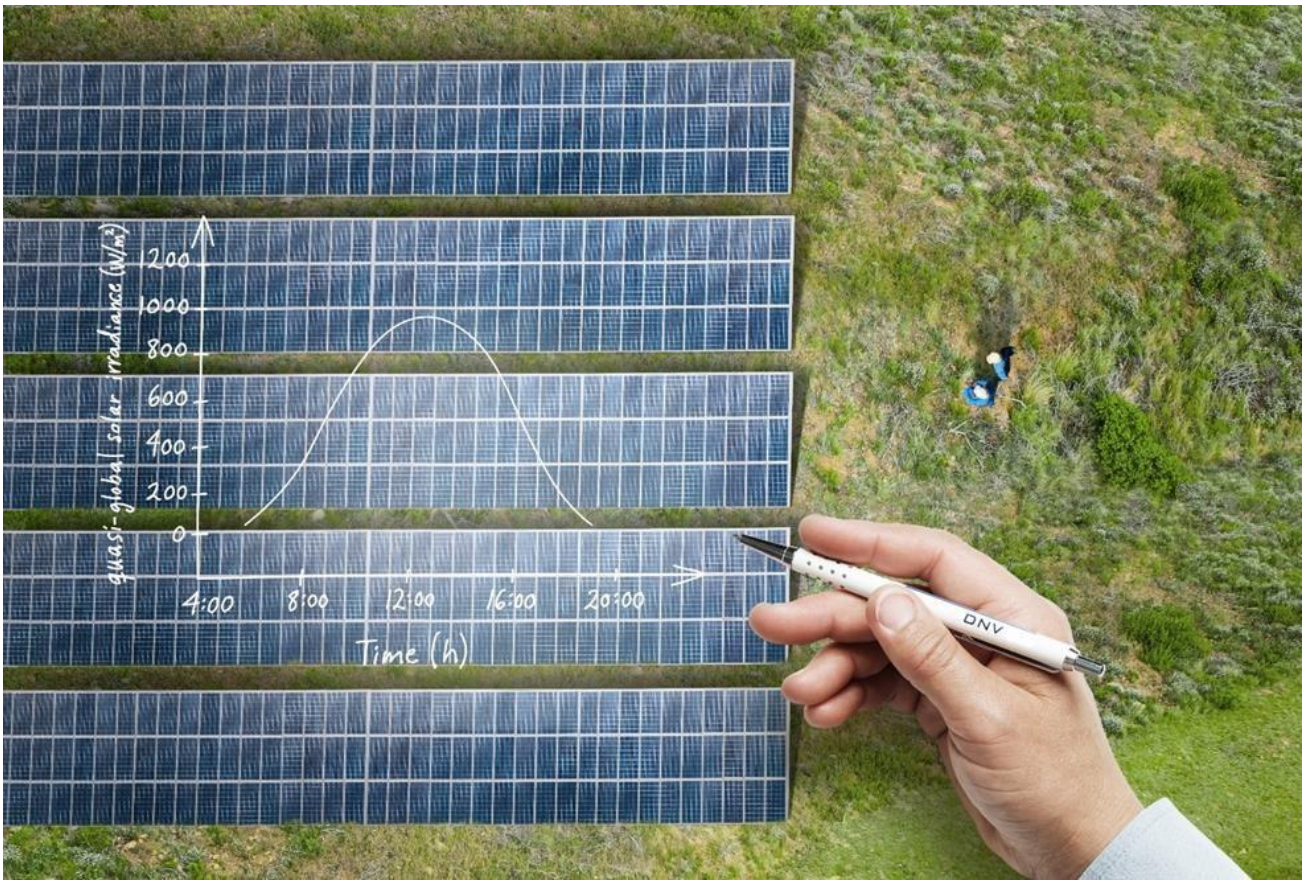
Highlights of DNV's in-depth technical review of Canadian Solar's TOPCon modules



DNV has conducted technical due diligence on Canadian Solar and Canadian Solar's eight new TOPCon modules belonging to the bifacial TOPBiHiKu series and monofacial TOPHiKu series. The report is available from Canadian Solar [link].

