatings for mirrors and will demonstrate the coatings in outdoor settings.
High Temperature Thermal Array for Next Generation Solar Thermal Power Production	LANL	Power Cycles	LANL will be investigating the use of extremely long (>300ft) heat pipes in place of traditional heat transfer fluids.
Core Facilities at the DOE National Solar Thermal Test Facility	SNL	Core Facilities	This is funding to maintain and operate the NSTTF at SNL
SAM Enhancements for CSP	NREL	Core Facilities	This is funding to improve and incorporate new capabilities into NREL's SAM.

Current CSP Program Portfolio

FOA	Initial and Continuing Awards	Objective
CSP R&D	12 Industry Awards; 4 Continuing in FY12 – on Dish, Trough and Tower Systems	Re-energize the US CSP Industry
Thermal Storage	15 Initial Awards; 6 Continuing in FY12 – on Dish, Trough and Tower Systems	Generate CSP TES approaches
ARRA Lab Awards	8 National Labs + 1 Industry; 5 Continuing in FY12 ($18M to SNL, $5.4M to NREL)	Investment in National Lab infrastructure
CSP Baseload	12 Industry Awards + 1 University; 9 Continuing in FY12 (Trough and Towers)	LCOE: < 8-9¢/kWh
CSP SunShot	21 Awards (including 7 National Labs and 5 Industries) – Dish, Trough & Tower Systems	Technical targets towards SunShot goal of 6¢/kWh
MURI HOT Fluids	2 University Teams	Development of High Temperature HTF
National Lab Funding	12 Awards to 6 DOE National Laboratories – Dish, Trough and Tower Systems	Support Near-, Mid-, and Long-term R&D at the Labs

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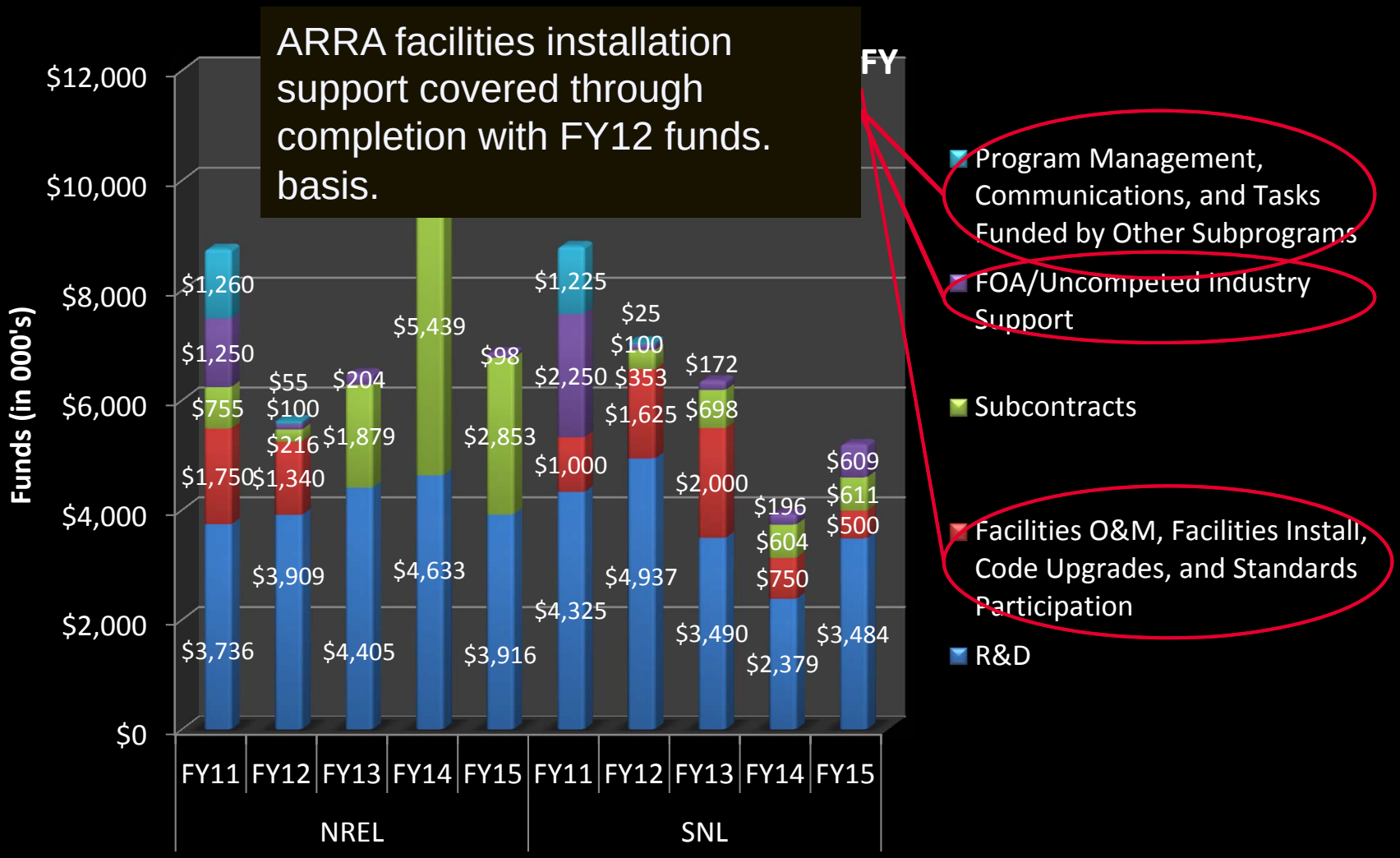
NREL & SNL Funding FY11 – FY15



