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

Lead:

- Cliff Ho, PI
- Sandia National Laboratories

Partners:

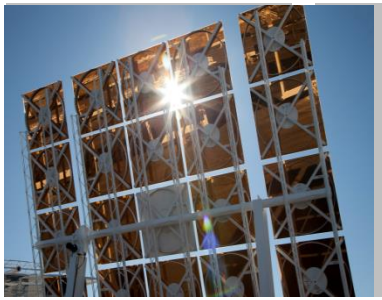
- National Renewable Energy Laboratory
- Sims Industries
- NRG
- DoD, Abengoa Solar

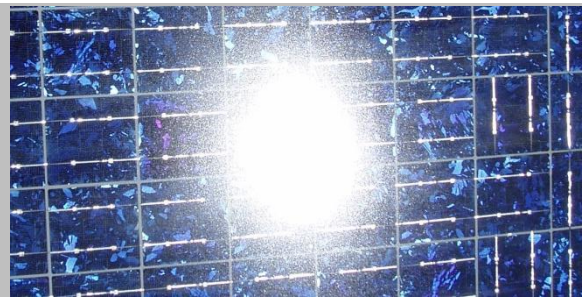
SAND2015-XXXX

SAND2015-4386PE

Exceptional service in the national interest

Sandia National Laboratories





U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

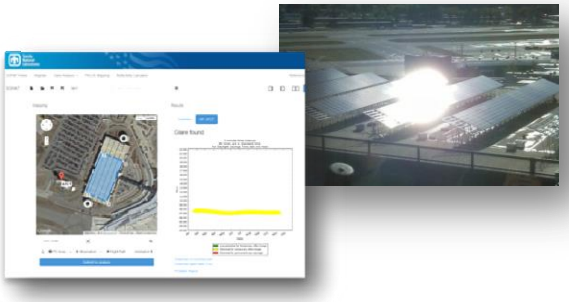
Objectives

- Reduce soft costs and barriers associated with siting, permitting, environmental compliance, and O&M to address glare and avian issues
- Enable greater deployment of both PV and CSP systems by developing tools and standards to address current federal and local policies





Approach



PV Glare Tools

Training & Outreach

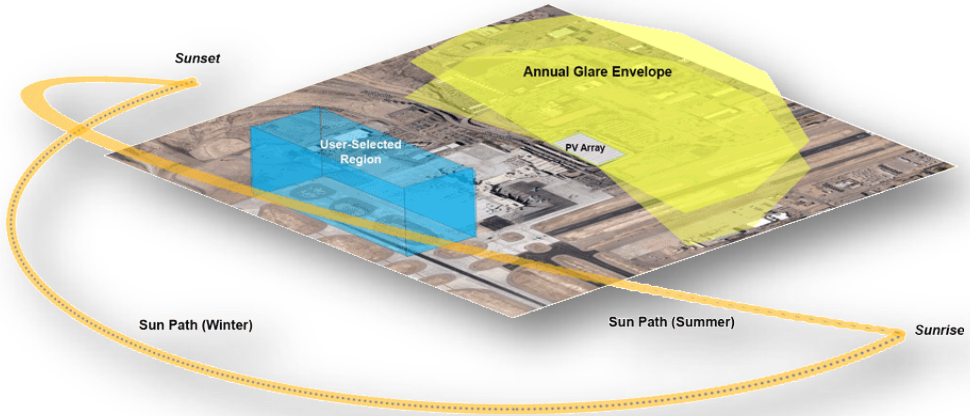
CSP Glare & Avian Flux Tools

Adoption, Commercialization and Increased PV & CSP Deployments

PV Glare Tools

- SGHAT training and development
  - Provide training and technical assistance in the use of SGHAT, which is required by federal policy (78 FR 63276) for glare evaluations
  - Develop enhancements to SGHAT to enable more widespread use and deployments

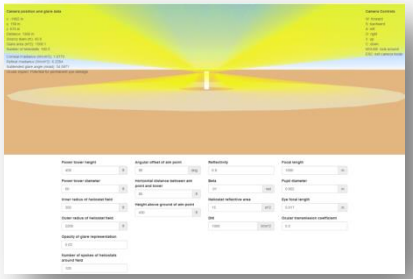
Glare observed from control tower at Manchester-Boston Regional Airport
($3.5M construction; $2M to reconfigure)



