

WEBINAR

JA SOLAR – PV TECH

400 TO 600 WP

UNDERSTANDING AND BENEFITING FROM THE RAPID SHIFT TO LARGER PV
PANEL SIZES FOR UTILITY-SCALE PROJECTS

JUNE 24TH 2020

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JA Solar Sr. Technical Manager



01

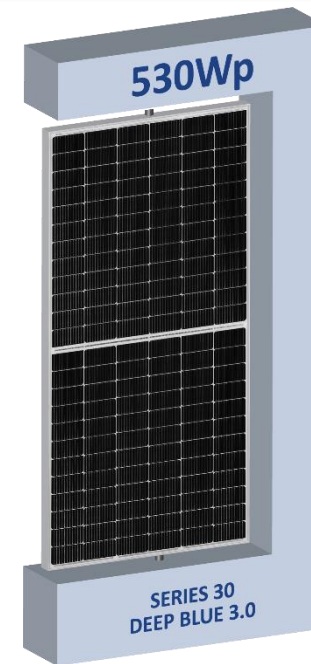
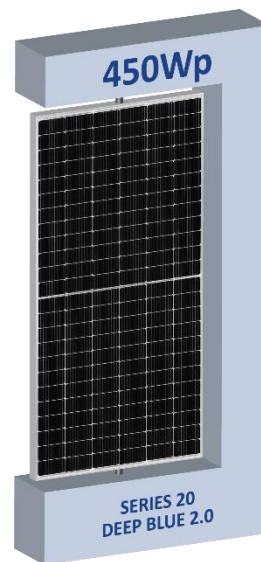
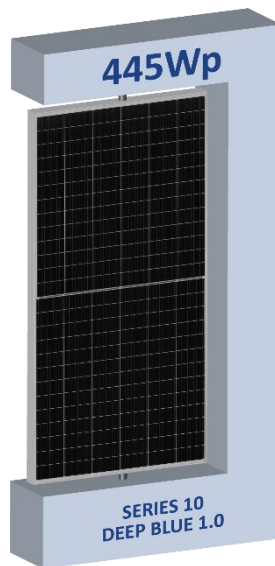
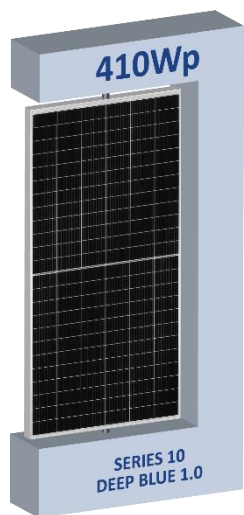
Larger Module Era

- Development Rationale
- Decoding the larger format modules
- Comparison of module choices

02

A Practical Point of View

- Compatibility
- Case Studies
- Making the best choice



PART 1

LARGER MODULES ERA



A Global Leader in the PV Industry

JA SOLAR



Founded in
**May
2005**



2nd Largest
Global Module
Supplier 2018-2020



37 Million US \$
R&D expenses 2019 (+11%)



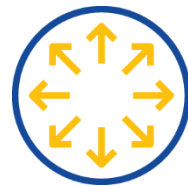
3.03 Billion US \$
Total Revenue of 2019 (+8%)



9% Global
Market
Share



22,000
Employees



>15 GW
Annual Capacity
(wafers, cells, modules)

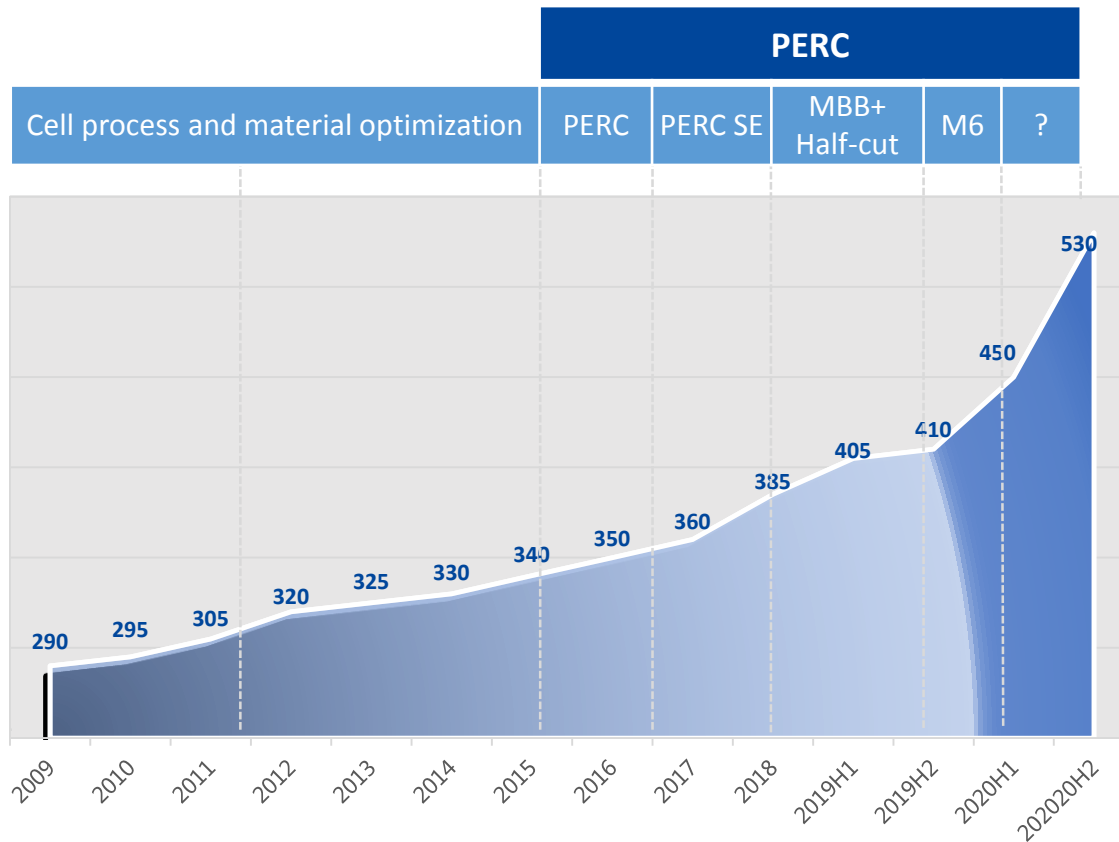


33,000
Customers
Worldwide



12 Global
Manufacturing
Bases

1. Background – Growth of module power



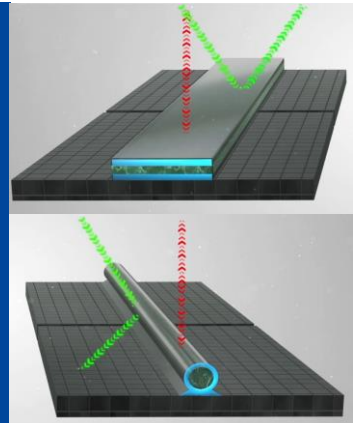
01 Half-cut technology

- Improved laser-cutting
- Lower Resistance Loss
- Lower NOCT
- Better shading behaviour
- Lower hot-spot temperature

