LCOE Analysis of Tiger Neo 3.0 and BC

The PV industry has never stoped its pursuit of higher energy efficiency, as TOPCon becoming dominant technology, Jinkosolar continues to push the bleeding edge to raise the bar of cell efficiency over 27%. Its latest Tiger Neo 3.0 claimed of 650-670Wp power output, 85+/- 5% Bifacility, -0.26% temp coefficient, -0.35% linear degradation, 96.77% low irradiance performance (200W/m²), etc., provides chance of lowering the levelised cost of energy (LCOE) than traditional TOPCon and N-type BC.

This paper is purposed to compare the LCOE of Tiger Neo 3.0 and its N-type BC in different scenarios as follows, based in the supposition that the price of Tiger Neo 3.0 is same with N-BC module,module information is listed in **table 1**. We chose four project scenarios (two rooftop, two utility scale) and four locations with typical climate features, irradiance levels and balance of system (BOS) cost levels.

Table 1

Product Type	Tiger Neo 3.0	N-Type BC
Cel (half-aut) Quartity	132	132
Module Length (mm)	2382	2382
Module Width (mm)	1134	1134
Nominal Power (W)	670	670
Module Eff.	24.8%	24.8%
Voc (V)	50.98%	50.12%
Bifaciality	85±5%	75±5%
Power Temp. Coeffcient	-0.26%/°C	-0.26%/°C
Low Irradiance Performance (200W/m²)	96.77%	94.28%
First-year Degadation	1%	1%
Annual Degadation	0.35%	0.35%

Energy generation is simulated with the PVsyst software. The Tiger Neo 3.0 and N-type BC module PAN file is based on the actual performance provided by Jinkosolar while the PAN files of N-type BC are based on a general industry-wide performance level.

We chose four typical locations, including Kagoshima (Japan), Berlin (Germany), Dubai (UAE), Qinghai (China). Their annual average irradiance and annual average temperature are listed in **table 2**.

Table 2

Locations	Kagoshima (Japan)	Berlin (Germany)	Dubai (UAE)	Qinghai (China)
Annual Average Irradiance	1387-1460kWh/m2	1100-1300kWh/m²	1700-1850kWh/m²	1700-1850kWh/m²
Annual Average Temperature	18.8°C	10.1°C	27.5°C	6.1°C

The calculation for LCOE is the net present value of total life cycle costs of the project, divided by the net present value of energy produced over the system's lifetime. The total life cycle costs can be disaggregated as initial investment, annual cost, depreciation tax benefit and system residual value. The initial investment (US$/Wdc) is the sum of the BOS cost and the module price. Module prices and BOS cost of Tiger Neo 3.0 and N-type BC are assumed to be the same at each location.

The AC capacity of the utility-scale plant is designed to be 100MW, 1500V system voltage, single axis tracker, albedo 30% in Dubai and 120MW, 1500V system voltage, fixed mounted, 20% albedo in Qinghai . The system lifetime is 30 years.

Tiger Neo III

Results

The energy yield gain of Tiger Neo 3.0 over N-type BC at modeled Dubai and Qinghai utility project is 3.52% and 3.28% respectively, primarily attributed to Tiger Neo 3.0's higher bifacility and outstanding performance at high temperature. Set LCOE of BC as baseline, the LCOE of Tiger Neo 3.0 is 3.45% and 3.60% lower in Dubai and Qinghai.

Dubai,UAE 100MW | Climate type: High temperature and high irradiance
Annual average irradiance:**1700-1850kWh/m²**

Product Type	Tiger Neo 3.0	N-Type BC
Module Power	670W	670W
Module Efficiency	24.8%	24.8%
Module Price	Same Price	
Bifaciality	**85%±5%**	75%±5%
Low Irradiance Performance (200W/m²)	**96.77%**	94.28%
BOS Difference	No Difference	Benchmark
First-year Power Generation / MWh	184,032	177,554
30-year Cumulative Power Generation /MWh	5,237,941	5,053,563
Power Generation Gain	**3.52%**	Benchmark
LCOE	**-3.45%**	Benchmark