Example of 3D block space visualization to represent annual glare envelope around a proposed PV site

CSP Glare & Avian Flux Tools

- Develop tools to quantify flux from heliostat aiming strategies and mitigate impacts of glare and avian hazards
  - Optimize operational performance
  - Perform validation tests at NSTTF



Tower Illuminance Model

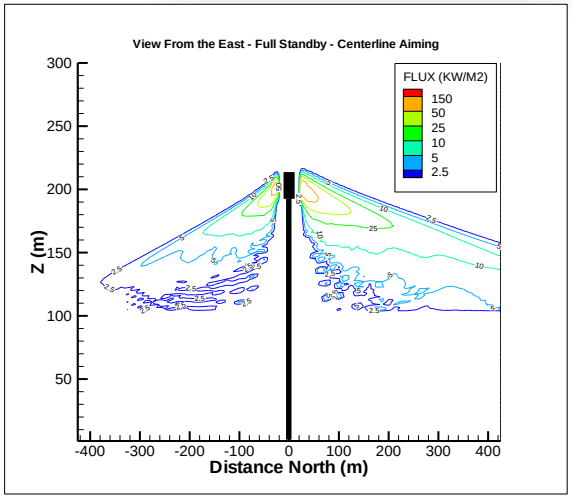


Photo and model of high-flux regions causing solar glare and avian hazards at Ivanpah Solar Electric Generating System

Training, Outreach, Commercialization

Sandia National Laboratories

- Training and Outreach
  - Develop training and certification package for SGHAT
  - Provide technical assistance for PV and CSP tools
  - Engage with federal and local governments and Soft Costs subprograms (Rooftop Solar Challenge, Solar Outreach Partnership, etc.)
- Commercialization and Deployment
  - Work with private industry (e.g., Sims Industries) to commercialize SGHAT
  - Host SGHAT on commercial server for long-term maintenance
  - Licensing, training, and certification will yield revenues
  - Work with NRG and Abengoa Solar to deploy CSP tools

Impact

- Thousands of users rely on SGHAT to comply with federal and local policies
  - Thousands of megawatts of proposed solar deployments
    - Over 100 airports; residential, businesses, 55 countries
  - 3D block space and mosaic tools, training and technical assistance will enable greater use and deployment
- Reduce millions of dollars (per site) dealing with glare and avian issues
  - Manchester-Boston Airport, NRG (Ivanpah), Agengoa Solar (Palen), DoD
- Increase solar deployments while complying with federal and local policies and maximizing energy production

"The hands-on demonstration of the SGHAT process you performed for a proposed solar panel installation by tenants at McCarran International Airport showed how simply modifying a few installation parameters (e.g., panel slope) would result in reduced glare and increased solar energy output... the application of your modeling created a win-win situation for our community."

Best regards,

TERESA R. MOTLEY, AICP
Airport Planning Manager

LAS VEGAS
McCARRAN INTERNATIONAL AIRPORT

January 14, 2014

Value Proposition

We will reduce barriers & soft costs and increase solar deployments by developing new tools, working with federal and local agencies, and training the workforce to mitigate glare and flux-related avian hazards...

while maximizing annual energy production

Questions?