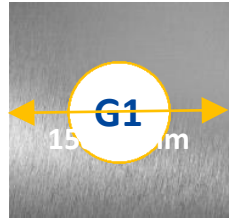


02 MBB technology

- Traditional flat ribbon is replaced by wire (round ribbon)
- Round ribbon enhances light absorption capability

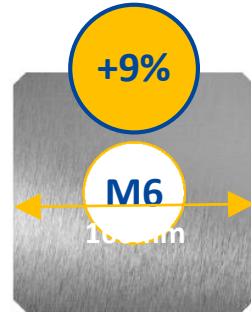


1. Background – **WAFER ENLARGES**



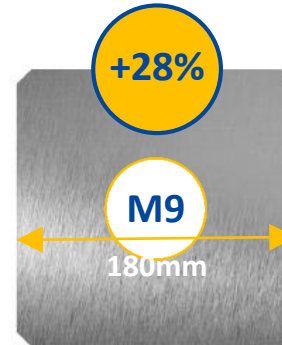
25,200 mm²

Series 10 Deep Blue 1.0



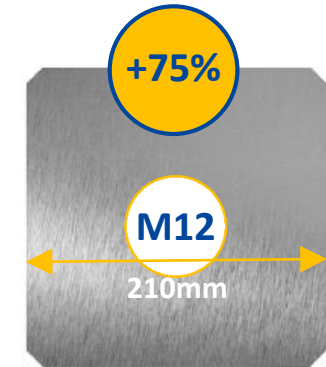
27,415 mm²

Series 20 Deep Blue 2.0



32,307 mm²

Series 30 Deep Blue 3.0



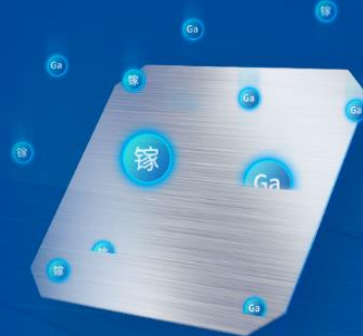
44,096 mm²

/

Gallium-doping

The first Module Supplier to apply
Ga-doped wafer on all high-eff. cells

IP rights granted in October 2019



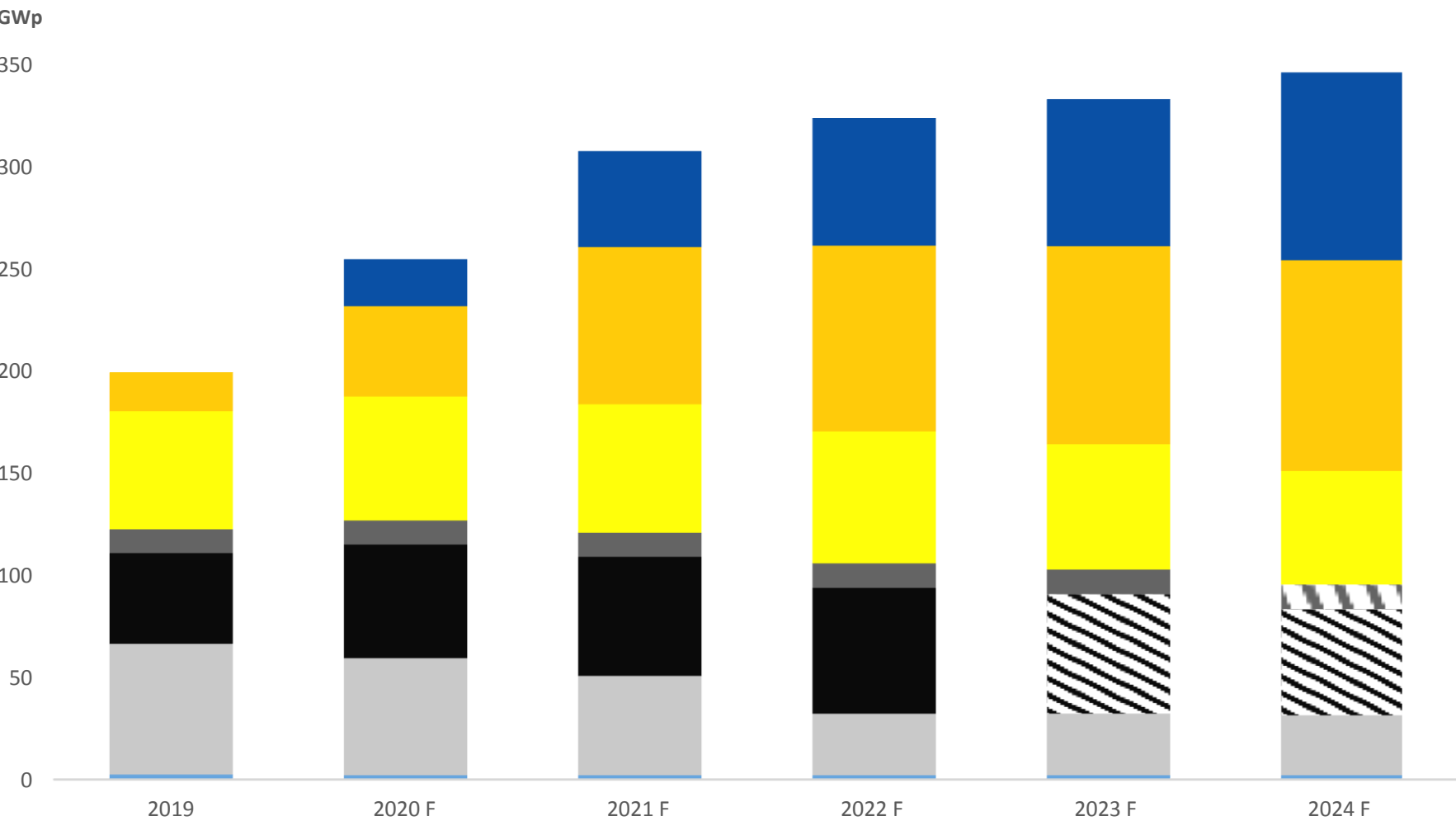
2%/0.55%

Warranty
(single glass)

