CSP SunShot: Collectors

Webinar “Target: CSP in Chile at 50 US$/MWh by 2025”

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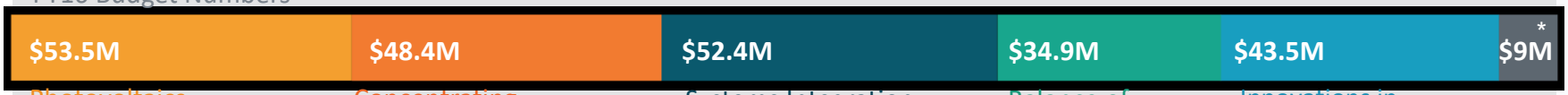
Solar Energy Technologies Office/SunShot Initiative Overview

WHAT WE DO: SunShot works to make it *faster*, *easier*, and *more affordable* for Americans to access solar power by making smart R&D investments to *lower costs* so solar electricity is fully *market-competitive* without subsidies.

HOW WE DO IT: SunShot's FY16 budget funds projects across five subprograms.

FY16 Budget Numbers



Photovoltaics

Concentrating Solar Power

Systems Integration

Balance of Systems - Soft Costs

Innovations in Manufacturing Competitiveness

IMPACT:

SunShot has funded work to drive down the cost of solar **90%** toward the 2020 cost target, supporting the **260,000 JOBS** in the solar industry.

FUTURE:

In addition to game-changing, cost-lowering R&D, SunShot will continue to *spur solar development* and *increase grid resiliency* across the country to diversify the U.S. domestic energy supply.

*NREL Site-Wide Facility Support ($9.2M)

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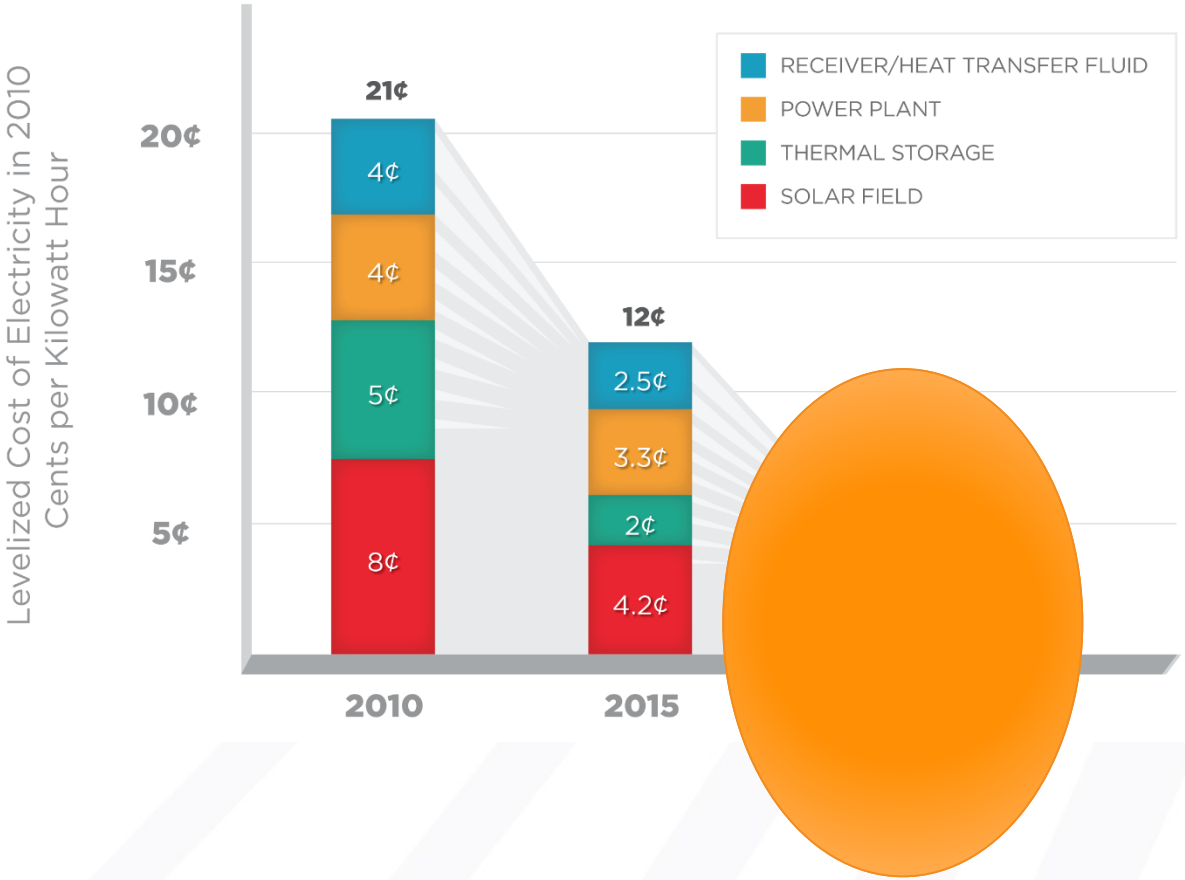
Driving down the costs of CSP through competitive R&D funding



