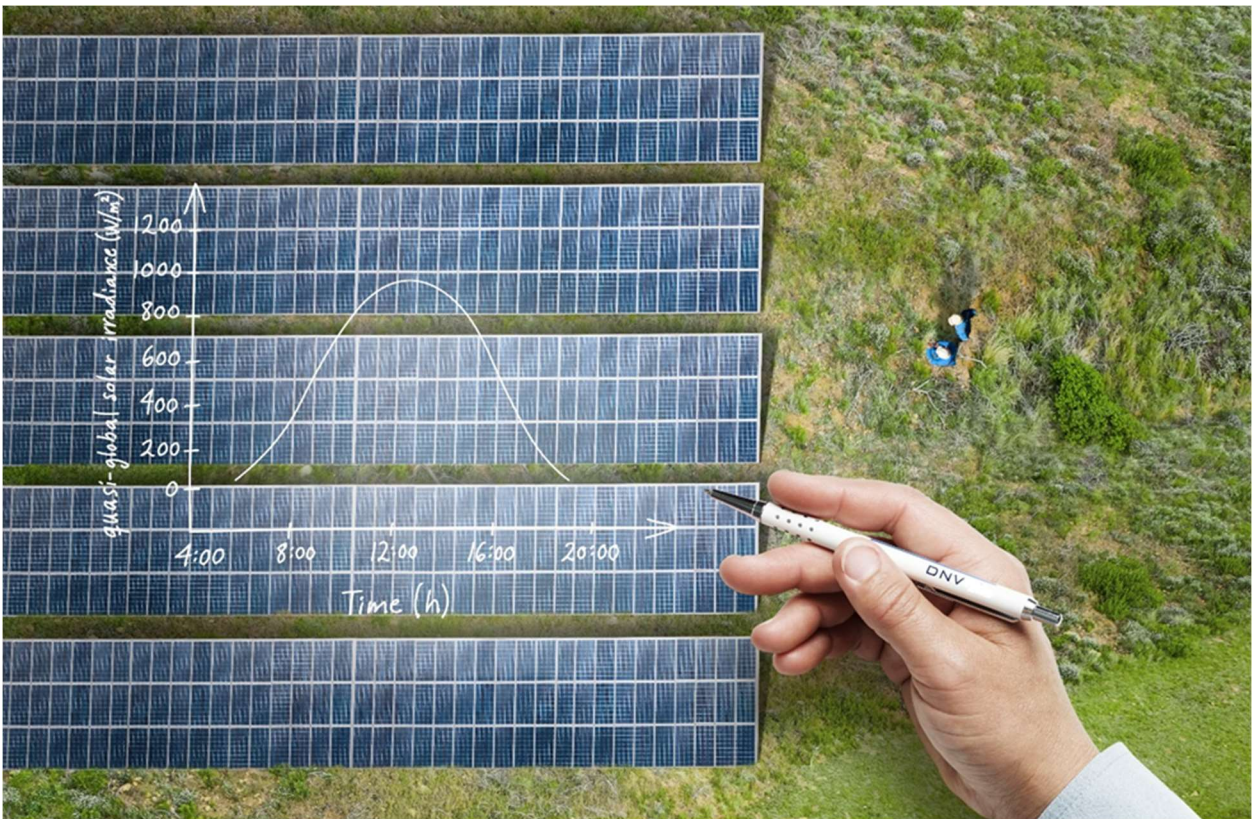


Summary of DNV's Canadian Solar TOPCon Technology Review Report



Page 2 of 5

DNV has completed a comprehensive technology review of the new Canadian Solar modules utilizing TOPCon cells shown in Table 1. The review covered the company, modules, performance, reliability, compatibility, field data, and an LCOE analysis.

Canadian Solar is a vertically-integrated manufacturer producing silicon ingots, wafers, photovoltaic cells, and solar modules with capacities shown in Figure 1. DNV notes that Canadian Solar has a long history of manufacturing PV modules and has demonstrated a deep understanding of quality manufacturing as well as cell and module technologies as evidenced by their innovative modules and our lengthy discussions with Canadian Solar technical staff.

DNV also notes that Canadian Solar has demonstrated major sustainability accomplishments as documented in their 2022 ESG Report. Canadian Solar is significantly reducing their environmental impacts and the green-house gas footprint of their PV modules and systems as shown in Figure 2. Canadian Solar also demonstrates commitments to equity, worker safety, and human rights.