Cliff Ho
(505) 844-2384
ckho@sandia.gov

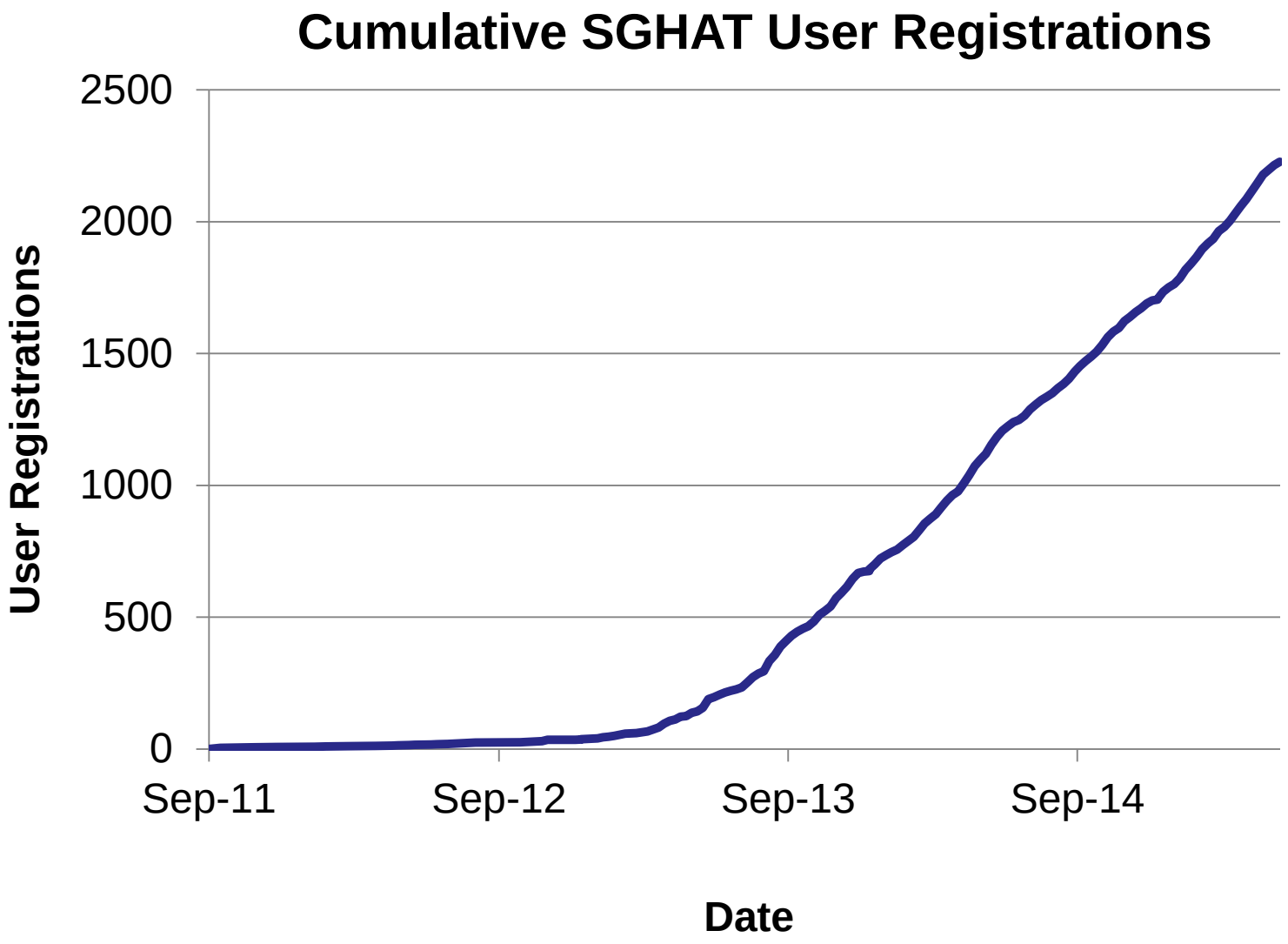
Sandia National Laboratories

Backup Slides

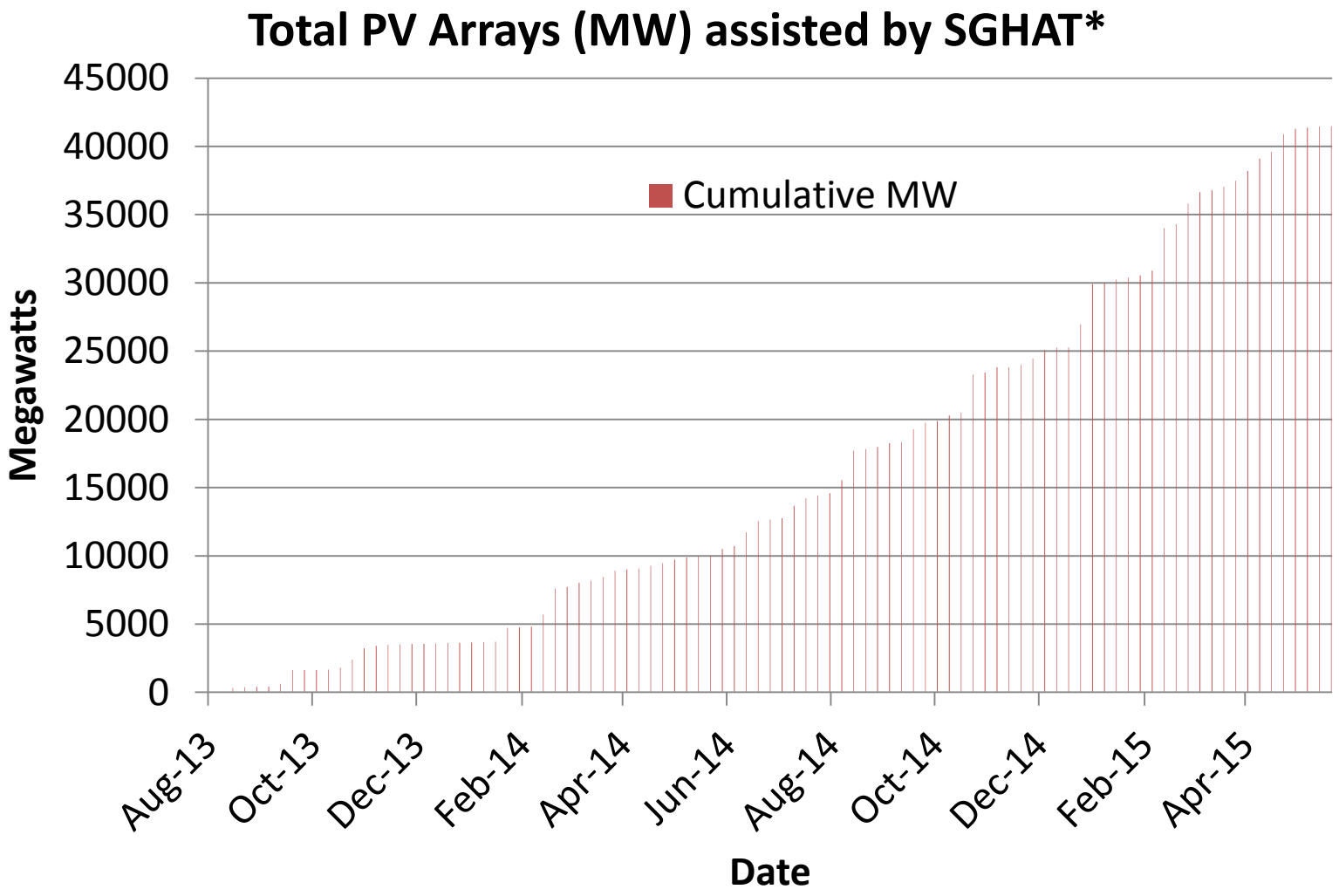
Work Plan

Budget Period	Period Duration	Budget Amount	Tasks
1	12 months	$643,295	Enhancements, training, and technical assistance for SGHAT. Tools and methods to evaluate flux levels for avian safety while maintaining operational performance.
2	12 months	$638,806	Development of mosaic-area siting feature for SGHAT. Validation of flux tools.
3	12 months	$392,883	Industry collaborations and application of tools and outreach.

