

HiKu7/BiHiKu7 Introduction

Feb. 2021

Tu Nguyen

665W The New Era

Technology Leader, Always

2008 : 6-Inch Cell Modules

2010 : Dual-Cell, Double-Glass Modules

2015 : Black Silicon Cell

2017 : 5BB Dual-Cell + Bifacial Module

2018 : 166mm MBB Dual-Cell / 400W+ Module Era / Poly-PERC

2019 : P5, High Efficiency Mono-PERC

2020 : 500W+/600W+ Era

**Technology
Leader,
Always**

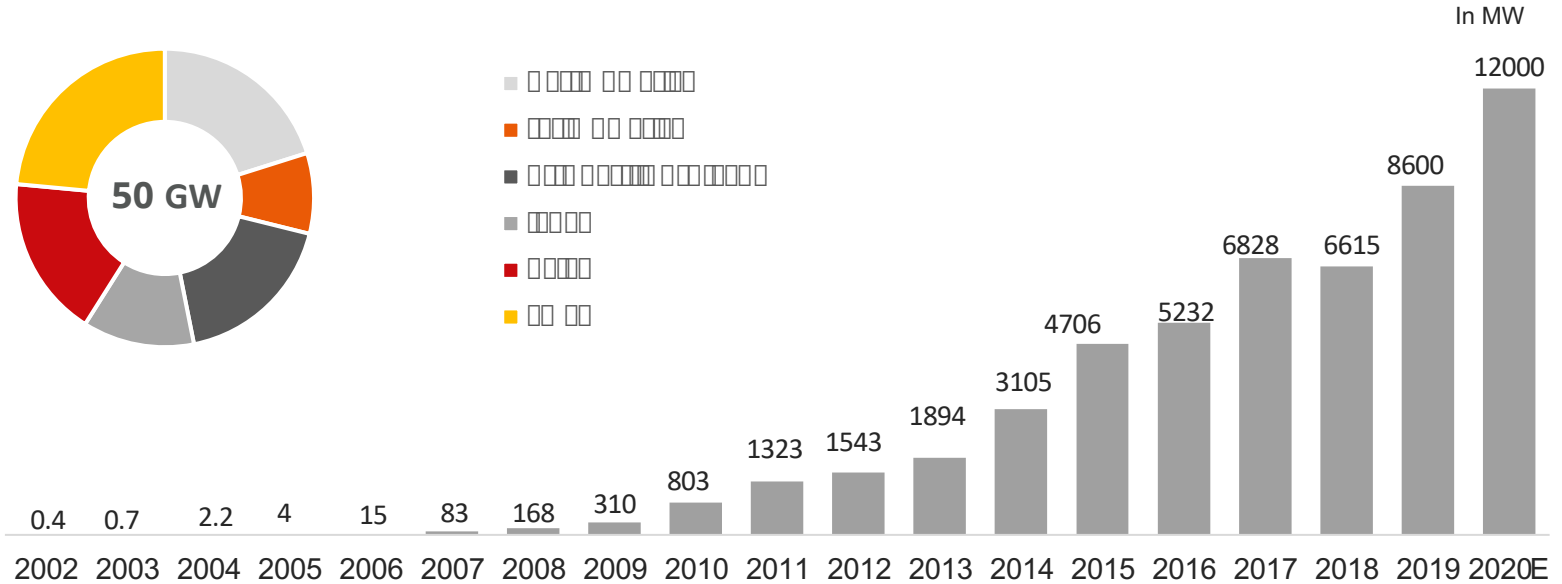
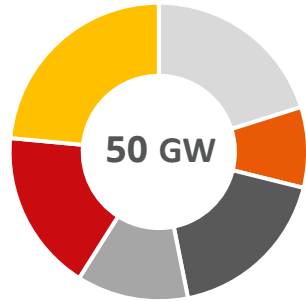
20 Years of Innovation

1,938 Granted Intellectual Properties

996 IP Applications in Process

No. 1 True Global Player

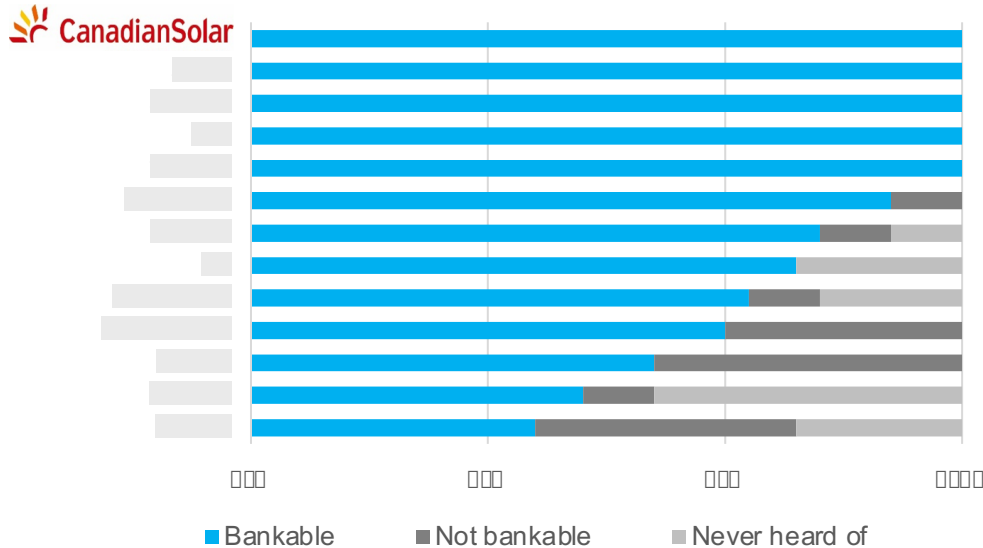
150 + Countries, 50 GW Module Shipment



Top-tier Bankable Solar Module Brand

No.1 Most Bankable Module Supplier by BNEF with 100% bankability for 6 consecutive years

2020 BloombergNEF's PV module bankability results

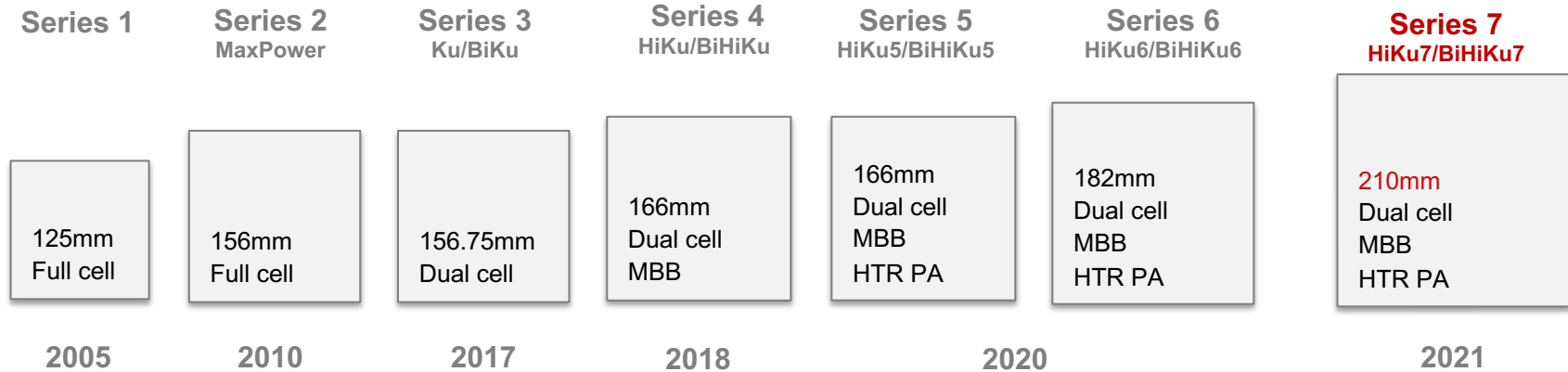


Key factors for the rating:

- **Quality**
- **Reliability**
- **Services**
- **Warranty**
- **Financial strength**
- **Track record**

Solar brand bankability ratings are used by financial institutions across the world for credit analysis, indicating the likelihood that projects using the said solar products will be offered non-recourse financing by banks. Factors considered for solar brand bankability ratings include quality and reliability of products and services, warranties, financial strength and track record.

20 Years of Module Technology Leadership



We were 1st to launch:

5BB Dual-cell

MBB Dual-cell

Bifacial Dual-cell

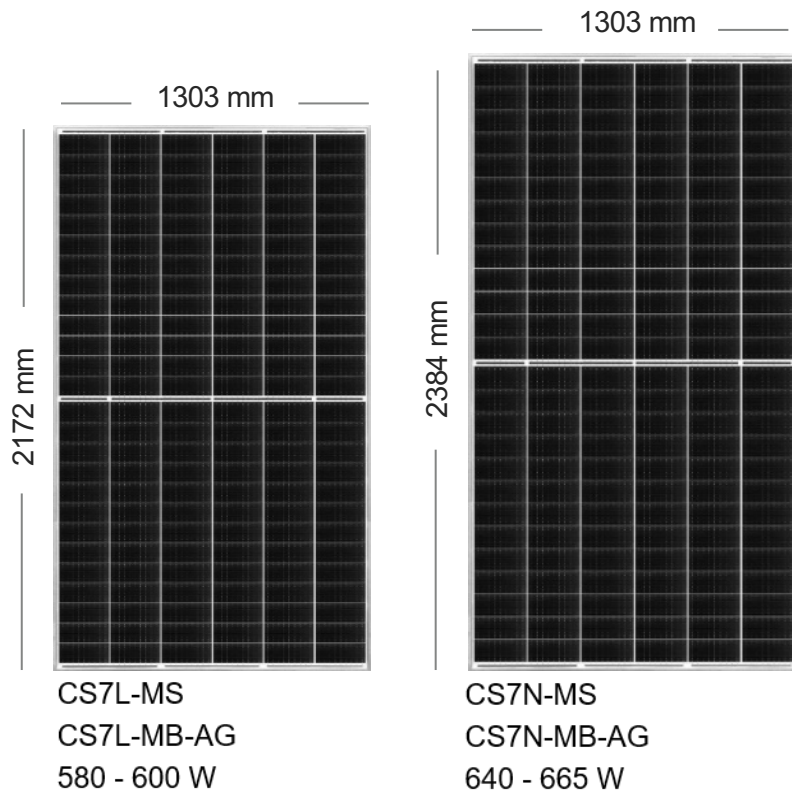
166mm cell

400W+ crystalline silicon module

182mm cell (co-launch)

210mm cell + HTR

HiKu7/BiHiKu7 Product Portfolio



665W
Power Output

21.4%
Module Efficiency

210 mm cells

Dual cells

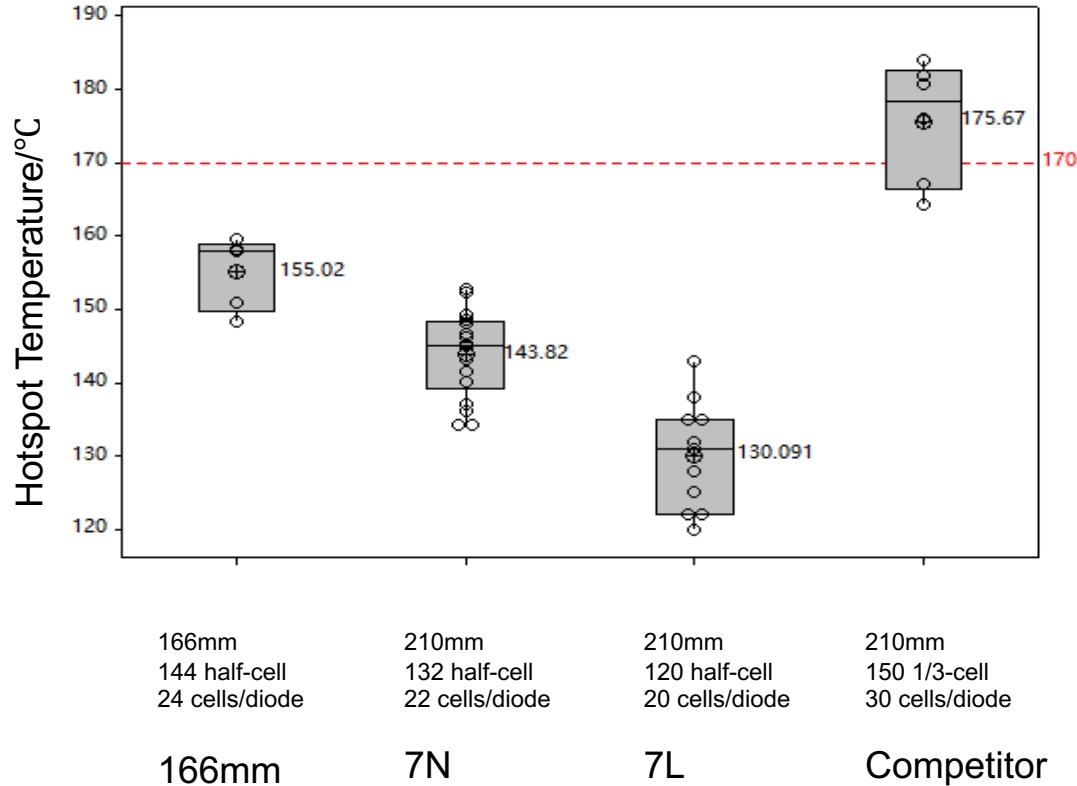
120 format & 132 format

Mono facial & Bifacial

Why 210mm, half cut and 6 strings?

