HEVEL Solar

Unfolding Russian Solar Potential

First International workshop of RUSTEC
November 15-19, 2010
Arizona State University

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Head of Project Integration
What is Hevel Solar?

• US$ 24.77bn
• Power sector
• Oil (TNK-BP)
• Aluminium
• Other

51%

Motivation
• Power sector
• Solar
• TF Silicon / Oerlikon Solar
• Russian market

49%

Motivation
• US$ 5 bn
• Know-how
• Technology development

• Nanotechnology
• Strategic investments
• Know How/Russian R&D

VISION: Be the leading supplier for the Russian and certain solar markets with Thin Film Silicon technology
## Production facility

<table>
<thead>
<tr>
<th>Location</th>
<th>Novocheboksarsk, Chuvash Republic, Russia, 500 km from Moscow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility area</td>
<td>28,000 sq. m.</td>
</tr>
<tr>
<td>Product</td>
<td>125 Wp TF silicon PV modules</td>
</tr>
<tr>
<td>Production capacity</td>
<td>130 MWp per year</td>
</tr>
<tr>
<td>Equipment</td>
<td>New-gen Oerlikon micromorph® turnkey FAB</td>
</tr>
</tbody>
</table>

- **construction starts**  
  Q2 2010
- **production starts**  
  December 2011
- **end of ramp-up**  
  July 2012
R&D center

• More than 1,000 researchers
• Over 90 years of leadership in science (since 1918)
• Worldwide recognition in scientific research

Main R&D directions

• Reduction in production costs
  • Thorough testing of materials and consumables (gases, glasses, junction boxes etc.) of different suppliers
  • Increase of throughput by increasing deposition rates and decreasing Si layer thickness
• Nanostructured Si materials (pm-Si or pc-Si) for the top cell
• Intermediate reflector between top and bottom cells = reduction of top cell thickness
  • Creates better stability
• Application of Ge alloys in modules with triple structure
  • using of lower band gap Ge alloys result in higher absorption
• R&D collaboration
  • Searching for partners to implement YOUR ideas
New-gen product

Micromorph®
PV modules

Nominal peak power \( P_{\text{mpp}} \)

- 125 Wp
  - for 1.4 sq. m.

Length 1,300 mm
Width 1,100 mm
Thickness 6.8 ± 0.4 mm
Surface area 1.43 m²
Weight 26 kg

Initial Efficiency | 8.9% | 125 Wp
Target Efficiency | 11.0% | 155 Wp

Next-gen micromorph® module: Low voltage module design

- More solar modules per string are possible: lower cable and wiring cost
- More flexibility to fit in voltage specification of inverters
- Similar to crystalline electrical characteristic (>80% market share)
- Best match to market standards

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Technology</th>
<th>( V_{\text{mpp}} )</th>
<th>( V_{\text{oc}} )</th>
<th>( I_{\text{mpp}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oerlikon</td>
<td>Micromorph today</td>
<td>103</td>
<td>129</td>
<td>1.0</td>
</tr>
<tr>
<td>Hevel Solar</td>
<td>Micromorph next-gen</td>
<td>37.8</td>
<td>52.4</td>
<td>3.3</td>
</tr>
<tr>
<td>First Solar</td>
<td>CdTe</td>
<td>69.4</td>
<td>92</td>
<td>1.08</td>
</tr>
<tr>
<td>Typical c-Si</td>
<td>Mono/poly</td>
<td>24-40</td>
<td>30-50</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Product: Advanced technology

Micromorph® - leading thin-film technology

- Low price (per watt)
- Low cost (per kilowatt-hour) (LCOE)
- High return on investments in solar installations

- Performs good under high temperature conditions (than other technologies)
- High efficiency in low or diffused light conditions (without tracking system)

- Guaranteed quality assurance:
  - 90% efficiency 90% in 10 years
  - 80% efficiency 80% in 20 years
- Pollution-free and environment-friendly

Additional microcrystalline layer gives up to 50% more energy yield
Performance measurement

LAB
- standardized conditions (STC)
- "label" value of module

Outdoor
- particular location and sun irradiation
- daytime variation
- seasonal variation
- varying temperature
- varying weather
- different characteristics of PV technologies

Performance = \( \frac{\text{Real outdoor energy output}}{\text{Label value at standard conditions}} \)

\( \text{KWh} \) = \( \text{KWp} \)

How much power/energy do we really get out of a Watt of installed power?
Performance measurement (2)

1MW c-Si
efficiency: 15%
10,000 sq.m.
1400 MW/year

1 MW TF Si
efficiency: 10%
15,000 sq.m.
1540 MWh/year

TF Si provides 5-15% more yield depending on conditions
RUSSIA: **High insolation** level over **large areas** with **high electricity demand**
Thank you!