3.68% Yield Gain of N-type over P-type BIPV Attributes To Lower Degradation and Optimized Temperature Coefficient

The study examined the challenges related to solar photovoltaic (PV) development with a pivotal focus on the impacts of the dynamics of the relevant markets and technological advancements in the solar industry. In regard of investments into N-type BIPV and P-type BIPV on C&I rooftop, there is an outdoor performance experiment conducted by China General Certification CGC in Feidong, Anhui province. It will contribute to select rooftop BIPV systems for the prosumer(combined producer and consumer of power) by measuring the variance of yield per kilowatt and working temperature between P-PERC and N-TOPCon BIPV modules.

Highlight:

The result showed that the TOPCon BIPV module has higher energy yield performance, which is up to 3.68% higher compare to PERC BIPV modules, the majority of the contribution from lower degradation, and optimized temperature coefficients.

Experimental Setup and Data Acquisition:

The solar power plant on which the investigations were carried out is located in Feidong (latitude 31°34'N, longitude117° 19' E), on 24 pieces N-type BIPV (JKBS360N-48HL4-BDV) and 24 pieces P-type BIPV (JKBS355M-48HL4-BDVP), the specification of PV modules is shown in Table 1. All types modules are placed vertically on a newly-built factory rooftop. The modules are connected to the grid using string inverters model SOFAR230KTL-HV (spec. see in Table 2) with nominal AC power 230 kW, characterized by the maximum efficiency of 98.6%. The inverter is equipped with 12 maximum power point trackers (MPPT) for 230kW inverter. The DC and AC electric power registered by inverters as well as solar irradiance and module temperature measurements were recorded every 5 min. by the central data logging computer to achieve synchronous data collection.

To check the variance of ambient and module working temperature, four temperature sensors are deployed in each array: two are placed underneath modules, one on the upper surface of colored steel tiles, and one between the modules and tiles. All the installed modules were new and the whole plant started to operate at the February 01 of 2023. The energy yield performance of TOPCon and PERC BIPV were revealed and systematically compared.

Type of sample	BIPV	
Type	JKBS360N-48HL4-BDV	JKBS355M-48HL4-BDVP
Specification	2267x768x5mm	
Quantities	24 pcs	24pcs
(W)	360	355
Voc(V)	33.97	36.12
Isc(A)	13.38	12.8
Vmp(V)	28.28	29.49

Table 1. Sample component parameters

Inverter	SOFAR230KTL-HV
kW	230
Max. input voltage/V	1500
Starting voltage/V	550
Max. input current/A	12×30
MPPT voltage range/V	800-1300
No MPPT	12

Table 2. Inverters parameters

Results:

Starting from February, with the time elapse and increase of irradiance which results in the increasing ambient tempeature and the back PV module surface temperature, the yield gain of N-TOPCon over P-PERC grows from 1.26% in February to 3.68% in June, shown in Figure 1. The lower degradation and lower working temperature of N-type TOPCon modules is the main reason for this changes.

Conclusion:

The harvested energy of advanced TOPCon modules has been proved in the field through this experimental study on the energy yield performance of the TOPCon BIPV compared to PERC BIPV modules in the east part of China, Anhui province. The experimental results have proven that the energy yield performance of TOPCon BIPV modules is up to 3.68% higher than that of the PERC BIPV modules, and the gain increases with time elapse and rising ambient temperature.

Energy output per watt	2023.2	2023.3	2023.4	2023.5	2023.6
N-BIPV	52.46	105.74	106.28	127.49	112.41
P-BIPV	51.81	102.97	102.88	123.67	108.42
Energy yield	**1.26%**	**2.69%**	**3.31%**	**3.09%**	**3.68%**

note: Daily power generation data from 8:00-18:00 is selected

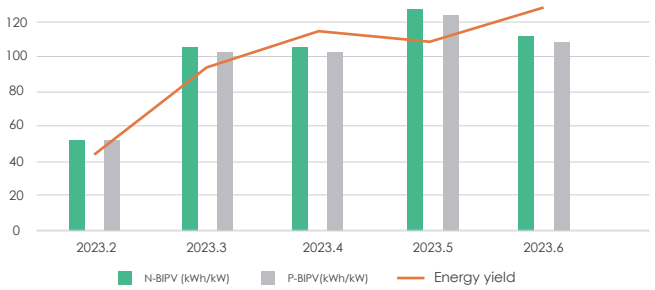

Figure 1. Comparison of the power generation performance of N-type double-sided modules and P-type double-sided modules