

# Development of Tools, Training, and Outreach to Address Solar Glare and Flux-Related Avian Impacts

Clifford K. Ho  
ckho@sandia.gov  
Sandia National Laboratories  
SuNLaMP  
1535

BOS - SOFT COSTS

## PROBLEM STATEMENT

Millions of dollars and significant resources are being spent by developers of solar photovoltaic (PV) and concentrating solar power (CSP) systems to address federal and local requirements regarding glare and avian hazards.



Glare from PV system near air-traffic control tower at Manchester-Boston Regional Airport



Hot spots caused by standby heliostat aiming strategies that have been reported to singe birds

MacGillivray Warbler with "Grade 3" solar flux injury found at Ivanpah CSP Plant (Kagan et al., 2014)



## PROJECT OVERVIEW

- ❑ Total Project Funding:
  - \$880,100 (DOE)
  - \$83,602 (cost share)
- ❑ Duration:
  - 2 years (10/1/2015 – 9/30/2017; extended to 6/30/18)
- ❑ Participants:
  - Sandia National Laboratories
  - National Renewable Energy Laboratory
  - Sims Industries
  - NRG

## PROJECT OBJECTIVE

The goal of this work is to reduce soft costs associated with siting, permitting, environmental compliance, and operations and maintenance of utility-scale PV and CSP systems to address solar glare and flux-related avian hazards. These cost reductions are realized through the development and enhancement of tools that mitigate glare and flux hazards and enable compliance with regulatory policies.

## VALUE PROPOSITION

This work will develop tools to characterize and mitigate potential hazards associated with solar glare and avian-flux hazards at PV and CSP plants. These tools will address regulatory policies and reduce costs and efforts associated with the proposed deployment of gigawatts of solar energy systems throughout the nation. The development of standardized and publicly available tools to address these regulatory policies and ensure public and environmental safety is an appropriate role for the government.

## TECHNOLOGY OVERVIEW

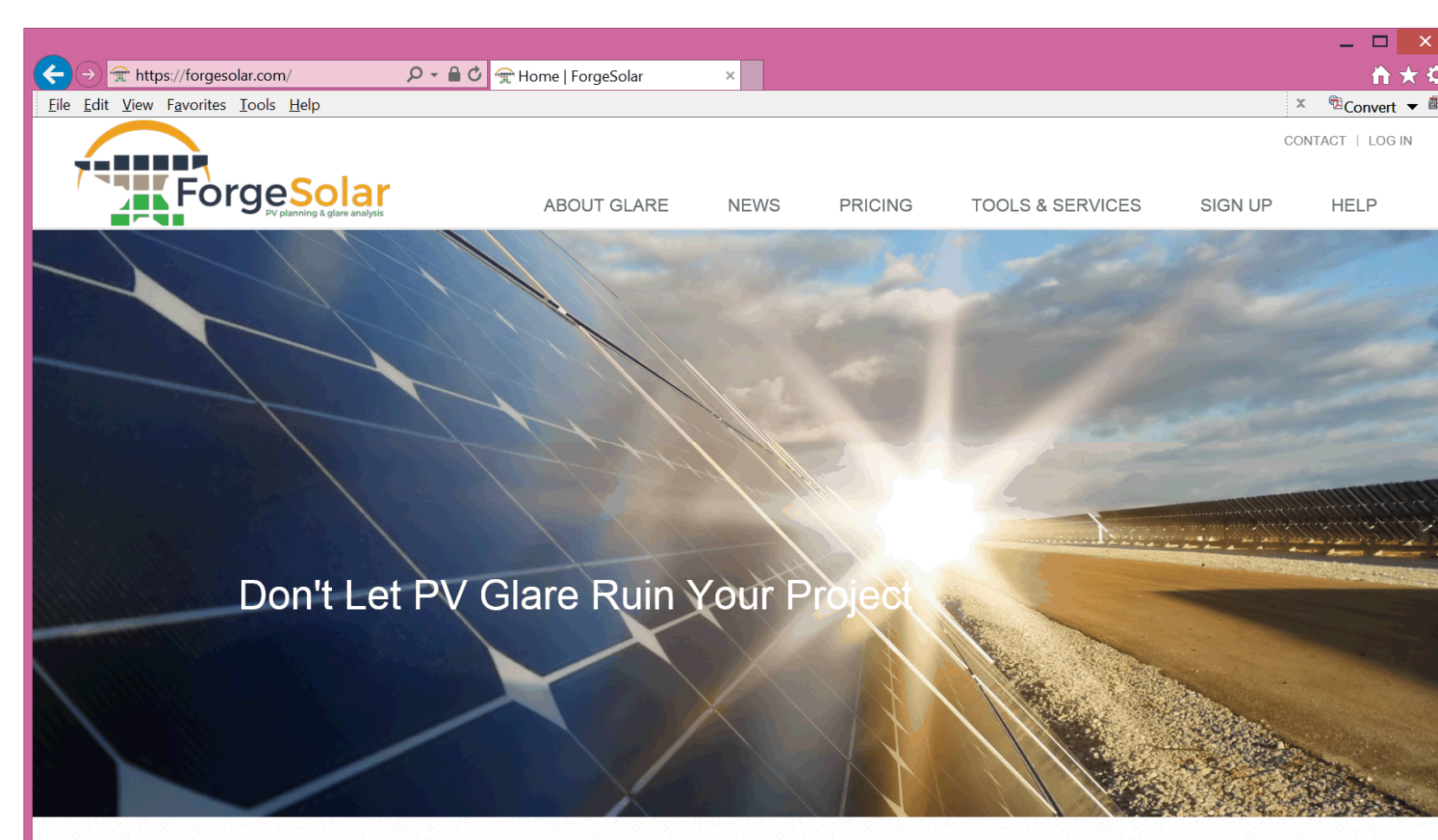
Cost reductions are realized through the development and enhancement of tools that mitigate glare and flux hazards and enable compliance with regulatory policies. Enhancements, training, and technical assistance was provided for the Solar Glare Hazard Analysis Tool (SGHAT), the world's leading software developed by Sandia and SETO to analyze and mitigate glare hazards for proposed photovoltaic plants while maximizing energy production. In addition, the Tower Illuminance Model (TIM) was developed and validated to characterize glare and avian flux hazards at concentrating solar power tower plants.

