WHEN TRUST MATTERS

LCOE analysis of big modules

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System configuration

Module power	585W	660W
Module	186 module	210 module ↑
Dimensions LxW (mm)	2411x1134	2384x1303
# Modules	188125	166518 ↑
Module per string	25	29
Inverter	Sungrow SG250HX (string inverter)	
Inverter capacity	225kWdc	
# Inverters	445	
Tracker	Tracker (1 module portrait)	
Tracker length	42.7125	56.898 ↑
# Tracker	2509	1914 ↓
Modules per tracker	75(3 Strings)	87(3 Strings)
Transformers	44 x 2.5 MW 1 x 1.5 MW	
DC capacity	110 MWdc	
AC capacity	100 MWac	
DC/AC ratio	1.1	
Pitch (m)	7.50	7.41
Ground Cover Ratio （GCR）	31.62%	

- Compare 2 module types (cell size different)
- 660 W module design: low voltage, high current
- Same DC & AC system capacity
- Same GCR: maintain bifacial and shading impacts
- Allow spacing for internal roads and equipment
- Longer tracker length because larger module width

Increase from prior module rating ↑

Decrease from prior module rating ↓

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Vertex module consideration

Inverters

	585W	660W
Cell size	182mm	210mm
Isc	13.91 A	18.45 A
Voc	53.4 V	45.9 V

Inverter string input now typical 15A, future need to design for 20A string to be compatible with larger modules

Wire length

Item	585W	660W
DC cabling length(m)	321,124	282,220
AC LV cabling length(m)	146,370	111,386
AC MV cabling length(m)	29,037	25,142

Compare with 585W, shorter DC homerun wiring (each string has more modules), shorter AC (less tracker and longer tracker length)

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Assumptions

- Assume the inverters can have higher string input 20A, but product not available yet, simulation do not use individual MPPT inputs
- The tracker price of 585 and 660 was given by the Nextracker base on tracker dimension change
- The PAN. file was given by customer and was not verified by third-party.
- Each system has similar DC capacity which O&M fee keep constant

Description	USA	Spain
Amount of equity	15%	30%
Cost of equity	10%	13%
Cost of debt	5%	5%
WACC (estimated)	5.75%	7.4%

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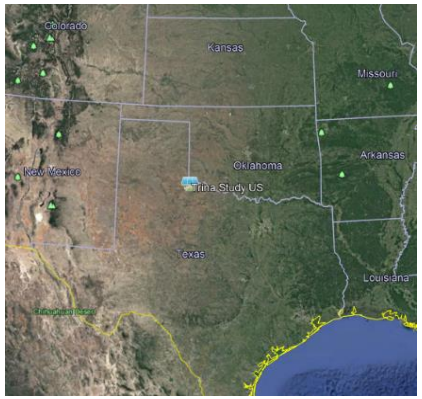
Energy model

Seville, Spain (37.27°, -5.74°)

Texas, USA (34.36°, -99.89°)



Energy increase w/ module power

Energy decrease w/ module power

	Sevilla, Spain		Texas, USA	
	585W	660W	585W	660W
Global horizontal irradiation (kWh/m2/yr)	1,856		1,856	
Global irradiation on the inclined plane (kWh/m2/yr)	2,507		2,541	
Atmosphere temperature	18.9 °C		17.5 °C	
Peak power (Kwp)	110,053	109,902	110,053	109,902
Shadings	2.4		2.3	
IAM	0.3		0.3	
Soiling	1.4		1.0	
Ground reflection on front side	-0.4		-0.4	
Bifaciality energy gain	-5.0		-4.5	
Low-irradiance efficiency fall-off	-0.2	-0.3	-0.2	-0.3
Temperature	5.9	5.7	5.8	5.6
Module quality	-0.2	0.0	-0.2	0.0
Light induced degradation (LID)	1.5		1.5	
Mismatch	0.4		0.4	
Mismatch for back irradiance	0.7		0.1	
Ohmic (DC)	0.6	0.8	0.6	0.8
Inverter	1.1		1.3	
Transformers LV-MV	1.4		1.4	
Transformers MV - HV	0.7		0.7	
Auxiliary loads	0.3		0.3	
Ohmic AC (AC cabling until connection point)	0.7	0.6	0.7	0.6
System unavailability	0.8		0.8	
Net Energy (P50 Year 1)	242,929	242,496	247,595	247,001
Yield Factor Net Energy	2,207	2,206	2,250	2,247
Performance Ratio Net Energy	88.1%	88.0%	88.6%	88.5%

LCOE comparison results

Conclusion

- The LCOE cost for 660W modules is lower than that for 585W modules
  - Overall 660w has less tracker materials
  - Less DC wires and AC wires, thus the cost of wires
  - O&M fees are same and OPEX are similar

$$LCOE = \frac{Capex + Opex}{Energy}$$

	Euro €/Wp		USD $/Wp	
	585W	660W	585W	660W
Module	0.1932		0.3200	
Inverter	0.0257		0.0279	
Tracker & mounting	0.0859	0.0761	0.1043	0.0925
EPC cost	0.4767	0.4635	0.8915	0.8677
Development	0.1001	0.0973	0.1516	0.1475
CAPEX	0.5768	0.5608	1.0431	1.0152
		-2.77%		-2.67%
Land	0.0009	0.0008	0.0029	0.0029
O&M fee	0.0150		0.0082	
Asset management	0.0020		0.0015	
OPEX	0.0178	0.0178	0.0127	0.0126
		-0.24%		-0.24%
LCOE	0.0341	0.0334	0.0428	0.0419
		-1.84%		-2.10%

- Cost estimations based on similar projects in Spain and USA
- Results comparable to Wood Mackenzie system pricing
- Development cost set as 21% Target EPC cost

Questions?

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