SGHAT Users

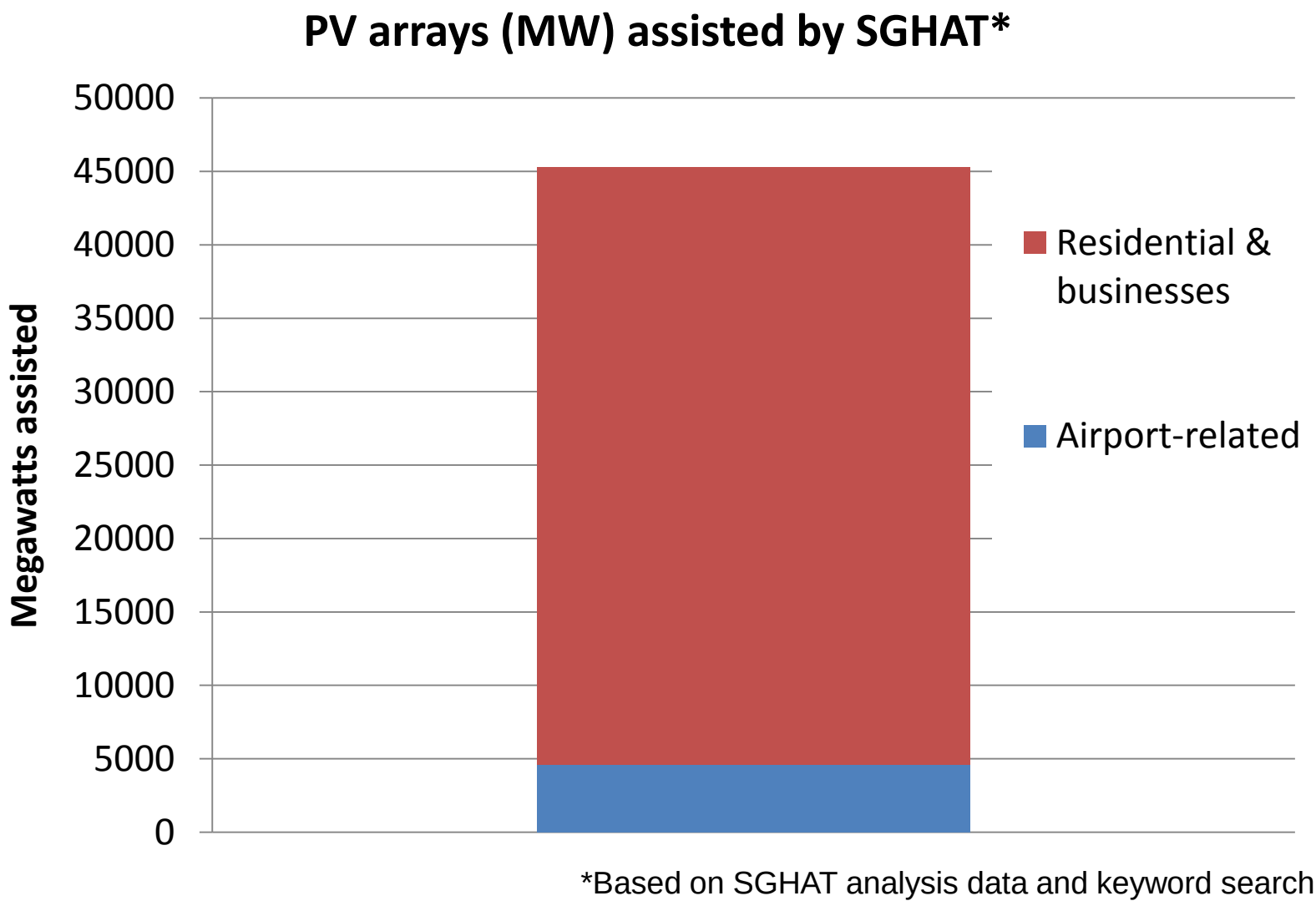

Cumulative SGHAT User Registrations
User Registrations
2500
2000
1500
1000
500
0
Sep-11
Sep-12
Sep-13
Sep-14
Date

