FACT SHEET

Bifacial Tracking

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Bifacial Tracking

Energy production of photovoltaic (PV) modules can be increased not only by solar cells that are more efficient but also by innovative system concepts.

**Bifacial PV modules:**
New cell designs allow light to reach the cell from the rear side with efficiencies from 60% to over 90% compared to the front side.

**Tracking Systems:**
Single (1T)- and dual (2T)-axis tracking systems adapt the orientation of PV modules to track the sun’s position, minimizing sunlight angle incidence on PV modules.

A combination of bifacial modules with single-axis trackers produces the cheapest electricity, by significantly boosting energy production (35% more than conventional systems).

Bifacial tracking systems have the lowest LCOE (Levelized Cost of Electricity) for >90% of the world. The LCOE is 16% lower than conventional systems.

Market development

Bifacial photovoltaic cells and modules are rapidly overtaking the market share of monofacial PV technologies. Trackers (notably single-axis trackers) are also growing in market share over time.

see Fischer et al., "International Technology Roadmap for Photovoltaics: 2022 Results". 2023 Edition
Market trends and drivers

- **Prices depend on**: design factors, terrain topology, steel prices.
  - SAT systems can increase annual yields by ~20% over fixed-tilt systems.
  - Developers value **reliable delivery schedule** as well as **availability of equipment** and are willing to pay more.

- **Supply chain issues** and **market prices** are important (i.e. steel - using local providers can offset cost and carbon emissions).

- Companies are focusing on **certain market sectors** (e.g., dual-uses for AgriPV, deployment on non-agricultural or usable land, highly sloped terrains). **Divergent perspectives on land-use and value.**

Tracker overview

<table>
<thead>
<tr>
<th>Mounting Options</th>
<th>Installation Methods</th>
<th>Movement drivers</th>
<th>Certifications</th>
<th>Algorithms</th>
<th>Extreme weather response methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-up</td>
<td>driven piles</td>
<td>central motor</td>
<td>wind</td>
<td>Backtracking</td>
<td>Tracker controller responds to wind, hail, and snow sensors or warnings and adjusts tilt angle to reduce risk to modules</td>
</tr>
<tr>
<td>2-up</td>
<td>piles in concrete</td>
<td>independent architecture</td>
<td>hail</td>
<td>Optimization</td>
<td></td>
</tr>
<tr>
<td>tilted</td>
<td>others (slip-formed; screw)</td>
<td></td>
<td>reliability</td>
<td>Slope-awareness</td>
<td></td>
</tr>
<tr>
<td>2-axis</td>
<td></td>
<td></td>
<td></td>
<td>Cleaning</td>
<td></td>
</tr>
<tr>
<td>2-axis novels</td>
<td></td>
<td></td>
<td></td>
<td>Safety</td>
<td></td>
</tr>
</tbody>
</table>

**Lengths of the tracker**

- < 80 m
- 80 m ~ 120 m
- > 120 m

IEA PVPS Task 13 obtained Data from interviews with 17 tracker companies (>87% of global market share from 2012-2021) and review of the 2022 Wood Mackenzie Global Solar PV Tracker report.

Tracker companies are international:

- 70% of companies have been in business for at least 10 years.
- ~50% of companies sell trackers in more than 20 countries.
- >80% of companies sell in more than 10 countries.
**System designs for optimal yield and value**

**Backtracking:**
As shading between panels starts to occur, the tracking angle no longer follows the sun's path but, instead, adjusts backward (decreases) to prevent shading.
All tracker companies surveyed offer backtracking.

**Complex terrain** presents challenges for certain tracker designs.
- Slope changes in the direction normal to the rows requires adjustment to each row's tilt angle.
- Slope changes parallel to rows requires flexible couplings on the torque tubes.

**Certain weather conditions** require rapid adjustment:
- Tracker controllers receive signal from wind (or sometimes hail) sensors dispersed in the field.
- Tilt adjustments to protect systems and modules
  - Maximum tilt – e.g., hail or snow
  - Horizontal position - in the case of wind gusts to reduce the sail effect.

**Performance modelling and yield assessment**

The IEA PVPS Task 13 (Activity 2.3) working group is currently conducting a study of best practices for bifacial PV tracking systems. As part of this activity, we are organizing a blind PV performance modeling study to compare different modeling tools and their performance predictions for varying system design parameters. Participants have been asked to simulate a set of six imaginary PV systems for which the system design and weather data have been provided.

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**Scenario definition for modelling in comparison**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>GCR</th>
<th>Albedo</th>
<th>Hub Height</th>
<th>Module Configuration</th>
<th>Ground Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0.4</td>
<td>0.2</td>
<td>1.5 m</td>
<td>1-Up portrait</td>
<td>Horizontal</td>
</tr>
<tr>
<td>S2</td>
<td>0.25</td>
<td>0.2</td>
<td>1.5 m</td>
<td>1-Up-portrait</td>
<td>Horizontal</td>
</tr>
<tr>
<td>S3</td>
<td>0.4</td>
<td>0.5</td>
<td>1.5 m</td>
<td>1-Up-portrait</td>
<td>Horizontal</td>
</tr>
<tr>
<td>S4</td>
<td>0.4</td>
<td>0.2</td>
<td>3.5 m</td>
<td>1-Up portrait</td>
<td>Horizontal</td>
</tr>
<tr>
<td>S5</td>
<td>0.4</td>
<td>0.2</td>
<td>1.5 m</td>
<td>1-Up portrait</td>
<td>10% grade down to the East</td>
</tr>
<tr>
<td>S6</td>
<td>0.4</td>
<td>0.2</td>
<td>1.5 m</td>
<td>1-Up portrait</td>
<td>10% grade down to the SW</td>
</tr>
</tbody>
</table>
Task 13 Objectives are to:

- Provide a **common platform** to summarize and report on technical aspects affecting the **quality, performance, and reliability of PV modules and systems** in a wide variety of environments and applications.

- Gather **modelled and measured data from different PV systems** from around the world. This will include summaries of different practices from each country, experiences with a variety of PV technologies and system designs.

- Disseminate Task 13 results and **communicate to our stakeholders** in a number of impactful ways including reports, workshops, webinars, and web content.

Sub Tasks:
1. Reliability of Novel PV Materials, Components, and Modules
2. Performance and Durability of PV Applications
3. Techno-Economic Key Performance Indicators
Bibliography


