Building Your Trust in Solar

GD Power Development Tianjin's 30MW Project Power Generation Comparison: JinkoSolar N-TOPCon Energy Yied Gain Reaches 5.15%

Background Introduction:

In the 30MW PV power plant developed by China Guodian Cooperation in Jixian, Tianjin, we conducted a comparative study on the power generation performance adopted bifacial PV modules equipped with two different cell technologies, TOPCon and PERC. Jixian, where the project is located, belongs to a warm temperate semi humid continental monsoon climate. The area is rich in heat with high temperature in summer, and cold in winter. The annual total solar radiation has reached 1450~1600kWh/m² (5220~5760 MJ/ m²). The excellent solar resource is favorable for the development and construction of PV projects.

Comparison	Capacity (MW)	Cumulative Power Generation (kWh)	Power Generation per Kilowatt (kWh/KW)	Gain (%)
N-type 560Wp	2.52636	428291.5	169.53	
P-type-1 545Wp	2.4525	395897.2	161.43	**5.02%**
P-type-2 545Wp	2.41326	389089.1	161.23	**5.15%**

Note: Data is provided by China Guodian Cooperation

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

Technical Specification:

The project has a rated capacity of 30 MW, consisting of in total 12 power arrays, 2.5MW for each. Each string is designed to consist of 26 pieces of modules, and every 17 strings are connected to one string inverter. Each array is equipped with 11 sets of 225kW string inverters and 1 set of 2500 kVA box type transformer. The DC/AC ratio of the project is 1. Fixed tilts are adopted with an inclination of 30°, modules are mounted in two rows and the minimum height of the module from the ground is about 0.5 meters. In order to compare the difference in performance between N/P type modules under real operating conditions, 20MW of P-type 545Wp modules are designed while the rest part adopted the N-type 555Wp modules.Two weeks of data were randomly selected for analysis, and the daily power generation is shown in the following graph.

Result:

Based on the advantages of N-type TOPCon modules in terms of power generation performance such as lower temperature coefficient, higher bifacial factor and lower degradation, they can bring at least 3% of extra power gain at the same installation capacity. Due to the high summer ambient temperature in the climate zone where the project is located, the extreme high temperature can reach 40℃. After considering the temperature rise of the module itself, the operating temperature of the module can reach nearly 60℃. A better module temperature coefficient can reduce the impact of temperature rise on the power output. The Tiger Neo series module equipped with TOPCon technology cells have a temperature coefficient as low as -0.29%/℃, which will effectively improve the power generation of the module under the same temperature compared to the conventional P-type product. By comparing the power generation of one N-type module array with two P-type module arrays, it's found that the per kW extra power gain of Jinko's N-type modules has reached **5.02%** and **5.15%** respectively. Also, this result has strongly supporting the excellent performance of N-type modules in the real outdoor application.

Conclusion:

Based on the comparison of the per kW power generation between P-N type modules, the excellent power generation performance of TOPCon modules has been fully highlighted. During the summertime, the power generation of the modules will increase with the boost of sunlight, but the rise of operation temperature from the environment and module itself will impact the output as well. Due to this, the priority of using N-type TOPCon modules with better temperature coefficients has been further enhanced. Not only that, unlike the conventional PERC modules with boron doped substrates, Jinko's N-type TOPCon modules with phosphorus doped substrates can effectively moderate the Light Induced Degradation from 2% to 1% during the first year. With high-quality materials selected, Jinko's Tiger Neo module can safeguard customers' full life cycle power generation income from its outstanding outdoor performance.

In terms of power degradation, n-type modules have a natural advantage, the first-year degradation is 1%, and annual linear degradation is 0.4%, while p-type modules' first-year degradation of 2%, annual linear degradation of 0.45%, in result n-type modules bring yield gain of about 1.8%.In terms of high-temperature power generation performance, it is closely related to the module temperature coefficient and module working temperature. The N-type module temperature coefficient is -0.29%/℃, while the p-type module temperature coefficient is -0.35%/℃. Under high-temperature conditions in summer, assuming that the module operating working temperature is about 55℃ (ambient temperature is about 30℃), the power loss of the n-type module is about 1% lower than that of the p-type module, and as the module operating with the further increase of module operation temperature, the advantage of high-temperature power generation of the n-type module will be more remarkable. At the same time, the higher conversion efficiency of n-type modules reduces the thermal conversion of absorbed light energy, thus lowering the operating temperature of the modules. n-type modules have an average operating temperature of about 1℃ lower than p-type modules, and combined with the excellent temperature coefficient and lower operating temperature, the power generation of n-type modules is about 2% higher than that of p-type modules.In terms of bifacial power generation performance, the bifacial factor of the n-type module is about 80% and the bifacial factor of the p-type module is about 70%, so the difference in bifacial factor (10%) brings the yield gain of the n-type module between 1% and 1.5%.

Theoretically, due to the lower degradation, optimized temperature coefficient, higher bifacial factor, lower irradiation, and other advantages, the theoretical yield gain of n-type modules is about 3%, while the case study project data show that the n-type module power generation per watt is more than 5% higher than that of p-type modules.**The comparison result of this 30MW real project demonstrates obvious "four high and four low" advantages of N-type TOPCon panels, i.e. high power, high efficiency, high bifacility and high power generation, low degradation, low temperature coefficient, low BOS and low LCOE.**

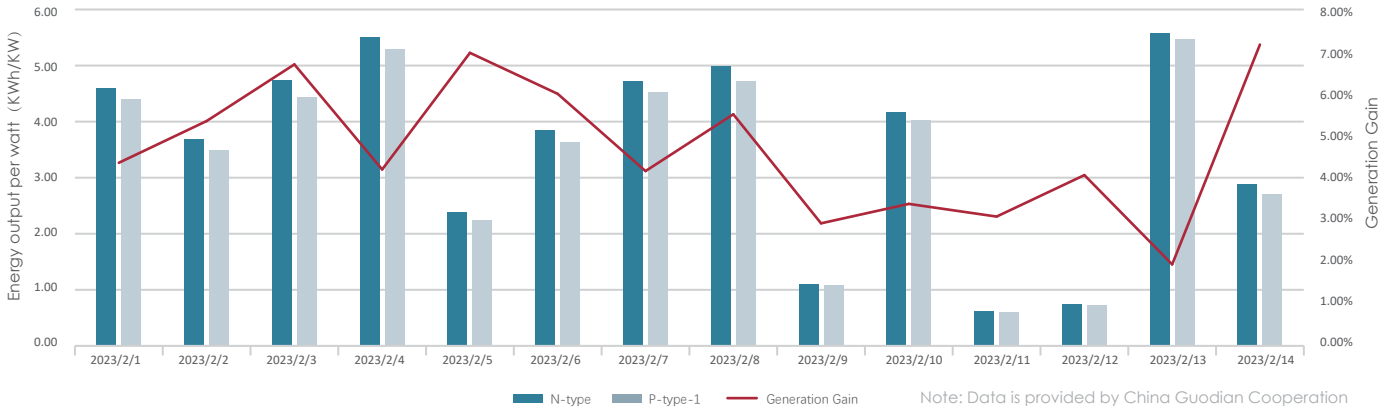

Figure 1: Comparison of daily energy yield of N-type and P-type modules