This DNV review covered technologies, sustainability, field testing, compatibility, LCOE, warranty and, notably, Canadian Solar's reliability, quality systems, testing programs, and factory audits. DNV's report reflects that Canadian Solar has a deep understanding of quality manufacturing as well as cell and module technologies, and underscores that Canadian Solar has a significant commitment to reliability and quality built into its corporate culture and across operating divisions.

Canadian Solar

Canadian Solar is vertically integrated and produces silicon ingots, wafers, photovoltaic cells, solar modules, and solar system solutions. Canadian Solar ranks as among the top ten largest PV manufacturers and has shipped more than 133 GWp of modules cumulatively to 160 countries. At the end of 2024, Canadian Solar expects to have production capacities as follows: 25 GWp of ingot production, 31 GWp of wafer production, 48 GWp of cell production and 61 GWp of module production.

TOPBiHiKu & TOPHiKu TOPCon module performance and design

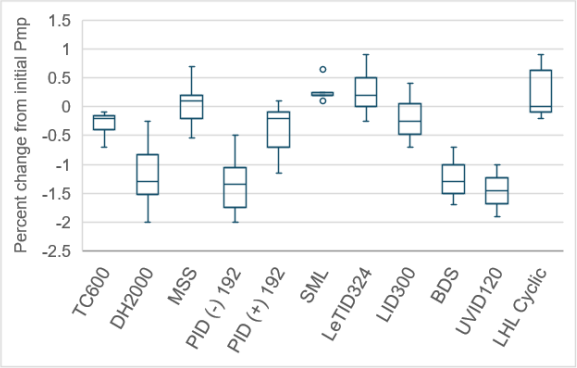
Canadian Solar's TOPCon modules cater to all industry segments with bifacial TOPBiHiKu module series and monofacial TOPHiKu module series. The Canadian Solar TOPCon modules are offered with half-cut cells of 210 x 210 mm for the CS7 module series, 182 x 182 mm for CS6 module series, 182.2 x 191.6 for the CS6.1 module series, and 182.2 x 210 for the CS6.2 module series. With exceptional performance specifications (top power bins reaching ≥23% module efficiencies, Pmax temperature coefficient of -0.29%/°C, a bifaciality of ~80% for bifacial modules). DNV's experts have come to the conclusion that the fielded performance of these modules is industry leading.

DNV has reviewed 3rd party test reports covering over 80 tests of the bifacial TOPBiHiKu and monofacial TOPHiKu modules for 8 BOMs. **Not only is such comprehensive testing uncommon in the PV industry, but TOPBiHiKu modules demonstrate exceptional durability across all extended-duration tests with degradation below 2%.**

Types of BOM-specific tests totalling over 80 3rd party tests on Canadian Solar's TOPcon modules:

- Thermal cycling testing (3x 200 cycles)
- Mechanical stress sequence testing on various mounts
- Potential-induced degradation testing (2x or 3x 96 hours)
- Light & elevated temperature-induced degradation testing (LeTID)
- Static mechanical load testing on various mounts
- Damp heat testing (2x 1000 hours)
- Light-induced degradation testing (LID)
- Hail testing
- UV-induced degradation testing (UVID)
- Cyclic loading testing

Test results demonstrate the high durability of the Canadian Solar TOPCon module designs and expert BOM selection and engineering.



Quality and Manufacturing

DNV's report found that that Canadian Solar has a complete suite of reliability programs from the new product inception and design to the ongoing production monitoring. For new product development, Canadian Solar has defined an internal process called integrated product development (IPD) which was utilized for the TOPCon modules. The IPD process includes 'design for reliability' methodology, and a rigorous qualification stage including process- and design- failure mode analysis (PFMEA/DFMEA), product laboratory testing, and BOM finalization improving manufacturing quality.

The report details Canadian Solar's component-level and module-level ongoing tests, some of which are Canadian Solar's own design. DNV determined that these tests exceed industry standards, and it is the opinion of DNV's experts that these tests should be considered as a potential best practice for all component manufacturers.