Table 1: Canadian Solar TOPCon modules reviewed

Module series	Cells	Faciality
TOPBiHiKu6 CS6W-TB-AG	144	bifacial
TOPBiHiKu7 CS7L-TB-AG	132	bifacial
TOPBiHiKu7 CS7N-TB-AG	120	bifacial

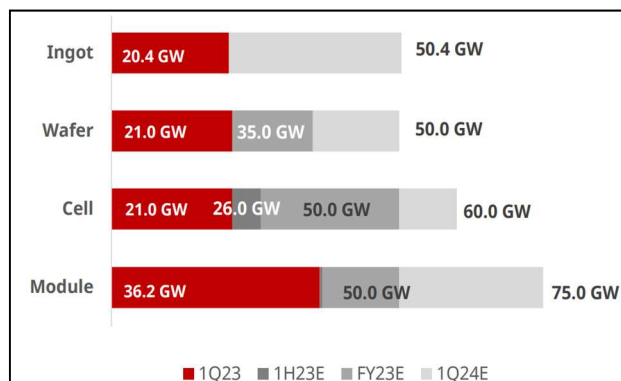


Figure 1: Canadian Solar manufacturing capacities
(According to CSIQ 2023 Q1 Financial Report)

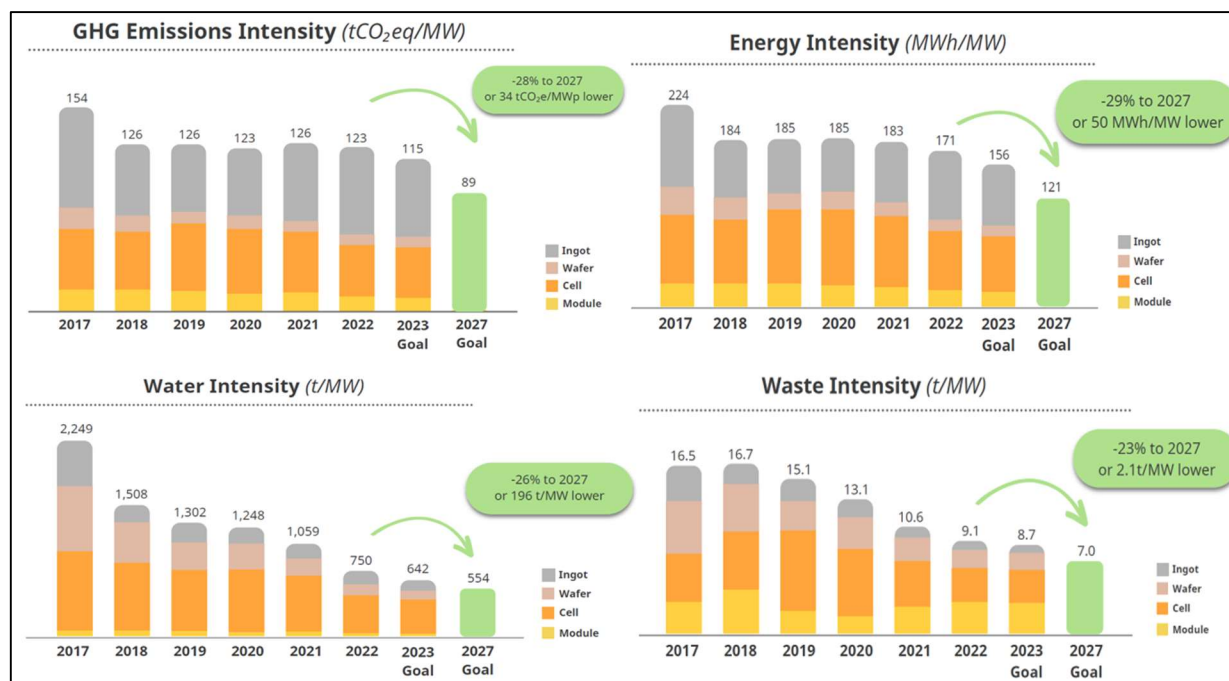


Figure 2: Canadian Solar's greenhouse gas emissions, energy, water, and waste intensity metrics and targets

The Canadian Solar bifacial TOPCon modules are offered with either 210 mm (CS7) or 182 mm (CS6) sized half-cut cells. Both module series are of bifacial dual-glass construction and feature front EPE encapsulation and super multi-busbar

Page 3 of 5

technology. All three of the CS7 modules listed in Table 1 possess industry-leading module efficiencies, up to 22.6%, temperature coefficients as low as $-0.29\%/^{\circ}\text{C}$, and bifaciality of $\sim 80\%$, which indicate that the expected field performance of these modules would be better than that of typical commercial modules. DNV notes that n-type cells are inherently less susceptible to LID and LeTID which is borne out by tests on these modules.

DNV has reviewed extensive information and documentation regarding Canadian Solar's broad efforts around module reliability. Canadian Solar actively collaborates with various research institutes (see Figure 3) on a wide variety of reliability topics to strengthen its own design and testing evaluations. These research programs provide Canadian Solar with relevant and important insights.

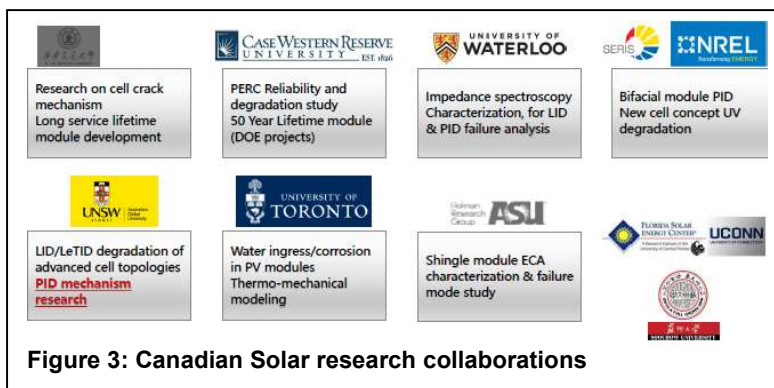


Figure 3: Canadian Solar research collaborations

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 validation.

