

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



DNV Energy USA has conducted a comprehensive technical due diligence on Canadian Solar and four of their new HJT modules belonging to the Low Carbon HiHero module series. The report is available from Canadian Solar [\[link\]](#).

This wide-spanning DNV review covered technologies, sustainability, field testing, compatibility, LCOE, warranty and, notably, Canadian Solar's reliability, quality systems, testing programs, and factory audits. Through DNV's lengthy discussions with Canadian Solar technical staff, DNV views Canadian Solar to have demonstrated a deep understanding of quality manufacturing as well as cell and module technologies. DNV concludes 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 170 GWp of modules cumulatively to 160 countries. At the end of 2025, Canadian Solar expects to have production capacities as follows: 31 GWp of ingot production, 37 GWp of wafer production, 32 GWp of cell production and 51 GWp of module production.



Low Carbon HiHero HJT module performance and design

Although solar panels generate electricity with zero operational carbon emissions, producing solar modules and system components still requires energy. Reducing the energy used in manufacturing is therefore just as important as using clean energy sources to lower the embedded carbon of solar modules and overall greenhouse gas emissions. Canadian Solar's Low Carbon HiHero HJT module achieves a carbon footprint as low as 285 kg CO₂-eq/kWp—an approximately 17% reduction compared with mainstream TOPCon and back-contact (BC) technologies. This reduction is enabled by several Canadian Solar innovations, including dual half-cut wafer design, ultra-thin wafers, and the inherently lower-energy processing of HJT technology.

Canadian Solar's Low Carbon HiHero modules cater to the commercial and utility segments. The Canadian Solar modules are offered with half-cut cells of 182.2 x 105 mm for the CS6.2 module series. With exceptional performance specifications, e.g. top power bins reaching 24.6% module efficiencies, P_{max} temperature coefficient of -0.24%/°C, and a bifaciality of ~85% for bifacial modules, DNV expects the fielded performance of these modules to be leading in the industry.

Types of BOM-specific 3rd party tests on Canadian Solar's Low Carbon HiHero HJT 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

DNV reviewed over twenty 3rd party test reports including EL images, pre- and post-test. DNV notes that the HJT modules demonstrate exceptional durability across all extended-duration tests with nearly all power degradation results below 2% from initial power. DNV views these exceptional test results to demonstrate the high durability of the Canadian Solar Low Carbon HiHero module designs and expert BOM selection and engineering.

Addressing industry concerns about UV induced-degradation, DNV notes that Canadian Solar Low Carbon HiHero UVID test performance is similar to PERC technologies and that Canadian Solar is leading the development of IEC standards for module and cell UVID testing. Canadian Solar has in-line process quality control testing that includes cell-level UVID testing as well as ongoing reliability monitoring on mini-modules, full-sized modules, and outdoor monitoring for UVID.

Quality and Manufacturing

DNV notes 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 Low Carbon HiHero HJT 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.

In the report, DNV details Canadian Solar's industry-leading component-level and module-level ongoing tests some of which are Canadian Solar's own design. In many instances, DNV considers these tests as going beyond basic industry standards.

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
- 4 types of glass tests
- Frame component testing
- Module level fatigue testing
- Mechanical load on tracker mounts



- Cell-level UV testing
- Module-level vibration testing

Furthermore, DNV views Canadian Solar's component validation and module service life modelling to be unique and exceptional in the industry.

A Canadian Solar factory, at which Low Carbon HiHero HJT modules are manufactured, was 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. The factory rated 'Above average' and therefore leading in the industry.

High level topics included in the factory audits of Canadian Solar's HJT 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 also notes that Canadian Solar has shown significant accomplishments in sustainability documented in their 2024 ESG Report. Canadian Solar is significantly reducing their environmental impacts and the green-house gas footprint of their PV modules and systems. Canadian Solar also demonstrates a commitment to equity, worker safety, and human rights.

DNV also reviewed field test results including 7 months of field data showing ~1.2% gain of the Low Carbon HiHero HJT modules compared to TOPCon modules.

DNV has reviewed materials provided by Canadian Solar on the compatibility of the Low Carbon HiHero HJT 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. For additional information about the Company, follow DNV on LinkedIn or visit www.dnv.com.

About Canadian Solar Inc.

Canadian Solar is one of the world's largest solar technology and renewable energy companies. Founded in 2001 and headquartered in Kitchener, Ontario, the Company is a leading manufacturer of solar photovoltaic modules; provider of solar energy and battery energy storage solutions; and developer, owner, and operator of utility-scale solar power and battery energy storage projects. Over the past 24 years, Canadian Solar has successfully delivered nearly 170 GW of premium-quality, solar photovoltaic modules to customers across the world. Through its subsidiary e-STORAGE, Canadian Solar has shipped over 16 GWh of battery energy storage solutions to global markets as of September 30, 2025, boasting a \$3.1 billion contracted backlog as of October 31, 2025. Since entering the project development business in 2010, Canadian Solar has developed, built, and connected approximately 12 GWp of solar power projects and 6 GWh of battery energy storage projects globally. Its geographically diversified project development pipeline includes 25 GWp of solar and 81 GWh of battery energy storage capacity in various stages of development. Canadian Solar has been publicly listed on the NASDAQ since 2006. For additional information about the Company, follow Canadian Solar on LinkedIn or visit www.canadiansolar.com.