Introduction of Hyundai PV business

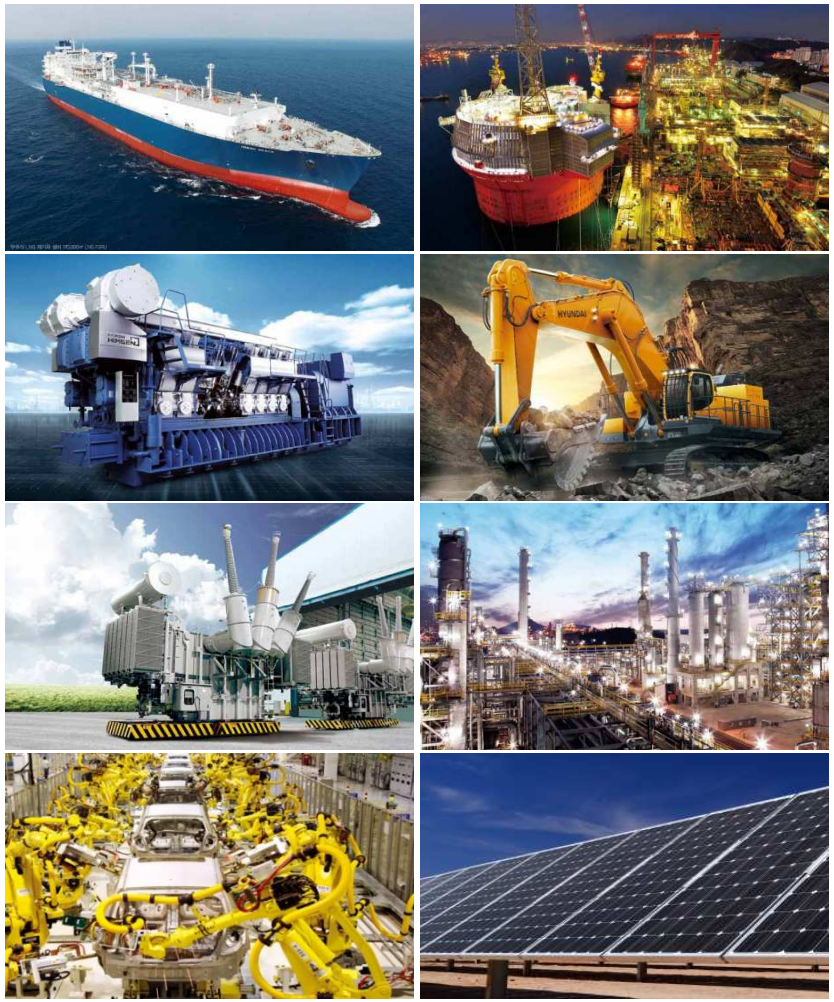
HYUNDAI ENERGY SOLUTIONS

About Hyundai

HYUNDAI HEAVY INDUSTRIES

- Established in 1972
- World No.1 Shipbuilder (Based on output)
  World No.1 Marine Engine Maker
- Sales : 46 billion USD (2018Y)
- Fortune 500 Company
- Business Scope :

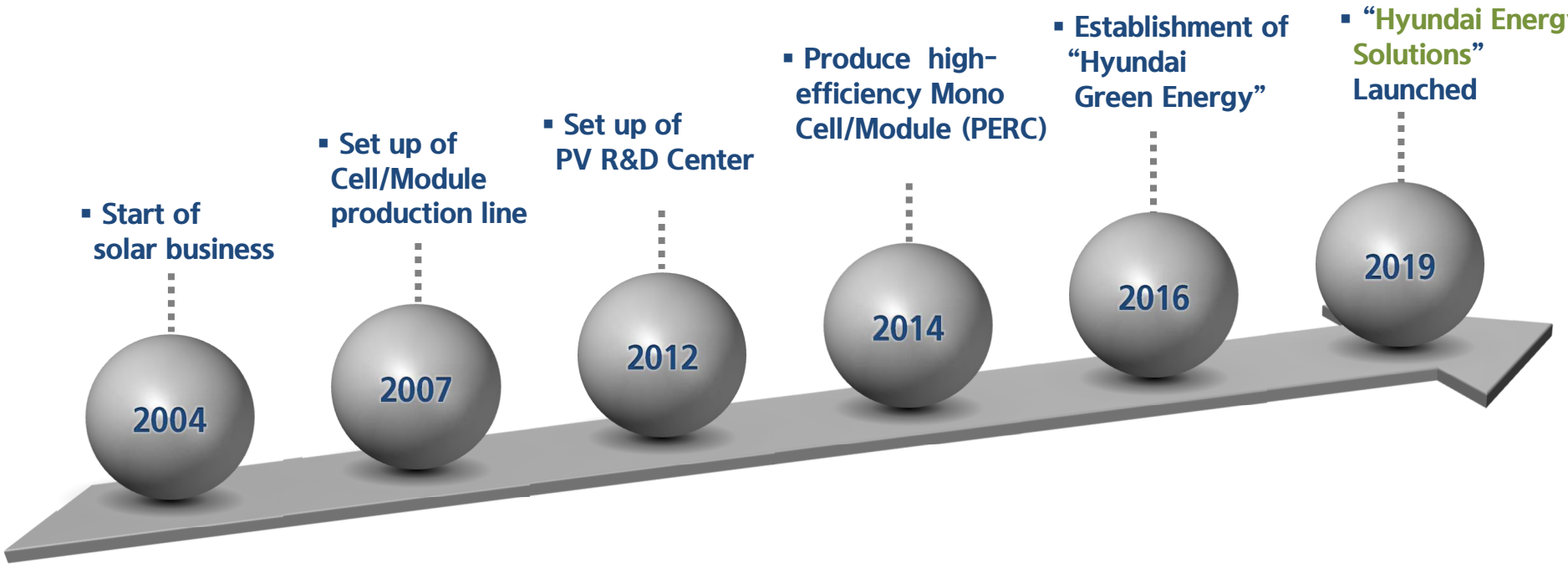
  Shipbuilding, Offshore & Industrial Plant,
  Motors, Engine & Machinery, Industrial Robot,
  Construction Equipment, Electro Electric Systems,
  Refining & Petrochemical,
  Renewable Energy
  (Hyundai Energy Solutions)



