

# SolarDynamics

## Advanced Trough with Lower-cost System-architecture (ATLAS)

SETO CSP Program Summit 2019  
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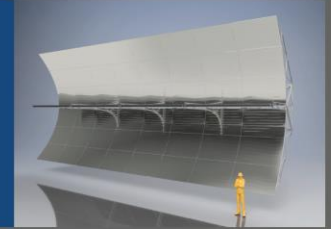
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*Presenting: Hank Price*

## Company Overview

- Solar Dynamics (SD) is a limited liability company formed in 2016
- SD is currently focused on 3 business areas:
  - Development of advanced parabolic trough collector & heliostat technologies,
  - Development of next generation CSP plant configurations to support development of new CSP projects, and
  - Technical support and services to existing CSP companies and CSP plants.
- SD has been awarded four U.S. DOE SunShot R&D Contracts
- SD Sub Tier Awards
  - Sandia – CSP Gen3 Particle Tower
  - NREL CSP Best Practices
- Other
  - Ashalim Parabolic Trough Plant – Technical Performance Model

### ADVANCED TROUGH COLLECTORS



### LOW COST HELIOSTATS



### DISPATCHABLE SOLAR POWER



### MOLTEN SALT FOR PARABOLIC TROUGHS



# SUMMARY STATEMENT

This project is modernizing a very successful parabolic trough collector architecture for lower cost and better molten salt HTF compatibility. The project targets a solar field energy delivery vs installed cost ratio  $\geq 20\%$  higher than the state-of-the-art trough system<sup>1</sup>, achieved by reducing collector installed cost from  $\$92/\text{m}^2$  to  $\leq \$72/\text{m}^2$  ( $\$_{2015}$ , not including receivers) with minimal or no performance loss

- **Project innovations:**

- World's largest CSP trough: 8.2m aperture, 21m-25m unit length, up to 210m long collector
- Built on extremely material-efficient SunBeam™ helical steel space frame
- Novel large-format glass mirror facets, drive actuator design, and pivot bearings
- Developed “from the ground up” for mass production and lean assembly

- **Challenges:**

- Balancing competing influences of:
  - ...larger aperture size vs (non-linear) wind load increases
  - ...challenging dimensional control requirements vs complexity of alignment
  - ...aggressive cost reductions sought for multiple components vs higher technical risks

- **Critical capability:**

- Experienced team, leveraging strong commercial background and state-of-the-art design capability

1) State of the art reference: Abengoa SpaceTube SolarMat version, as reported under DE-EE0006357. Metric comparison based on both new and state-of-the-art collector systems circulating solar salt HTF with 565C maximum outlet temperature

# KEY ACTIVITIES

- **Budget Period 1**

- Reoptimize field layout using latest knowledge of cost, wind loads, HTF compatibility issues
- Improve wind load mitigation strategies; validate in wind tunnel
- Use “digital prototype” to co-optimize novel space frame, mirrors, drive, pylons
- Integrate mass production and lean assembly methods “from the ground up”
- Develop pathways for transition to wireless control and autonomous power supply

