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Seraphim Solar System

7 April 2021

11 am – 12 pm | CEST, Berlin

10 am – 11 am | BST, London / WET, Lisbon

5 pm – 6 pm | CST, Beijing

pv magazine
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Optimizing ROI: How to profit from using modules with high-power and large wafers?



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Small Changes, Big Accomplishments

Seraphim Solar
2021.04

SHIFTING • THE FUTURE



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- 2. Lower LCOE & Higher Efficiency**
- 3. Seraphim S4 Series Half-cell Module**



01

About Seraphim

A Global Leading Solar Module Manufacturer

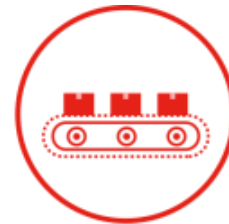
Founded in 2011, Seraphim has become a respected leader in the photovoltaic manufacturing industry. At present, the company has a global production capacity of 5.5 GW and is listed as a Tier 1 solar module manufacturer by BNEF, as well as the Top Performer by PV Evolution Labs. Seraphim is committed to R&D and has been awarded more than 100 technical patents. At the end of 2020, over 11 GW of Seraphim products have been installed in over 40 countries.



1500+
Global Employees



5.5 GW
Capacity



40 Destination Countries
11 GW+ Shipment



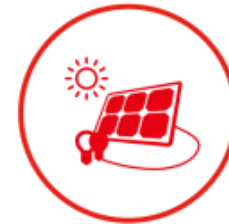
50+ Global Financial
Partners



100+
R&D Technicians



100+
Technical Patents




Tier 1 Solar Module Maker
Listed by BNEF



Top Performer Listed
by **PVEL**

Global Sales and Manufacturing Network





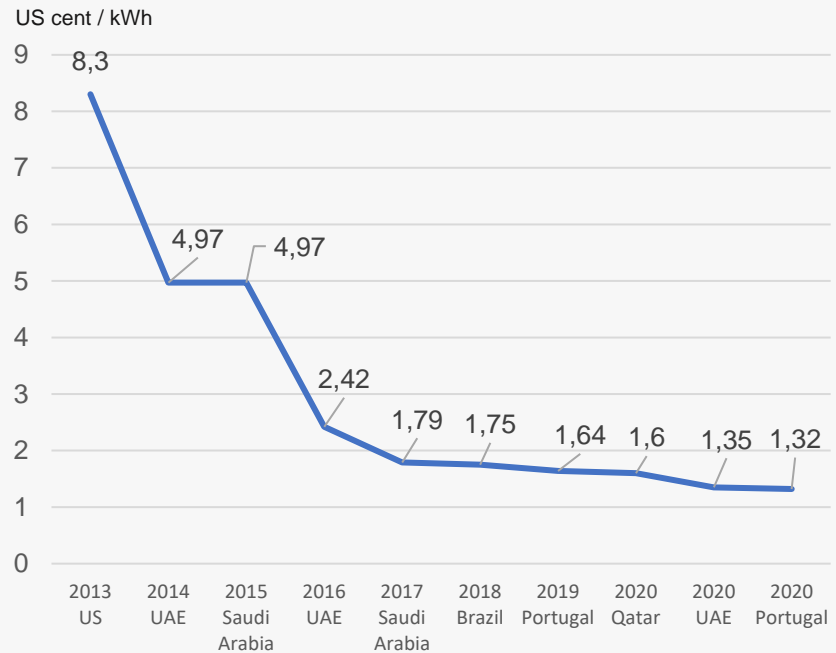
02

**Lower LCOE &
Higher Efficiency**

Global LCOE Trending Down

The global PV project bidding price dropped considerably between 2013 and 2017 and has continued its downward trend.

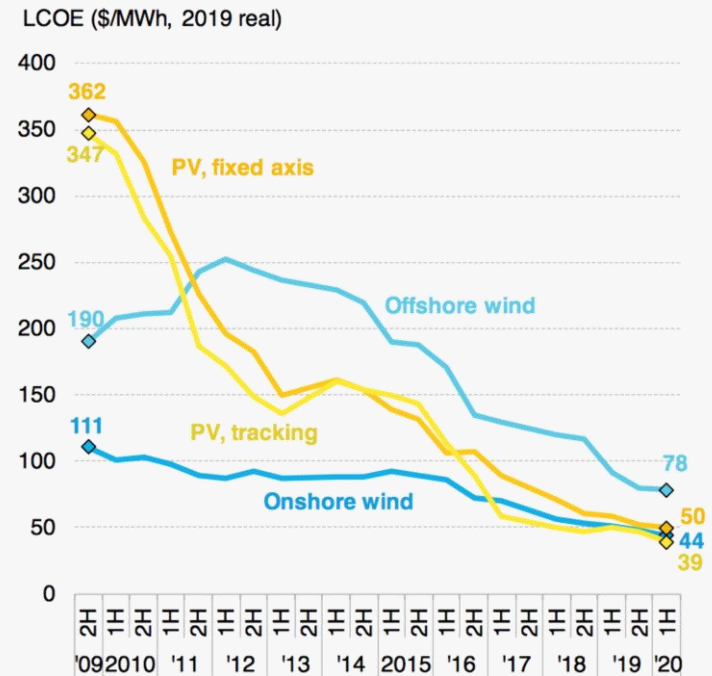
Global Bidding Price



Source: CPIA

This learning curve has been made possible by a combination of technology innovation, economies of scale and manufacturing experience.

