A Summary : Solar Collector Systems

Guangdong Zhu, PhD
Thermal Energy Systems Group
National Renewable Energy Laboratory (NREL)
Guangdong.Zhu@nrel.gov
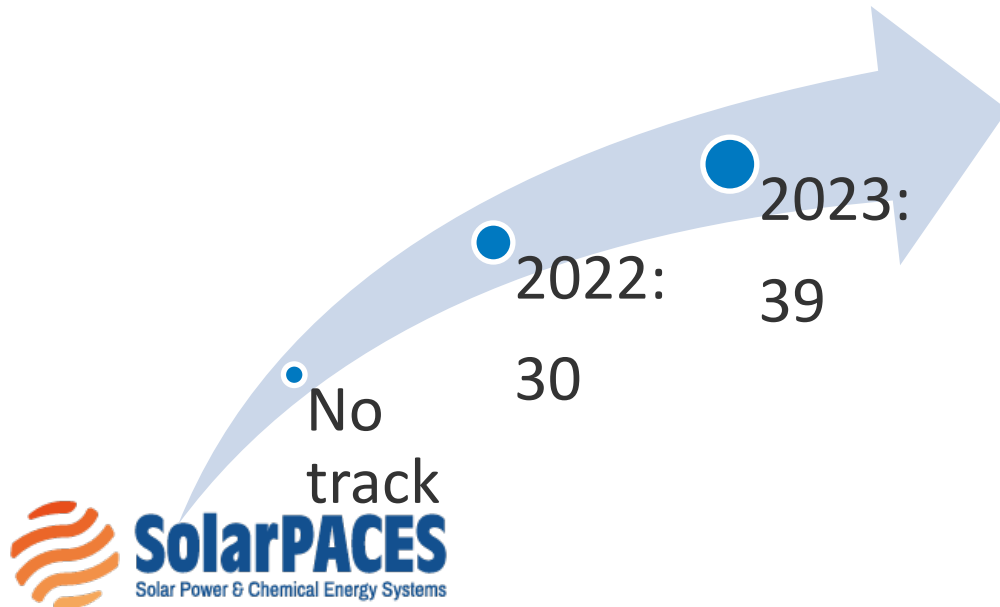
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Proud Sponsor from Solar Collector: Heliostat Consortium (HelioCon)

Topic: Solar Collector Systems

- Trend in the past SolarPACES conferences

2023: 39

2022: 30

No track

SolarPACES
Solar Power & Chemical Energy Systems

SolarPACES
Solar Power & Chemical Energy Systems
29th SolarPACES Conference
October 10-13, 2023
Sydney, Australia

C3.2

8:30am – 10:00am
Solar Collector Systems

10:30am – 12:30pm
Solar Collector Systems

1:45pm – 3:45pm
Solar Collector Systems

4:15pm – 6:15pm
Solar Collector Systems

Topic: Solar Collector Systems

- Distribution between countries

Submissions

- Australia — 27%
- China
- Germany
- Greece
- Iran — 45%
- Mexico
- Senegal
- South Africa
- Spain — 14%
- United Arab Emirates
- United States of America

