Rooftop Nearshore PV Site in Laizhou, Shandong: Jinko TOPCon VS P-type BC – Consistent 3.14% Outperformance in Per Watt Generation

Recently, Jinko Solar conducted a performance comparison of energy output across different module strings at a residential PV site in Laizhou, Shandong. Based on energy yield data from July to November, the latest generation of Tunnel Oxide Passivated Contact (TOPCon) modules demonstrated higher per-watt energy output compared to P-type (BC) modules. A comprehensive analysis indicated that:

1.In Shandong's high temperatures (July to September), Jinko's TOPCon modules show significantly lower power degradation than P-type BC modules in rooftop installations. Jinko TOPCon' s superior heat dissipation reduces the negative impact of heat on efficiency, boosting annual energy output.
2.In low-irradiance conditions (7:00-9:00 AM and 3:00-5:00 PM), Jinko' s TOPCon generates 8% more power than P-type BC modules, delivering stable, higher energy output, especially during cloudy or low-light periods.
3.Through field tests and offshore PV project testing, Jinko' s TOPCon module had demonstrated high reliability and durability in harsh environments, such as high humidity and salt mist, ensuring efficient power generation and longer system lifespan.

Due to the superior high-temperature performance, low-irradiance efficiency, and reliability in near-shore environments of TOPCon modules, the average power generation gain per watt is 3.14% higher than that of P-type (BC) modules. Data monitoring is conducted by esteemed third-party organization. TÜV Rheinland.

Project Background:

As the photovoltaic industry advances, N-type TOPCon technology has emerged as the preferred solution for mainstream solar installations. Recently, manufacturers of BC modules have promoted several advantages of their products, particularly the rated power and front-side efficiency of BC modules without gridlines. In Laizhou—a coastal city with abundant sunlight and a maritime climate—a pilot project was launched to evaluate the performance of these modules under diverse environmental conditions. This study, based on a real-world residential PV installation, compared the energy generation of TOPCon and P-type BC modules. Preliminary results indicate that N-type TOPCon technology delivers superior energy yield, demonstrating why it has become the optimal PV solution for clients.

Figure 1: Project Picture

Project Overview:

This residential PV project is situated in Laizhou, Shandong, approximately two kilometers from the coastline. The test site includes two types of solar modules: Jinko's N-type TOPCon modules (rated power 575W) and P-type BC modules (rated power 580W). Both module types are installed facing due south at a 20 ° tilt. Each module type consists of 15 modules per string, connected to inverters from the same manufacturer. Modules are mounted about 10 cm above the rooftop with no shading interference.

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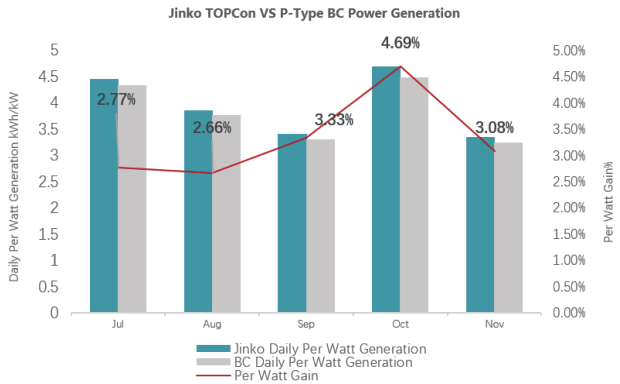
Data monitoring is performed using high-precision voltage and current measurement equipment with a sampling accuracy of 0.5 and an interval of one minute. Environmental data, including irradiance on the module surface, back-panel temperature, ambient temperature, humidity, atmospheric pressure, wind speed, and wind direction, are also recorded every minute.

Test Results:

Between July and November 2024, Jinko' s N-type TOPCon modules generated an average daily output of 3.94 kWh/kW, outperforming the P-type BC modules, which generated 3.82 kWh/kW—a generation yield gain of 3.14%. The TOPCon modules particularly excelled under low-light conditions. From July to November, during sunny weather conditions, in early mornings from 7:00-9:00 AM and in afternoons from 3:00-5:00 PM, TOPCon modules outperformed P-type BC modules by 8.29%

Months	JINKO TOPCon Daily Per Watt Generation	P-type BC Daily Per Watt Generation	Per Watt Gain
July	4.45	4.33	2.77%
August	3.86	3.76	2.66%
September	3.41	3.30	3.33%
October	4.69	4.48	4.69%
November	3.35	3.25	3.08%
Jul-Nov Total	3.94	3.82	3.14%

In this residential photovoltaic application, Jinko's TOPCon modules demonstrated superior performance compared to P-type BC modules, despite limited utilization of backside energy generation due to installation conditions. Real-world data from other third-party verified projects confirm that in ground-mounted solar farms or elevated distributed systems that can leverage bifacial gains, TOPCon' s high bifaciality coefficient further amplifies energy yield, maximizing client returns on energy investments.