PV & Wind LCOE Global Benchmarks

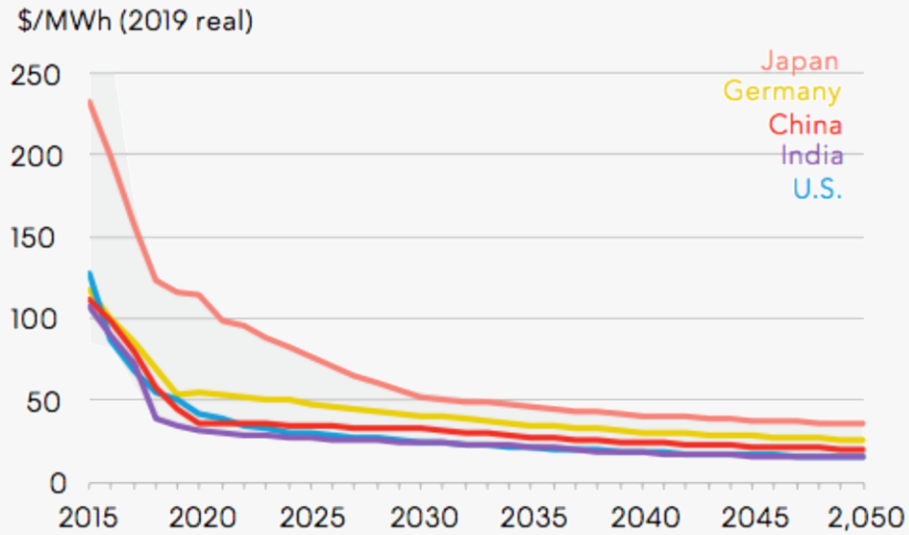


Source: BNEF

Global LCOE Downward Trend

Ongoing reductions in equipment costs, improving efficiency, declining financing and development costs are expected to further lower the global benchmark LCOE.