Competitive Programs

$9M	COLLECTS (2016)
$32M	CSP: APOLLO (2015)
$29M	CSP SuNLaMP (2015)
$1.4M	SolarMat II (2014)
$10M	CSP: ELEMENTS (2014)
$1.1M	SunShot Incubator (Recurring)
$4M	PREDICTS (2013)
$2M	SolarMat (2013)
$10M	CSP-HIBRED (2013)
$27M	National Lab R&D (2012)
$10M	SunShot MURI (2012)
$56M	CSP SunShot R&D (2012)
$0.5M	BRIDGE (2012)
$62M	CSP Baseload (2010)

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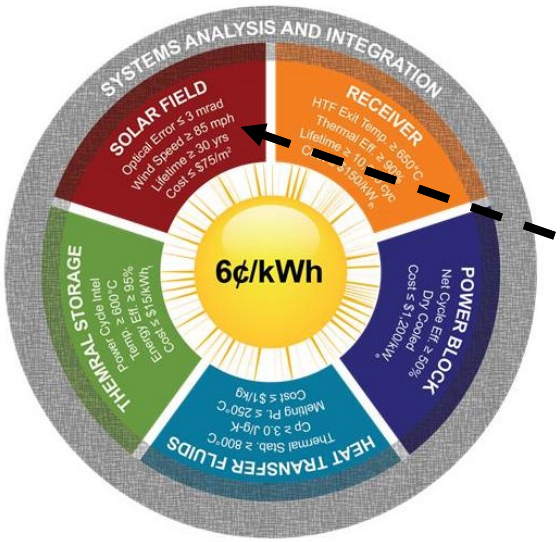
Challenges to Reaching the Technical Targets for CSP Collectors



SUNSHOT GOAL

	Technical Targets (2020)	Challenges
Solar Field	Optical Error ≤ 3 mrad	• Labor intensive • Material degradation • High O&M costs • Weight/handling • Tracking costs • Optical accuracy
	Wind Speed (operational) ≥ 35 mph Wind Speed (survivable) ≥ 85 mph	
	Cost ≤ $75/m^2	
	Lifetime ≥ 30 years	

- Much of the reduction in solar collector cost is driven by higher production volumes and more efficient manufacturing and business processes, however significant opportunities remain

General approaches to overcoming challenges

- Manufacturing (labor costs)
  - Higher levels of automation and controls/More efficient manufacturing techniques
- Fundamental Physics
  - Predictive modeling of intrinsic degradation mechanisms for reflector materials
- O&M (Collector cleaning)
  - Superhydrophobic coatings
  - Electrodynamic screens
- System Level (Materials & Supporting Structures)
  - Lightweight polymeric optical films and supporting structures
- Tracking costs
  - Passive Collectors
- Optical Accuracy
  - Flat glass molding