2%/0.45%

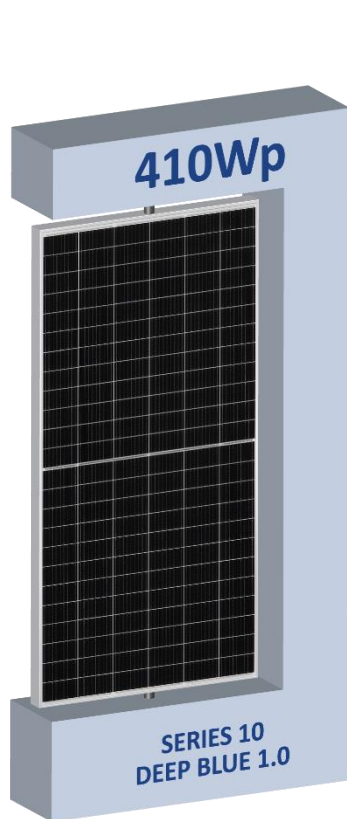
Warranty
(double glass)

Cell Capacity Changes



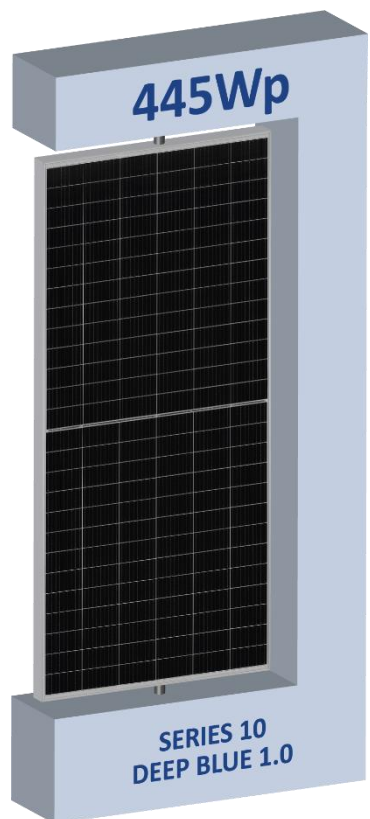
158

WAFER



445Wp

SERIES 10
DEEP BLUE 1.0

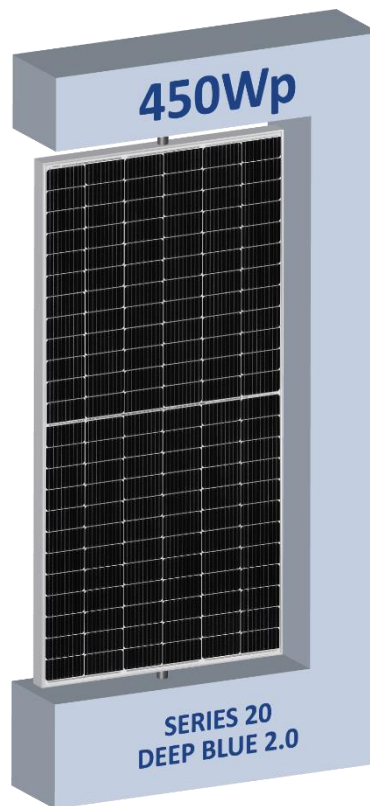


166

WAFER

450Wp

SERIES 20
DEEP BLUE 2.0



210

WAFER

500Wp

210 WAFER
PRODUCT

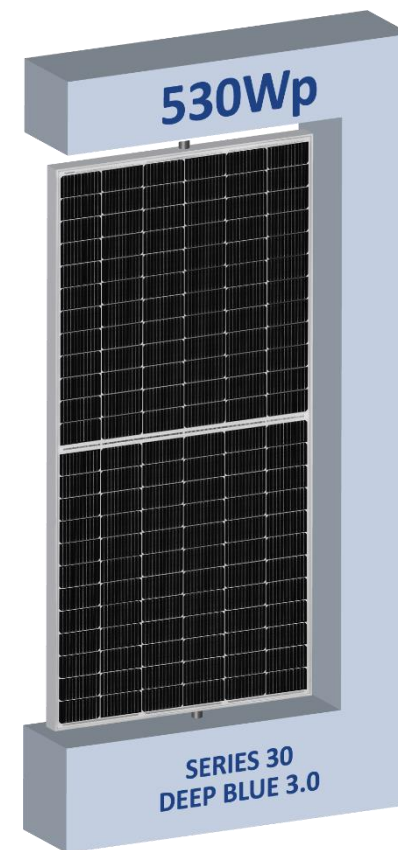


180

WAFER

530Wp

SERIES 30
DEEP BLUE 3.0



158.75 mm Wafer

158

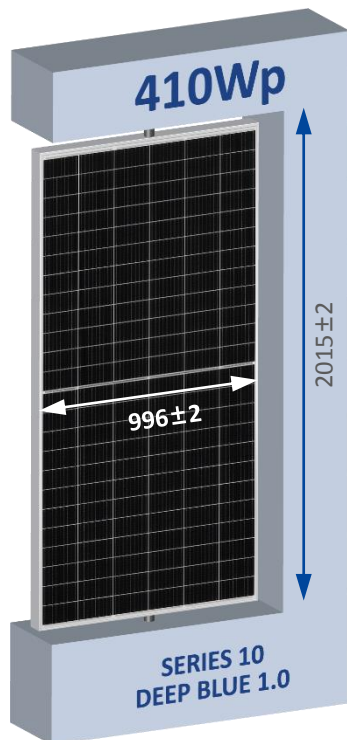
WAFER

72

CELLS

2

CUT



ESTABLISHED PRODUCT

- Field data. Bankable.
- Mounting kit and BOS compatible now.