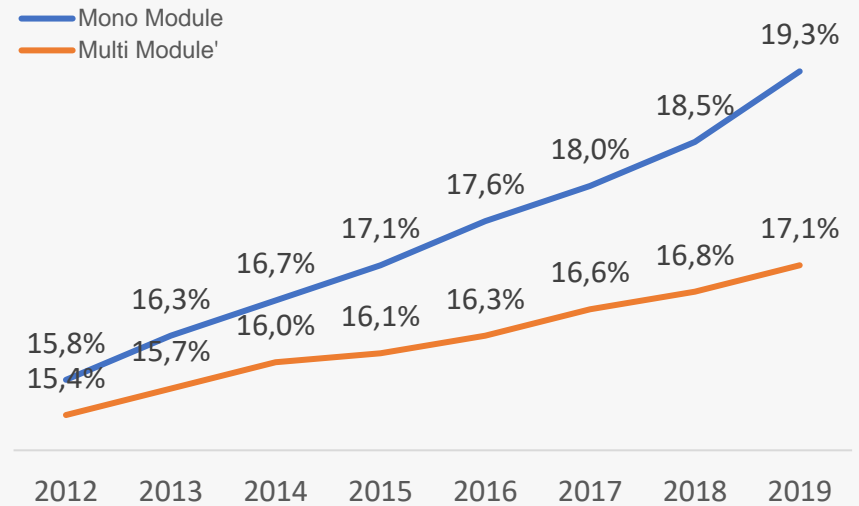
Utility-scale PV LCOE forecasts



Source: BNEF

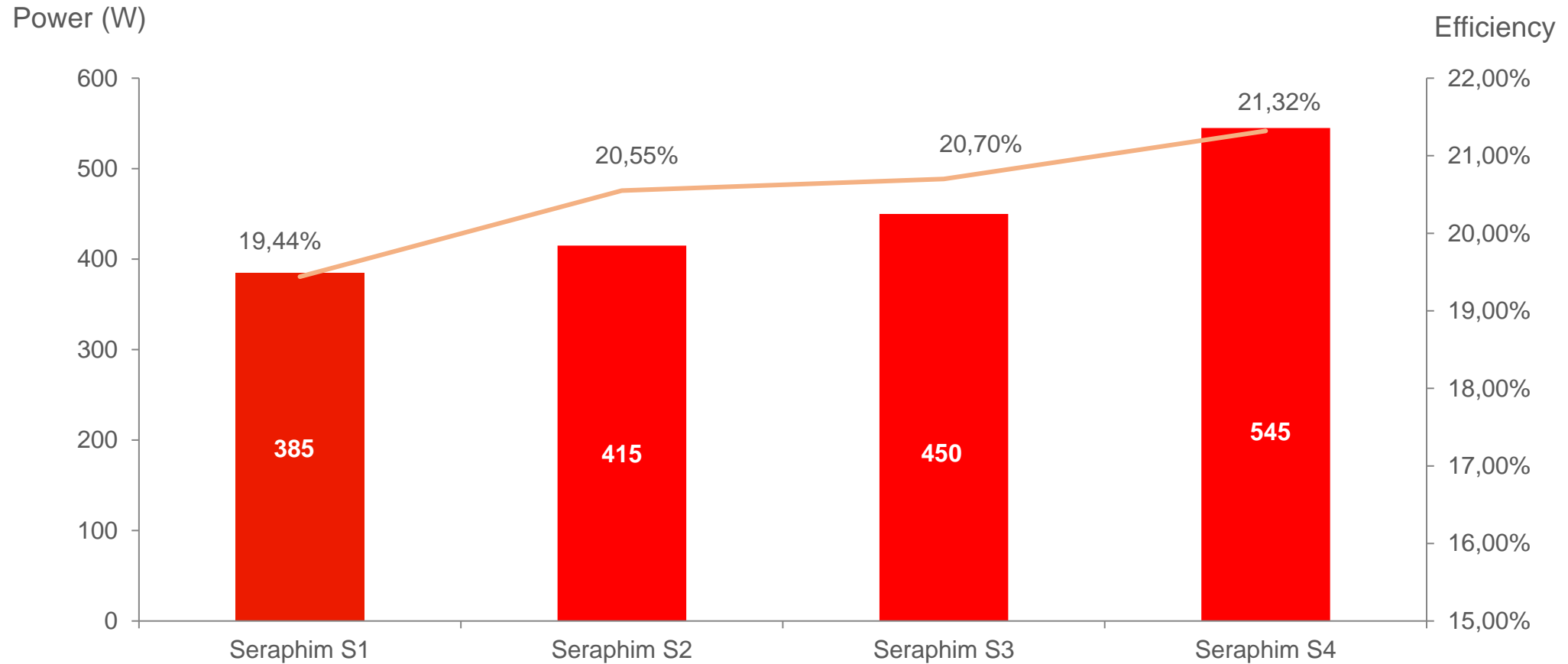
Module efficiency continues to improve year-on-year, driven by manufacturing innovation and a shift towards new PERC (passive emitter rear contact), half-cut cell designs, and larger wafers etc.


