

Black & Veatch LCOE Assessment Confirms: Trina Solar's 590W Vertex N PV Modules Reduce CAPEX to Deliver Lowest LCOE

Since the launch of Trina Solar's Vertex N with innovative n-type TOPCon PV technology, world-renowned institutes and international third-party experts have praised the module's performance, reliability, and BOS and LCOE advantages. Black & Veatch (B&V), a global independent services provider to solar projects, completed a CAPEX and LCOE assessment of the 590W Vertex N modules, comparing them to other types of n-type and pPERC PV modules available in the market.

Key Findings

Black & Veatch's assessment found that Trina's Vertex N 590W modules resulted in the **lowest calculated LCOE** of the four modules, costing **\$0.45 less** than the next lowest Generic 610W module. In addition, the assessment showed Vertex N delivered:



The highest number of modules per string: Most balance of system savings on DC wiring costs



The highest specific yield: Best power production per kW of power

The 590W 210mm N-type cell performance ratio closely rivals that of the generic 610W 182mm N-type cell, meaning fewer Vertex N modules are needed to achieve energy production goals for utility-scale solar applications.

Modules Compared

Generic, N-type, 182mm cell module - 610W
 Generic, pPERC, 182mm cell module - 590W
 Generic, N-type, 182mm cell module - 565W
 Trina Vertex N TSM-590NEG19RC.20 - 590W

Project Site and Details

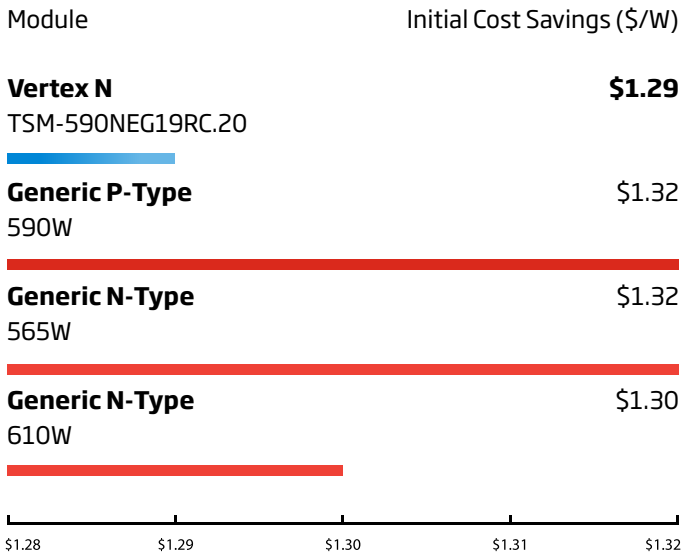
Trina Solar provided B&V with the associated .PAN files for the four module types used in the hypothetical projects and the following high-level assumptions were provided by Trina Solar and agreed upon:

Location:	Denver, Colorado US Latitude: 39.92° Longitude: -104.65°
Annual GHI:	1,745.2 kWh/m ² Average temperature: 10.09°C
Project Size:	50MW (DC, STC)
Project Life:	30 years
Trackers:	Nextracker NX1P single-axis tracker
Central Inverters:	Sungrow SG3600UD-MV
Ground Covered Ratio (GCR):	0.35
DC/AC Ratio:	1.26
Terrain:	Regular lot shape, flat terrain, no irregular shading

Performance Analysis

System Design Parameter	Vertex N TSM-590NEG19RC.20 590W	Generic, pPERC, 182mm cell 590W	Generic, N-type, 182mm cell 565W	Generic, N-type, 182mm cell 610W
System DC Capacity (kWp)	50,023	50,013	50,019	50,010
String DC Voltage	1,500	1,500	1,500	1,500
Modules per String	28	24	26	24
Number of Modules	84,784	84,768	88,530	81,984
Y1 Annual Energy Production [MWh]	100,871	99,562	100,790	100,762
Annual Specific Yield [kWh/yr/kWp]	2,019	1,994	2,018	2,017
Performance Ratio	82.2%	81.2%	82.0%	82.2%

CAPEX Summary



Comparison Results

Vertex N 590W versus P-Type 590W:

Rack & Post Install and Construction ~ \$875K
 Civil Costs: ~ \$122K
 Total initial cost CAPEX savings: ~ \$1.25M (or \$0.0250/Watt)

Conclusion:

Vertex N-type panel beats P-type panel in CAPEX savings.