4% 5% 5%
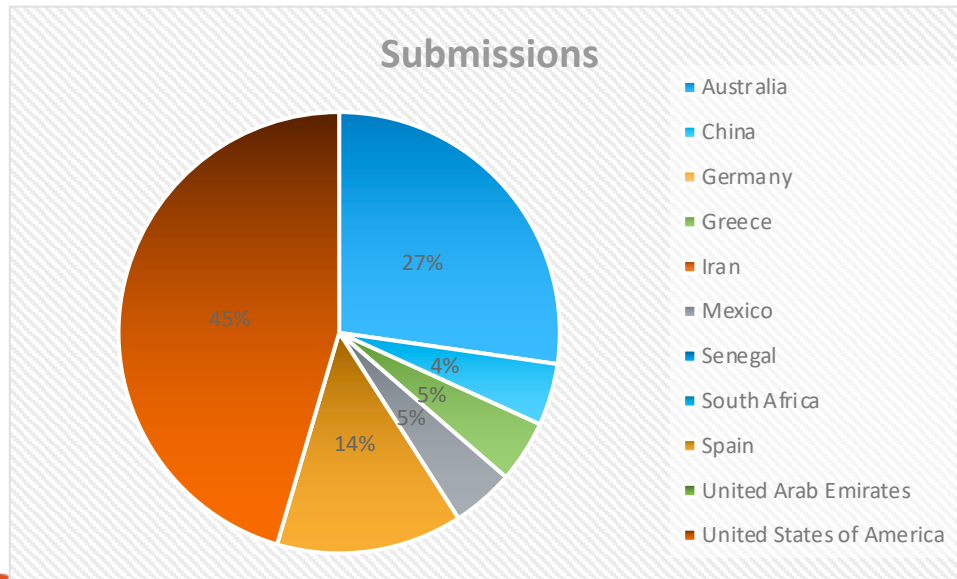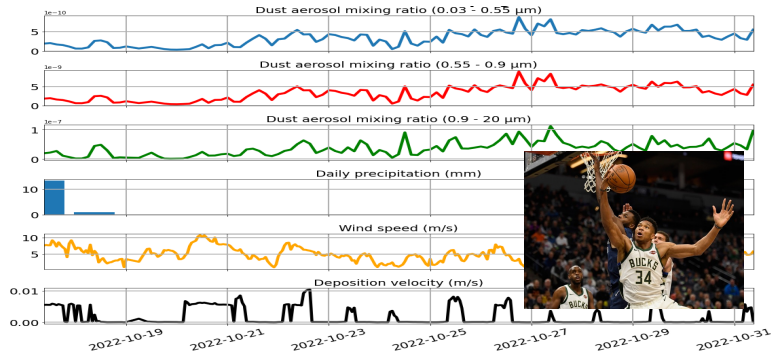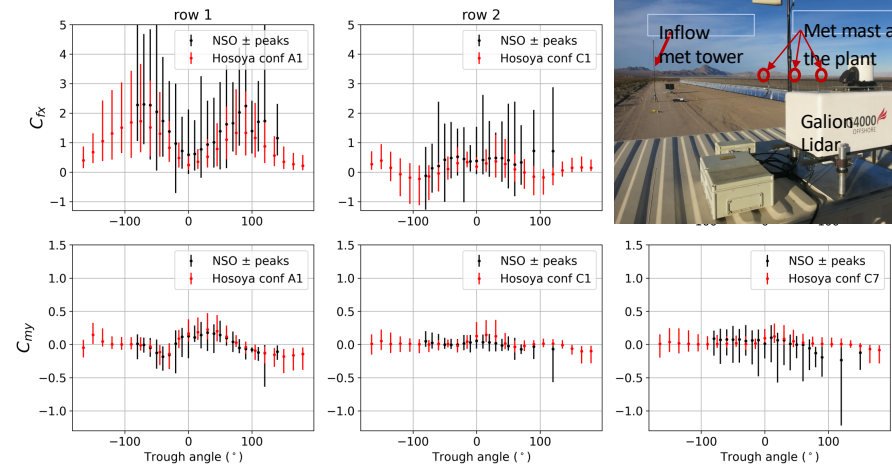
Parabolic Trough Collectors: Characterization

Presenter: Dr. Spiros Alexopoulos, the FH Aachen University of Applied Sciences
Title: Sensitivity of Dust Deposition for Parabolic Trough Collector Mirrors to different Meteorological Drivers

Presenter: Dr. Shashank Yellapantula, NREL
Title: Wind Loading on Parabolic Trough Solar Collectors: Insights from Measurements at an Operational Powerplant
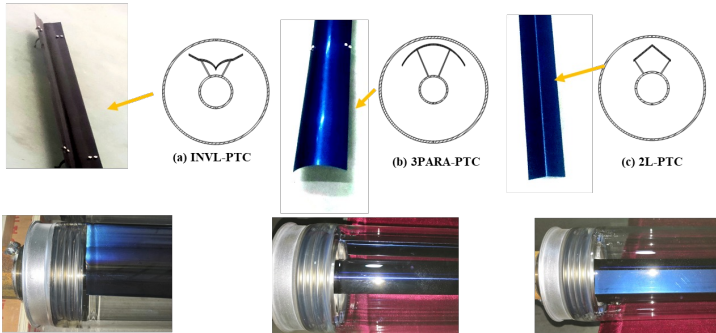
Parabolic Trough Collectors: Improvements

