HORIZON EUROPE PROGRAMME
TOPIC HORIZON-CL5-2021-D3-03
Demonstration pilot lines for alternative and innovative PV technologies
(Novel c-Si tandem, thin film tandem, bifacial, CPV, etc.)
GA No. 101084046

Digitalised pilot lines for silicon heterojunction tunnel interdigitated back contact solar cells and modules

PILATUS

PILATUS – Milestone MS08

Initial market and competitive

Analysis

08.04.2024

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This report aims to bring a global overview of the photovoltaic market encompassing the market opportunity, trends, and competitors of the tunnel-IBC technology developed in Pilatus.

1. Market opportunity

One of the task of the WP7 in the scope of PILATUS is to explore market opportunities for Tunnel-IBC solar cells based on heterojunction technology. Besides the well-established residential and utility segments, the solar energy market continues to expand towards niche applications that requires specialized design for architectural integrations to buildings (BIPV) or vehicles (VIPV), many of these aesthetic installation brings design, weight or colour constrains. If we consider the mass market; despite the advantages such as higher efficiency due to reduced recombination losses, enhanced aesthetics with no visible front-side metal contacts, improved durability and reliability; tunnel IBC brings along some market challenges such as higher production costs compared to traditional solar cell manufacturing and limited scalability in the initial stages of adoption. Therefore, their adoption can be facilitated toward the application where the cost is not the most important decision criteria. Such potential integration fields can be listed as

- **Architectural Integration**: facades, windows, charging stations, building-integrated photovoltaics (BIPV), vehicle-integrated photovoltaics (VIPV).
- **Aesthetic Installations:** Artistic and customized solar panels for decorative purposes in residential and commercial infrastructures.
- **Portable Devices:** Lightweight and flexible panels for outdoor activities and remote locations.

In case the requirements of the various market opportunities are determined wisely and right business model is adopted; such niche applications can demonstrate impactful use-cases and lead to successful commercialization of the novel tunnel-IBC technology.

With this strategy, Meyer Burger is already developing state of the art solar tiles. Meyer Burger tile is characterized by attractive aesthetics with very high-energy yield as well as easy installation and maintenance that gives the roofer maximum flexibility. In Pilatus, the merging this innovative design with the novel Tunnel-IBC technology and demonstrate the high value for the end customer is adopted as one important target. Additionally the Pilatus consortium inform itself about the product requirement for VIPV application and its compatibility with the tunnel-IBC technology.

2. Market trends

When the PILATUS project started end of 2022, Chinese manufacturers reported PV panels production costs of ~20$cts/Wp, which were the initial Pilatus's target. Currently, with spot price of photovoltaic module in the range of ~10-14$cts/Wp (spot price for TopCon/HJT technologies), the global market is under a strong pressure. More recently, Longi, one of the bigger producer of PV panels worldwide, reported that the current situation is not economically sustainable in long term. No one is able to tell if these low prices level will continue after 2025, most probably after the general market consolidation and the PV module stock reduction, standing at ~65GW in Europe by end of 2023.

Indeed, the collapse of the PV spot price in 2023 has triggered a cascade of factory closures in Europe, including Norwegian Crystal (Norway), Exasun (Netherlands), Energetic Industry (Austria) and Meyer Burger (Module manufacturing site in Germany)[1]. Solarworld and Heckert, both located in Germany,

[1] https://table.media/en/china/news/solarwatt-surrenders-to-chinese-competition/

are also considering stopping their activities in Europe[2] without state support. State funds in China have been used since years to enable the domination of PV production, exceeding now 609GW cumulative capacity[3]. In contrary to Europe, after the IRA in USA and PLI in India, Australia[4] announced a similar state fund program to support the local production of PV panels. Consequently, Meyer Burger is shifting in 2024 its production capacity to USA with a 2GW capacity of HJT cells and modules.

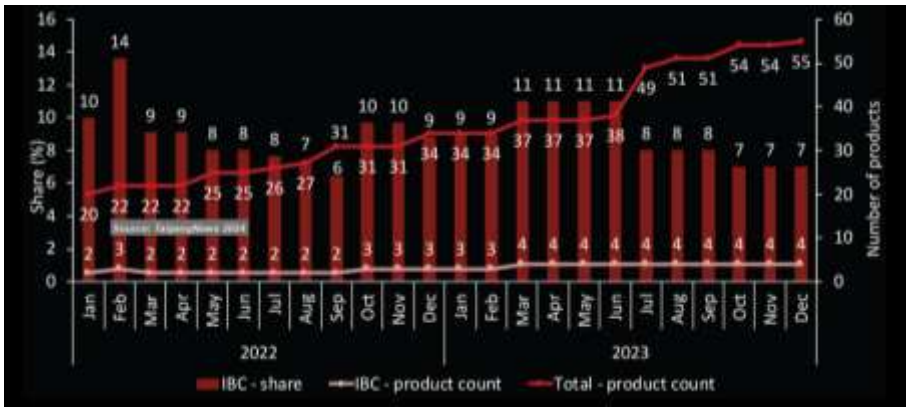
Topcon/HJT Module spot prices (April 2024)
https://www.infolink-group.com/spot-price/

Longi's message about the PV situation in China (source PV-tech, march 2024)

The current situation makes it very difficult to forecast– after PILATUS ends- where the production of the tunnel-IBC technology will be located, together with a massive financial support enabling its GW scale production.

3. Market competitors

In today's market landscape, IBC represents the highest efficiency; on the other hand, it has the lowest product count showing the fact that only a few companies have developed skills for the production of the IBC cell technology[5].



Source: https://taiyangnews.info/top-ranking-for-ibc-modules/

[2] https://www.reuters.com/business/energy/solar-suppliers-call-eu-aid-imports-crush-margins-2024-03-21/
[3] https://global.chinadaily.com.cn/a/202402/29/WS65dfd921a31082fc043b9af9.html
[4] https://www.energytrend.com/news/20240401-46254.html
[5] https://taiyangnews.info/top-ranking-for-ibc-modules/

Historically it was only LG and Maxeon, LG exited the solar industry in April 2022 while SPIC's IBC product based on ISC Konstanz' Zebra technology entered the market in March 2022. In November 2022, LONGI released its HPBC, and in March 2023, Aiko came out with its ABC modules, which increased the product count to 4 and share to 11% of the market. While the product count remained the same, today IBC's share declined to 7% due to the fast deployment of the TOPCon modules during 2023. Recently, in February 2024, Aiko announced an impressive new world record with its ABC solar panels, achieving a 25.15% power conversion efficiency[6]. According to TaiyangNews's commercially available high efficiency solar modules list, first, second and forth position are occupied with IBC modules.

Company	Model	Type	Cell Size	Cell No	Module design	Power	PCE
Aiko	ABC White Hole	N	182	144	Half-Cell, BC	620	24.0
Longi	Hi-MO X6	P	182	144	Half-Cell, BC	600	23.2
Maxeon	Maxeon 6	N	166	66	BC	445	23.0
SPIC	Andromeda 3	N	166	120	Half-Cell, BC, MBB	410	22.8

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[6] https://taiyangnews.info/aiko-solar-announces-new-world-record-efficiency/