Performance Analysis and Ranking of Bifacial Modules

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Why Black & Veatch

Experience

35+ years solar energy development experience with first major assignment for NASA in 1973

Versatility

Completed solar projects for:

- Utilities
- Independent power producers
- Federal, state, and local agencies

Innovation

Constructed solar suite of services:

- Independent assessments of solar technologies
- Solar portfolio reviews
- Due diligence for utility scale projects

What is Ranking Solar PV

Black & Veatch and Renewable Energy Test Center (RETC) are performing the solar industry's first bifacial photovoltaic (PV) module rankings.

- Manufacturers of solar modules tested under this process will receive scores that are then ranked anonymously against other unnamed industry providers.
- Rankings are based on a comprehensive analysis of bifacial solar PV module performance in laboratory and field conditions.

Why Rank Solar PV

- To improve the understanding of current and upcoming commercial bifacial modules, and how thay outperform monofacial PV modules in certain applications.
- Results will serve as a guide for developers, lenders and investors to generate quality-based finance and procurement strategies to ensure long-term project viability.

Program is Growing

- Bifacial PV module manufacturers
- Developers
- Financial institutions
- Tracker manufacturers

Bifacial modules are no longer a niche product. We are seeing increased interest from developers and project stakeholders in bifacial technologies and many module manufacturers are noticing. Advanced testing and results assessment customized for bifacial modules is critically needed to assess long-term bifacial module performance.

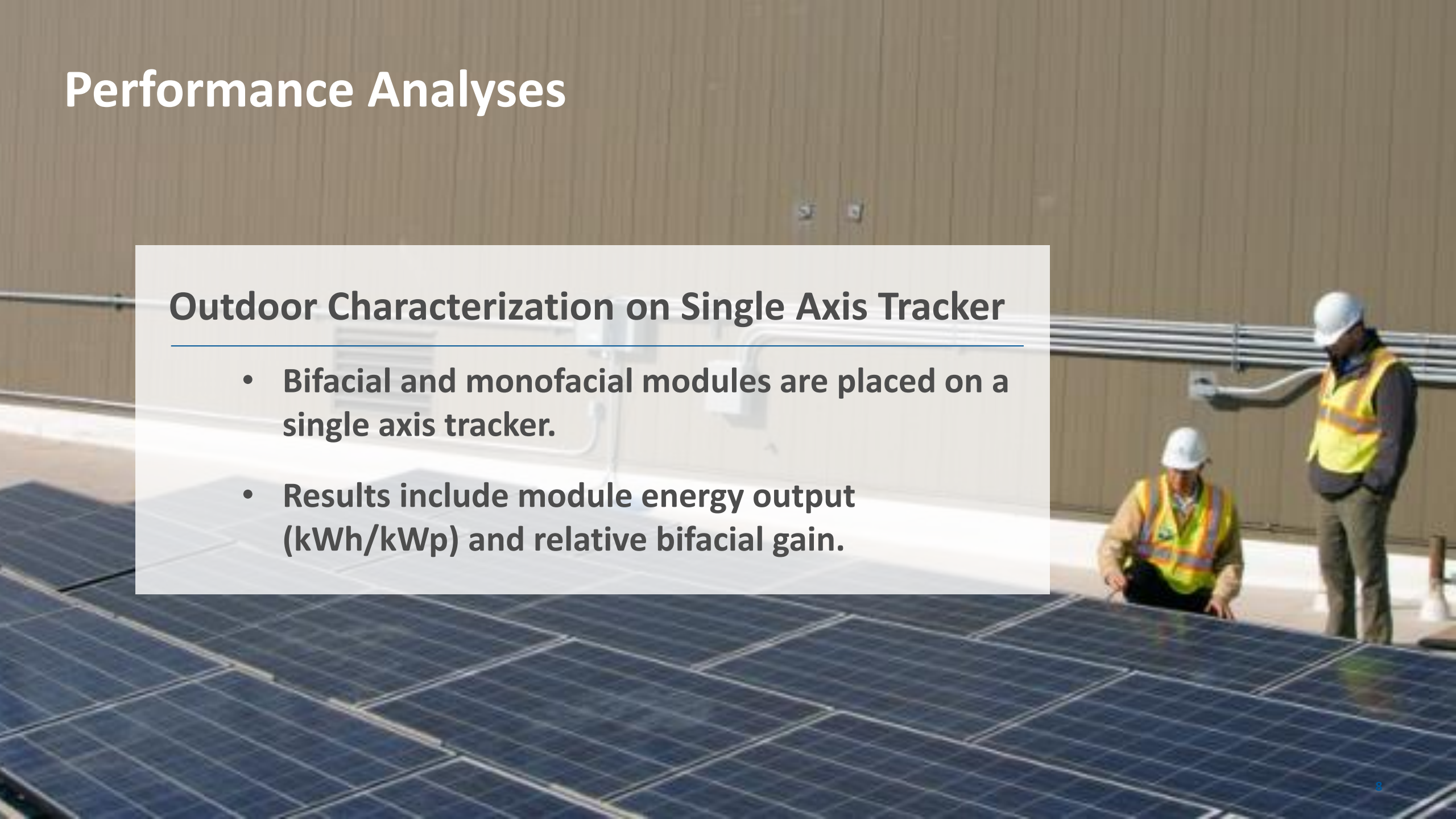
- Cherif Kedir | Executive Vice President, Renewable Energy Test Center

Performance Analyses

Indoor Module Characterization

- Testing of modules by industry performance and energy standards.
- Light-induced degradation (LID)
- Performance-induced degradation (PID)
- Determination of PV Syst inputs for performance modeling

Performance Analyses



Outdoor Characterization on Single Axis Tracker

- Bifacial and monofacial modules are placed on a single axis tracker.
- Results include module energy output (kWh/kWp) and relative bifacial gain.

Performance Analyses

Outdoor/Commercial Characterization at Fixed Tilt

- Bifacial and monofacial modules will be placed outdoors, at a fixed tilt and height.
- Three albedo types are used.
- Results include energy output (kWh/kWp) versus albedo and relative bifacial gain.

Performance Analyses

Extended Outdoor Characterization

- String of bifacial modules are placed outdoors at a fixed tilt and height in a hot desert climate for at least one year.
- Racking system will be optimized for bifacial modules and the modules will be connected to an inverter.
- Individual modules will be equipped with module level electronics to ensure maximum power point operation.
- Results will include energy output (kWh/kWp) and relative bifacial gain.

BUILDING A WORLD OF DIFFERENCE

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