SGHAT-enabled proposed PV capacity



*Based on SGHAT analysis data

SGHAT-enabled proposed PV capacity



*Based on SGHAT analysis data and keyword search

Examples of Glare from Solar Technologies

Sandia National Laboratories

Photovoltaics

Concentrating Solar Power

Heliostats and Central Receiver at Sandia Labs, Albuquerque, NM

Dish Collectors at Sandia

Parabolic Trough Collectors at Kramer Junction, CA

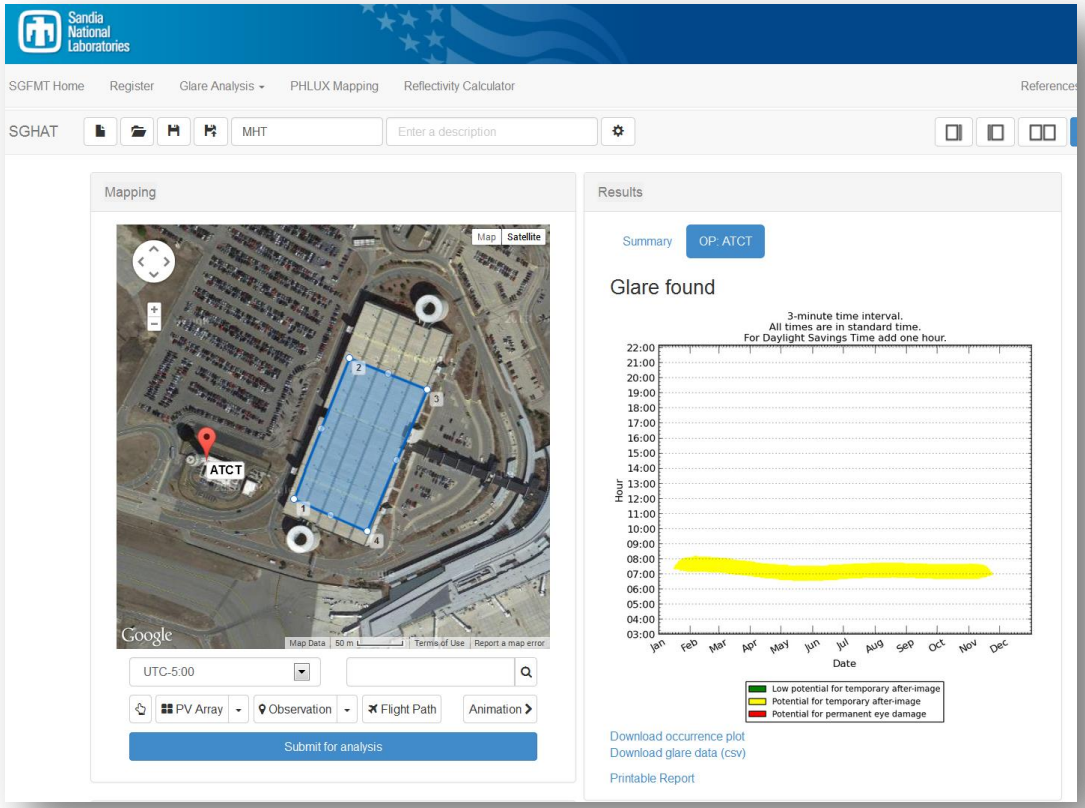
Examples of Glare from Solar Technologies

Glare observations from C-12 cockpit at Kramer Junction, CA
(from Air Force Flight Test Center 412 TW at Edwards AFB, approval #13166)

Glare observed from airport traffic control tower at Manchester-Boston Regional Airport (May 2012). The $3.5M array had to be tarped.