Half-cut Plus Less Number of Cells: **Excellent** Hotspot Performance

Hotspot Temperature Comparison



$$P_{\text{hotspot}} = P_{\text{illu}} + (S-1) * P_{\text{normal}}$$

Note:

This equation holds when bypass diode is activated

P_{hotspot} is the total heat generated at hotspot cell

P_{illu} is the heat generated by sunshine at hotspot cell

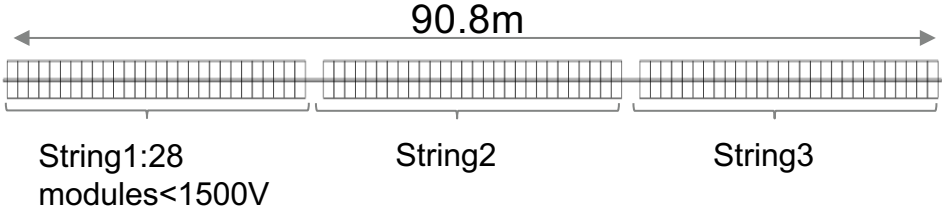
S is the number of cells series connected in one string

P_{normal} is the power generated by one normal cell

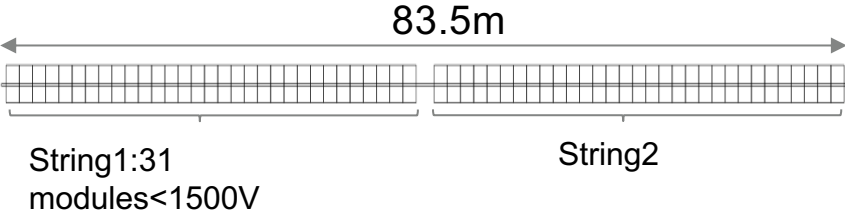
Wafer size has mild influence on the hotspot temperature. The number of cells per string in one diode dominates the hotspot performance.

7 series 7L/7N modules using 20/22 cells per diode show less risk than 166mm/144 half-cell because of 16.7% and 8.3% less cells per diode. 210mm/150 1/3-cell design has high hotspot risk because of 30 cells (25%+) per diode.

High Wattage, Efficiency and Current **Cuts** Mounting structure cost Significantly



37.4KW/Row
166mm/144half-cell/445W



40.3KW/Row **8%+**
7N: 210mm/132half-cell/650W

More power per tracker length: With 7% shorter tracker, support 8% more power

High Wattage, Efficiency and Current **Cuts** DC Electric BOS Significantly

12.5KW/String
166mm/144half-cell/445W



20.2KW/String **+61.6%**
7N : 210mm/132half-cell/650W

138Kg/MW String cable
24 strings/Combiner box, 299kWp/Box

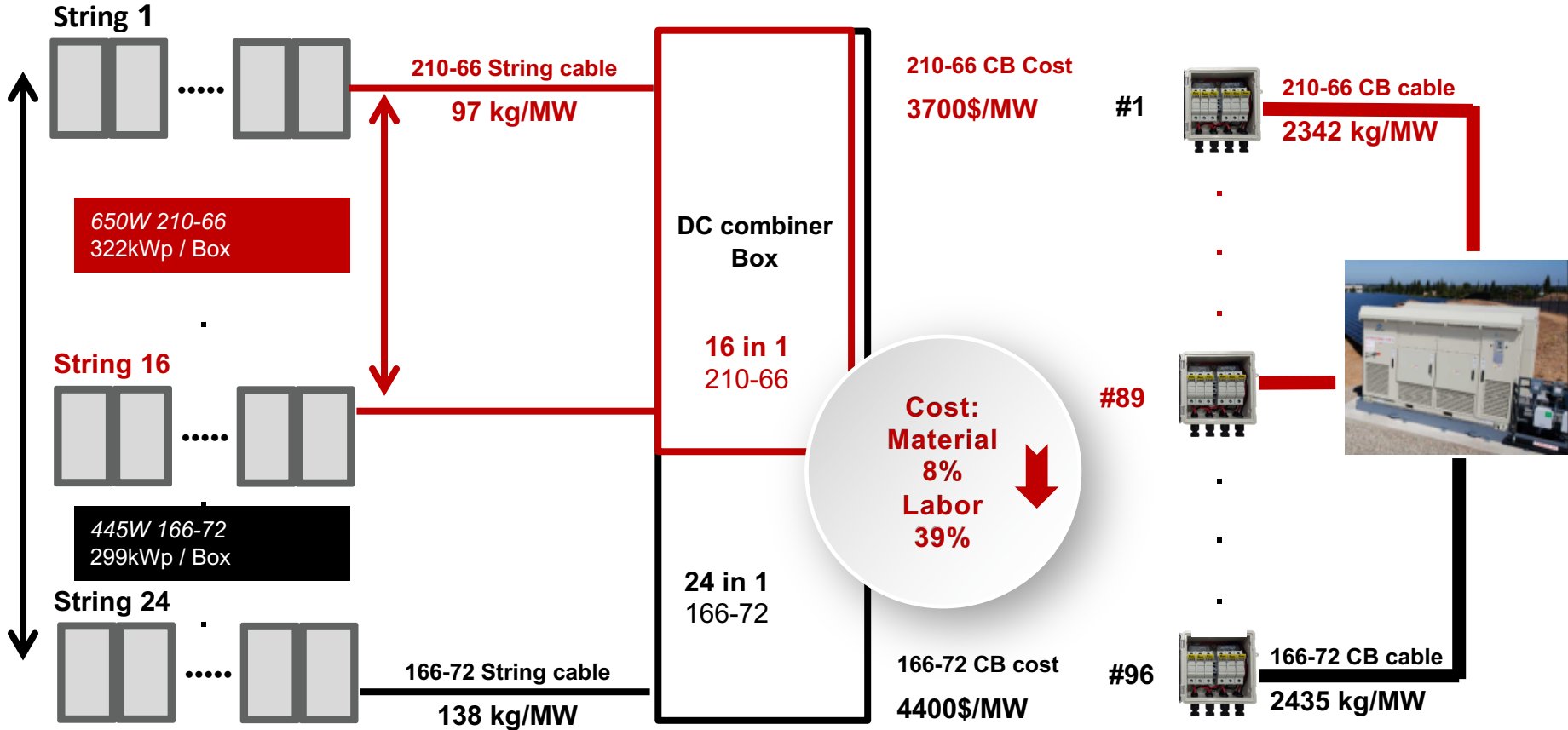


97Kg/MW String cable **-29.7%**
16 strings/Combiner box, 322kWp/Box

Note : Based on a 27.3MW utility project (1P tracker and central inverter) in Los Angeles. Assume 4mm² cable diameter for 166mm/144 half-cell modules and 6mm² for 7N(210mm/132half-cell) modules.