## MILESTONES

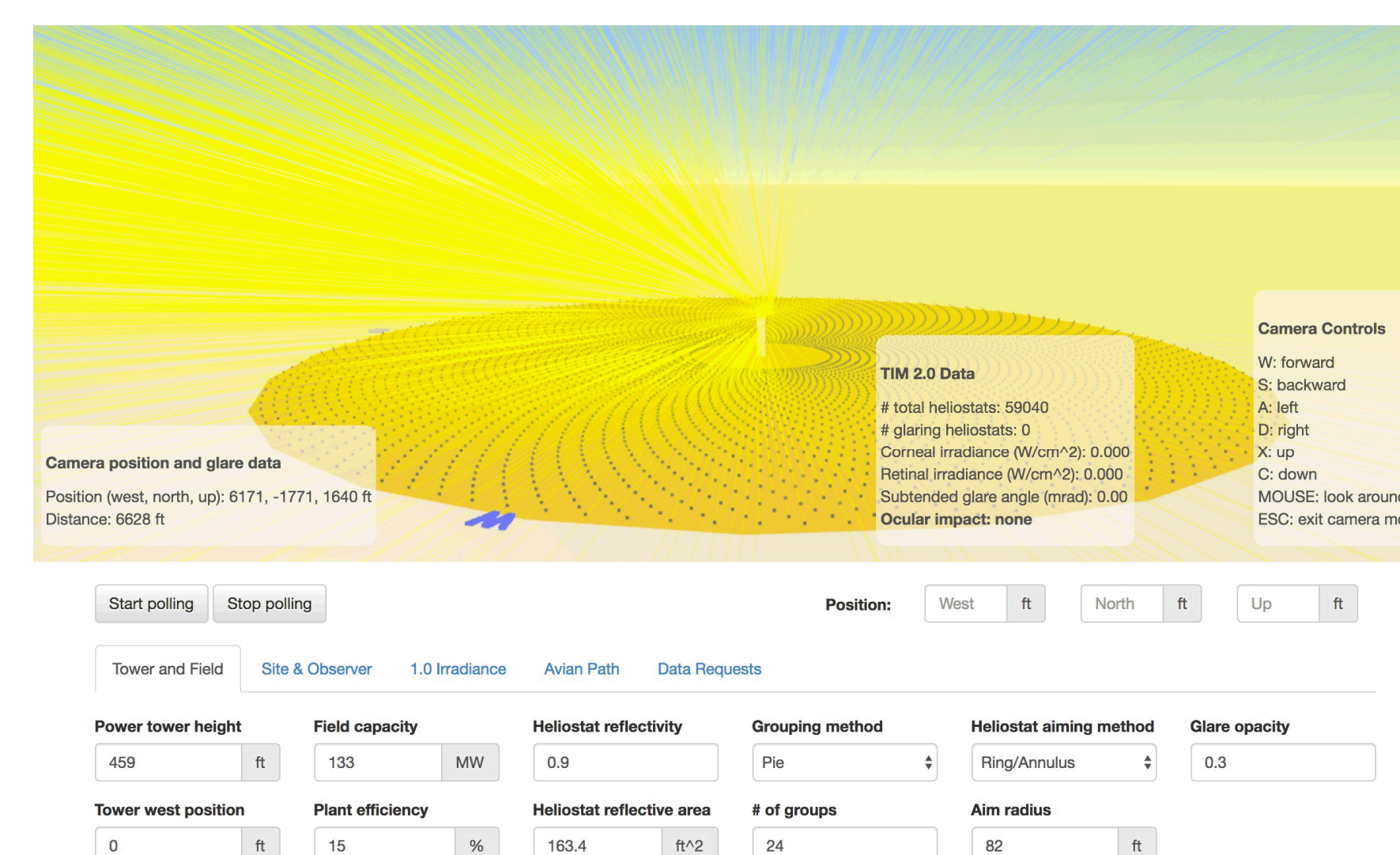
- ❑ Year 1
  - Provide SGHAT technical assistance to >50 MW of proposed PV plants per year in the form of training, direct technical consultation
  - Develop training package for certified SGHAT users and present training to at least 1 conference or seminar per year
- ❑ Year 2
  - Compare TIM to ray tracing tool with parity plot that shows  $R^2 > 0.9$  and  $0.9 \leq \text{Slope} \leq 1.1$ .
  - Validation of TIM with measured irradiances for at least 5 locations around the tower with parity plot that shows  $R^2 > 0.9$  and  $0.9 \leq \text{Slope} \leq 1.1$

## RESULTS

- Development of first methodology to quantify impacts of alternative heliostat aiming strategies on avian flux hazards and plant operational performance
- Development of Tower Illuminance Model (TIM) – the first glare and avian hazard assessment tool for concentrating power tower technologies.
- Benchmarking and validation of TIM with Soltrace raytracing tool
- Copyright assertion of SGHAT v. 4.0 and continued outreach and technical assistance for users of SGHAT
- Licensing of SGHAT to Sims Industries



Successful Tech-to-Market transfer of Solar Glare Hazard Analysis Tool (SGHAT) to commercial industry.