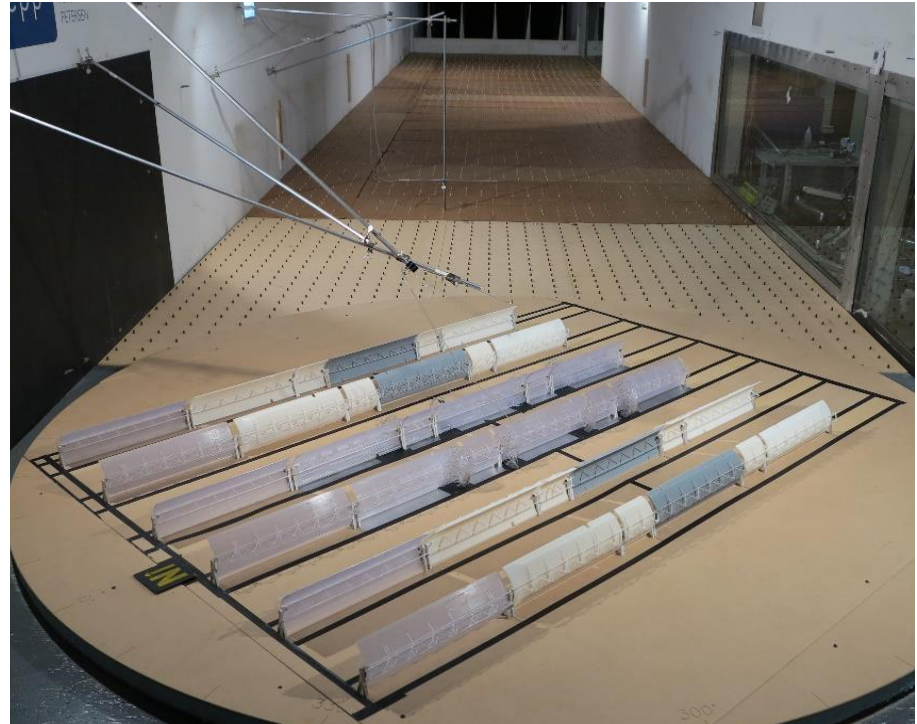
- **Budget Period 2**

- Erect first-article mock up frame to inform design and manufacturability refinements
- Construct realistic ATLAS Near-Term prototype and obtain 3rd party optical qualification
- Contract 3rd party engineering review and component bench testing
- Build and test ATLAS Mid-Term prototype to initially validate most-aggressive designs
- Commercial outreach to secure path for industry funded demonstration and scale-up

# Wind Tunnel Testing

## Areas of exploration

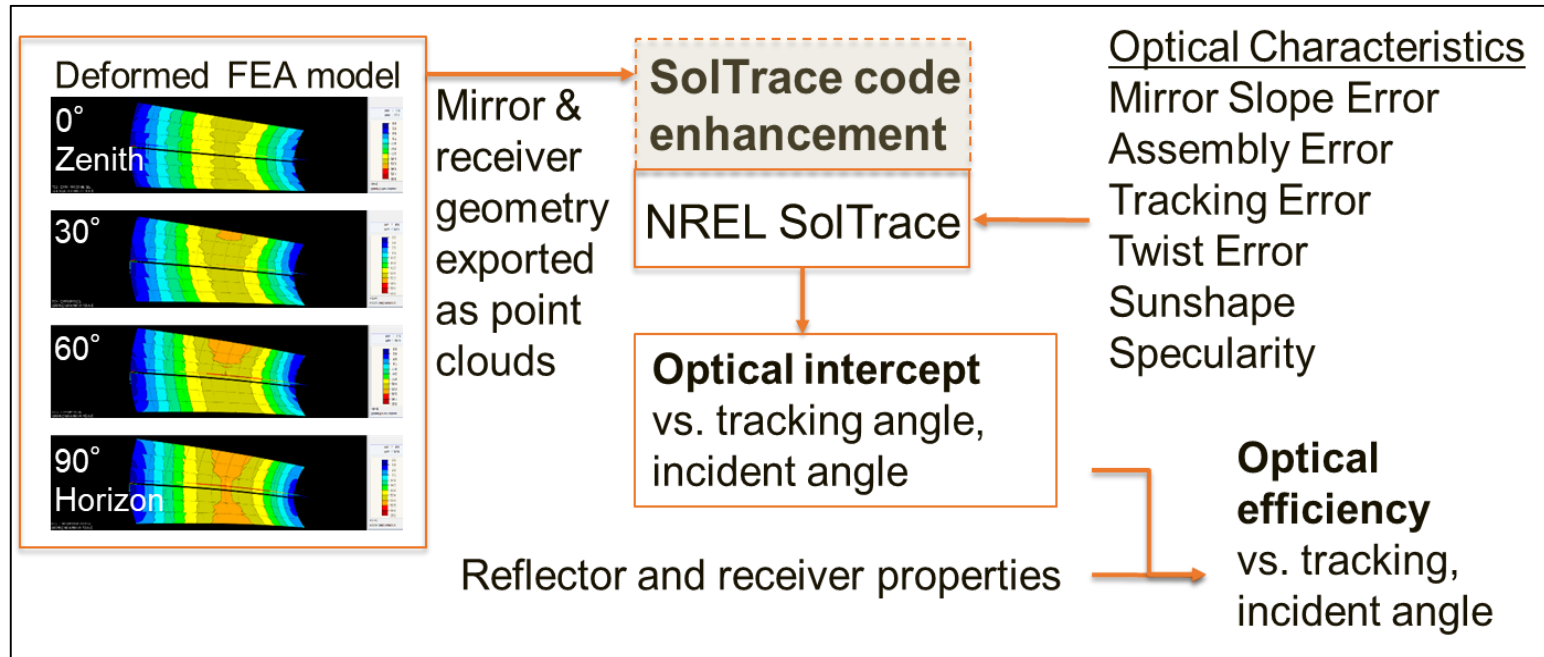
- Loads at edge vs interior of solar field
- Correlated loading of linked multiple linked modules
- Row-to-row shielding, influence of tighter spacing
- Influence of mirror gaps
- Potential for alternative stow positions to reduce loading



