Integrating bifacial - New system design and bespoke products

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PV Info Link

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NEXTtracker
Swan Bifacial Module
Short Introduction of JKS

- **Shipments**: #1
- **Delivered**: 48GW
- **Market Share**: 12.8%
- **Cell Efficiency Record**: 24.58%
- **Bankability**: #1

7 Global Factories | 34 Sales Offices | 80+ countries where Modules are delivered | 15,000+ Employees

Data source: By the end of 2019
## JKS Product Portfolio 2020

<table>
<thead>
<tr>
<th>Model</th>
<th>Technology</th>
<th>BBs</th>
<th>Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cheetah FC</strong></td>
<td>Mono PERC Full Cell</td>
<td>5BB</td>
<td>Up to 400 Wp</td>
</tr>
<tr>
<td><strong>Cheetah HC</strong></td>
<td>Mono PERC Half Cell</td>
<td>5BB</td>
<td>Up to 410 Wp</td>
</tr>
<tr>
<td><strong>Swan Bifacial DG</strong></td>
<td>Mono PERC Half Cell</td>
<td>5BB</td>
<td>Bifacial Dual Glass</td>
</tr>
<tr>
<td><strong>Swan Bifacial TB</strong></td>
<td>Mono PERC Half Cell</td>
<td>5BB</td>
<td>Transparent Backsheet</td>
</tr>
<tr>
<td><strong>Tiger Monofacial</strong></td>
<td>Mono PERC Half Cell</td>
<td>9BB</td>
<td>Up to 470 Wp</td>
</tr>
<tr>
<td><strong>Tiger Bifacial TB</strong></td>
<td>Mono PERC Half Cell</td>
<td>9BB</td>
<td>Transparent Backsheet</td>
</tr>
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</table>
2020 flagship product – Tiger series

- EPC cost can decrease by 1.1%+ compared to that of 430W large cell PERC modules
- Land cost can decrease by 6.9%+ compared to that of 430W large cell PERC modules
- Electricity generation can increase by 1.6%+ compared to that of 5BB HC modules

**Tiger Monofacial**

**Tiger Bifacial**

Transparent Sheet

- **Tiling ribbon**: Eliminate cell gap to increase module efficiency
- **Half cell technology**: improve shading tolerance
- **Nine bus bars**: decrease power loss
- **Electricity generation from the rear side (bifacial products)**: higher IRR
- **Less Weight**: Weight of bifacial products close to that of monofacial modules
- **Tedlar transparent sheet (bifacial products)**: easy to clean

**Key Benefits**

- EPC cost can decrease by 1.1%+ compared to that of 430W large cell PERC modules
- Land cost can decrease by 6.9%+ compared to that of 430W large cell PERC modules
- Electricity generation can increase by 1.6%+ compared to that of 5BB HC modules
JKS Swan Bifacial Features

158.75 mm cell dimension

Front side max power 415 Wp

Bifacial Power 500+ Total Watt

25% Lighter Compared to DG

30 Years Linear Power Warranty

Rear side: plus 5-25% Power Gain

Reduces BOS Cost by 3%
Reduces O&M Cost by 5%
Reliability of Modules with Tedlar® backsheets

35+ Years Field Proven Records of Modules with Tedlar® Backsheets

- SUPSI Switzerland 1982
  0.4% annual degradation

- Nara, Japan 1983
  0.2% annual degradation

- Sacramento, US 1984
  0.9% annual degradation

- Guangzhou, China 1985
  0.4% annual degradation

- Mont Soleil, Switzerland 1992
  0.3% annual degradation

- Beijing, China 1999
  0.7% annual degradation

Courtesy of DuPont
Energy Generation

Clear Tedlar® backsheets or Dual glass --- Energy Generation

Energy gain of SWAN TV compared with SWAN BDVP

<table>
<thead>
<tr>
<th></th>
<th>Bifacial DG</th>
<th>Bifacial TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand-Fix installation</td>
<td>0.85%</td>
<td></td>
</tr>
<tr>
<td>Sand-Tracker</td>
<td></td>
<td>1.62%</td>
</tr>
<tr>
<td>Cement-Fix installation (p type)</td>
<td></td>
<td>1.81%</td>
</tr>
<tr>
<td>Cement-Fix installation (n type)</td>
<td></td>
<td>1.85%</td>
</tr>
</tbody>
</table>

Location: Haining, China

- Bifacial with Clear Tedlar® backsheet in four different kinds of field test shows 0.85%~1.85% higher energy generation compared with bifacial modules with dual glass.
Heat Dissipation

Illustration of Heat Dissipation of PV Module

• Glass becomes opaque at wavelength longer than approximately 3 \( \mu m \).