Some Past DOE CSP Projects that addressed the challenges

Manufacturing (labor Costs)		System-Level	
2013 SolarMat ABENGOA SOLAR	2012 SunShot R&D BrightSource	*2012* SunShot R&D JPL	2012 SunShot R&D NREL NATIONAL RENEWABLE ENERGY LABORATORY
Tracking Costs		**Optical Accuracy**	
2012 SunShot R&D PENNSTATE 1855		2012 SunShot R&D THE UNIVERSITY OF ARIZONA	
Fundamental Physics		**O&M (Collector Cleaning)**	
2013 PREDICTS NREL NATIONAL RENEWABLE ENERGY LABORATORY		2012 SunShot R&D BOSTON UNIVERSITY	2012 CSP Lab Call OAK RIDGE National Laboratory

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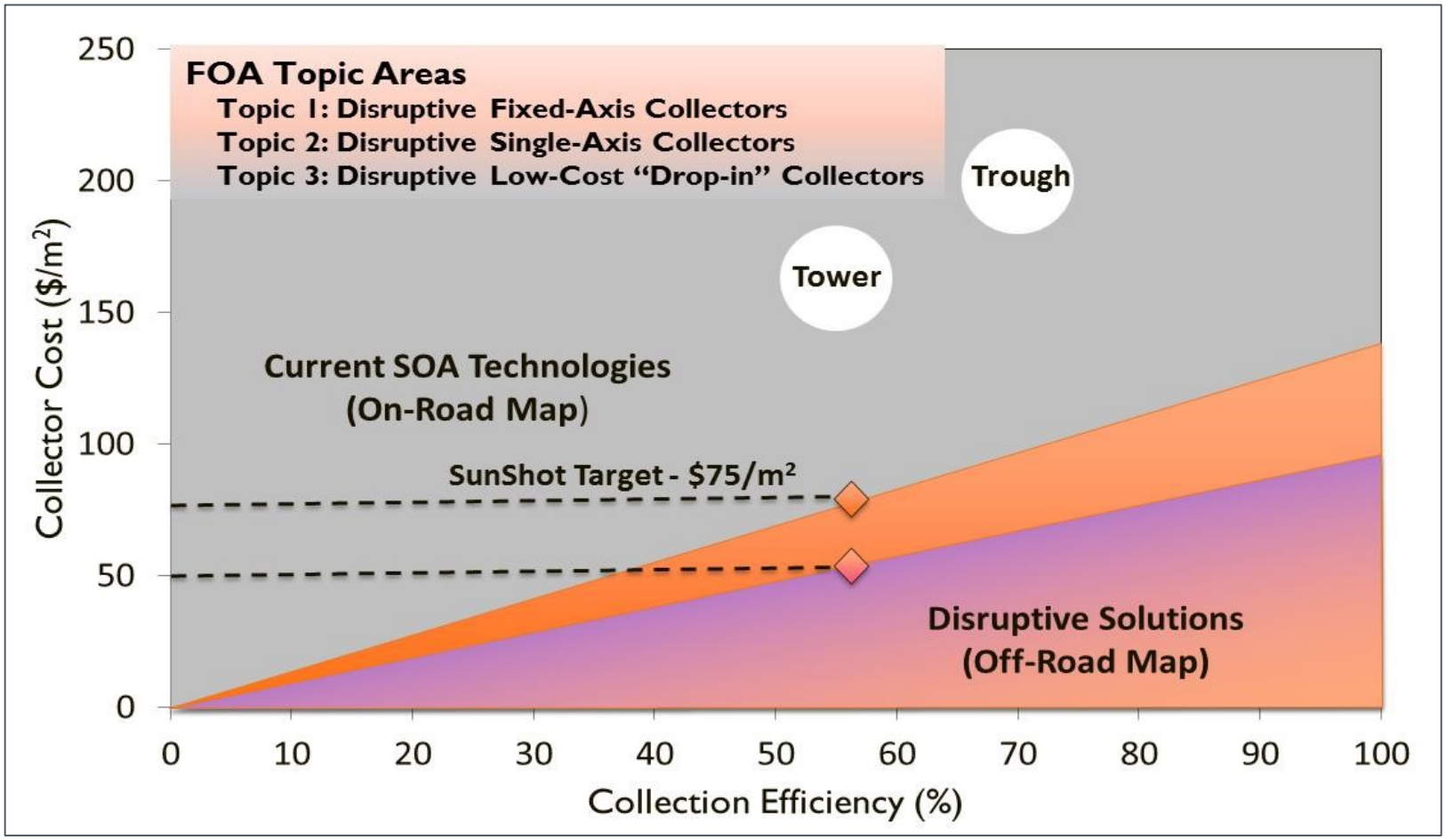
Some Current DOE CSP Collector Projects