DNV commends Canadian Solar's rigorous component validation process and has reviewed its extensive UV, PID, and damp heat testing for encapsulants, as well as accelerated testing for new junction box designs. DNV views Canadian Solar's component validation and service life modelling to be leading in the industry. Canadian Solar also maintains high reliability through a re-testing program in which modules are put through a suite of tests for each BOM change or modification, to ensure high reliability across all BOMs. DNV finds the re-testing requirements to be extensive and thorough.

DNV notes that Canadian Solar performs on-going component-level and module-level testing, some of which are of its own design, going beyond normal industry standards. Examples of such testing include two types of cell-level corrosion tests and cell-level UV testing. Additional examples of testing include glass temper and 4 point bending, frame component testing, and module-level fatigue, mechanical load, and vibration testing (see Figure 4). Some of the Canadian Solar ongoing testing is targeted at concerns raised by the research community which thereby ensures the high damp heat and UV durability of the TOPCon modules. DNV commends Canadian Solar's on-going component-level and module-level testing programs.



Figure 4: Vibration testing

As part of the report, a factory audit was performed at the module factory in Jiaying, China which is manufacturing the TOPCon modules. (TOPCon module manufacturing is planned for Thailand factories as well.) The audit highlighted not only the production process, but additional aspects of the factory including Canadian Solar's supplier quality management, use of MES and SPC, and human resource management. Based on the results of the audit, DNV views the Canadian Solar quality systems in the audited factory to be leading that of other module factories in the industry and to present a low risk of module underperformance.

Page 4 of 5

These technologies, in conjunction with Canadian Solar's integrated product development process, reliability assurance program (including on-going reliability testing), component-level testing for service life, and mechanical testing have led to exceptional durability as evidenced by P_{max} degradation levels below 2% across a wide range of 3rd party extended-duration tests as shown in Table 2. DNV views the extended-duration test to demonstrate high durability of the module design.

Table 2 Summary of 3rd party extended-duration test results CS7N-TB-AG

Test	Hours or cycles	Num. tested	Description	Deg. (%)	EL results	DNV comment
Thermal cycle	600	3	600 thermal cycles between -40 °C and 85 °C	-0.2	Changes observed	leading durability
Damp heat	2000	2	2000 hours, 85 °C, 85% RH	-0.9	Minor changes	leading durability
Mechanical stress sequence	1000/50/10	1	SML (3600/1600Pa) + DML + TC50 + HF10	0.1	Minor changes	leading durability
PID (-)	192	2	192 hr, 85°C, 85% RH, -1500 V	-1.7	Changes observed	PID resistant
PID (+)	192	2	192 hr, 85°C, 85% RH, +1500 V	-0.3	No changes	PID resistant
Backsheet stress sequence	200/2x[60/10]	2	DH200, 2x[UV60, HF10]	-1.7	Changes observed	leading durability
LeTID	324	2	324 hours, 75°C, 2x(Isc-Imp)	-0.1	No changes	low LeTID risk
Light-induced degradation	300	4	Natural sunlight exposure to 300 kWh/m ²	-0.5	No changes	demonstrates low LID risk
Static mechanical load	5400/2400	4	1hr 5400 Pa front, 1hr 2400 Pa rear, 3x	+0.2	No changes	leading durability
LHL Cyclic loading test	1920	1	Multiple load cycles, Pt=1920 Pa using 4 bolts	-0.2	No changes	Frame passes
Hail test	35	1	35 mm hail, 11 impacts + DML + TC50 + HF 10	-0.1	Minor changes	
Ultraviolet	90	1	90 kWh/m ² UV(280 - 350 nm)	-1.3	No changes	
Were modules randomly sampled by 3rd party?			Yes			

DNV views Canadian Solar to be capable of supplying PV modules that provide enhanced quality and reliability over similar modules in the market. Based on test results, factory audit, BOM review, and analysis of Canadian Solar's testing and quality efforts, DNV expects the TOPCon modules to deliver high energy yields over an expected useful life exceeding 30 years (assuming proper system design). Additionally, LCOE modelling suggests that in a utility model, the TopBiHiKu6 and TopBiHiKu7 modules provide a 2.5% and a 3.2% reduction in LCOE, respectively, over PERC modules using 144 half-cut cells of 182 mm width.



We are the independent expert in assurance and risk management. Driven by our purpose, to safeguard life, property and the environment, we empower our customers and their stakeholders with facts and reliable insights so that critical decisions can be made with confidence. As a trusted voice for many of the world's most successful organizations, we use our knowledge to advance safety and performance, set industry benchmarks, and inspire and invent solutions to tackle global transformations.