Intersolar Europe Restart 2021
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INTERSOLAR EUROPE TREND PAPER: NEXT GENERATION SOLAR CELLS

Munich/Pforzheim, 17.08.2021: Bigger, more powerful and more cost-effective: Photovoltaic modules are becoming increasingly more powerful while PV system costs continue to fall. This change is being driven by a huge learning curve in the industry due to growing production, increased installation capacity and technical optimization as well as the use of larger wafers, half-cell modules and the refinement of PERC cell technology (Passivated Emitter and Rear Cell). And it doesn't stop there, the development is very dynamic. The most efficient technologies such as silicon heterojunction technology (SHJ), integrated back contact solar cells and PV tandem technology are set to become increasingly important in the coming years. That was reflected in The smarter E webinar on ITRPV and a view on the module format rally, during which the results of the 12th International Technology Roadmap for Photovoltaic from the German Mechanical Engineering Industry Association (VDMA) were presented and discussed.

In 2020, new photovoltaic installations with a total output of 135 gigawatts (GW) were installed worldwide. Total output reached significantly more than 700 GW. This year, around 150 GW are expected to be deployed. The ITRPV expects the steep learning curve within the PV industry to continue. In other words, every time the number of installations of PV module capacity doubles, this will result in a price reduction of 23.8 percent. This is down to a number of cost-saving measures: improved, larger silicon wafers, implementation of cell improvements, optimized cell front and backsheets, enhanced layouts, the introduction of bifacial cell concepts as well as optimized cell and module technologies.

The average spot market price for PV modules was 0.21US$/W at the end of 2020 compared to US$0.23/W in 2019 (new installations at 130 GW) Despite the effects of the Covid-19 pandemic, (e.g. polysilicon prices doubling within six months), it is expected that by the end of 2021 PV module prices will even out to a similar level to that of the previous year.

In trend: larger and thinner cell formats
The current trend in terms of cell formats is larger sizes with thinner wafers, making modules bigger and more powerful. The smaller wafer sizes of 156.75 by 156.75 (M2) and 158.75 by 158.75mm² (G1) are expected to be replaced by larger wafer sizes over the next four years. Currently the most popular wafer sizes are 166mm² (M6), 182mm² (M10) and 210mm² (M12). It is also expected that the market share of the current most popular size, M6, will drop from 34 percent in 2021 to 5 percent in 2031, while M10 and M12 will lead with 42 percent each.

These significantly larger wafer sizes will in turn make for larger modules in both roof-mounted and free-field PV plants. The road map predicts that half of all installed PV modules on roofs will be bigger than 1.8m² by 2031. Currently only a fraction are installed at this size (17 percent). Weight and manual installation are currently the limiting factors here, as highlighted by Markus Fischer, Vice President R&D Operation at Hanwha Q CELLS and Co-Chairman of the ITRPV since 2010. When it comes to free-field PV plants, a quarter of all modules are currently larger than 2.2m², however this proportion will increase to over 90 percent by 2031. It is also expected that 16 percent of modules will be larger than 3m². This will lower the levelized cost of electricity further even though making mounting the heavier modules as cost-effective as possible must also be taken into consideration.

Larger wafers don't necessarily have to be thicker and use more material. The IRPV estimates that the amount of polysilicon for a M6 monocrystalline (mono c-Si) wafer will shrink from the current 13.4 grams to 10.2 grams by 2031. It is also predicted that the average thickness of p-type mono c-Si wafers will decrease from 170 µm (Micron = 0.001 mm) to 150µm by 2031. N-type mono wafers are predicted to shrink to a thickness of less than 140µm. HJT technology allows for even thinner wafers.

The same goes for the silver content of crystalline high performance solar cells. The ITRPV predicts that the silver content per p-type cell (M6 size) will shrink from 80mg in 2021 to 50mg in 2031. This will be achieved by further reducing the finger width from the current 34µm to 20µm as well as the optimization of the screen-printing process.