SUPPLY ECONOMIES OF SCALE

- Wide choice in market

LOWER OPERATING CURRENT

- Lower operating temperature
- Better Yield in very hot areas

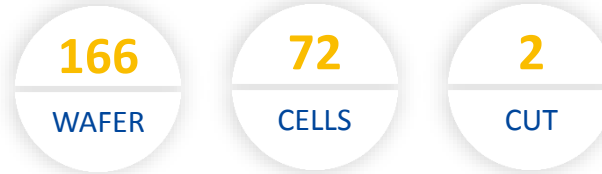
CONVENTIONAL SIZE

- Suitable for traditional installation
- Roof top C&I application

Power	410 Wp
Voc	50.1 V
Isc	10.4 A
Vmp	41.9 V
Imp	9.8 A
Weight	22.7 kg

Power	445 Wp
Voc	54.56 V
Isc	10.4 A
Vmp	44.46 V
Imp	9.8 A
Weight	24.6 kg

166mm M6 Wafer



BANKABLE

- Mature supply chain
- Proven Technology

LESS COMPROMISES

- Lower VoC compared to other technologies, string length remains

BOS Savings

- Reduce costs for mounting hardware, pile foundations, cabling (Balance of System)

Power	450 Wp
Voc	49.7 V
Isc	11.4 A
Vmp	41.5 V
Imp	10.9 A
Weight	25.0 kg

180mm M9 & 210mm M12 Wafers

JA SOLAR

50

CELLS

3

CUT

210

WAFER

DEEP BLUE 3.0

72

CELLS

180

WAFER

2

CUT

ELECTRICAL PARAMETER

- Lower current for 210 mm modules
- Lower voltage for 180 mm modules

PRODUCTION STABILITY

- Traditional Cell Cutting
- Lower Production yield loss

SUPPLY SIDE ECONOMIES OF SCALE

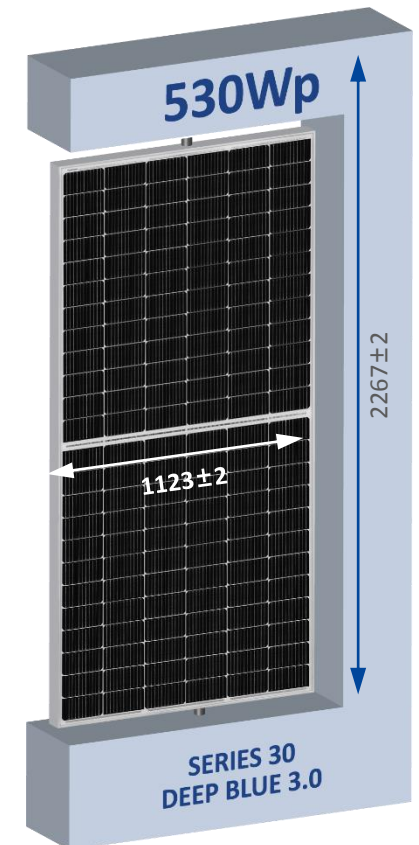
- Major Players in 180mm

2222±2

Power	500 Wp
Voc	51.6 V
Isc	12.2 A
Vmp	42.5 V
Imp	11.8 A
Weight	28.0 kg



Power	530 Wp
Voc	49.7 V
Isc	13.4 A
Vmp	41.8 V
Imp	12.7 A
Weight	28.5 kg



PRODUCTION COSTS PROS OF 180 mm VS. 210 mm

- Wafer cost lower
- Better to exploit economy of scale

WAFER COST



CELL COST



MODULE COST



■ 525W 180 ■ 500W 210 ■ 410 158

LOGISTICS COSTS MINIMIZED WITH 180 mm

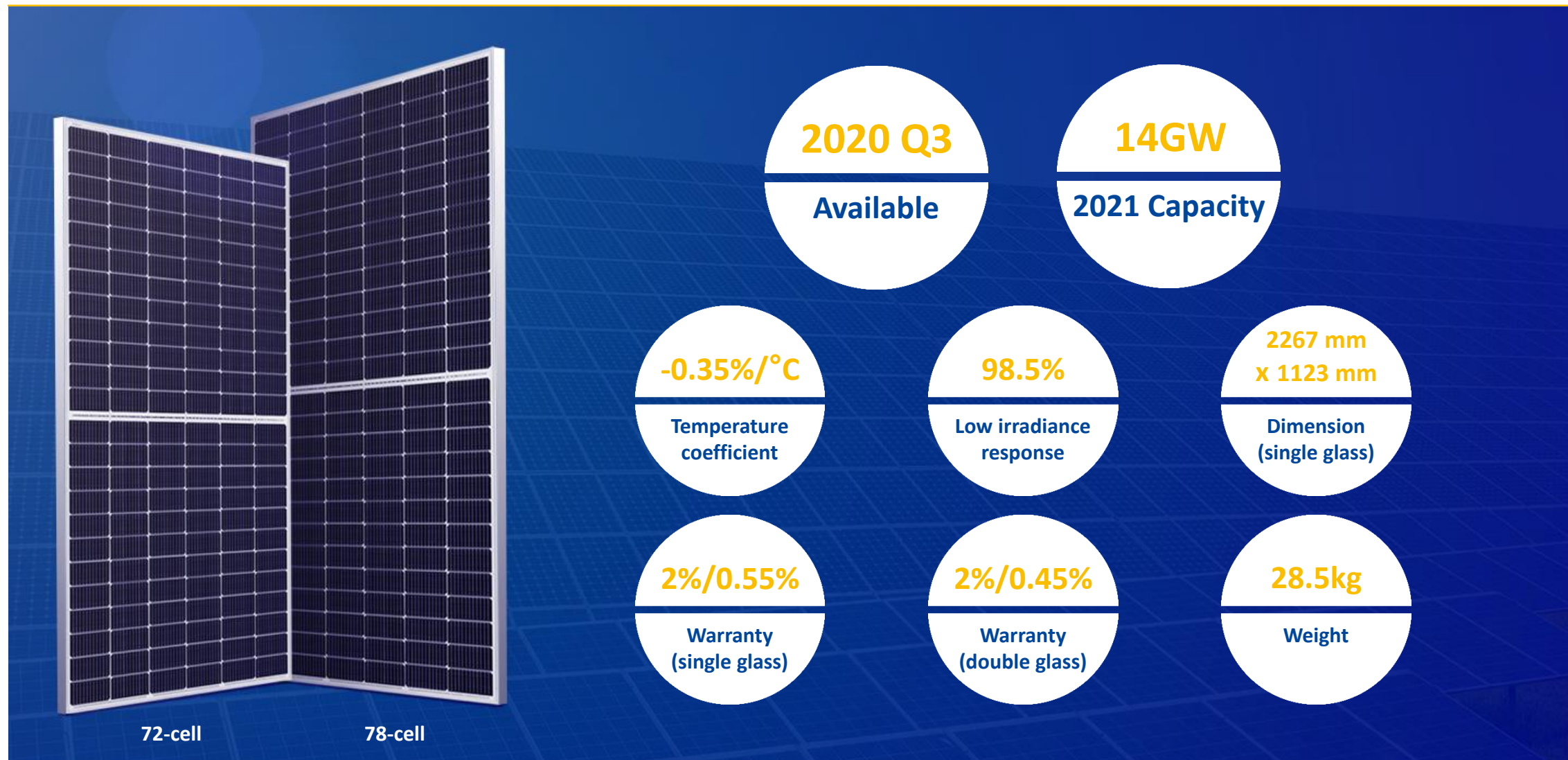
- Module dimensions are limited by the size (especially door's height) of the container
- Module size of DeepBlue 3.0 optimized for loading maximum amount in 40 ft. container (more than 280 kWp)