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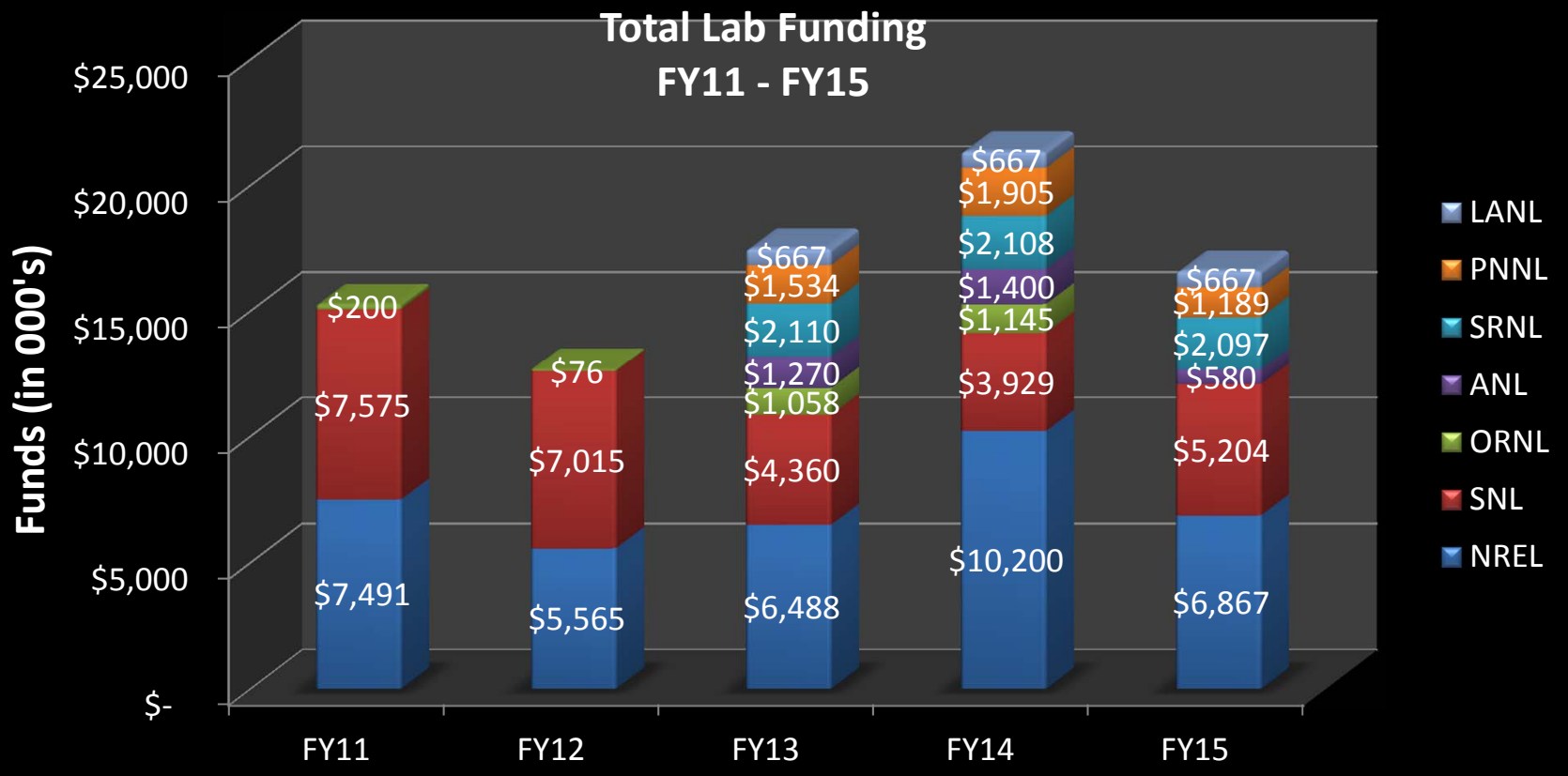
Details on the calculations behind these budgetary breakdowns can be discussed further upon request.

