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International Technology Roadmap for Photovoltaic: Twelfth Edition Published Online

- **High-efficiency modules and large module formats achieve higher market share**
- **Larger wafers are established**
- **Further cost reduction for PV systems observed**

Frankfurt, April 29, 2021 - The 12th edition of the International Technology Roadmap for Photovoltaic (ITRPV) is now available for download. With the help of 56 international experts along the PV value chain, the edition summarizes and discusses over 100 parameters in numerous diagrams. On April 29, 2021, the results will be presented in a web seminar.

In 2020, 135 GW of photovoltaic capacity was installed worldwide for power generation, so that the cumulative PV capacity significantly exceeds 700 GW. For several decades, the analogous trend to the general concept of an experience curve has been observed. This shows that each doubling of cumulative PV module capacity installation is associated with a price reduction of 23.8 percent. Based on recent results, the trend is expected to continue along this experience curve over the next several years. This will be realized through a combination of several measures: improved and larger silicon wafers, implementation of cell perfections, optimized cell fronts and backs, refined layouts, the

introduction of bifacial cell concepts, and optimized cell and module technologies.

In the area of new formats, a strong trend towards larger wafers and also larger modules is becoming obvious. The smaller wafer formats of 156.75^2 mm^2 and 158.75^2 mm^2 will disappear in favour of larger formats within the next four years. Currently, the focus is on the formats of 166.0^2 mm^2 (M6), 182.0^2 mm^2 (M10) and 210.0^2 mm^2 (M12). The market share of the current mainstream format M6 is expected to 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 formats will also result in larger modules, both in rooftop and in power plant applications. In rooftop applications, modules smaller than 1.8 m^2 have a market share of 83 percent. The limitation in terms of module area can be attributed, among other things, to manual installation. In power plant applications, 25 percent of modules are currently larger than 2.2 m^2 , with this share expected to increase to over 90 percent in 2031. It is also expected that 16 percent of modules will be larger than 3 m^2 .

The market share of monocrystalline silicon wafers (mono-Si) will be nearly 80 percent in 2021 and is expected to grow further. The share of higher-quality n-type material will increase from the current 10 percent to about 50 percent in ten years. Influenced by this, the expected trend for product warranty is to increase to 15 years and performance warranty is to increase to 30 years. Degradation after the first year of operation will decrease to one percent.

In terms of cell technologies, PERC cell technology with its high-efficiency variants was the dominant technology in 2020 with a market share of 80 percent. Combined with the implementation of half-cell modules and larger module formats, modules with more than 600 W were established in the market. PERC cell technology is expected to

remain dominant with a 70 percent market share in 2031. Silicon heterojunction technology (HJT) is expected to achieve a 17 percent market share, while other high efficiency technologies, such as integrated back-contact and tandem technology, follow with 5 percent each.

ITRPV

The ITRPV (International Technology Roadmap for Photovoltaic) is updated regularly by the VDMA with contributions from leading international crystalline silicon producers, wafer suppliers, cell manufacturers, module manufacturers, PV machine builders, material manufacturers as well as PV research institutes and consultants. The aim of the ITRPV is to provide information on expected technology trends in the crystalline silicon (c-Si) based photovoltaic industry and to initiate discussions on required improvements and standards.

For additional information, please visit the website (itrpv.org).

Do you still have questions? Dr. Jutta Trube, VDMA Photovoltaic Equipment, Phone +49 (0) 69 6603 1879, jutta.trube@vdma.org, is happy to answer your questions.

The VDMA represents around 3300 German and European companies in the mechanical engineering industry. The industry represents innovation, export orientation, medium-sized companies and employs around four million people in Europe, more than one million of them.