S10 Deep Blue 1.0 410 Wp	S20 Deep Blue 2.0 410 Wp	S30 Deep Blue 3.0 410 Wp	210 mm 500 Wp
244	267	286	270
kWp/container			

570W+

- Possible with Tiling, Module efficiency raises 0.4%
- Higher Efficiency but higher CTM loss



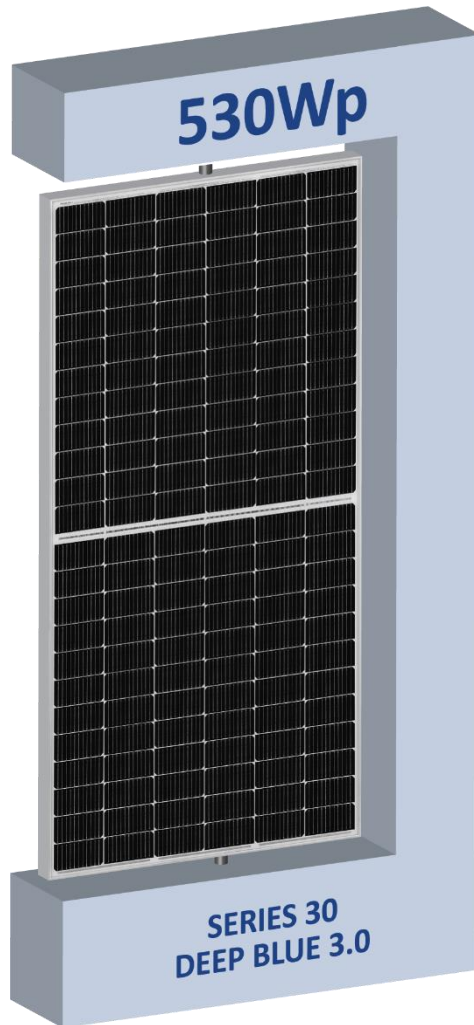




PART 2

A PRACTICAL POINT OF VIEW

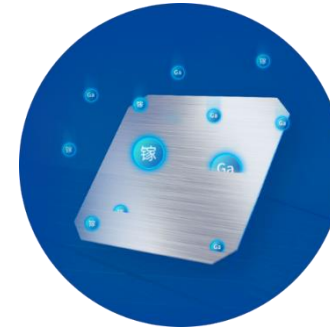
2. Practical Point of View – Large Modules



Gallium inside

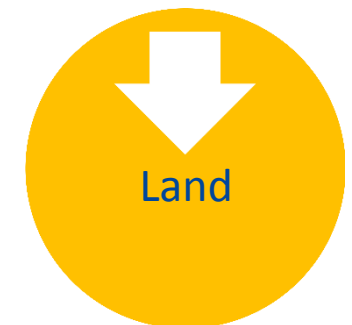
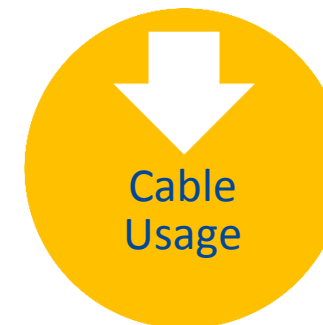
Lower power attenuation
(at 2% for 1st year)