- ## Improvements

**Presenter:** Dr. Dongqiang Lei, Chinese Academy of Sciences
Title: Simultaneously improving concentration ratio and reducing heat loss of large aperture parabolic trough collector using secondary concentrator
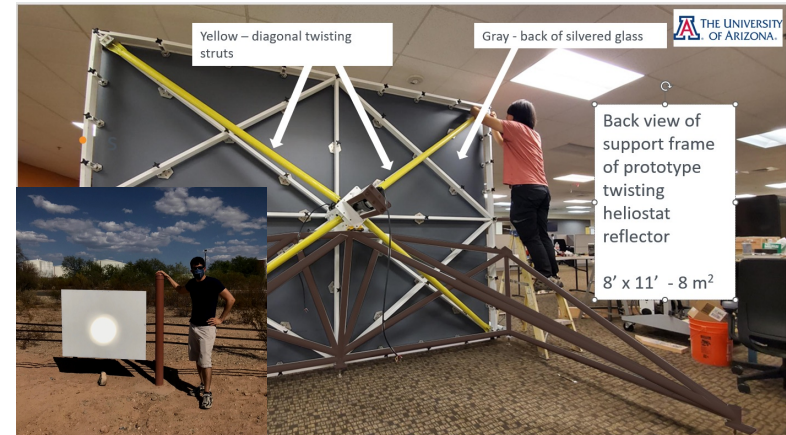

(a) INVL-PTC (b) 3PARA-PTC (c) 2L-PTC

Heliostat Field: Designs

Presenter: Kyle Kattke, SolarDynamics

Title: SunRingTM Heliostat: Minimizing Slope Error with Smart Design and Assembly
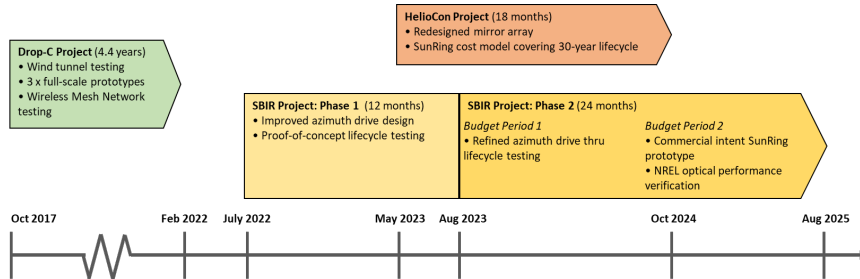
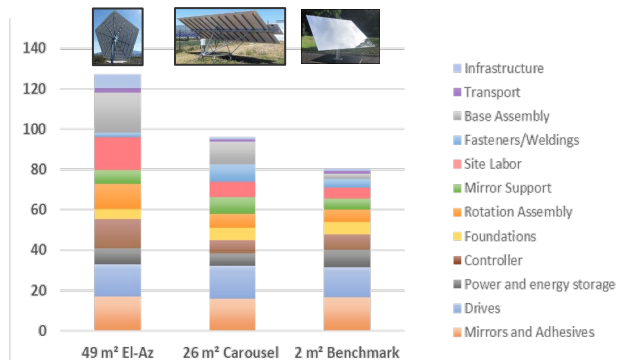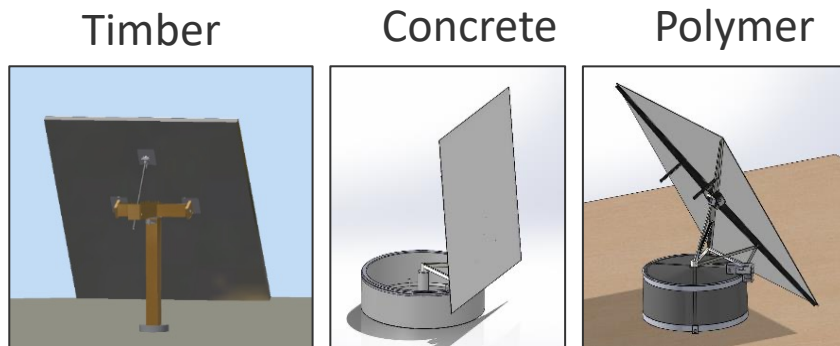**Presenter:** Nick Didato, Univ. of Arizona

Title: Design and Performance of a Heliostat with a Twisting Mechanism to Maintain Focus Through the Day

Heliostats: Designs

Presenter: Andreas Pfahl, DLR

Title: Low-Cost Materials for Heliostats
Cost Comparison of Extensive or Moderate
Use of Timber, Concrete, and Polymers