Hyundai PV History

PV (Solar) Business History

- 2004 : Start of solar business
- 2016 : Spin-off and establishment “Hyundai Green Energy”
- 2018 : Start of EPC business & merge of ESS/Inverter business
- 2019 : Changed the name to “Hyundai Energy Solutions”



Hyundai Bankability

- Bloomberg New Energy Finance (BNEF) qualified Hyundai as Tier 1 panel manufacturer in the world (Q1 2020).

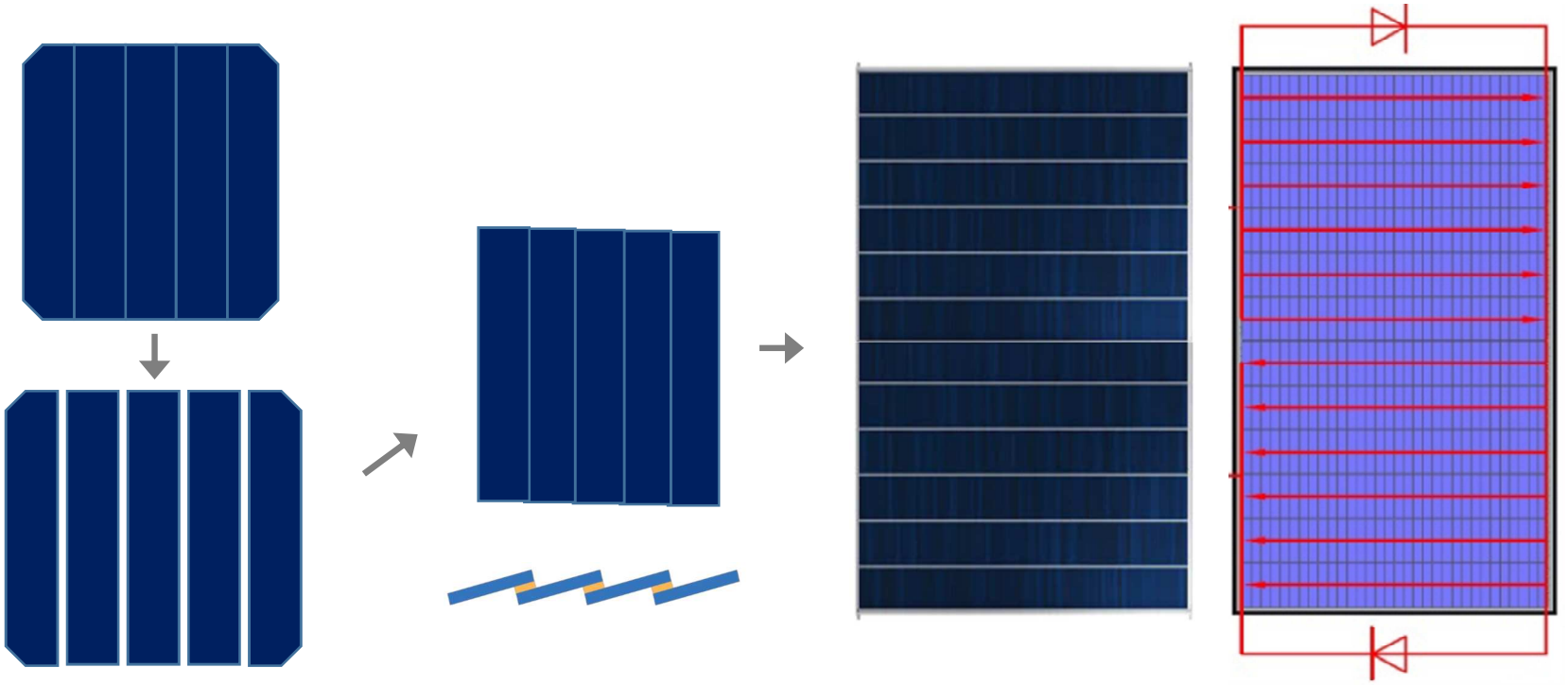
Table 3: List of module makers meeting the tier 1 criteria, as of 1Q 2020