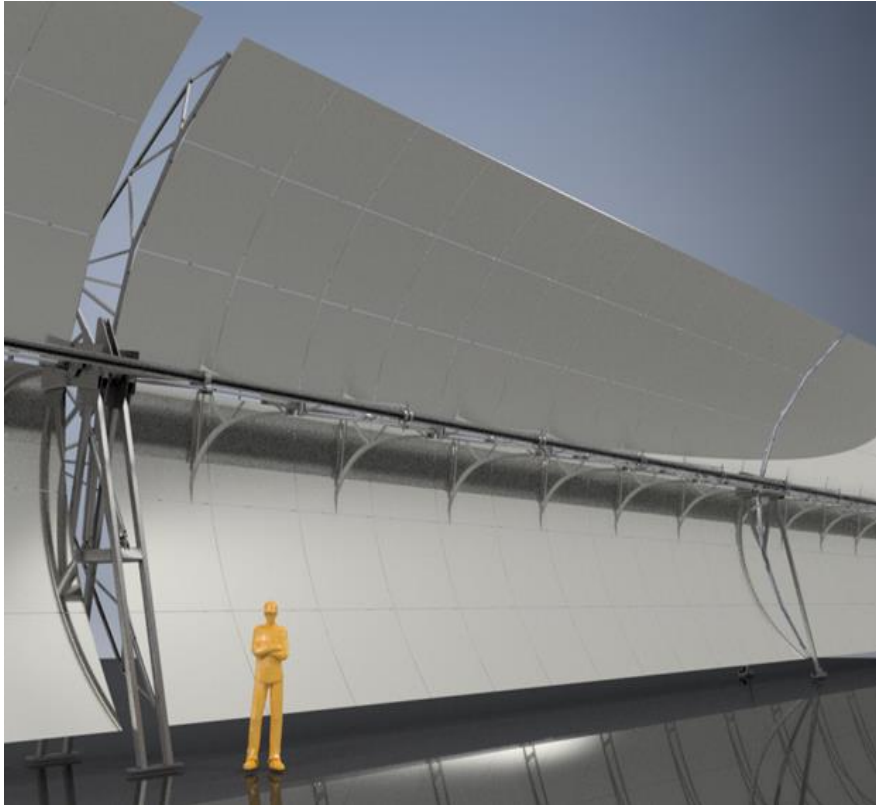
## Project wind tunnel study

## Digital Prototype

## Optical forecasting using new code developed for NREL SolTrace



# ATLAS Collector



**ATLAS concentrator digital and physical prototypes**

## Key metric improvements driving system cost savings

		<b>EuroTrough</b>	<b>Abengoa SpaceTube</b>	<b>Solar Dynamics SunBeam (low-risk variant)</b>
Concentrator Aperture W x L (m, gross)		5.77 x 11.9	8.18 x 15.9	8.18 x 20.5
Concentrator / Collector Aperture (m <sup>2</sup> , gross)		69 / 824	125 / 1,250	168 / 1,680
% relative to State-of-the-Art (Abengoa SpaceTube)	Collector Aperture	-37%	-	+29%
	Frame components, per m <sup>2</sup>	Not meas.	-	-32%
	Fasteners, per m <sup>2</sup>	Not meas.	-	-44%
	Steel content under comparable design loading, mass per m <sup>2</sup>	Not meas.		-15%
	Foundations, Pylons, Axle Assemblies, Concentrator Modules, Assembly/Installation Steps (per m <sup>2</sup> )	+82%	-	-25%
	Loops, Piping, Interconnects, Collectors, Drives, Controllers, Instrumentation, Wiring (per m <sup>2</sup> )	+52%	-	-22%