*Centralized ground power station; power generation is based on PVsyst simulation with Albedo=20
1P tracker installation

Qinghai,China 120MW | Climate type: High temperature and high irradiation
Annual average irradiance:**1700-1850kWh/m²**

Product Type	Tiger Neo 3.0	N-Type BC
Module Power	670W	670W
Module Efficiency	24.8%	24.8%
Module Price	Same Price	
Bifaciality	**85%±5%**	75%±5%
Low Irradiance Performance (200W/m²)	**96.77%**	94.28%
BOS Difference	No Difference	Benchmark
First-year Power Generation / MWh	171,840	166,205
30-year Cumulative Power Generation /MWh	4,890,931	4,730,547
Power Generation Gain	**3.28%**	Benchmark
LCOE	**-3.60%**	Benchmark

*Centralized ground power station; power generation is based on PVsyst simulation with Albedo=20
2P fixed insatllation

In contrast, the two rooftop projects of 500kW in Kagoshima,Japan and 1MW Berlin German features of low contribution of bifacility result in the less energy yield gain over BC of 0.54% and 0.77% respectively mainly due to better low light performance of Tiger Neo 3.0. Set LCOE of BC as baseline, the LCOE of Tiger Neo 3.0 is 1% and 1.11% lower in Kagoshima amd Berlin.

Kagoshima,Japan 500KW | Monsoon climate - four distinct seasons, mild climate
Annual average irradiance:**1387-1460kWh/m²**

Product Type	Tiger Neo 3.0	N-Type BC
Module Power	670W	670W
Module Efficiency	24.8%	24.8%
Module Price	Same Price	
Low Irradiance Performance (200W/m²)	**96.77%**	94.28%
BOS Difference	No Difference	Benchmark
First-year Power Generation / MWh	730	726
30-year Cumulative Power Generation /MWh	20,777	20,664
Power Generation Gain	**0.54%**	Benchmark
LCOE	**-1.00%**	Benchmark

*Distributed rooftop project; power generation is based on PVsyst simulation with Albedo=0

Berlin,Germany 1MW | Climate type: Temperate marine climate - cloudy and rainy
Annual average irradiance:**1100-1300kWh/m²**

Product Type	Tiger Neo 3.0	N-Type BC
Module Power	670W	670W
Module Efficiency	24.8%	24.8%
Module Price	Same Price	
Low Irradiance Performance (200W/m²)	**96.77%**	94.28%
BOS Difference	No Difference	Benchmark
First-year Power Generation / MWh	1,040	1,032
30-year Cumulative Power Generation /MWh	24,897	24,705
Power Generation Gain	**0.77%**	Benchmark
LCOE	**-1.11%**	Benchmark

*Distributed rooftop project; power generation is based on PVsyst simulation with Albedo=0

The two products of same power exhibit different performance in energy generation due to their differences in bifacial factors, performance in low irradiance, first-year degradation values which can be primarily attributed to light-induced degradation (LID).

Conclusion

It should be pointed out that the module prices of Tiger Neo 3.0 and N-type BC and BOS cost are assumed to be the same in LCOE analysis. In most cases, the LCOE of Tiger Neo 3.0 is lower than N-type BC, and more competitive with fixed mounted or tracker system, high ground albedo, high temperature. In rooftop systems where bifacility advantage can not play to full, the better low irradiance performance of Tiger Neo 3.0 translates into longer working hour, which allows it to perform well throughout the year.

Regarding energy generation, Tiger Neo 3.0 is higher than N-type BC, especially in hot and sunny regions with high albedo. This is due to their advantage of high bifaciality and low temperature coefficient. On the other hand, in rooftop installations, particularly in high latitude with low irradiance or humid regions with more rainy and cloudy weather, the advantage of low light performance of Tiger Neo 3.0 prolongs the generation hour per day and per year. In LCOE analysis, Tiger Neo 3.0 has the high priorities in most scenarios and all climate and environment.