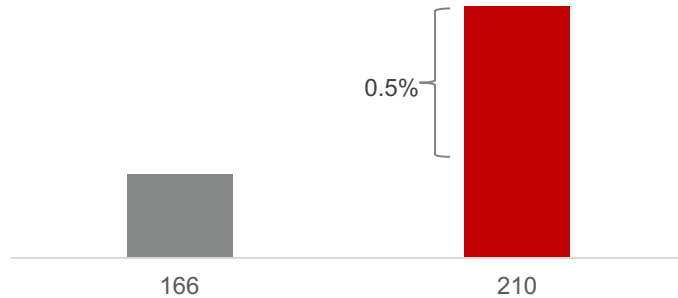
Significant less usage of string cable and other DC electric component because of above **30% less number of strings**

High Wattage, Efficiency and Current **Cuts** DC Electric BOS Significantly



High Current Brings **More** Power Under Low Irradiance

200W/m² Low irradiance performance

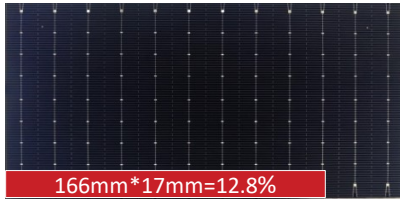
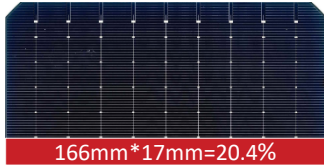


$$P_{\text{resistance_loss}} = I^2 * R$$

$$P_{\text{resistance_gain}} = (I_{1\text{sun}}^2 - I_{0.2\text{sun}}^2) * R$$

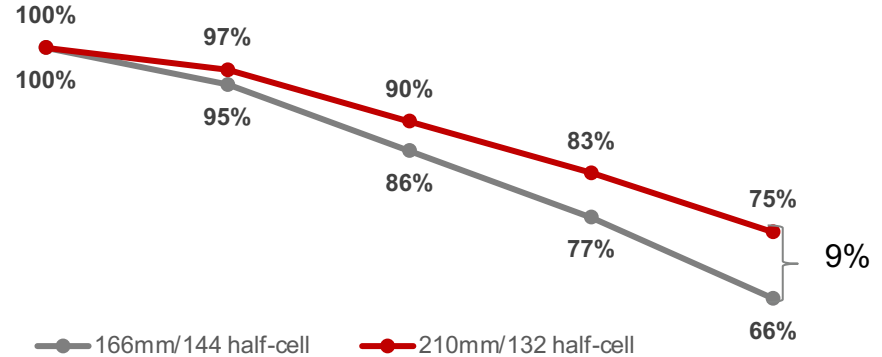
At low irradiance, resistance loss becomes resistance gain. This gain is proportional to the square of the current. Therefore, relatively speaking, when cell size increases, there is more resistance gain at low irradiance. As a result, the low light performance becomes better.

Larger Size Guarantees **Better** Shading Performance



The same area has a smaller percent of shading on bigger cell

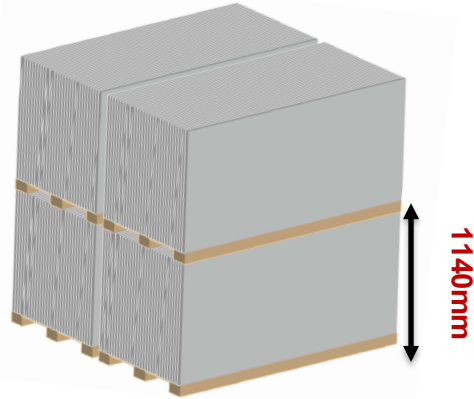
Relative output power under shading



166mm*0mm 166mm*17mm 166mm*33mm 166mm*50mm 166mm*66mm

The output power loss for 7N(210mm/132 half-cell) is lower than that of 166mm/144 half-cell due to less influence from shading

40-foot High Cube Container Set the Module Width **Limit** in the Traditional Packaging Method



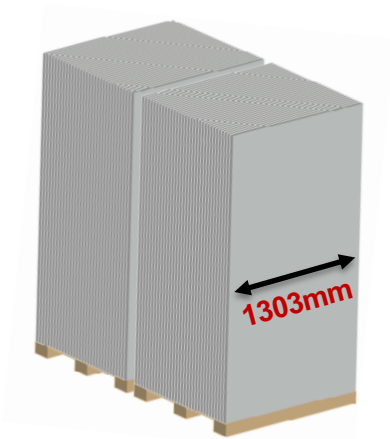
“Horizontally” packed and two pallets stacked on each other



40-foot high cube container

In traditional packaging, about **1140mm** is the upper limit of the module width

CSI's Original "Vertically" Package **Breaks** the Width Limit



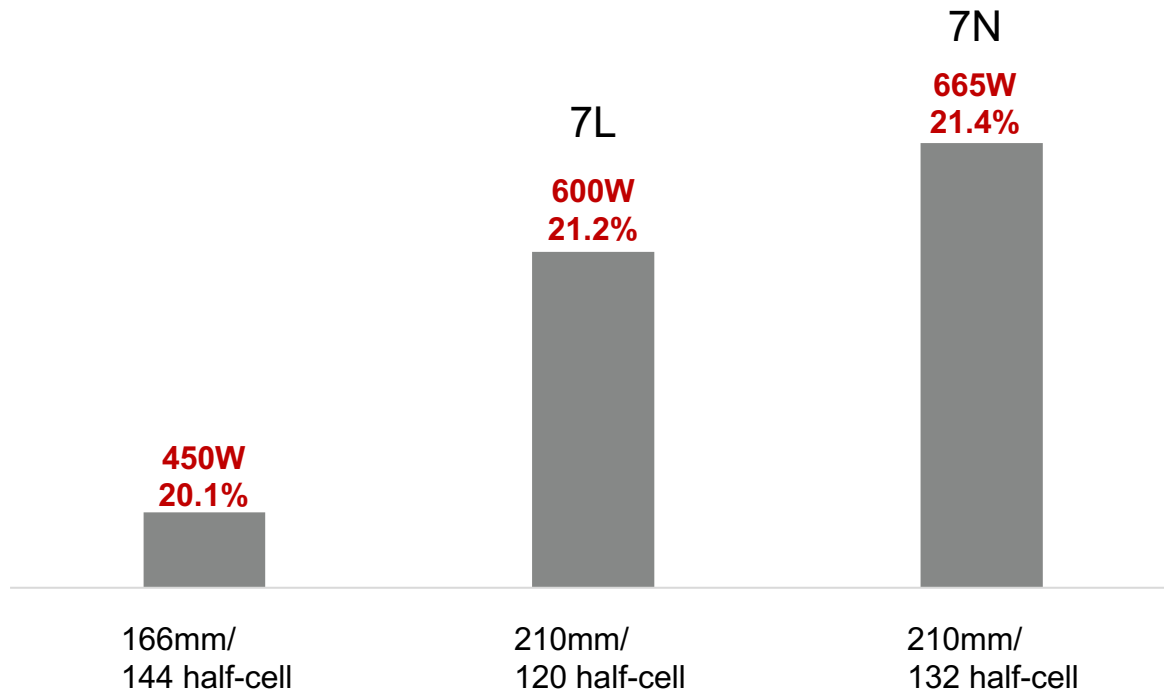
"vertically" packed and
one pallet



40-foot high cube container

With CSI's original "vertical" packaging, there is no limit for module width

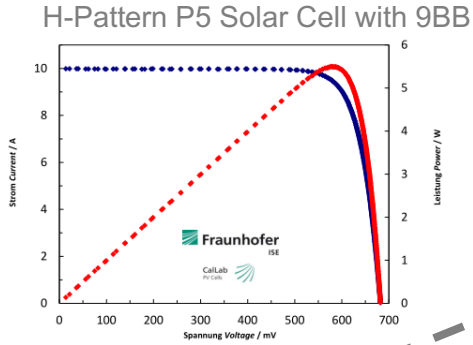
HiKu7/BiHiKu7: a Utility-Friendly Above **600W** Solution



With smart 120/132 half-cell and 6 string design, HiKu7/BiHiKu7 became the most utility-friendly module, which are powerful, safe, generate more power in the field because of better low light performance and anti-shading, and cut mounting structure and cable cost significantly.