Average Mass Production Module Efficiency



Source: BNEF

Roadmap of the Seraphim S Series Module in 2021



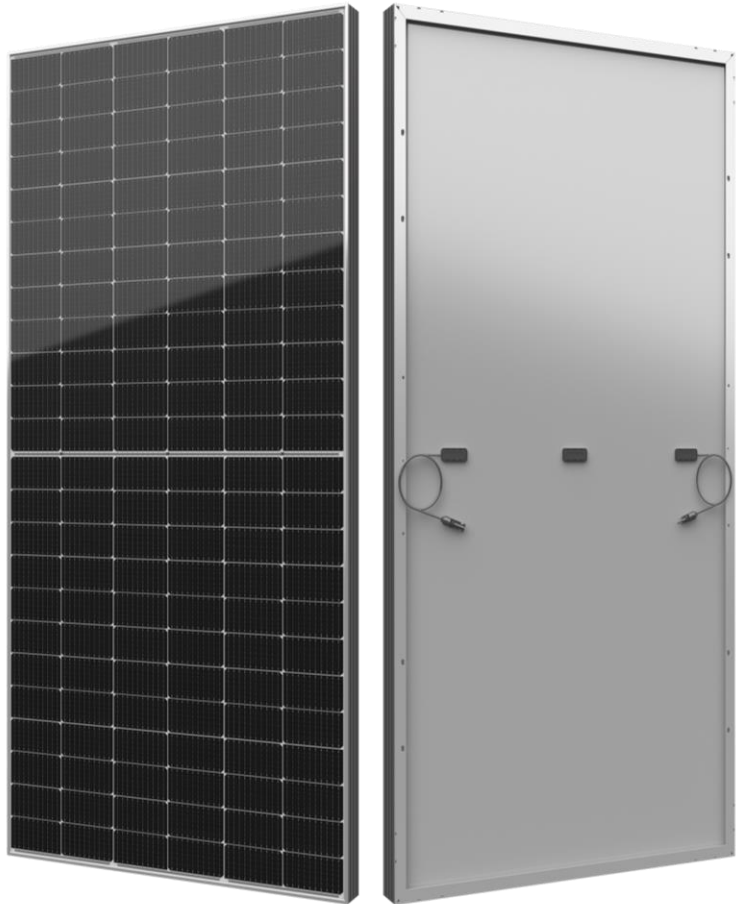


03

Seraphim **S4** Series Half-Cell Module

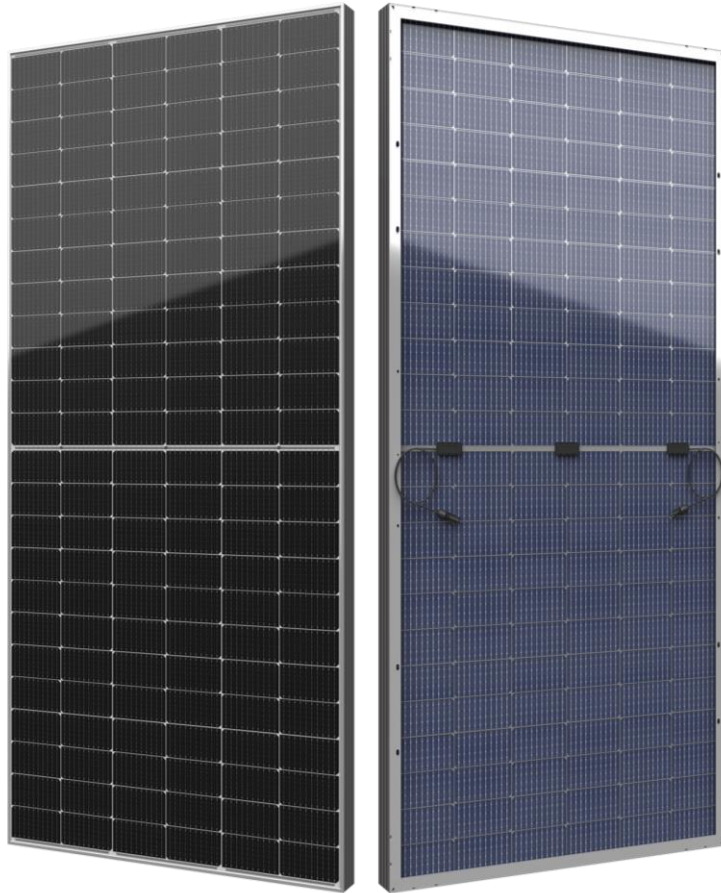


Seraphim S4 Series Half-Cell Module



Module Type	144 Cells Module (535-545W, 182mm, 10BB)
Module Power (Wp)	535-545
External Dimensions (mm)	2256×1133×35
Weight (kg)	26.5
Front Glass	3.2 mm AR coating tempered glass, low iron
Mechanical Load (Pa)	Front 5400 Pa / Back 2400 Pa

Seraphim **S4 Bifacial** Series Half-Cell Module

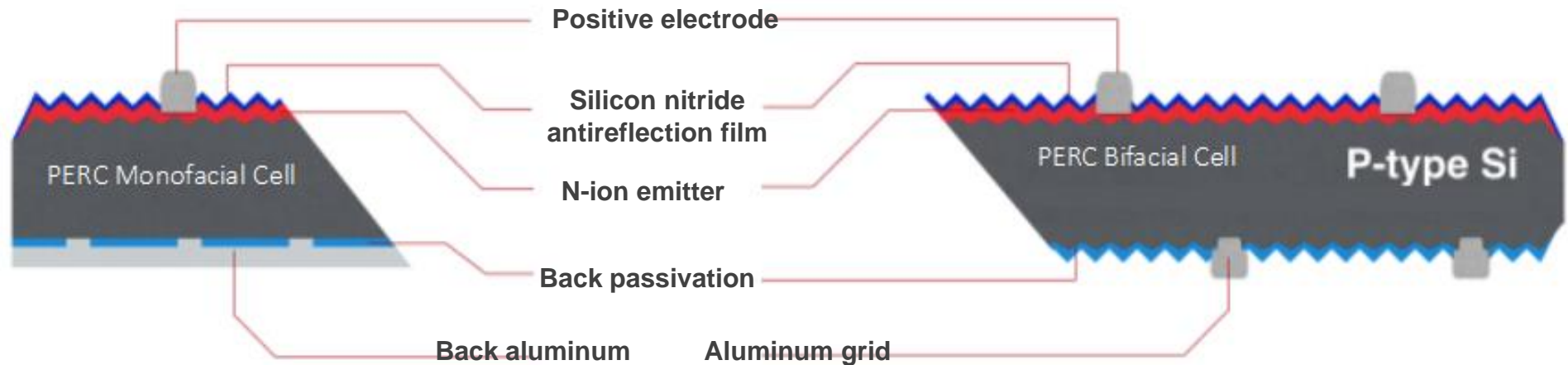


10-30% Additional Power Output from Rear Side

Module Type	144 Cells Module (535-545W, 182mm, 10BB)	
Module Power (Wp)	Front	Back
	535-545	405-415
External Dimensions (mm)	2256×1133×30	
Weight (kg)	32	
Front/Back Glass	2.0 mm AR coating semi-tempered glass, low iron	
Mechanical Load (Pa)	Front 5400 Pa / Back 2400 Pa	

Seraphim S4 Bifacial Series Half-Cell Module

Seraphim S4 series half-cell module will have a rear side gain of 10% to 30% in different installation environments. Ideally, this module can reach a maximum output power of 700W from both sides combined.



