

Introduction of Hyundai PV business (Q3 2022)



About Hyundai



- 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)

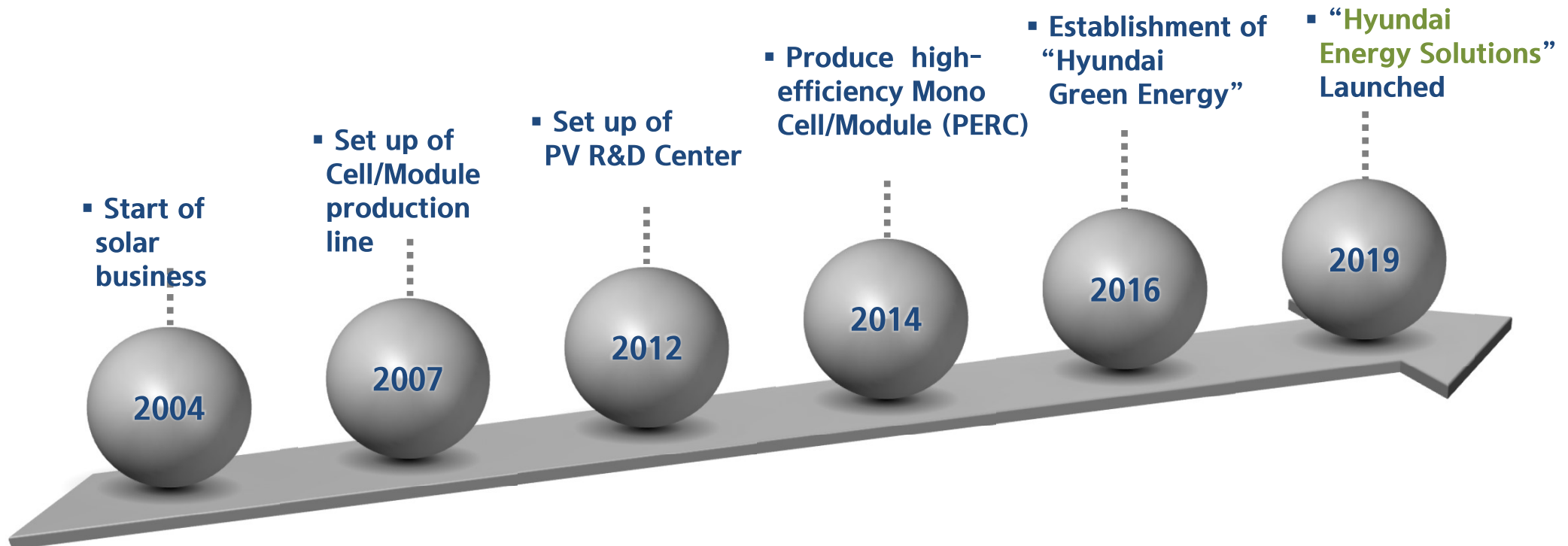


Hyundai PV History



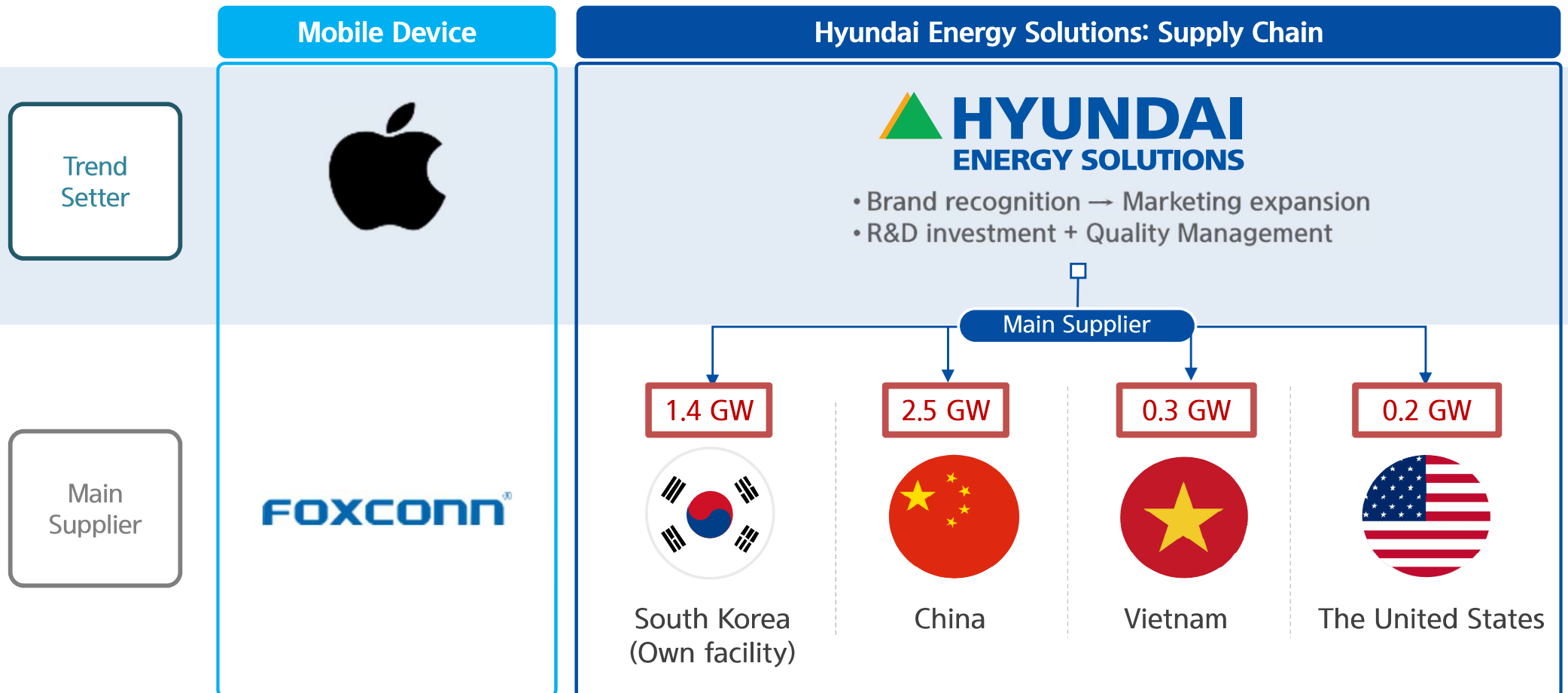
PV (Solar) Business History

- 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**”



Production Capacity in 2022

- Hyundai has total production capacity of 4.4 GW worldwide
- Production sites are diversified to Korea, China, Vietnam and the U.S.



Hyundai Bankability

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

BloombergNEF

3Q 2022 Global PV Market Outlook
August 26, 2022

Table 3: Photovoltaic module manufacturers meeting BloombergNEF's Tier 1 criteria as of 3Q 2022

Firm/ brand	Annual module capacity, MW/year	Firm/ brand	Annual module capacity, MW/year
ZNShine*	10,000	Jiangsu Akcome*	7,200
Yingli*†	7,000	Jetion	2,500
Waaree*	4,000	JA Solar	12,500
VSUN Solar*	2,600	Hyundai†	1,400
Ulica Solar	1,200	HT-SAAE*	3,100
Suntech†	11,000	Hanwha Q-Cells*†	12,400
Sumec/ Phono Solar	3,000	Hansol Technics†	600
Seraphim / SEG†	7,750	Haitai	8,000
S-Energy	530	GCL System	15,000
Risen Energy*†	24,600	First Solar*	8,800
Rezosola Yixing	5,000	Exiom Group	700
Recom†	1,100	ET Solar Inc*	2,000
Neo Solar Power/ URE	1,800	Eging*	5,000
Maxeon*†	4,400	DMEGC*	5,000
Longi†	65,000	Chint/ Astronergy*	17,000
Leapton Energy	2,000	Canadian Solar	27,900