Solar Glare Hazard Analysis Tool

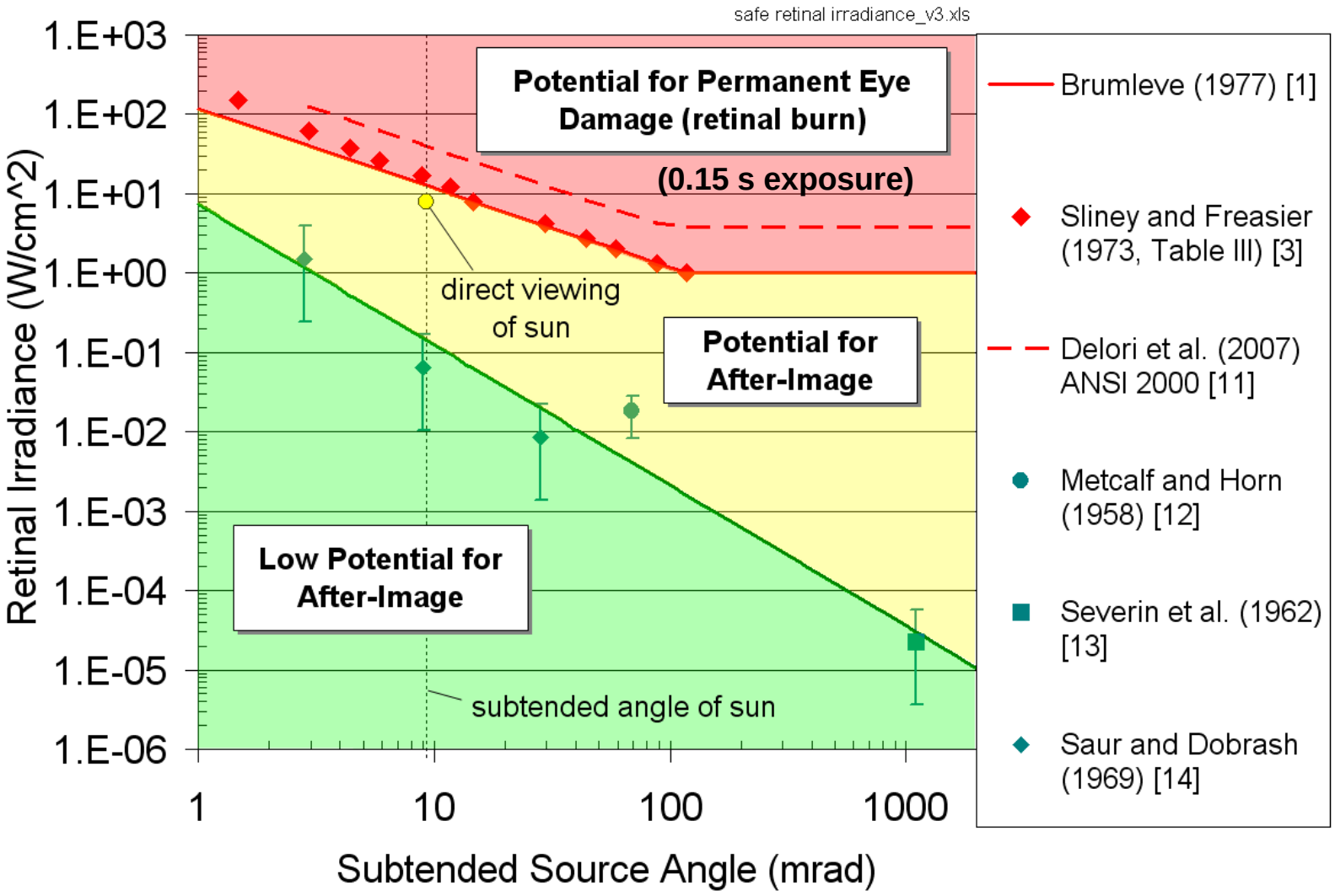
- Free web-based software that predicts impacts of glare and annual energy production from photovoltaic arrays



- Uses interactive Google Maps
- Very fast annual simulations

SGHAT Slides

Potential Ocular Impacts



Equations and analysis methods detailed in Ho et al. (2010, 2011)

SGHAT Impact

- Expected to save millions of dollars in siting, re-siting, and litigation
- Increased public safety

Manchester-Boston Regional Airport will spend ~$2M to reorient their solar panels

Road sign on Massachusetts State Route 2

"This is a superb software tool for a vital and much-needed area of study for the solar industry and for the aviation industry. I think it is comparable to the best that could be offered in the private sector (even though there is nothing in the private sector for this). And it's free! This is the kind of thing that makes me happy to pay my taxes."

~Lyle K. Rawlings, P.E., President & CEO, Advanced Solar Products, Inc.

Acknowledgments

- DOE Solar Technologies Soft Costs Subprogram
- Bill Petrak and Chris Hugunin, FAA
- Sandia Colleagues
  - Cianan Sims, Master's Student/Contractor (Programmer)
  - Julius Yellowhair, Ph.D., SMTS
  - James Yuan, SMTS
  - Evan Bush, Student
  - Andrew Sharp, Student