Timber   Concrete   Polymer


for 1 Mio m² Heliostats Produced

Heliostat & Heliostat Field: Wind Loads

Presenters: Univ. Adelaide, Prof. Maziar Arjomandi; Dr. Matthew Emes
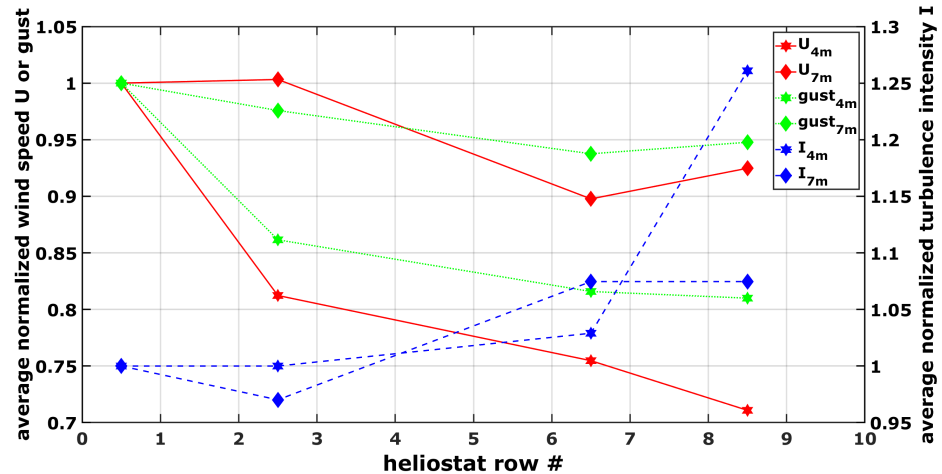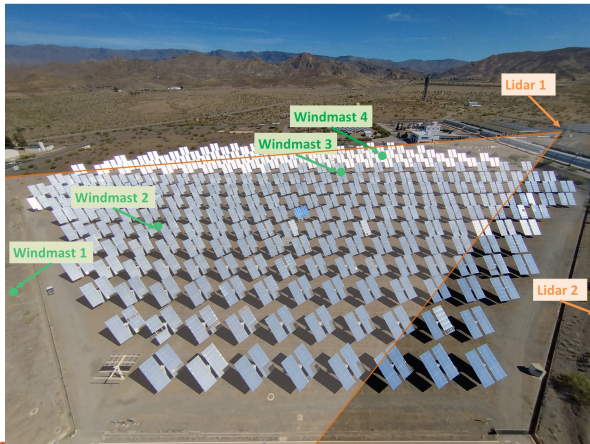
Presentations:

1. Heliostat Wind Load – Decade of Research at the University of Adelaide
   - **Shared 13 Learns learned**
2. Impact of Atmospheric Turbulence on Dynamic Wind Loads on Heliostats
3. Field Measurement and Analysis of Wind Loads on a Single Heliostat at the Atmospheric Boundary Layer Research Facility (ABLRF)
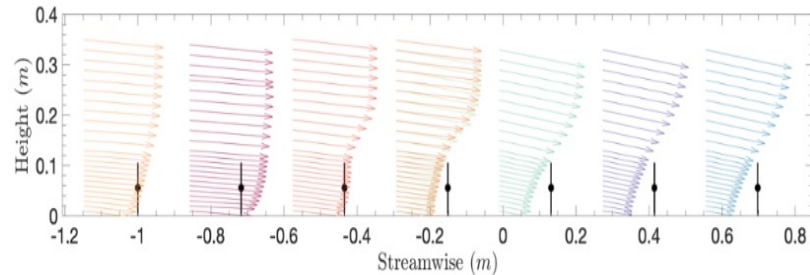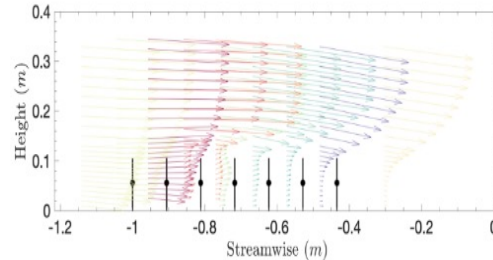
Heliostat Field: Wind Loads

Presenter: Marc Röger, DLR

Title: Long-term Analysis of two-dimensional Aerodynamic Conditions within a Real-Scale Heliostat field

Significant effect of heliostat tracking angles on wind pattern within the field visible

Heliostat: Soiling Characterization

Presenter: Giovanni Picotti, Queensland Univ. of Tech.
Title: Stochastic Assessment of Predictions and Uncertainties for Reflectance Losses Based on Experimental Data for Three Australian Sites

Losses between 0.3%-3% per day reported

Reflectance losses:

- Mount Isa (0.31 pp/day)
- Brisbane (0.77 pp/day).