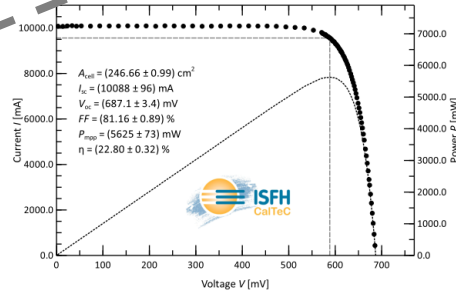
Technology Leader Always

3 Time World Record Holder

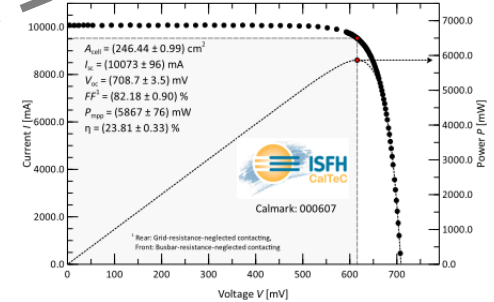


1st
Fraunhofer 22.28%
April 10th, 2019

2nd
ISFH 22.80%
2019/9/3
September 3rd, 2019

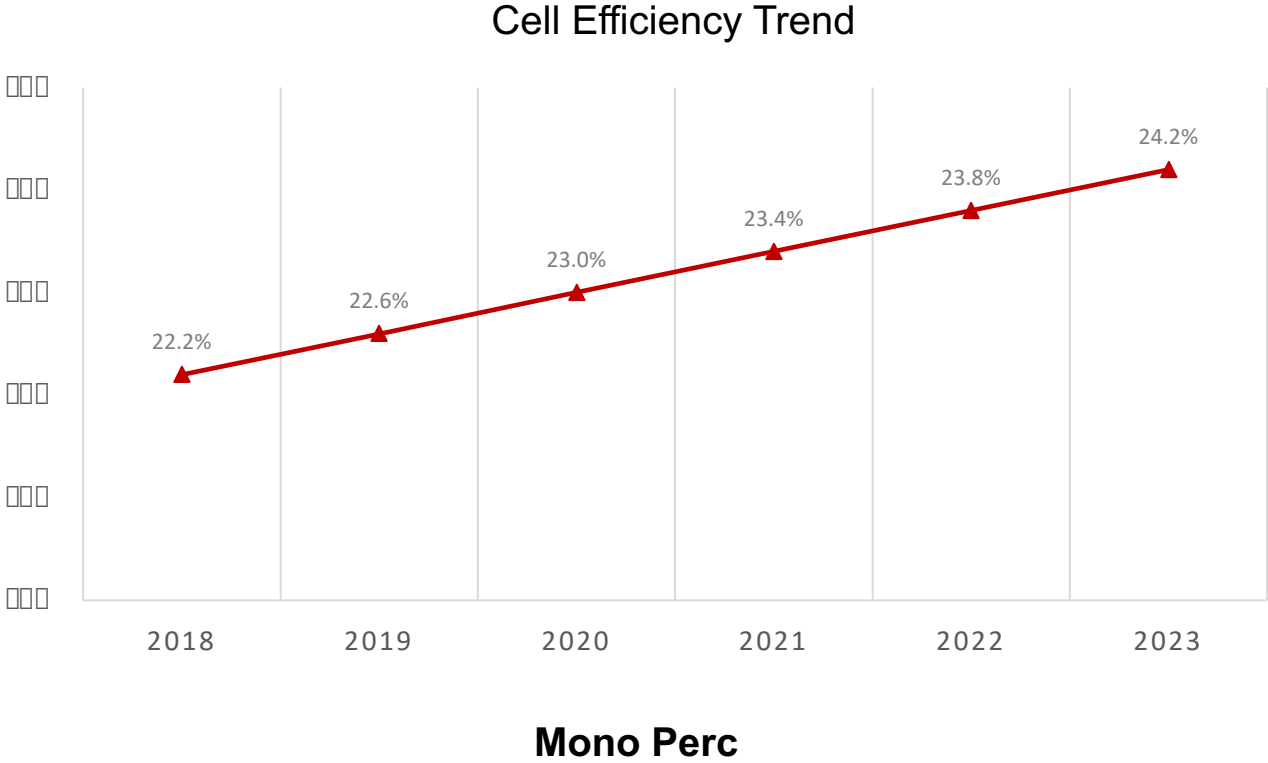


3rd
ISFH 23.81%
December 13th, 2019

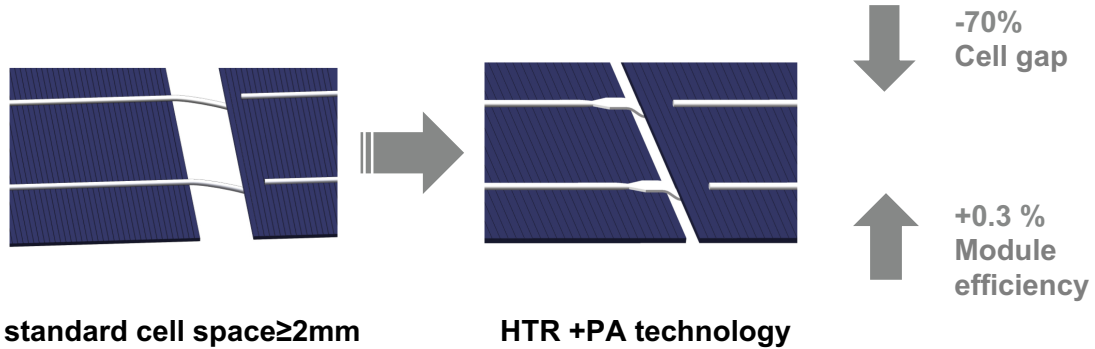


Advanced cell technology sets **3** world records for efficiency in **9** months

Continuously **Rising** Cell Efficiency



HTR +PA : **Higher** Module Efficiency

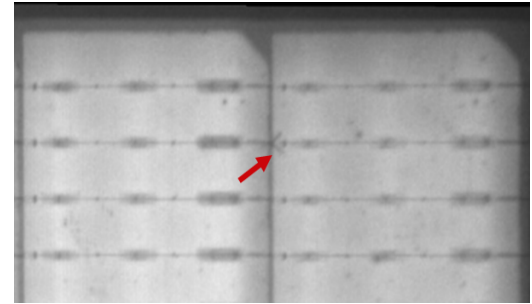


standard cell space ≥ 2mm

HTR +PA technology

-70%
Cell gap

+0.3 %
Module
efficiency



HTR eliminates cell cracks accompanying small cell-gap by lowering the stress between cell and ribbon

Thanks to CSI unique Hetero Type Ribbon (HTR) and the paving technology, Series 7 reaches a power up to **665W** with efficiencies up to **21.4%**. HTR also eliminates cell cracks, which always accompany small gaps because of higher stress. It ensures a better reliability for HiKu7/BiHiKu7.