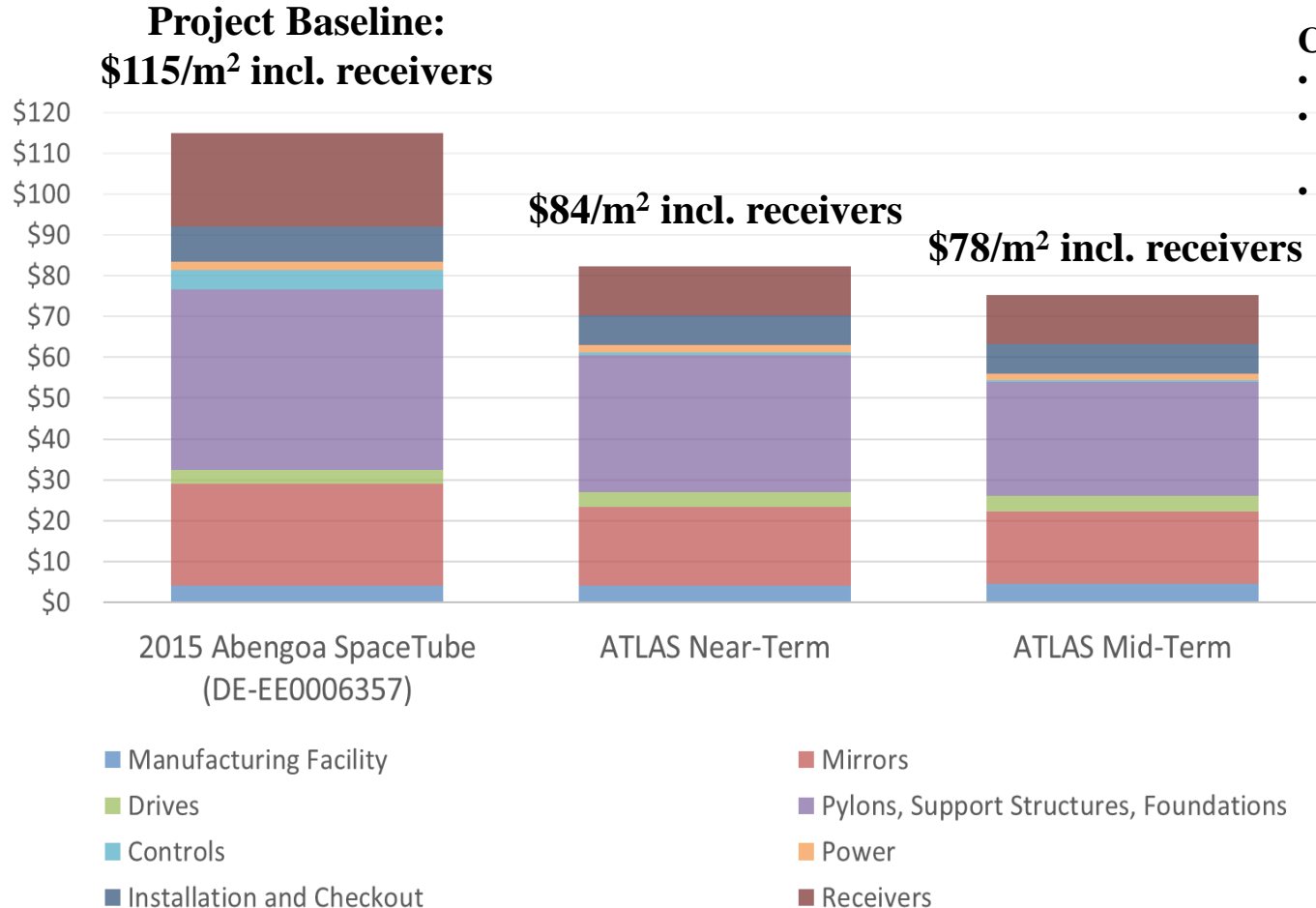
# KEY OUTCOMES AND IMPACT

• **Period 1 Outcomes**

- **ATLAS “near-term” 8.2 x 21m concentrator:** 1<sup>st</sup> generation product-candidate using standard glass mirrors
- **ATLAS “mid-term” 8.2 x 25m concentrator:** 2<sup>nd</sup> generation longer and lower-cost concentrator using new “large format” mirrors, streamlined support structure, and improved assembly/alignment scheme

Project savings

- Cost analysis based on:**
- 1 million m<sup>2</sup> deployment
  - US 2015 construction and labor costs
  - US 2015 steel prices



## Acknowledgment

- This project was made possible with funding from the US Department of Energy's Solar Energy Technology Office under award DE-EE0007121