Vertex N 590W versus Higher Wattage N-Type 610W:

Rack & Post Install and Construction ~ \$531K
 Civil Costs: ~ \$49K
 Total initial cost CAPEX savings: ~ \$547K (or \$0.0109/Watt)

Conclusion:

210mm n-type beats higher wattage 182mm n-type in CAPEX savings.

Vertex N 590W versus Lower Wattage N-Type 565W:

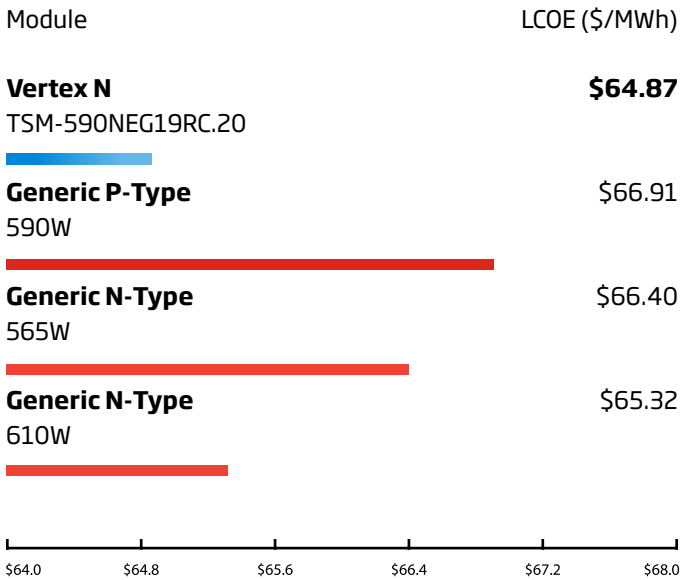
Rack & Post Install and Construction ~ \$1.17M
 Total initial cost CAPEX savings: ~ \$1.63M (or \$0.0326/Watt)

Conclusion:

210mm n-type beats lower wattage 182mm n-type in CAPEX savings.





LCOE Summary





The difference in project construction CAPEX and LCOE arises from the varying balance-of-system (BOS) costs, including rack, post, and labor. These costs are impacted by the module characteristics and the amount of rack and posts required to meet the constant capacity assumption made throughout the hypothetical project. A project utilizing a module with lower wattage will require more modules and therefore have higher BoS costs, including additional expenses for acreage, siting, clearing and grading, racking quantity, cabling, and associated labor and installation.

Vertex N reduces BOS costs by increasing overall module wattage and voltage, translating into shorter string lengths and fewer modules required to meet the constant capacity assumption made throughout the hypothetical project. This results in the lowest LCOE and the best utility-scale solar project value.

Results & Assessment

-  Trina Vertex N requires the least CAPEX to attain the most energy goals.
-  The lowest LCOE implies the best performance ratio, which thus gives you the highest annual specific yield.

-  Vertex N with 210mm cells beats 182mm n-type by 1 cent (higher wattage) to 3 cents (lower wattage).
-  Vertex N-type panel produces more energy than P-type under the same conditions, with **overall cost savings of 2.5 cents per watt.**

About Trina Solar

Trina Solar invests heavily in technological innovation. After launching the Vertex series based on the 210mm technology platform, Trina Solar ushered in the n-type TOPCon era, based on its golden dimensions concept and all-scenario highly reliable and high-performance Vertex n-type products. Combining 210mm technology and n-type TOPCon Advanced technology, Trina's mass-produced modules' power output is forecast to exceed 700W next year.

The company's cumulative shipments of 210mm modules have reached 65GW+, ranking it in the top 210mm module shipments worldwide. The Vertex series has been widely recognized by customers globally, opening a new channel to reduce the cost of electricity and guarantee the long-term stable returns of power plants. Trina Solar and eight other module manufacturers agreed on standardizing dimensions,

delivering high customer value, and moving the industry toward adopting 210mm technology.

As the world's leading provider of PV smart energy and energy solutions, Trina Solar is committed to bringing its product advantages into working with global partners to accelerate the global application of smart energy and create a new world of carbon-free energy.

www.trinasolar.com/us | info@trinasolar.com

7100 Stevenson Blvd
Fremont, California 94538