CSAR : Industry **Lowest** LeTID

The Intensified Inline Control

Ingot : impurity control and dopant optimization

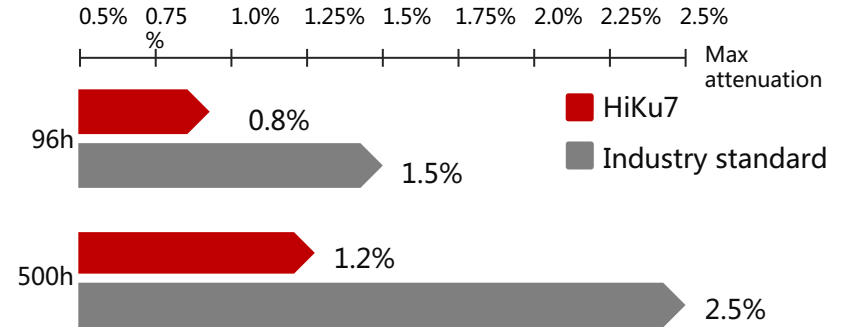
Cell : optimize diffusion, passivation and firing processes to control hydrogen passivation and defect growth

CSAR : CSI proprietary advanced regeneration technology

HiKu7/BiHiKu7 shows about 50% less LID/LeTID degradation after “CSAR”(Canadian Solar Advanced Regeneration) treatment

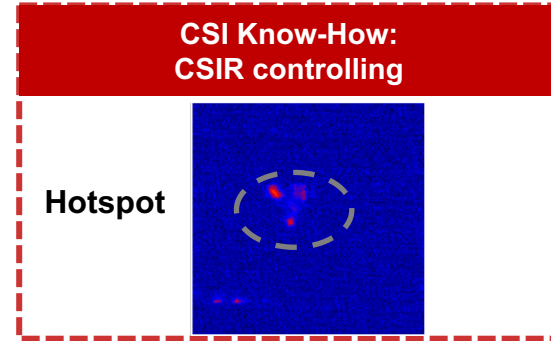
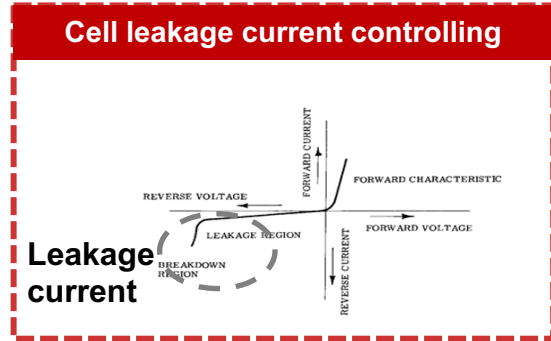
LeTID lab results

*Test method :Module temperature 85 °C, energize I(test)=Isc-Imp



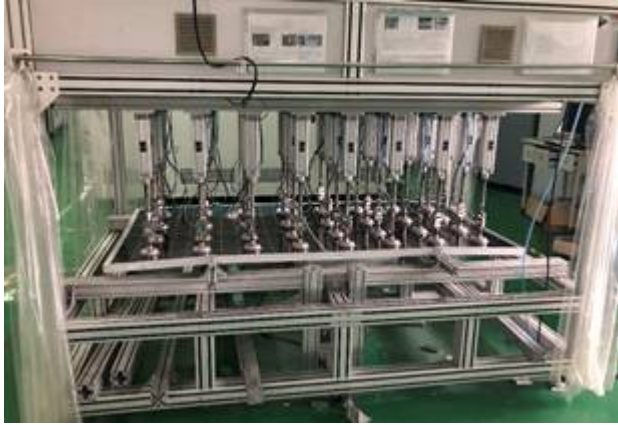
CSI is leading the development of cell-level LeTID IEC standard.

CSIR : Cell-level Hot-spot Control

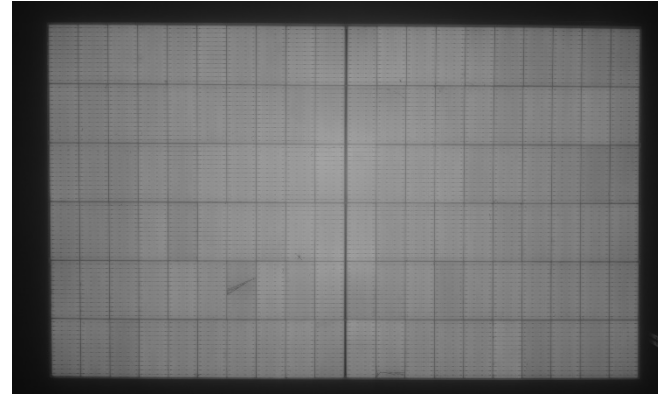


A combination of leakage current and CSI' s unique CSIR (Canadian Solar Infrared Ray) technology is used in HiKu7/BiHiKu7 modules to guarantee a **tighter** control for hotspot risk

Repetitive Simulation and Test Results in **Good** Loading Performance



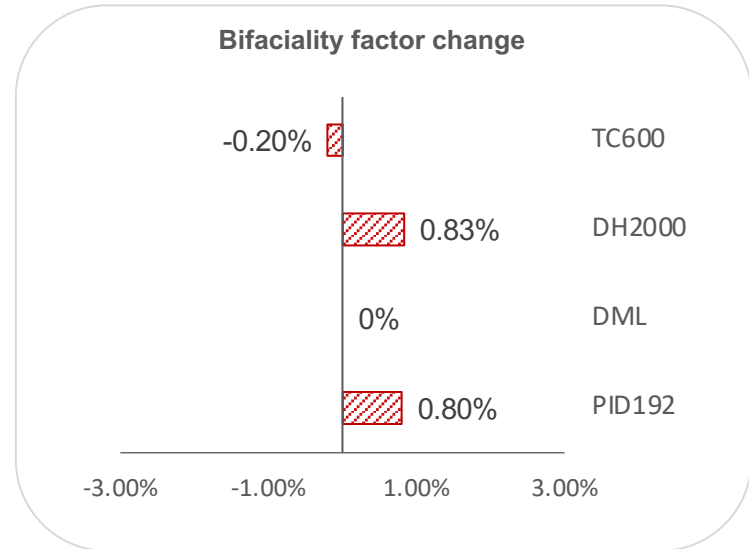
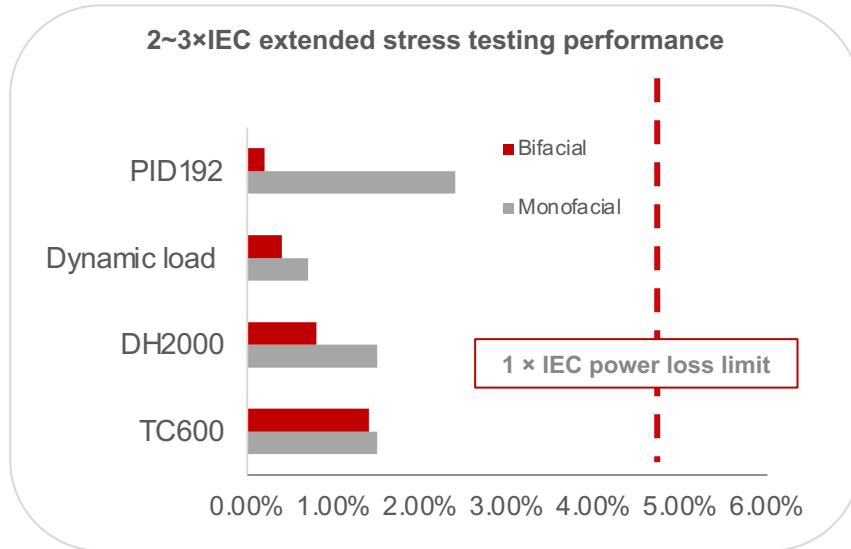
Series 7 in test