CSP: COLLECTS Overview



Green Parabolic Trough Collector (GPTC)

SUNVAPOR, INC

Project Summary

The industry standard Parabolic Trough Collector (PTC) has reached an asymptote on cost that can only be disrupted by a bold change in material and typology (global geometry), along with more efficient means of assembly. The GPTC uses a surprising outdoor-proven structural material (Select Structural Grade Douglas Fir) which is only 15% the price of steel per unit weight, and a contrarian structural typology with trusses on the concave side of the parabola.

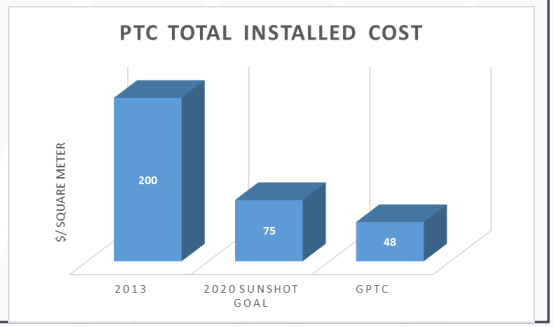
This typology minimizes the amount of structural material needed to achieve the required stiffness, and reduces the number of assembly fixtures and process steps in construction. Our aim is to design, build, and test an outdoor full-scale prototype. The supply chain is 100% made-in-the-USA , leveraging forestry, roof-truss manufacturing, and unique assembly tooling.

Key Milestones & Deliverables

Year 1:	Detailed Design of GPTC meets COLLECTS targets
Year 2:	Full-scale prototype tested for 3 months on-sun meets COLLECTS targets

Project Impact

The LCOE of CSP has been above 20 ¢/kWh. By 2020 we expect the LCOE to reach 6 ¢/kWh with GPTC, with a reduced collector cost <$50/m^2.



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Low Cost Concentrated Solar Power Collector

HYPERLIGHT ENERGY

Project Summary

Hyperlight® is a linear Fresnel reflector (LFR) CSP collector. It uses lightweight, low-cost materials to hold its mirror surfaces in position. The primary bearing surface is a zero-evaporation waterbed enclosed by low profile walls. Because this technology achieves the DOE's optical performance technical targets with fundamentally low cost materials, it presents a pathway to disruptive breakthroughs in CSP deployment.

To achieve this objective, this project will advance this technology to commercial deployment at an existing geothermal power plant in a hybrid configuration. Geothermal CSP hybridization has a near term potential of 1,000 MW. With increasing focus on dispatchable renewable energy, the round-the-clock capability of this approach has the long-term potential to transform the energy industry.

Key Milestones & Deliverables

Year 1:	First Phase Test Bed demonstrated geometric accuracy to support targeted annual efficiency of 48%. Bottom-up cost estimate completed.
Year 2:	Annual efficiency 55% with 3rd party test Q2 FY18

Project Impact

Low cost collector (<$50/m^2). Ready for commercial deployment through 3rd party certification and testing, proving suitability for use at an existing geothermal power plant in a hybrid configuration as well as other industrial process heat applications for biomass processing.

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How can CSP collectors contribute to system level costs 50 US$/MWh by 2025?

- Continue to develop adjacent solar thermal technology applications which will further increase the deployment and cost reduction of CSP-type collectors
- Continue to expand the use of advanced manufacturing and minimization of CSP collector soft costs

SunShot projects that with the successful implementation of the above, an additional ~20 US$/MWh reduction in costs, solely due to CSP collectors, can occur by 2020.

End of Presentation