• Clear Tedlar® film in the infrared spectrum is transparent to the heat dissipation of solar cells from the back of the bifacial module.

SWAN TV has lower operating temperature.
UV Protection

- UV light transmittance of Clear Tedlar® backsheet is less than 1%, compared to 40%-50% of glass
- UV rays degrade the high-transmittance POE encapsulant and PV cells on the module rear side
- Thus bifacial DG shows 50% higher rear-side power degradation after UV exposure compared to bifacial TV
- Bifacial module with clear Tedlar® backsheet shows better reliability in high UV environment
Corrosion Resistance to Saline and Alkali

- Glass might be slowly corroded and its light transmittance reduces during long-term operation in saline/alkali environment (seaside/greenhouse/saline-alkali soil), which leads to reduced back-side power
- Clear Tedlar® backsheet has good corrosion resistance to salt and alkali, thus bifacial TV has lower risk of power degradation
O&M: Anti-soiling and Easy-cleaning

The hydrophobic surface of clear Tedlar® film offers excellent anti-staining features, making cleaning of the modules easier.

Bifacial with dual glass:
There are dirt and mud spots which is not easy to clean.

Bifacial with transparent backsheets:
There is no obvious dirt, and very little dust in the middle area.

Soiling rate of the rear side is only 11.3% of the front side (Field test result in Chile)

The frequency of bifacial rear-side cleaning is much lower than the front side.
Installation and Maintenance Convenience

Bifacial modules with clear Tedlar® backsheet can save:

- 15% mounting construction costs
- 20% labor costs, related to module installation
Installation Design: Angle & Height

Install tilt Angle:
1. Latitude: 30°(N)~30°(S)  \( \theta = 30° \)
2. Latitude: >30°(N or S)  \( \theta = \text{latitude} \)

Mounting Height:
- **1.2 m** is recommended for fixed racks and **1.5 m** for trackers
  - <1.2 m  →  Decreasing rear side energy generation gain
  - >1.2 m  →  Increasing mounting construction cost
Installation Design: Fixed tilt or Tracking

Energy Gain (%)  
Simulated, albedo 0.35  
Location: Haining, China

<table>
<thead>
<tr>
<th>Design Type</th>
<th>Energy Gain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monofacial-fix</td>
<td>9.6%</td>
</tr>
<tr>
<td>Monofacial-tracker</td>
<td>10.4%</td>
</tr>
<tr>
<td>Bifacial-fix</td>
<td>22.6%</td>
</tr>
</tbody>
</table>

Benchmark
Swan bifacial with clear Tedlar® backsheet showed average bifacial gain of **10.22%**, while bifacial with dual glass showed average bifacial gain of **9.37%**.

Swan bifacial with clear Tedlar® backsheet generated **0.85% more energy** compared with bifacial with dual glass.
Compared with bifacial with dual glass, bifacial with clear Tedlar® backsheet generate 1.62% more energy.
Summary

<table>
<thead>
<tr>
<th>Type</th>
<th>Bifacial with Clear Tedlar® Backsheet</th>
<th>Bifacial with Dual Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended application area</td>
<td>1. On-ground PV station</td>
<td>Most on-ground PV station, except areas with hail weather, strong UV rays, saline-alkali corrosion</td>
</tr>
<tr>
<td></td>
<td>2. High labor cost regions, like EU, Japan, Australia (light weight module can effectively reduce labor cost)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Commercial roof-top project</td>
<td></td>
</tr>
</tbody>
</table>

- Light Weight
- Resistance to Hot and Humidity
- UV Protection, Resistance to Saline-Alkali
- Mechanical Properties, Hail Resistance
- Easy to Clean
- Power Generation

Bifacial with Clear Tedlar® Backsheet
Bifacial with Dual Glass
Thank you!