Total CSP Lab Funding FY11 – FY15



This chart reflects all CSP program support to the national laboratories, minus any program management, communications, and tasks that have been moved to other DOE programs.

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DOE CSP Approach to Lab Facilities

- The cost of maintaining the lab facilities has been an issue that NREL and SNL have been asked to address beginning in late FY10 as a part of the FY11 AOP development process, with that request reiterated throughout the course of FY11 and FY12.
  - SNL and NREL were asked to develop "user-schedule fees" so that they could charge DOE appropriately for work being performed under the AOP process (FY11 & FY12), the FY13-FY15 competitive lab process, and any FOA awards won. The balance of funds needed to maintain the facilities would be covered under work for others (WFO).
- During the course of FY12, the DOE CSP subprogram provided funding to the labs so that they could generate these "user-schedule fees" by performing an in-depth analysis of their current costs.
  - By completing this process, NREL and SNL identified that it was costing the CSP program well over $5M/year to maintain the facilities at NREL and SNL. This cost exceeds the appropriated CSP budget from many recent years, including FY06. While concerning, this would be acceptable if the facilities were being extensively used.
  - Because NSTTF at SNL is the majority of these costs, the costs were further examined with SNL during early FY12. Based upon this analysis, significant opportunities for cost reduction were identified and it was left to SNL to reduce cost in FY12.

DOE CSP Approach to Lab Facilities

- DOE has asked the labs to evaluate the use of their facilities, beyond merely maintaining them. There are currently facilities at both SNL and NREL that have not been used over the entire course of FY12 or longer.
  - SNL and NREL are being asked to identify facilities that are not being used on a regular basis and to critically examine the prospect for meaningful and sustained future use.
  - SNL and NREL are also being asked to look at their costs for these facilities to make sure they are appropriate and reasonable for WFO opportunities.

Lab Facilities – DOE's Commitment

- DOE recognizes the unique capability of the NSTTF in general, and therefore is willing and has made a greater commitment to the facility.
  - DOE has committed $1M in FY13, $750k in FY14, and $500k in FY15 and beyond (subject to appropriations) to maintain the facility as a baseline. The remainder of the funds is to be covered through SNL work won through competitive awards, WFO, or cost reductions.
  - DOE personnel will work with SNL personnel to better market the facilities for WFO work. One example of this is that DOE will create and pay for a detailed website highlighting the NSTTF capabilities and house it on the SunShot website.
  - At the same time, DOE has asked SNL to critically evaluate the costs of maintaining the site. This includes combining personnel functions, where appropriate, and to shut down any capabilities at the site that are not being used.
- SNL management has been on-board with this process and has already taken steps to identify change leaders to head up this process. They have also committed to hiring a lean six Sigma consultant to evaluate the NSTTF costs.

SNL – DOE's Commitment

- DOE recognizes that SNL performed poorly in the peer-reviewed process for FY13-FY15 funding.
  - DOE has committed $1M in FY13 to SNL in order to bring in new talent to the facility. This $1M is expected to cover up to 4 new hires at SNL in FY13. After FY13, it is expected that this personnel time will be covered through competitively awarded funds.

Conclusions

- DOE believes the appropriate action of funding the labs in the future is through a **competitive process** in order to ensure only the **best ideas** are funded to meet the SunShot goals.
  - As can be seen on slide 13, this has served to further bring new DOE laboratories into the CSP portfolio and will serve to let industry know of potential laboratory partners that may serve them better, in addition to being more closely aligned with their geographic location.
- NREL funding from FY13 – FY15 exceeds FY11 and FY12 funding, when evaluating strictly on an R&D basis.
- DOE recognizes that SNL performed poorly in the FY13-FY15 funding competition, and therefore has provided SNL up to $1M in FY13 to bring in new talent in order to improve their ability to compete.
- DOE is committed to the NSTTF and will provide baseline funding to the facility (subject to appropriations). DOE will work with SNL to better market the NSTTF while simultaneously reducing the cost of the NSTTF, thereby allowing the lab to better compete for WFO.

Conclusions

- The funding presented in this presentation for FY13 – FY15 does not represent all the funding going to SNL and NREL in these years.
  - SNL and NREL will be able to compete in any FOA's that DOE releases during these years.
  - SNL and NREL will be able to partner to provide testing or other consulting to any entity competing in any FOA during these years.
  - DOE will also continue to provide, subject to FOA awardee request and DOE approval, FOA support for existing FOA contracts awarded in FY07 – FY10 to the labs.
- DOE believes that, through the actions taken in FY12, NREL and SNL will provide better, more cost-efficient testing support to industry moving forward. Additionally, the research that is performed at these and other DOE national laboratories will only be the best, most relevant research to aide industry in achieving the SunShot goal.
- Lab funding is broad based, with technologies applicable to all CSP configurations and spanning near-term to long-term research.

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