Types of component-level and module-level testing routinely performed by Canadian Solar:

- Cell-level current induced degradation (CID) testing
- Cell-level 4-point bending
- 2 types of cell-level corrosion tests
- Solder flux testing
- Cell-level UV testing
- 4 types of glass tests
- Frame component testing
- Module level fatigue testing
- Mechanical load on tracker mounts
- Module-level vibration testing

Furthermore, DNV's report shows that Canadian Solar's component validation and module service life modelling to be best-in-class for the industry.

Two Canadian Solar factories, at which TOPCon modules are manufactured, were audited across a wide scope covering factory management, materials control, and each processing step. The audit also highlighted additional aspects of the factories including Canadian Solar's supplier quality management, use of MES and SPC, and human resource management. Both factories were rated 'Above average" and therefore leading in the industry.

High level topics included in the factory audits of Canadian Solar's TOPCon factories:

- Incoming materials management
- Production area cleanliness and safety
- Production process
- Equipment management
- Non-conformance handling
- Off-line testing review
- Quality management
- Employee management

> **"The rigor and extent of Canadian's quality systems, testing, and manufacturing, serves as an example for the entire PV industry". Parth Bhatt, Ph.D. DNV**

DNV's assessment finds that Canadian Solar's sustainability achievements include a reduction in environmental impacts and green-house gas emissions from the manufacturing of PV modules and systems as well as a commitment to equity, worker safety, and human rights.

DNV also reviewed field test results including nine months of field data showing ~1.16% gain of the bifacial TOPCon module (CS6W-TB-AG) compared to the bifacial PERC module (CS6W-MB-AG).

DNV has reviewed materials provided by Canadian Solar on the compatibility of the TOPCon modules with trackers and inverters. Canadian Solar has an extensive tracker qualification program that reviews multiple aspects of module-tracker compatibility. Compatibility letters are only issued after tracker qualification testing has been successfully completed. DNV views the Canadian Solar tracker compatibility program to be comprehensive and rigorous.

About the Authors

Henry Hieslmair, Ph.D., has been involved in PV materials, cell physics, and manufacturing for over 30 years. Henry joined DNV in 2017 and has been focused on various module topics including photovoltaic system degradation, PV module useful life assessments, PV module waste volume, toxicity and circularity (Nature Physics 19.10 (2023)), module O&M modelling, utility plant construction automation, and emerging module technologies.

Parth Bhatt, Ph.D., has been involved in PV materials and cell physics over 11 years. He has overseen module manufacturing including quality systems at various PV manufacturers for over 7 years. Parth joined DNV in 2023 and has been focused on various module technical due diligence, factory audits, and emerging module technologies.

About DNV

DNV is an independent assurance and risk management provider, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry standards, and inspires and invents solutions.

DNV provides assurance to the entire energy value chain through its advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, the assurance provider helps industries and governments to navigate the many complex, interrelated transitions taking place globally and regionally, in the energy industry. DNV is committed to realizing the goals of the Paris Agreement and supports customers to transition faster to a deeply decarbonized energy system.

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About Canadian Solar Inc.

Canadian Solar was founded in 2001 in Canada and is one of the world's largest solar technology and renewable energy companies. It is a leading manufacturer of solar photovoltaic modules, provider of solar energy and battery storage solutions, and developer of utility-scale solar power and battery storage projects with a geographically diversified pipeline in various stages of development. Over the past 22 years, Canadian Solar has successfully delivered over 102 GW of premium-quality, solar photovoltaic modules to customers across the world. Likewise, since entering the project development business in 2010, Canadian Solar has developed, built, and connected over 9 GWp of solar power projects and over 3 GWh of battery storage projects across the world. Currently, the Company has approximately 700 MWp of solar power projects in operation, 8 GWp of projects under construction or in backlog (late-stage), and an additional 17 GWp of projects in advanced and early-stage pipeline. In addition, the Company has a total battery storage project development pipeline of 52 GWh, including approximately 2 GWh under construction or in backlog, and an additional 50 GWh at advanced and early-stage development. Canadian Solar is one of the most bankable companies in the solar and renewable energy industry, having been publicly listed on the NASDAQ since 2006. For additional information about the Company, follow Canadian Solar on LinkedIn or visit www.canadiansolar.com.