The market share of monocrystalline silicon wafers (mono c-Si) will reach almost 80 percent in 2021 and is predicted to continue to rise. The share of high-quality n-type material will increase from the current 10 percent to around 50 percent over the next 10 years. The expected impact of this is that product warranty will increase to 15 years and performance warranty to 30 years. Degradation after the first year of operation will reduce to one percent according to the ITRPV.

Trends in cell technology: PERC cell technology dominates the market
In the field of cell technology, highly efficient PERC cell technology, with highly efficient variants, was the market leader holding 80 percent of market share in 2020. In 2020, the implementation of half-cell modules combined with larger module formats led to modules with more than 600 W output being launched. PERC cell technology is expected to remain the market leader, reaching a market share of 70 percent in 2031. Silicon heterojunction technology (SHJ) is expected to reach a market share of 17 percent, followed by high efficiency technologies, such as integrated backsheets or tandem technology, at 5 percent respectively.

Efficiency and power output are expected to increase accordingly. The ITRPV predicts that the efficiency level of p-mono PERC cells will rise from the current 23 percent to 24.5 percent by 2031. For SHJ cells this will increase from 24 percent to 25.2 percent and for tandem cells to 28 percent in just a few years. The efficiency of modules using tandem cell technology will be able to hit 26 percent by 2031, according to the ITRPV. They also anticipate that n-SHJ and n-TOPCon modules can achieve 23 percent efficiency (currently 21.5 percent and 21.3 percent, respectively) and modules with p-PERC cell technology 22.2 percent (currently 20.7 percent). A key element of this is also the significant improvement of the CTM (cell to module loss) value to around 2 percent in half cell modules.

Overall, levelized cost of electricity for photovoltaics will sink from a current average of around $5.5cents/kilowatt hour (kWh) to $4.2cents/kWh over the course of the next ten years, according to ITRPV estimations. This is due to further developments and optimizations.

Summary: Development requires change
During the webinar discussion it became clear that the development of high-efficiency cells and modules as well as the use of larger wafers requires readjustments in production process and some machinery in new production facilities. This is both an opportunity and a challenge for the renaissance of European PV production, which is currently being driven by the Greenland Gigafactory Project, amongst others, says Jochen Rentsch, Head of Department Production Technology – Surfaces and Interfaces at Fraunhofer ISE.

Solar cells at Intersolar Europe Restart 2021 and the accompanying conference
This year, Intersolar Europe will take place from October 6 to 8 as Intersolar Europe Restart 2021 at Messe München as part of The smarter E Europe Restart 2021. As a driving force for the industry,

Intersolar Europe Restart 2021 will also be dedicated to the exciting developments in next-generation solar cells in the halls of Messe München:

Intersolar Europe Conference:

Date	October 6-7, 2021
Opening Hours	9.00am–6.00pm
Venue	CCN – Conference Center Nord München Messe München 81823 Munich, Germany
Attendees & Speakers	500 expected (Intersolar Europe Conference, ees Europe Conference)
Sessions	"A Strong Return - The Resurgence of the European PV Market" "A Solar Boom - Solar Manufacturing in Europe is Back!"

Intersolar AWARD Finalists:

- LG Electronics Inc. (South Korea): The solar car roof module for the curved shape of a glass car roof
- Maxeon Solar Technologies, Ltd. (Singapore): The Maxeon Air, a 4mm thick module with reduced weight for use on roofs with limited loads
- Mitrex Building Integrated Solar Technology (Canada): "Solar cladding" involves sandwiching crystalline silicon solar cells between a lightweight yet sturdy aluminum substrate with a honeycomb structure and a custom glass panel.
- Trina Solar (Schweiz) AG (Switzerland): The Vertex range from Trina is based on the new wafer format with an impressive edge length of 210 mm.

Intersolar AWARD Winners:

- LONGi Solar Technology Co., Ltd. (China): The Hi-MO5 is a high-performance bifacial PV module using PERC technology, designed for large solar parks.

All finalists and winners will exhibit their innovations at Intersolar Europe Restart 2021. All finalists can be found in our Hall of Fame: https://www.thesmartere-award.com/en/hall-of-fame/hall-of-fame

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