Background: Since summer 2018, European Energy A/S and DTU have measured the performance of bifacial PV strings mounted on trackers and fixed tilt systems located in Northern Europe (55.6°N, 12.1°E). A new publically funded project is underway with the intent to evaluate in-house and commercially available bifacial PV performance models. The facilities include several sub-systems where the conditions known to affect bifacial performance are varied including tracker spacing (GCR), albedo (ρ) and module tilt (β).

Equipment and Layout
• Monofacial and bifacial strings of similar front side power mounted side-by-side.
• Horizontal East-West (HSAT) trackers (x8) and south facing 2V racks with adjustable tilt angle (x8).
• Tilted single axis trackers (x2) and dual axis tracker (x1).
• Multiple ground covers under test:
  • Seasonal grass
  • Coarse sand
  • Medium-size gravel
  • White polymeric tarp
  • μ-structured reflector
• Spectrally resolved reflectance can be measured in the DTU Fototik laboratories.

Sensors and Detailed Monitoring

Max-power current (I_{max}) and voltage (V_{max}) measurements on 64 individual strings.

Performance Modeling
We are using the onsite meteorological data as inputs to bifacial PV models. The model's output is then compared to our electrical measurements. View factor models under consideration currently include MoBiDIG (ISC Konstanz), PVsyst, and SAM. Ray trace models currently being tested include Zemax and Radiance.

Model Assumptions

Obtain Model Outputs
• DC+AC power
• Transposed irradiance
• Cell temperature (Tcell)

Compare to Field Measurements
• DC+AC power
• Plane of array irradiance (front and rear)
• Tcell (currently only mono-f)

Click to expand the diagram.

Modeling using: Zemax, PVsyst, and SAM. Ray trace models currently being tested include Zemax and Radiance.

Obtain Model Outputs
• DC+AC power
• Transposed irradiance
• Cell temperature (Tcell)

Compare to Field Measurements
• DC+AC power
• Plane of array irradiance (front and rear)
• Tcell (currently only mono-f)

Click to expand the diagram.

Spectrally resolved reflectance can be measured in the DTU Fototik laboratories.

Acknowledgements
The work is supported by the Danish Energy Technology Development and Demonstration Program (EUDP) under project contract 64018-0604A which is gratefully acknowledged. We are also grateful for European Energy's financial support for most of the capital equipment at the facility.

Partners

EUROPEAN ENERGY
ISC International Solar Energy Research Center Konstanz
www.solartrackercontroller.com

DTU Fototik, Roskilde, 4000, Denmark; 2Startak, Hvidovre, 2650, Denmark;
3ISC Konstanz, Konstanz, 78467, Germany; 4European Energy A/S, Søborg, 2860, Denmark