Improvement of the module bifaciality rate up to $70 \pm 10\%$.

Scenario 1	Asphalt Ground	Scenario 2	Grass	Scenario 3	Snow
Surface Reflectance	10%	Surface Reflectance	30%	Surface Reflectance	45%
Power Generation Gain	7%	Power Generation Gain	10%	Power Generation Gain	15%


Seraphim S4 Bifacial Series Half-Cell Module

Seraphim S4 series half-cell module will have a rear side gain of 10% to 30% in different installation environments. Ideally, this module can reach a maximum output power of 700W from both sides combined.


For example, 530W module comprehensive power and electrical parameters are as follow:

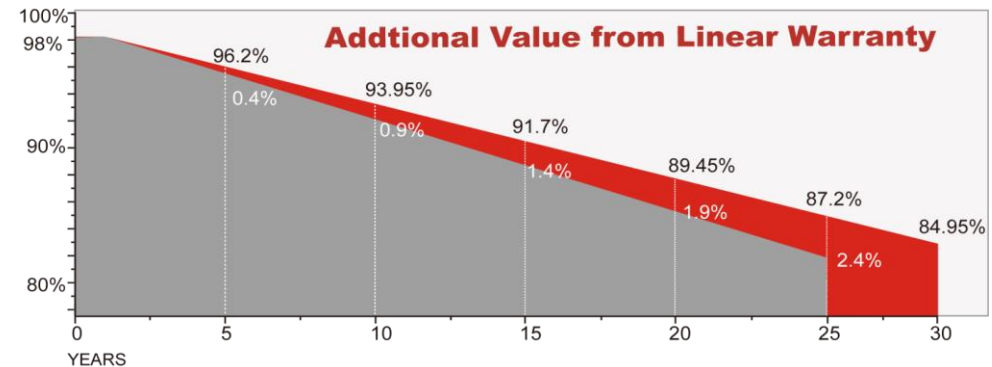
Power Gain	10%	15%	20%	25%	30%
Maximum Power - P_{mp} (W)	583	610	636	663	689
Open Circuit Voltage – V_{oc} (V)	49.33	49.33	49.33	49.33	49.33
Short Circuit Current – I_{sc} (A)	14.96	15.64	16.32	17.00	17.68
Maximum Power Voltage – V_{mp} (V)	41.03	41.03	41.03	41.03	41.03
Maximum Power Current - I_{mp} (A)	14.21	14.86	15.50	16.15	16.80

High Reliability and Leading Warranty


 Class A Fire Resistance
 5400pa/2400pa Mechanical Load




 Extended Product Warranty:
5 years longer than industry
 mainstream



Manufacturer	Seraphim	Brand A	Brand B	Brand C	Brand D	Brand E	Brand F	Brand G	Brand H	Brand I	Brand J
Product Warranty (Years)	15	12	12	12	12	10	10	10	10	10	10

S4 Series Module Certifications

S4 Series	Module Type	TUV	PID	Salt Mist	Ammonia Corrosion	Sand & Dust	LID	LETID	Panfile
	SRP-XXX-BMA-HV	√	√	√	√	√	√	√	√
IEC	SRP-XXX-BMD-HV	√	√	√	√	√	√	√	/
	SRP-XXX-BMA-BG	√	√	√	√	√	√	√	√

S4 Series	Module Type	UL61730	CEC Listing
	SRP-XXX-BMA-HV	√	√
UL	SRP-XXX-BMD-HV	√	/
	SRP-XXX-BMA-BG	√	√