Tower Illuminance Model (TIM) to evaluate glare and avian-flux hazards at solar power tower plants.

## INDUSTRY IMPACT

- ❑ Licensing of SGHAT to industry (Sims Industries)
- ❑ SGHAT used by nearly 5000 users in over 60 countries
- ❑ Current FAA and DoD policy requires use of SGHAT
- ❑ Worked closely with NRG and Brightsource to identify new heliostat standby aiming strategies to reduce glare and avian flux hazards at Ivanpah CSP plant



### Publications

- Ho, C., T. Wendelin, L. Horstman, and J. Yellowhair, 2016, A Method to Assess Flux Hazards and CSP Plants to Reduce Avian Mortality, in SolarPACES 2016, Abu Dhabi, October 11 - 14, 2016.
- Ho, C.K., T. Wendelin, and L. Horstman, 2017, Evaluation of Heliostat Standby Aiming Strategies to Reduce Avian Flux Hazards and Impacts on Operational Performance, Proceedings of the ASME 11th International Conference on Energy Sustainability, 2017.
- Sims, C.A., C.K. Ho, L. Horstman, T. Wendelin, and J.E. Yellowhair, 2017, Tower Illuminance Model (TIM): Interactive Real-Time Flyover Simulation Tool to Evaluate Glare and Avian-Flux Hazards, in SolarPACES 2017, Santiago, Chile, September 26 - 29, 2017.