Firm/ brand	Annual module capacity, MW/year	Firm/ brand	Annual module capacity, MW/year
Jinko*	16,000	Waaree*	2,000
Longi*	15,000	REC Group*	1,800
JA Solar*	15,000	Neo Solar Power/ URE	1,800
Canadian Solar	13,000	HT-SAAE*	1,500
Risen Energy	11,100	Adani/Mundra*	1,500
Hanwha Q-Cells*	10,700	Vietnam Sunergy (VSUN Solar)*	1,500
Trina Solar*	8,000	Boviet*	1,000
GCL Systems*	7,200	Lightway	1,200
First Solar*	6,200	Vikram Solar*	1,200
Talesun	6,000	Jolywood	1,100
Seraphim*	5,000	Hengdian DMEGC	1,000
Wuxi Suntech*	4,500	Ulica Solar	800
Chint/Astronergy*	4,200	Hansol Technics	600
ZNShine*	3,500	Hyundai	600
Jinneng/ Jinergy	2,700	S-Energy	530
BYD	2,400	Goldi Solar	500
SunPower/ Maxeon*	2,400	Recom	500
LG Electronics*	2,000	Heliene*	390
Sumec/ Phono Solar	2,000	Sharp	210
		Total	156,630

*Source: BloombergNEF Note: Methodology here. Note: * denotes a company for which technical due diligence reports are available from PVEL. Contact Tara.Doyle@pvel.com for details. Amended to include * for VSUN on February 20, 2020.*

New PV module Technology

- **Shingled** technology is an innovation process of manufacturing for PV Modules.
  1) Utilizing more space in a PV module → **Higher module efficiency and power**
  2) Using ECA instead of soldering ribbon → **Higher reliability**
  3) Parallel & series connection → **Better shading performance**



Laser Cutting **ECA Overlap** **String assembly to shingled module**

Hyundai Shingled PV Module

- Hyundai offers shingled module for more efficiency and higher reliability
- Hyundai provides **20 years product warranty** on the shingled module
  (Europe distribution channel only)

Mono PERC module
(Module Efficiency: ~19.4%)

20 Years Product Warranty

Mono PERC shingled module
(Module Efficiency: ~20.2%)

