

PROJECT NAME: Optimized Bifacial PV Systems

Last 5 digits of project number: 34367 / 34910
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BACKGROUND / INDUSTRY IMPACT

- Bifacial PV is the fastest growing new PV technology in the market. Bifacial modules to reach 50% market share by 2029.
- We are developing open-source modeling tools (bifacialvf, SAM, and bifacial_radiance), field performance data, and technical standards.

PROJECT OVERVIEW / OBJECTIVES

- Develop open-source models (e.g., bifacial_radiance, electrical mismatch, etc.) to accurately simulate bifacial PV performance
- Instrument & validate models with field data
- Leverage HPC to optimize bifacial system designs
- Build US and international stakeholder community

METHODS

- Monitor bifacial PV at miniature- and large-scale deployments to validate models and compare cell and module technologies
- Develop optimized single-axis tracking algorithms
- Run numerical optimization studies using HPC
- Define and measure important inputs (e.g., albedo)

KEY OUTCOMES / MILESTONES

- Developed and published model for mismatch derived from non-uniform irradiance on backside.
- Monitoring of bifacial performance (SAT at NREL and SNL, fixed-tilt at SNL, NREL, AK, and Finland)
- Miniaturized bifi SAT testbed at Sandia
- Annual BifiPV Workshops in US and international, New website, Lead for IEA PVPS bifacial PV report
- Bifacial_radiance major releases, GUI, HPC and AWS integration. Multiple software validations.

CONCLUSION / REMAINING RISK

- Project has been very successful in building a US community of practice around bifacial PV.
- We have set the standard for bifacial PV modeling.
- The rapid shift to bifacial PV technology presents risks related to future degradation and failure modes (e.g., glass-glass and/or transparent back-sheets, new cell technologies, different deployment methods, etc.)

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PHOTOVOLTAICS TRACK (System Design and Energy Yield)

This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

Optimizing the performance of bifacial PV systems using open-source models and HPC can lead to new design concepts and lower LCOE.

75kW SAT at NREL for technology comparison (5 bifi & 3 mono)

Albedo comparisons and database for 36+ locations

Bifacial in Alaska

Clear-sky daily power profile from Finland

Electrical Mismatch for Module and Row

Vertical bifacial in Finland

SAT at NREL

100 kW SAT in Oregon

Irradiance non-uniformity

Sensitivity studies on bifi SAT factors influencing annual energy

International Collaboration

Studies investigating "Edge" effects and their influence on performance

SAT at Sandia

BifacialVF bifacial_radiance

Backside irradiation Total backside irradiation

bifacialvf SAM bifacial_radiance

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