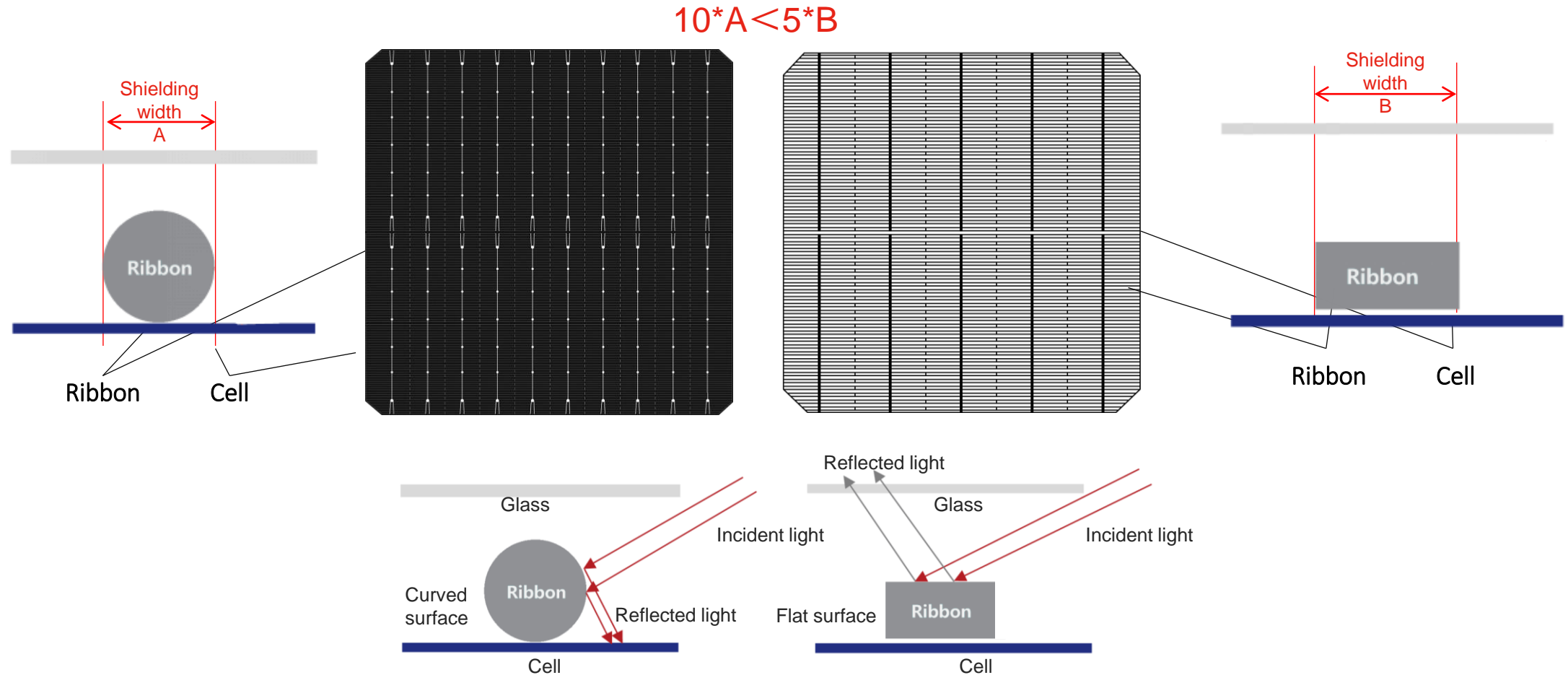
S4 Series Module Certifications

Certification	Applicable area	Testing standard	Mark	Certification	Applicable area	Testing standard	Mark	Certification	Applicable area	Testing standard	Mark
IEC	The global	IEC 61215 IEC 617 730-1&2		CQC	China	IEC 61215 IEC 617 730-1&2		INMETOR	Brazil	IEC 61215 IEC 617 730-1&2	
TUV	Germany & Europe	IEC 61215 IEC 617 730-1&2		CE	EU	IEC 61215 IEC 617 730-1&2		MCS	The UK	IEC 61215 IEC 617 730-1&2	
CRG	Netherlands	IEC 61215 IEC 617 730-1&2		RETIE	Columbia	IEC 61215 IEC 617 730-1&2		CEC	Australia	IEC 61215 IEC 617 730-1&2	
CEC	California	UL1703		CSA	Canada	UL1703		ICIM	Italy	IEC 61730-2	