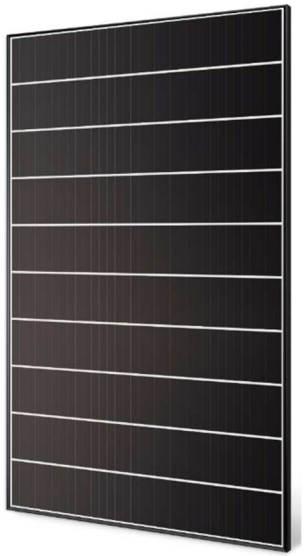
Quality Assurance

Certificates

IEC 61215
IEC 61730 & CE

KS C 8561

PID
IEC TS 62804-1



UL 61730 / 61215

Salt Mist Corrosion
IEC 61701

Ammonia Corrosion
IEC 62716

Dust and Sand
IEC 60068-2-68

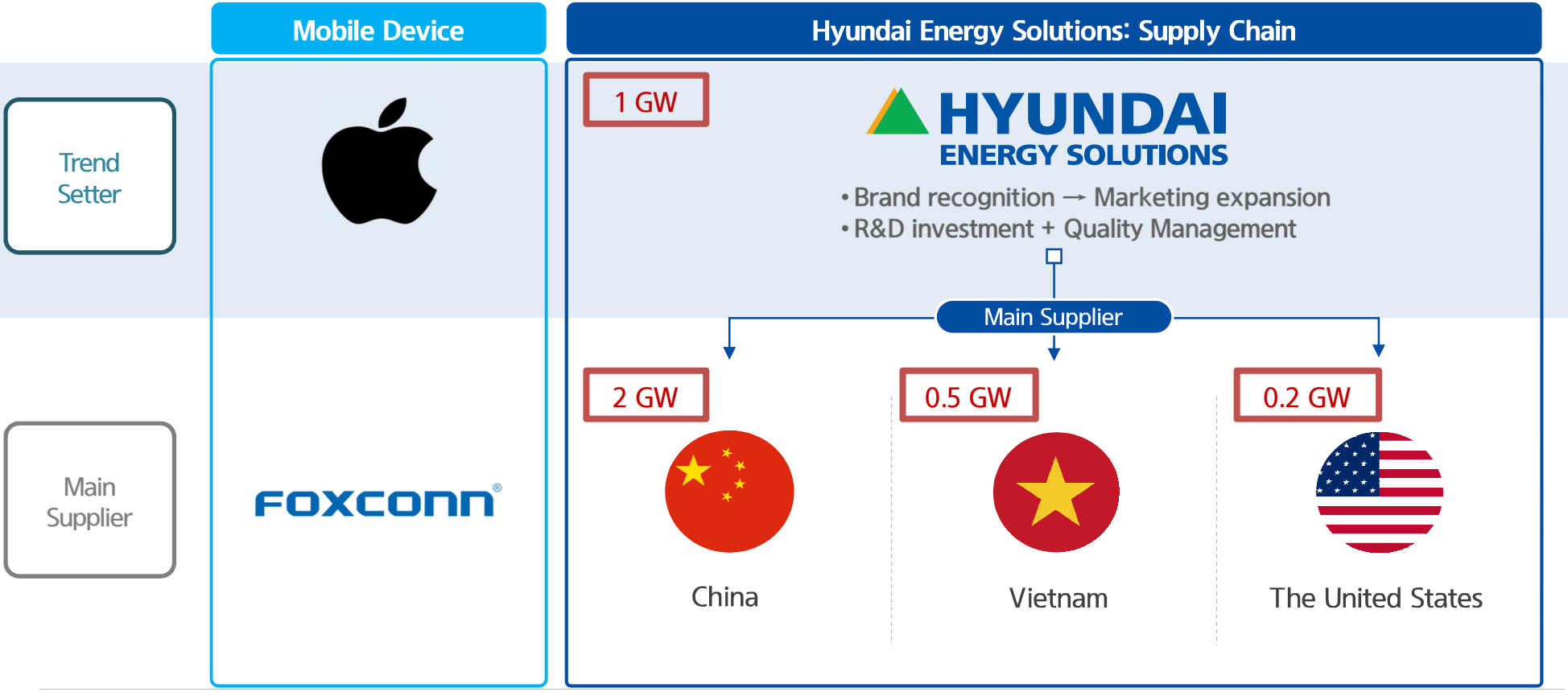
Hyundai Test Standard

Item	IEC Standard	HES' Internal Standard
Damp Heat	85℃, 85%RH 1000hr	85℃, 85%RH **3000hr (x 3)**
Thermal Cycling	-40℃~+85℃ 200cycle	-40℃~+85℃, **600cycle (x 3)**
UV Exposure	60kWh/m^2	**90kWh/m2 (x 1.5)**
PID	85℃, 85%RH, 192hr, -1000V	85℃, 85%RH, **600hr (x 3)**, -1000V

[Hyundai test laboratory]

Production Capacity in 2020

- Hyundai has total production capacity of 3.7 GW worldwide
- Production sites are diversified to Korea, China, Vietnam and the U.S. to meet each demand



Product Road Map in 2020

- Hyundai keeps upgrading the module power and efficiency in 2020

Items		Product availability			
		Q1	Q2	Q3	Q4
Cell type	Mono PERC shingled	M2 (156.75 mm)			
			M3 (158.75 mm)		
				M6 (166 mm)	
Module Power (Wp)	60# All Black	340/345	350/355	385/390	385/390
	60# Black frame	345/350	355/360	390/395	395/400
	72# Silver frame	410/415	425/430	465/470	470/475

Cell type (size in mm)	Module size (L x W, mm)	
	72#	60#
M2 (156.75 mm)	1,942 x 1,069	1,622 x 1,068
M3 (158.75 mm)	1,969 x 1,084	1,646 x 1,084
M6 (166 mm)	2,056 x 1,153	1,719 x 1,153

Hyundai Project References

FLUOR 142MW

Maricopa, AZ, USA

BayWa r.e. renewable energy 32MW

Bordeaux, France

CONERGY 15MW

North Carolina, USA

"la Caixa" 8.5MW

Murcia, Spain

Sun Energy europe 7.7MW

Meldorf, Germany

Deutsche Bank 7MW

Albacete, Spain

IBERDROLA RBS 3.5MW

Caceres, Spain

KB 3.3MW

Jihomoravský, Czech