- **PLEASE JOIN THEM FOR THE SOILING DATABASE!**

![SolarPACES Solar Power & Chemical Energy Systems]

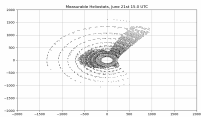# Heliostat: Optical Characterization

Presenter: Rebecca Mitchell, NREL

Title: Non-Intrusive Optics (NIO): Technology for Characterizing Commercial Heliostat Optical Errors

Authors: Masdar Institute Solar Platform, Khalifa University
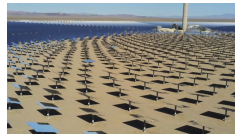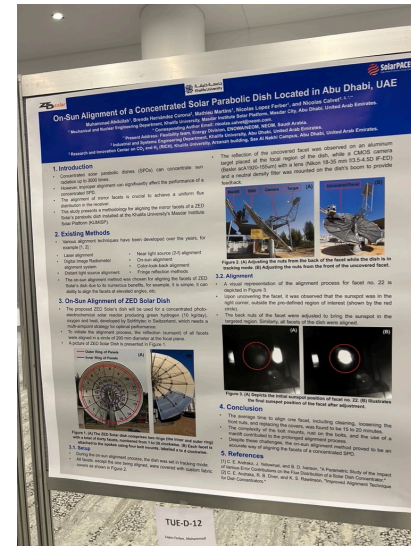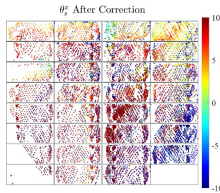
Heliostat: Modeling

Presenter: Rebecca Mitchell, NREL

Title: Modeling Receiver Flux of Commercial Power Tower Concentrating Solar Power Plants Using Ray Tracing: A Round-Robin Comparison of SolTrace, Solstice, and TieSOL
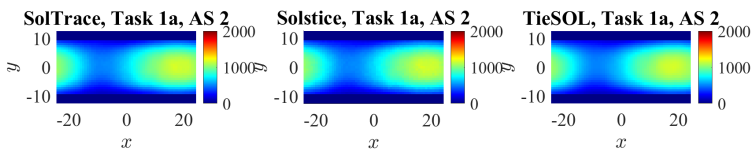
Tool	# of rays	Run time
SolTrace	200M	~15 minutes
Solstice	20M	~10 minutes
TieSOL	**360M**	**4-7 seconds**

Presenter: Michel Izygon, Tietronix Software

Title: Stop Spending Your Time Developing or Using Analytical Methods for Heliostats Flux Density Computation!

- Analytical
  - *SolarPilot*
  - *DELSOL*
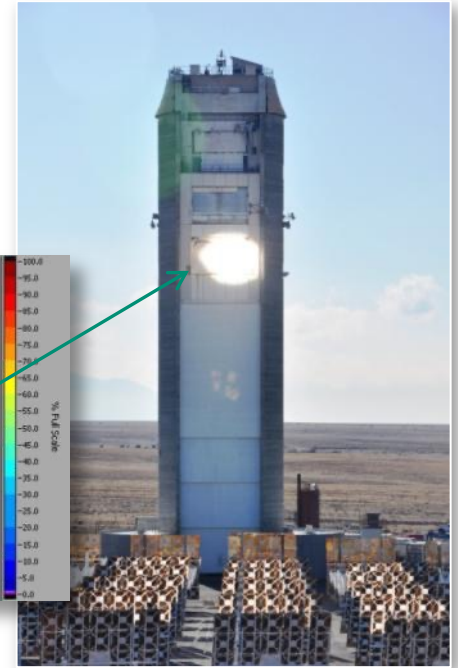 - *Helios*
  - *HFLCAL*
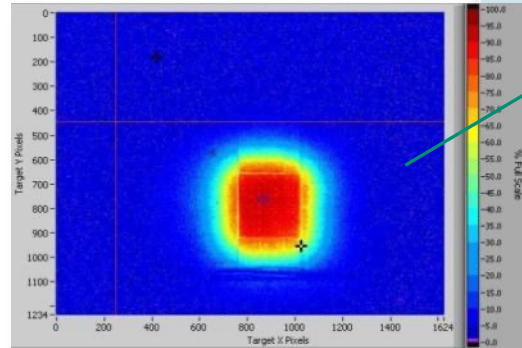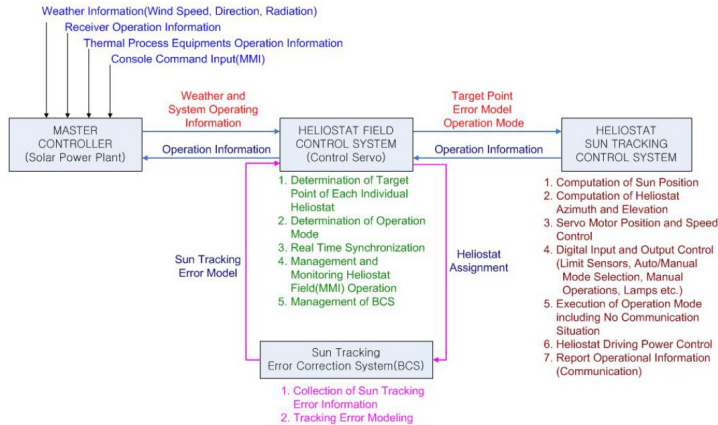 - *...*

