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5.62% Yield Gain of N-TOPCon Concluded in Field Performance Comparison of 100MW Alshaa Aimag Solar Power Plant

Abstract:

A filed performance comparison study of N-type TOPCon and P-type PERC bifacial modules was conducted at the 100MW solar power plant located at Alshaa Aimag, Inner Mongolia developed by SPIC (State Power Investment Corporation). The obtained field performance data released by SPIC has shown that Jinkosolar' s N-type TOPCon bifacial PV modules and systems deliver up to 5.62% more energy than equivalent p-type PERC bifacial modules in the same environment and working condition.

Project Introduction:

The project location of Alshaa Aimag (39° 46'51.97"N, 106° 37'45.05"E), Inner Mongolia has an extreme continental climate which is typically cold and dry durign the winter and this might last for almost 5–6 months. The summertime is normally dry, hot and sunny. The Gobi Desert attribution determines its very windy and of extreme temperature, during winter it reaches -35℃, during summer you can expect +44.8℃. It has rich solar resources with an annual average solar radiation of 1769.9kW/m².

The total capacity of this project is 119.5 MWp, comprised of 34 solar arrays equipped with Jinkosolar' s n-type panels and p-type panels as comparisons, with string inverters of 196 kW being connected to both sets. The panels were installed on fixed structures with a tilt angle of 40 degrees and at a height of 1.5 meters above the ground.

Two N-type arrays were selected for comparison with P-type array in the same environment and with the same capacity in Table 1
The comparison of the arrays' single day yield gain is shown in Figure 1

Comparison	Capacity (MWP)	Cumulative Power Generation (kWp)	Power Generation per Kilowatt (kWh)	Gain (%)
P-Type	0.22672	28974.81	127.80	Baseline
1#N-Type	0.23712	31790.91	134.07	**4.90%**
2#N-Type	0.23712	32005.00	134.97	**5.62%**

Table 1: Comparison of energy yield and gain of N-type and P-type modules

Results:

For the days shown, the n-TOPCon bifacial modules in these arrays significantly outperform the p-PERC references. Yield gains vary between 4.90% and over 5.62%. The highest gains are associated with ambient temperature that are not optimal for PERC. P-type and n- type c-Si have different temperature coefficients and performance characteristics that cause. Power output from the n-type array occurs earlier and produces power for longer time periods than for p-type.

The n- type TOPCon bifacial panels has low temperature coefficient, low degradation rates, high bifacial ratios and experience little to no light induced degradation (LID) while the p-type cells greatly suffer from LID and LeTID.

Conclusion:

Field data from a collection of 100MW SPIC n-type TOPCon bifacial PV project in Alshaa Aimag, Inner Mongolia has been analyzed and compared with similar p-type PERC bifacial arrays. The following conclusions can be drawn from this analysis.
1. n-type TOPCon performance always exceeds PERC performance in same environment and conditions.
2. Power gains increase as the increased ambient temperature, with enhanced albedo of ground surface, array height increases, etc.
3. N-type modules produce energy earlier and later in the day than p-type arrays.

N-type TOPCon bifacial modules, and systems offer a rapid pathway to significantly decreased levelized cost of energy compared with conventional p-type PERC PV modules. Relying on enriched knowledge and experience with system designs, SPIC take advantage of the specific features of Jinkosolar' s n-TOPCon bifacial modules in its 100MW project.

This real project study helps to better understand the actual performance potential of n-TOPCon bifacial PV systems. The obtained field performance data released by SPIC has shown that use of N-type TOPCon bifacial modules increase system yield achieved by 4.90~5.62% over P-type PERC bifacial modules under same conditions. The N-type benefit appears to increases with increased ambient temperature, module height above ground surface, reflectivity of the ground, low light condition, and over time.

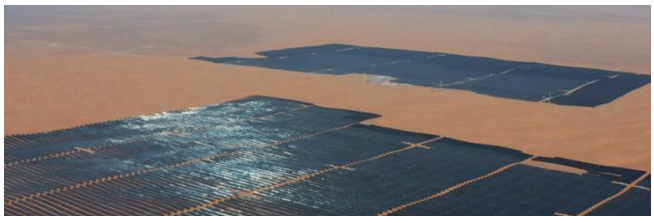

Figure 2: Project Picture

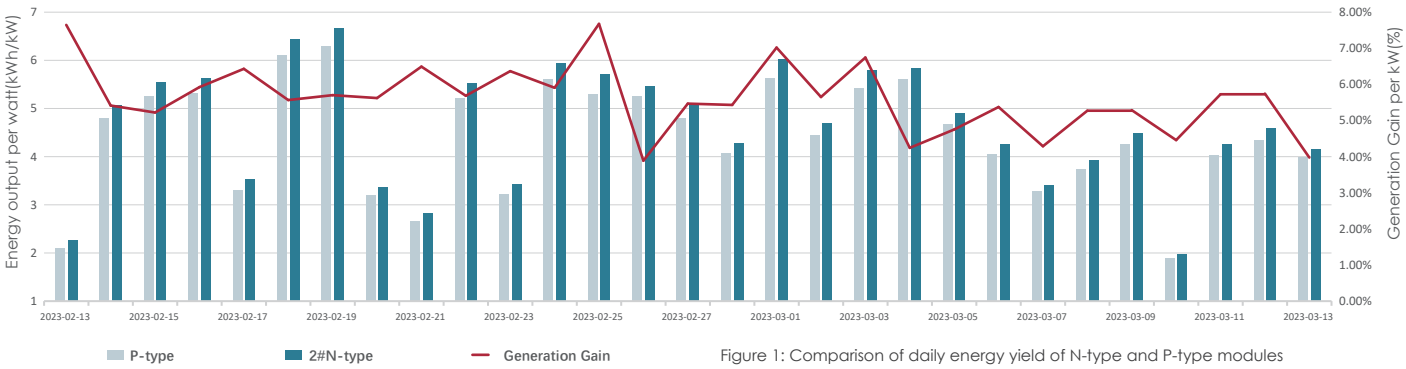

Figure 1: Comparison of daily energy yield of N-type and P-type modules