Field Test in Lebanon Carport: TOPCon Modules Outperform N-Type BC Modules in Power Generation, with Up to 7.96% Higher Yield in Early/Late Hours

A one-month carport field test experiment had been conducted, comparing the performance under different daytime duration of TOPCon and N-type BC solar modules in Lebanon. They assessed the outdoor panel to evaluate energy yield across the day and month, providing a critical insights into their real-world energy yield under different irradiance as well as material-level reliability.

Highlights

1. During the summer season from July 29 to August 31, the specific yield of TOPCon modules was **2.78%** higher than that of BC modules in average.

2. Under the dual influence of low irradiance in early morning and later afternoon, and high ambient temperature, the yield gain of TOPCon is a **7.08%** increase in 7am-8am and **7.96%** in 5pm-6pm in specific yield compared to BC modules.

3. The vacant duration of carport during 12pm-1pm , the higher the bifacial factor advantage of TOPCon contributes greatly to the high productivity of **4.62%** specific yield over BC modules.

The experiment group included eight pieces of TOPCon bifacial modules (630 Wp) and eight pieces of N-type BC bifacial panel (640Wp), both from tier-1 manufacturers. The modules were installed in two carports, with each connected to an inverter operated at maximum power point tracking (MPPT). The testing field was located in Mkalles, Lebanon (33.8623190N, 35.5508300E), with a carport near-flat tilt of 5 degrees, facing southeast, and with about 2.5 meters above the ground.

Cell Technology	Module Power	Module type
Jinko TOPCon	630W	Bifacial Dual-Glass
N-type BC	640W	Bifacial Dual-Glass

Figure 1: Project picture

All modules were equipped with high-precision sensors to monitor power generation data in real time to ensure the accuracy and credibility of the test results. During the test, a number of key data were collected at in interval of 6 minutes, including DC voltage, current, power, module temperature, front irradiance etc. These data provide detailed information, allowing us to conduct in-depth analysis and comparison of the performance of the modules.

Test Results

Some significant irradiance and performance changes were observed in initial days from July 29 to August 31, 2025. The daily average irradiance recorded in was 455.9 W/m², and the ambient temperature recorded was 30.22 ° C. The most observed irradiance range was 100-200W/m² occurred in 7am-8am and 5pm-6pm, which in turn affected the power generation of the modules.

Under such conditions, the power generation of TOPCon modules was 141.07 kWh/kW, versus BC of 137.26 kWh/kW, 2.78% higher than that of BC modules. However, with the arrival of low irradiance, high temperature, TOPCon modules showed their excellent performance, with a 7.08% increase in 7am-8am early morning and 7.96% in the later afternoon 5pm-6pm in power generation compared to BC modules. Another peak yield gain was observed of 4.62 % during 12pm-1pm, which is the lunch time, most car parked underneath are driven out, leaving the carport less unoccupied and effect of ground reflection maximized. This significant gain not only proves the high yield of TOPCon modules in low light environments, but also highlights their high bifaciality, and high efficiency under high temperature.

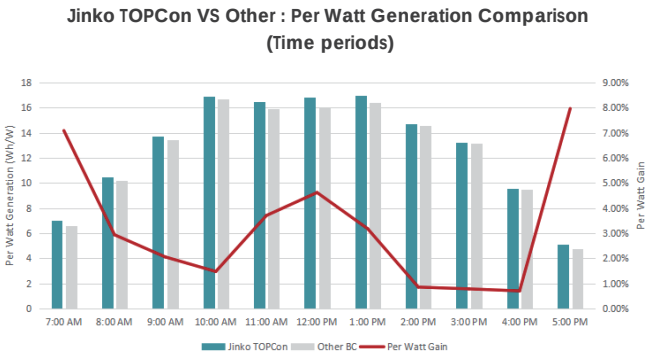

Figure 2: Time interval based per watt gain comparison

Conclusion

This comparison test, characterized by monitoring and tracing the generation changes of N- type TOPCon and N-type BC modules across the daytime, low and high irradiance, elevated temperatures, intense and unintended ground reflection, provides an ideal environment to gain critical