- Ray Tracing software
  - *SolTrace*
  - *Solstice*
  - *Tracer*
  - *Tonatiuh*
  - *SBPray*
  - *STRAL*
  - *SPray*
  - *TieSOL: GPU based ray tracing*
  - *...*

Winner

TieSol: Achieved 1Billion rays/second (on RTX 2080 Ti)

Heliostat Field: Control

Presenter: Kenneth M. Armijo, Sandia

Title: NSTTF HelioCon Wireless Closed-Loop Controls Test Bed Development

Heliostat & Heliostat Field: HelioCon Update

Presenter: Guangdong Zhu, NREL

Title: An International Heliostat Consortium (HelioCon): Progress Highlight in 2023

34 Projects in Total

Presenter: Rebecca Mitchell, NREL

Title: Heliostat Consortium: Update on Resource, Training, and Education Development and Women+ in Concentrating Solar
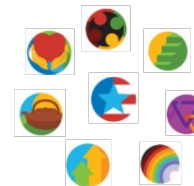
We need to grow our workforce

Education Institute Involvement

Training Resources

Diversity, Equity, and Inclusion

Online Database

Take-Aways: 1

- Heliostat RD dominates the track

- HelioCon is a little bit overselling
    - But hope to encourage more attention to heliostat technologies and solar collectors in general

Take-Aways: 2

Missing Presentations

- ## Start with anxiety

What makes heliostat development so fascinating?

Maybe because it's almost impossible to fulfill the following requirements at once:

- High precession
- High wind loads
- Long live time
- Low maintenance
- Suitable for all solar sites

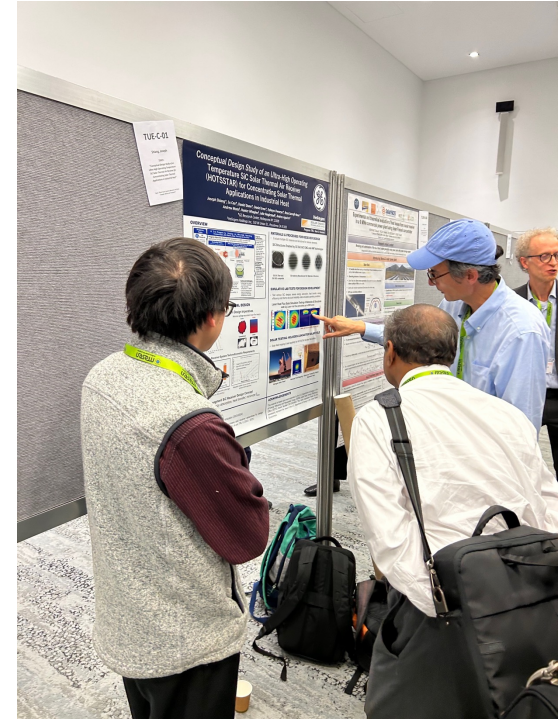**MISSION: IMPOSSIBLE**❓

Let's see!

Take-Aways: 3

- Site characterization are important
  - Soiling
  - Windload
- Will impact heliostat cost, performance, OM optimization, and commercial risks

Take-Aways: 4

- Great participations in the topic

Take-Aways: 5

- Observed commitment, enthusiasm and passions

Ending at: 6:15pm

- 6:15pm

- 6:45pm

Take-Aways: 6

- Steep learning curves on solar collectors research:
  - It is very easy to go wrong when one starts
  - Need a little bit of everything,
    - Optics
    - Metrology
    - Mechanical engineering
    - Chemical engineering
    - Civil engineering
    - System analysis
  - and no one knows everything.

- **There is still hope!**

Posted by Ivan Acosta Pazmino

Thank you!

www.nrel.gov