EL after test

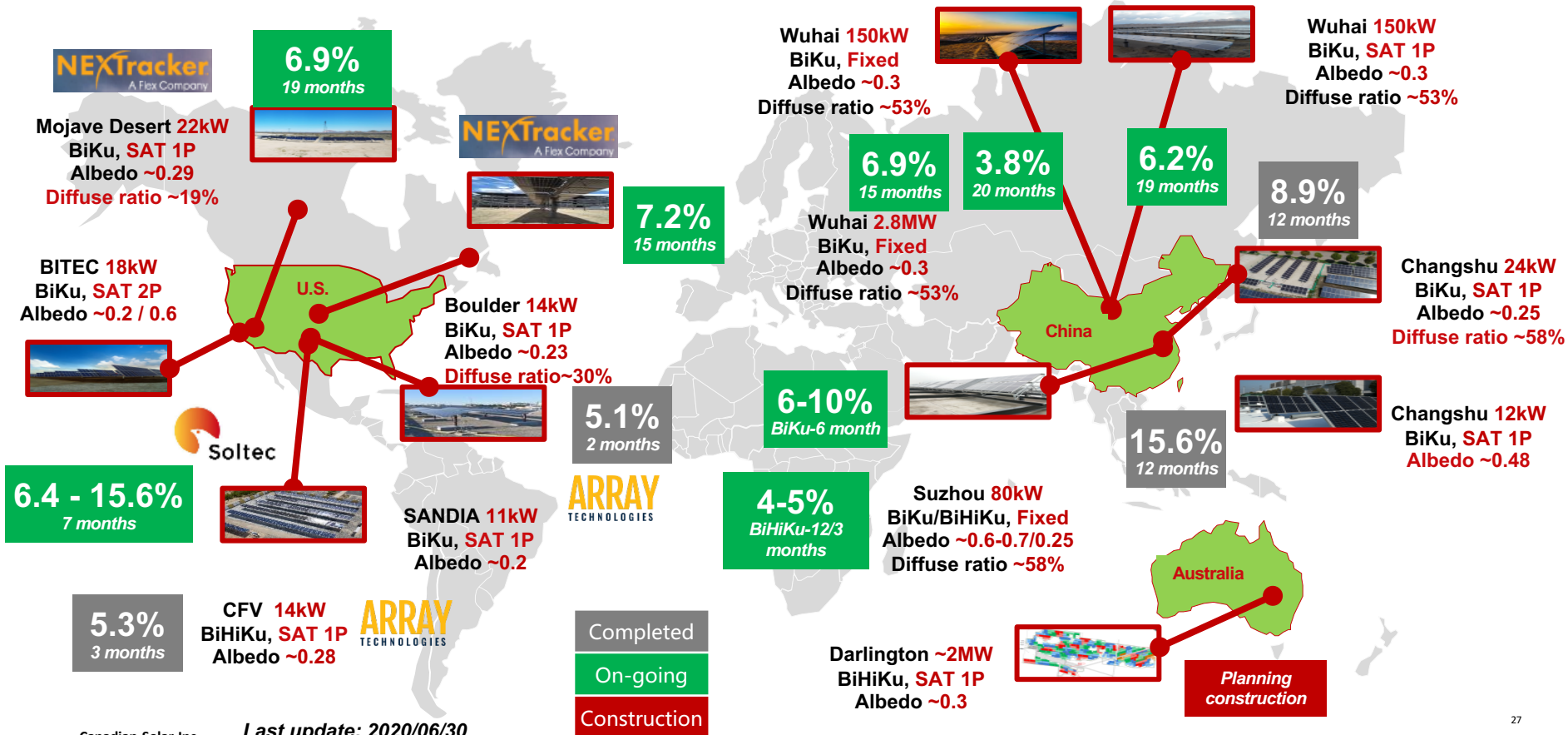
Series 7 has passed a stringent mechanical loading test with 5400Pa/2400Pa static loading and then 500 cycles of 1500Pa dynamic loading

CSI's Bifacial Module: Better, Always after $3 \times \text{IEC}$



DNV Bankability Report shows that CSI's bifacial module performance exceeds mono facial in all 3xIEC extended stress testing sequence with bifaciality factor almost unchanged

CSI's Bifacial Module: **Proven** Bifacial Gains Worldwide



System Level Compatibility

Tracker Compatibility



Type	Brand	CS7L-MS	CS7L-MB-AG	CS7N-MS	CS7N-MB-AG
1P	NEXTracker	OK	OK	OK	OK
	ArrayTechnologies	OK	OK	OK	OK
	Arctech Solar	OK	OK	OK	OK
	PVH		2021 Q1		
2P	NEXTracker	OK	OK	OK	OK
	Arctech Solar	OK	OK	OK	OK
	Soltec	OK	OK		2021 Q1
	PVH		2021 Q1		

HiKu7/BiHiKu7 modules have a **good** compatibility with mainstream PV trackers

Inverter Compatibility



Type	Brand	Model	CS7L-MS	CS7N-MS	CS7L-MB-AG	CS7L-MB-AG
Central inverter	Sungrow	Central inverter SG3125HV &SG3600UD series(for NA)	Ok	Ok	Ok	Ok
	SMA	Sunny central 3000-EV series	Ok	Ok	Ok	Ok
	Power electronics	Central inverterFS3430K series	Ok	Ok	Ok	Ok
	Fimer	R27515TL series	Ok	Ok	Ok	Ok
String inverter	Sungrow	SG250HX series and SG250HX-US(for NA)	Ok	Ok	Ok	Ok
	Solis	GCI-230K-EHV-5G series	Ok	Ok	Ok	Ok
	SMA	Sunny Tripower CORE2	Ok	Ok	Ok	Ok