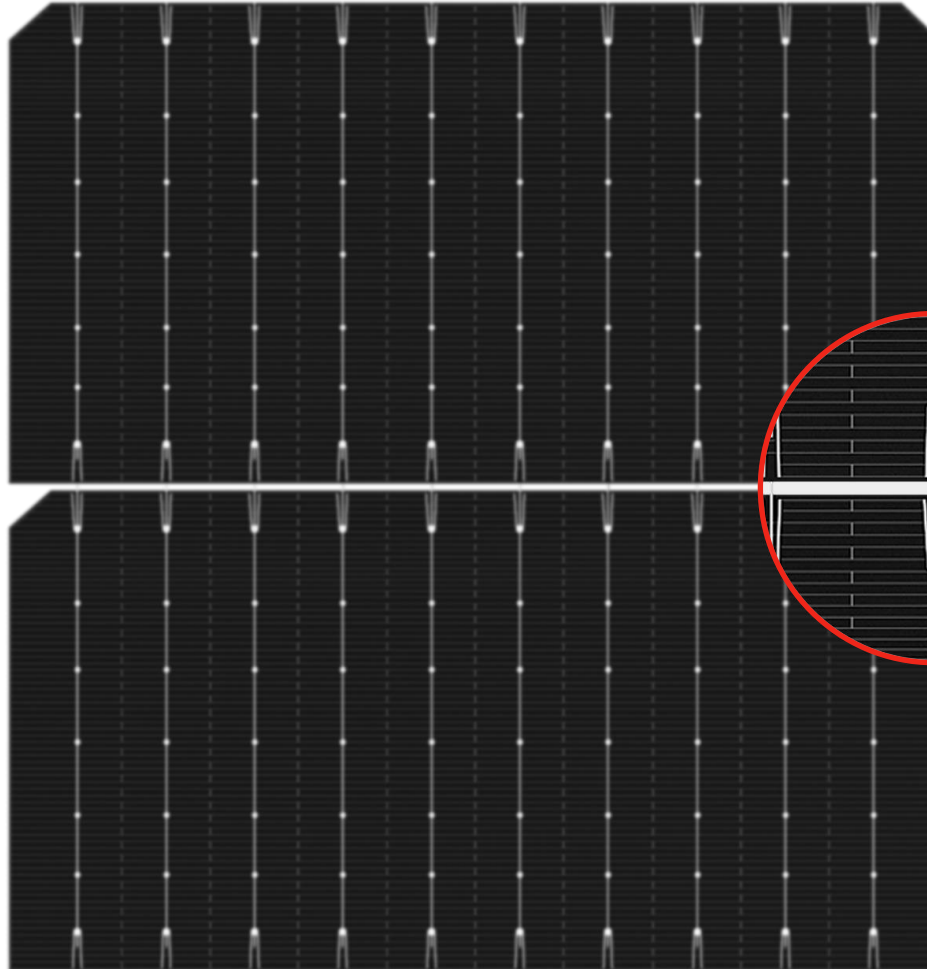
Optical Advantages of 10 MBB

10BB increases the effective light receiving area of the cell.

The optical utilization rate of the ribbon area is increased from less than 5% to more than 45%.



Minimized Cell Gap

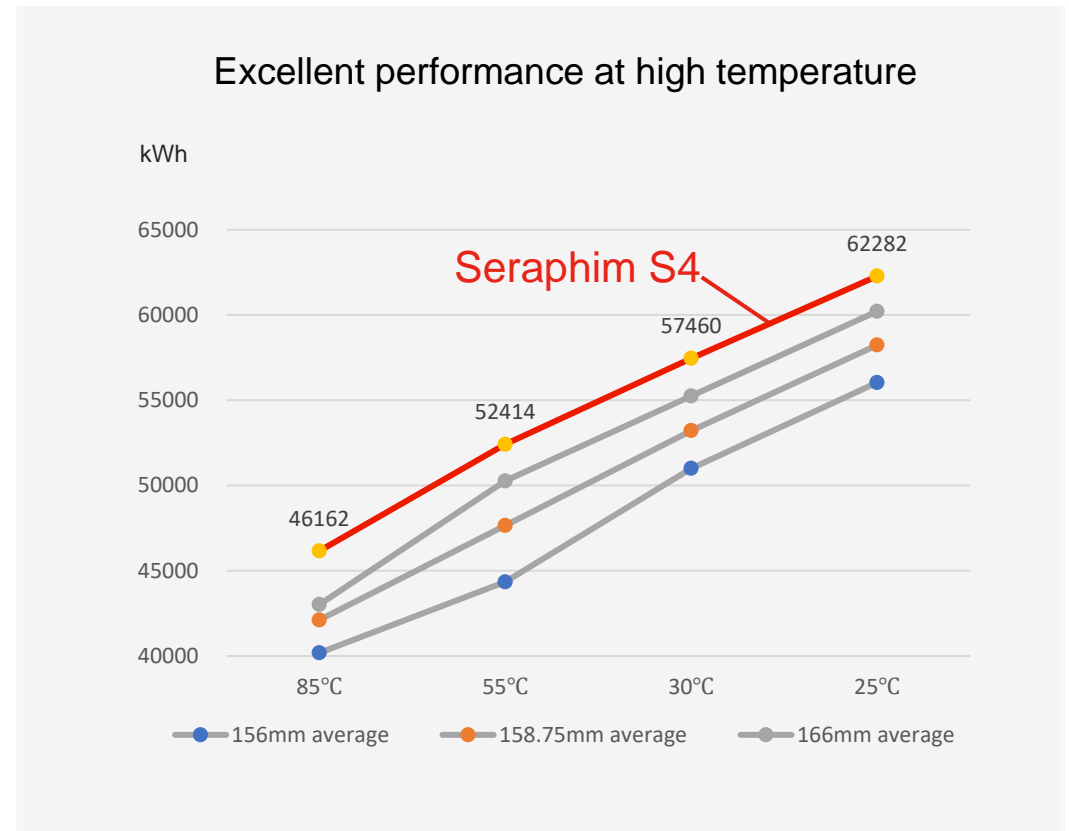
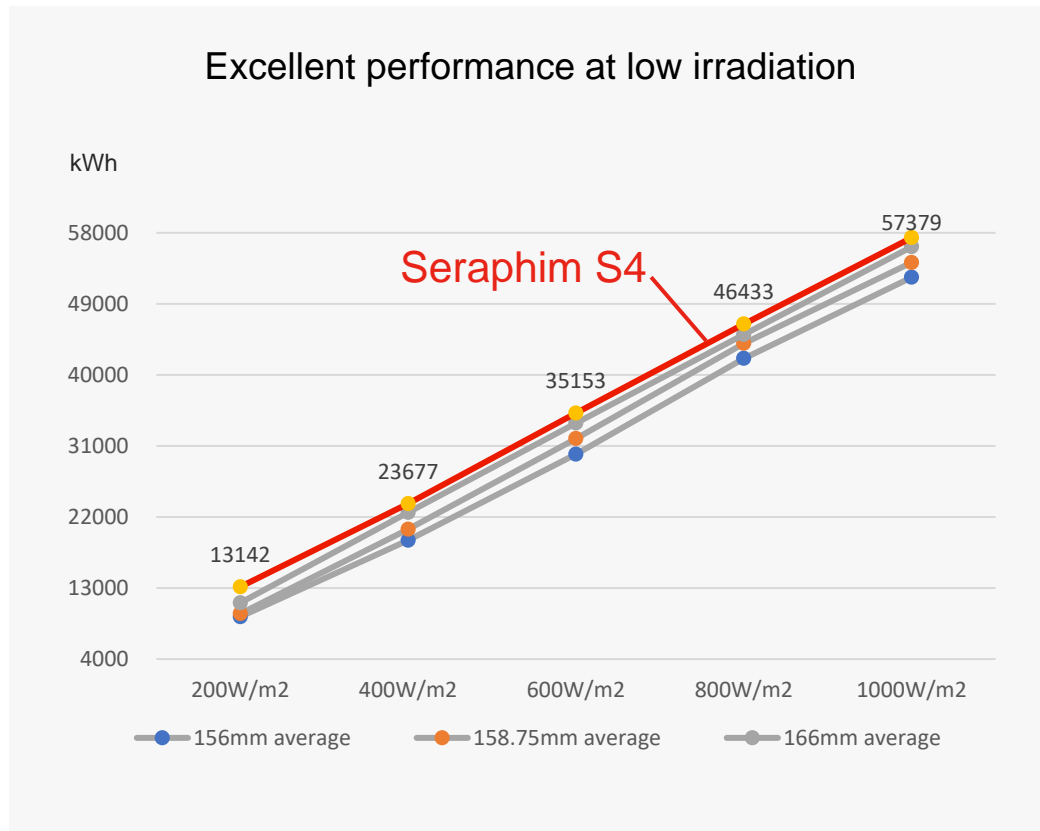