Year degradation 0.55%/a



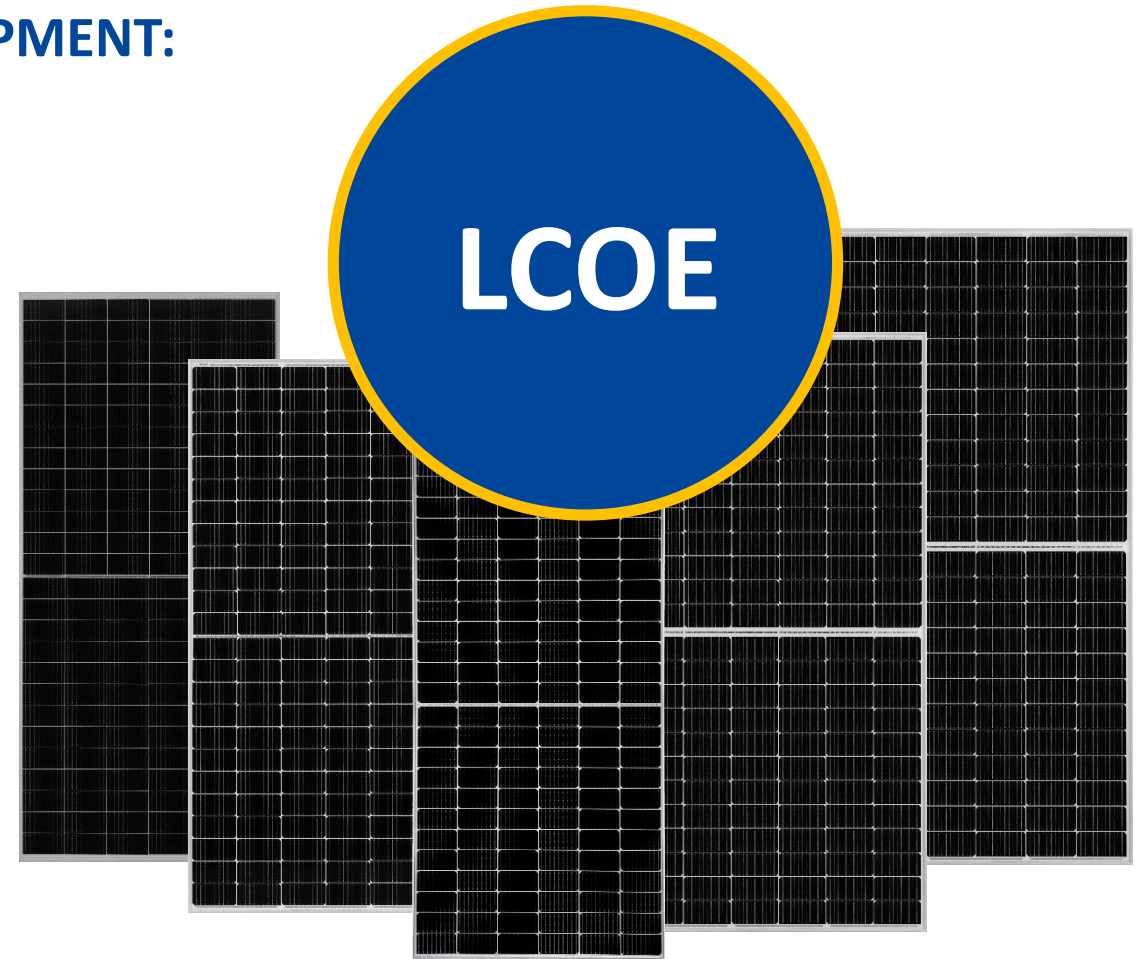
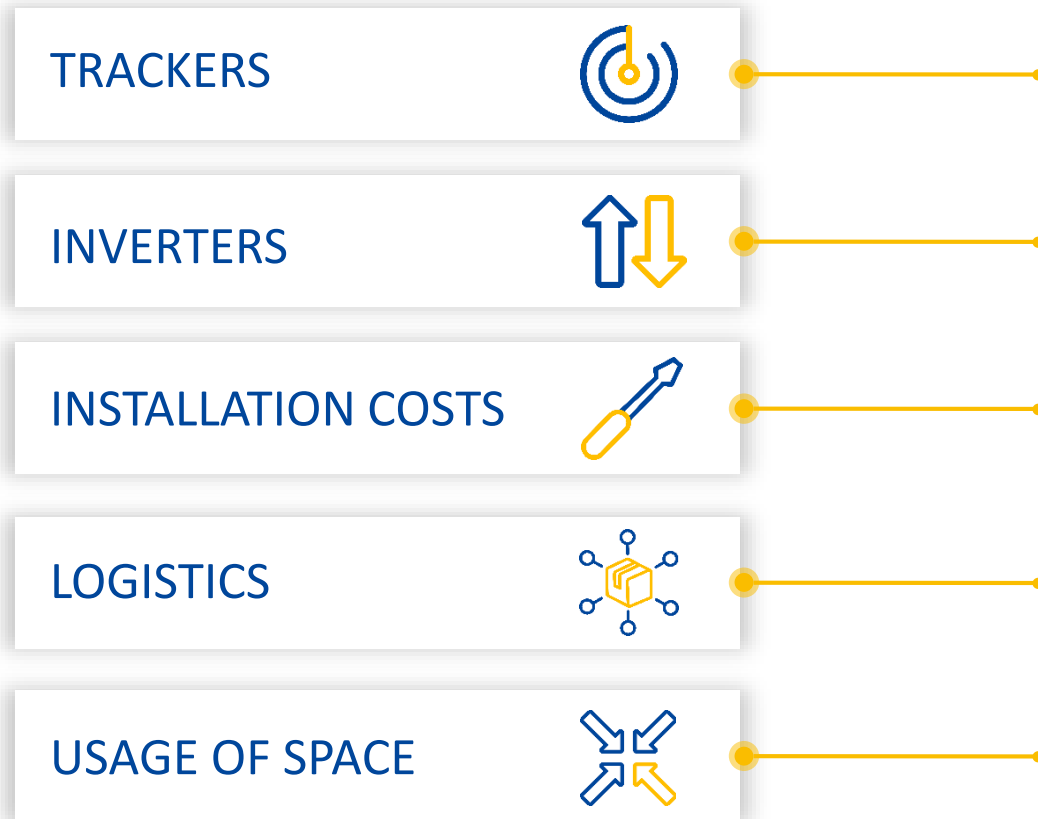
Lower LCOE

From BOS system gains
Larger Installed volume



2. Practical Point of View – Large Modules

COMPATIBILITY WITH REST OF PV PLANT EQUIPMENT:



2. Practical Point of View – Large Modules

COMPATIBILITY WITH REST OF PV PLANT EQUIPMENT:

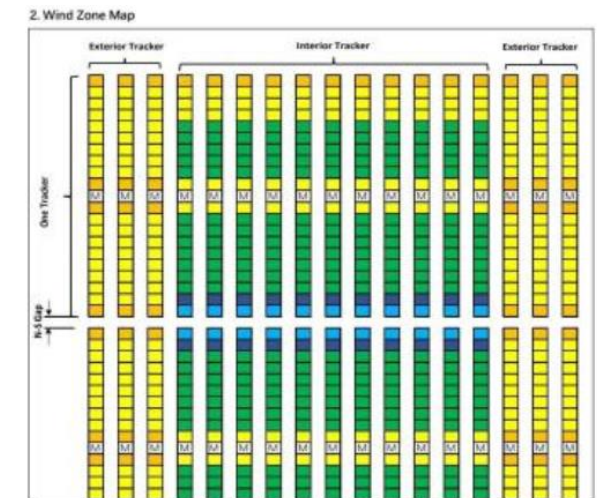
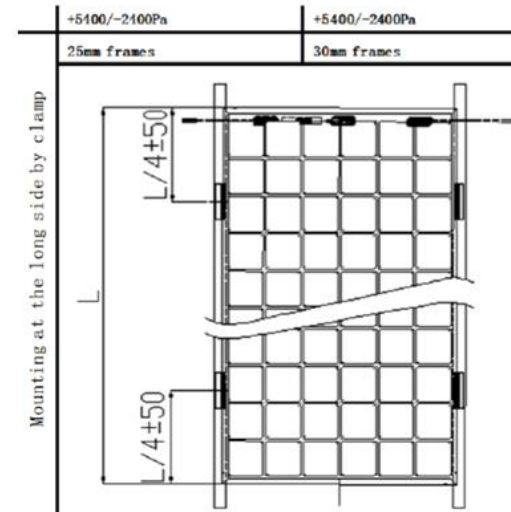
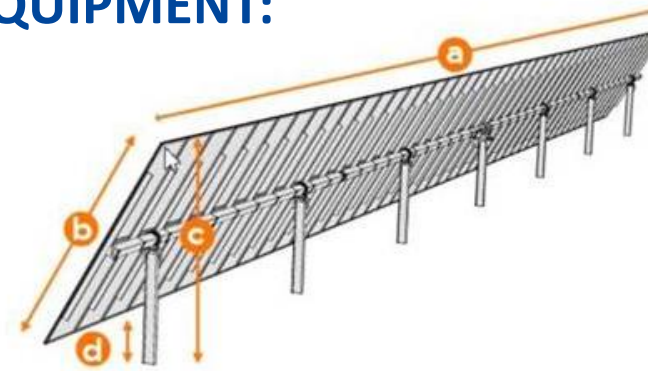
TRACKERS



- Width limit of the trackers
- Different wind loads affect to trackers design
- Different Regulation Laws affect trackers design
- Fasteners
- Bifacial (need an inter-space)

JA Solar Modules are compatible with mainstream trackers:

- 2P – 4L
- 1P – 2L
- Fixed Mounting System



3. Wind Pressure on Panel (Testing Load)

Uplift (Pa)	Downforce (Pa)
1117	3295
869	1846
466	861
512	917
745	1253



2. Practical Point of View – Large Modules

COMPATIBILITY WITH REST OF PV PLANT EQUIPMENT:

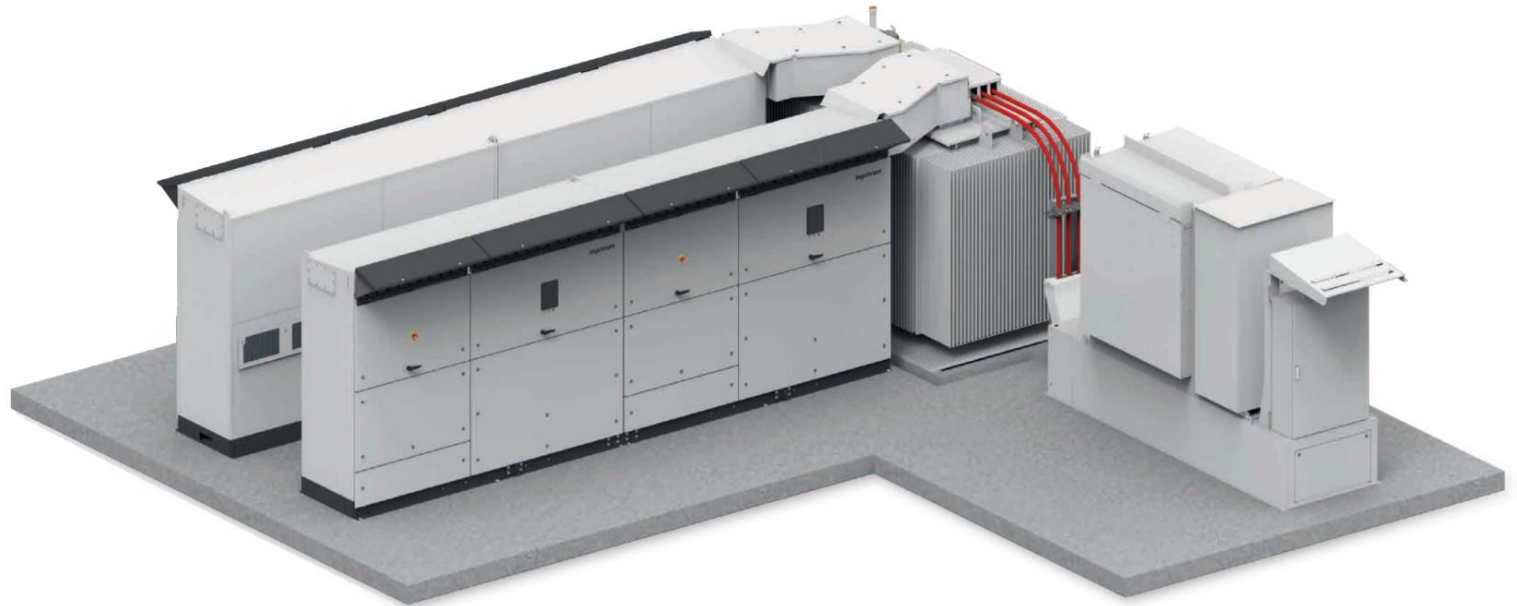
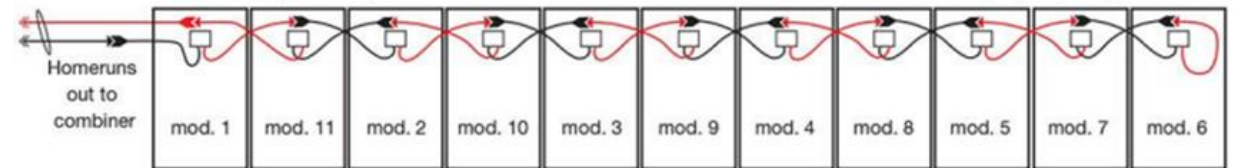
INVERTERS



- String length (BOS savings)
- Isc at the input current

JA Solar Modules are compatible with mainstream inverters:

- String Inverters
- Central inverters



2. Practical Point of View – Large Modules

COMPATIBILITY WITH REST OF PV PLANT EQUIPMENT:

INSTALLATION COSTS



- Less equipment / Less Labour

LOGISTICS



- Optimize Container Usage

USAGE OF SPACE



- Less Space / More power



2. Practical Point of View – Case Studies

CASE 1 100MW PV Plant Heavy Wind Load Conditions Cadiz, Spain (139km/h)



PLANT CHARACTERISTICS

- Same Peak Power 127MWp (106MWn)
- 2P tracker
- String Inverter
- Price parity on modules

CASE 2 100MW PV Plant Normal Wind Load Conditions Fortaleza, Brasil (108km/h)



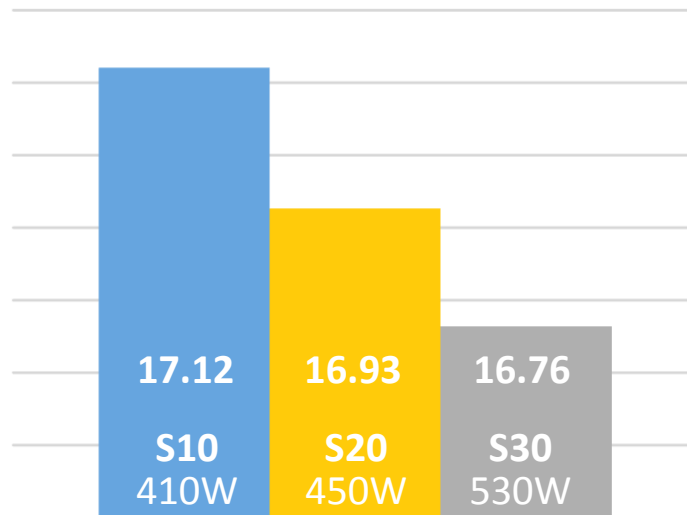
	S10 – 410W	S20 – 450W	S30 – 530W
Module Dimensions	2015 x 996 x 40 mm	2120 x 1052 x 40 mm	2260 x 1120 x 40 mm
Number of Modules	311,561	283,989	241,000
Modules Increment	0	-27,572 pcs	-70,561 pcs
Area	154 Ha	153 Ha	141 Ha
Area Increment	0.0%	-0.65%	-8.44%
Number of Trackers	3,462	3,155	2,678
Tracker Increment	0.0%	-8.85%	-22.65%

2. Practical Point of View – Case Studies Results

CASE 1 Heavy Wind Load Conditions

	S10 – 410W	S20 – 450W	S30 – 530W
Tracker Cost	+2.2%	0%	+1.0%
LCOE	0%	-1.13%	-2.08%

LCOE
€/MWh

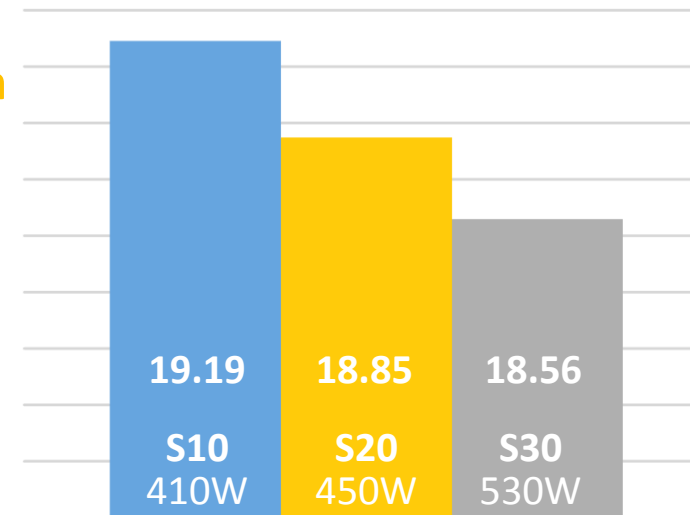


- Edge trackers are shorter to comply with EUROCODE
- Fasteners shall be longer to withstand same mechanical loads

CASE 2 Normal Wind Load Conditions

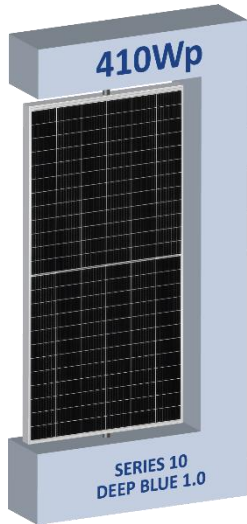
	S10 – 410W	S20 – 450W	S30 – 530W
Tracker Cost	+10.9%	+3.9%	0%
LCOE	0%	-1.78%	-3.29%

LCOE
€/MWh

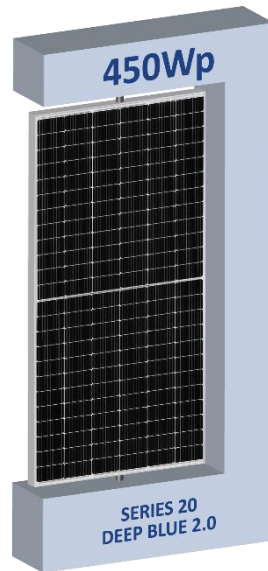


- Same length of external/internal trackers
- Massive tracker cost savings
- Less CAPEX improving LCOE

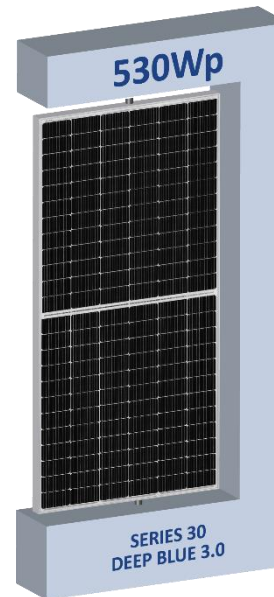
2. Practical Point of View – Making the best choice



- CAPEX reduction, competitive price



- Better Balance for 2P trackers
- Power Density Benefits – Good LCOE



- Best LCOE and ROI
- Less Mounting & Labour
- Less Terrain Risk (rock below)
- Best choice 1P tracker (larger modules problems with trackers avoided)

MARKET

TREND