HiKu7/BiHiKu7 modules have a **good compatibility with mainstream PV inverters**

Lowest LCOE Solution

Key Elements of the LCOE

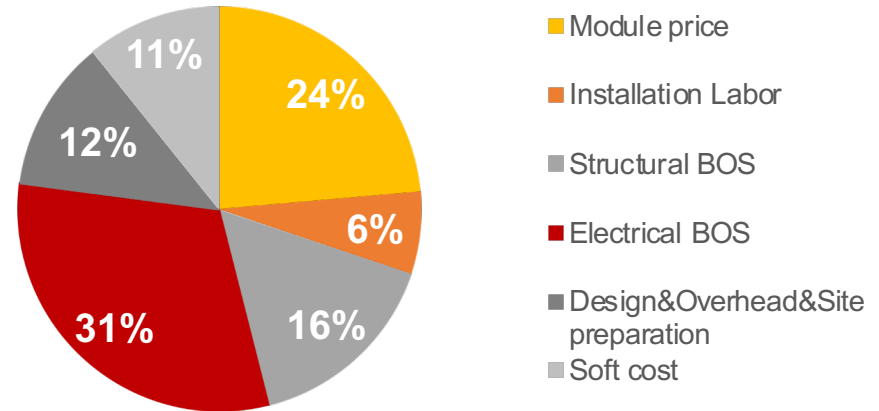
$$LCOE = \frac{\text{Project cost} + \sum_{n=1}^N \frac{AO}{(1+DR)^n} - \frac{RV}{(1+DR)^N}}{\sum_{n=1}^N \frac{\text{Initial kWh} \times (1-SDR)^n}{(1+DR)^n}}$$

1. Module cost
2. BOS

Module power generation

*where *AO* is the annual operations cost,
DR is the discount rate, the weighted average cost of capital (WACC) to build a power project,
RV is the residual value,
SDR is the system degradation rate,
N is the number of years the system is in operation.

SYSTEM COST BREAKDOWN



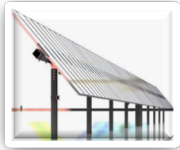
Note : Based on a 27.3MW utility project (1P tracker+ Central inverter) in Los Angeles, using 445W module (166mm half cut mono)

To lower the LCOE significantly, module's design should be able to cut the electrical components, mounting structure and installation labor's cost

HiKu7/BiHiKu7: 5.7%/4.6% Less BOS



Module
28% Labor cost down



Structure
14% material cost down
35% installation cost down



Foundations
6% post material cost up
4% installation cost down



HiKu7 BOS cost down 5.7%
(HiKu7 650W VS HiKu 445W)



Soft costs



4% EPC OH & Profit, etc.

DC EBOS



8% DC material cost decrease
39% DC labor cost



AC EBOS



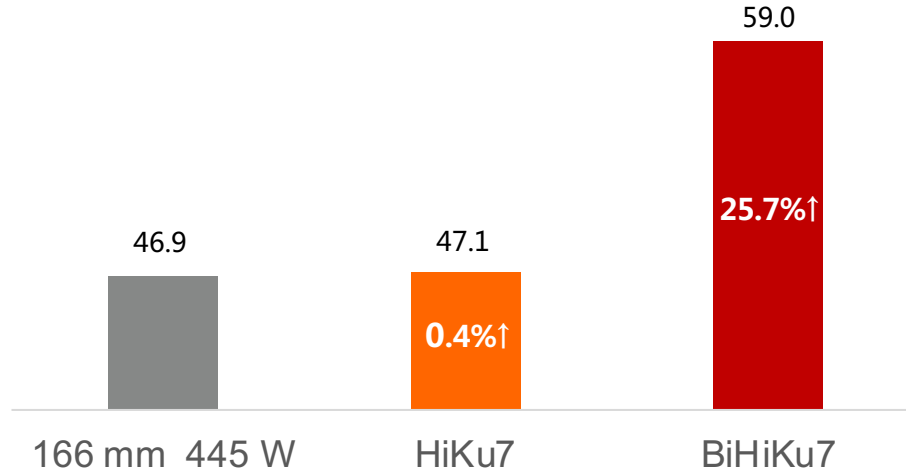
Same inverter & MV/HV station cost



Note : Based on 27.3MW utility project (1P tracker+central inverter) in Los Angeles

HiKu7/BiHiKu7: **0.4%/25.7%** More Lifetime Energy Generation

Lifetime Energy Generation (MWh/kW)



Note : BiHiKu7 CS7N-MB-AG 645W vs HiKu7 CS7N-MS 650W vs 445W (166mm half cut) based on 27.3MW utility project (1P tracker+ central inverter) in Los Angeles

HiKu7/BiHiKu7: A New Norm in the Coming Decade!



Super high power

Super high efficiency

High energy yield

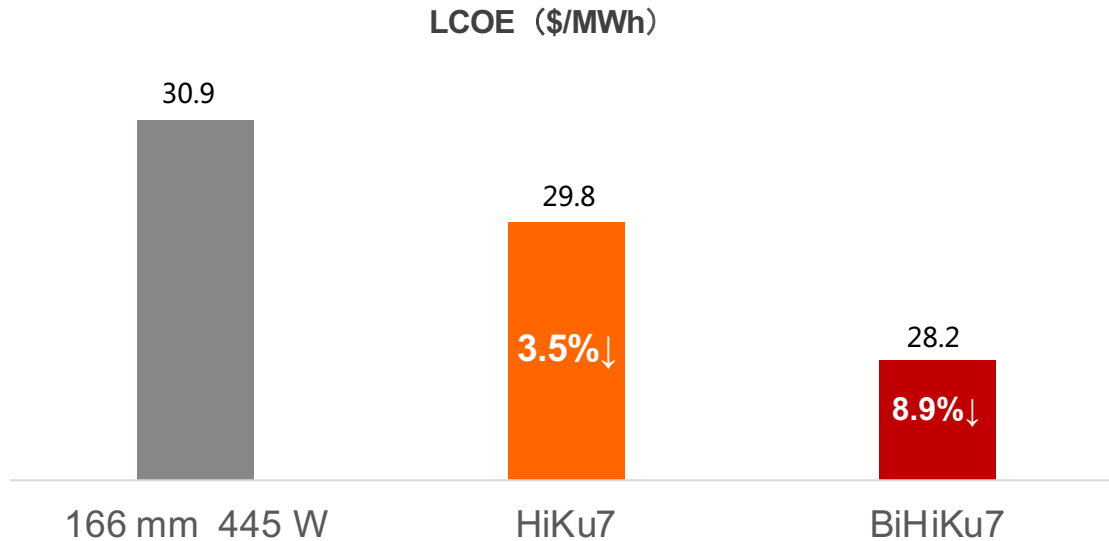
Highly reliable

Cut BOS cost significantly

Lowest LCOE

Available In April 2021

HiKu7/BiHiKu7: **3.5%/8.9%** Saving in LCOE



Note : BiHiKu7 CS7N-MB-AG 645W vs HiKu7 CS7N-MS 650W vs 445W (166mm half cut mono) based on 27.3MW utility project (1P tracker+ central inverter) in Los Angeles

Contacts



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**MAKE THE
DIFFERENCE**