0.6 mm

High density encapsulation with
0.6mm only cell gap

Excellent Performance

Seraphim S4 series solar modules continue to respond well at low irradiation with outstanding performance in a low temperature environment, resulting in higher power generation. This, due to constant improvements in solar cell surface texturing, such as sueded structures which increases the absorption and reuse of available sunlight.



Excellent Performance

Actual Test Data from Seraphim In-house Lab

PV Module Type	DM7872201201900021: SRP-535-BMA-BG BM7872210101200021: SRP-535-BMA-HV
Module Description	2256*1133*30mm

S4 Bifacial and Monofacial Performance at Low Irradiation

Module Type	Power attenuation at 200 W/m ² relative to STC
SRP-535-BMA-BG	-2.39%
SRP-535-BMA-HV	-3.02%

Measurement of Temperature Coefficients of S4 Bifacial and Monofacial Module

Module Type	P _{max} Temperature Coefficient (%/°C)	V _{oc} Temperature Coefficient (%/°C)	I _{sc} Temperature Coefficient (%/°C)
SRP-535-BMA-BG	-0.343	-0.273	0.057
SRP-535-BMA-HV	-0.338	-0.265	0.051

Optimal Design, High Compatibility



Inverters

Compatibility with mainstream inverters



Tracker

Compatible with mainstream 1P & 2P horizontal tracking system



Transportation

Compatible with the existing packaging scheme, container space and logistics methods



Installation Feasibility

Provides for two installation methods depending on field conditions: by rails and clamps

BoS Analysis – Qinghai, China

Module Type	158mm Half-cell Module	166mm Half-cell Module	Seraphim S4
Module Power	410W	450W	540W
Module Efficiency	19.6%	20.7%	21.1%
Extra Output	Reference	+1.2%	+1.4%
BoS	Mounting System	Reference	-8.8%
	Land	Reference	-5.2%
	Cable	Reference	-2.8%
	Labor	Reference	-5.5%
	Total BoS	Reference	-3.6%
LCOE	Reference	-2.5%	-4.0%



-4.0%
LCOE



+1.4%
Life Cycle Performance
Improvement

100MW G-mounted plant
3.13MW centralized inverter (1500V)
1.2 capacity ratio
Fixed-tilt mounting system
Double row vertical installation



THANK YOU

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