Jolywood	3,000	Boviet Solar*	1,500
Jinneng/ Jinergy	4,000	AE Solar	1,525
Jinko*†	50,000	Total	370,105

Source: BloombergNEF Note: Methodology [here](#). * denotes a company for which technical due diligence reports are available from PV Evolution Labs, PVEL. Contact Tristan.eron-lozico@pvel.com. † denotes manufacturers upon which RETC has conducted or is conducting technical due diligence. Contact info@retc-ca.com for details. Brands are shown in reverse alphabetical order to avoid giving the impression that position in the list is significant. Companies can download the dataset of financings [here](#).

Hyundai received the rating “5A1” which is the strongest rate assigned by D&B.



Decide with Confidence

D&B Report

Delivery Date: Jul 22, 2020
Subscriber No: 410900085
Inquiry Name: HYUNDAI ENERGY SOLUTIONS CO., LTD.
Ticker Key: 2020072200410017
Attention: 20200722_HES

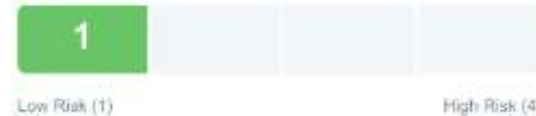
HYUNDAI ENERGY SOLUTIONS CO., LTD.

ACTIVE SINGLE LOCATION

Previous Name: HYUNDAI HEAVY INDUSTRIES GREEN ENERGY CO., LTD.
Address: 4/F, BUNDANG FIRST TOWER, 65 BUNDANG-RO, BUNDANG-GU, SEONGNAM, GYEONGGI, 10691, REPUBLIC OF KOREA
Tel: 82 - 3183056965
DUNS: 69 483 0679

Risk Assessment as of JUL 22, 2020

Risk Indicator



Risk Level of the Company is : **STRONG**

D&B Rating

Financial Strength: 5A
Based on net worth
Risk Indicator: 1
Strong (Minimal Risk)

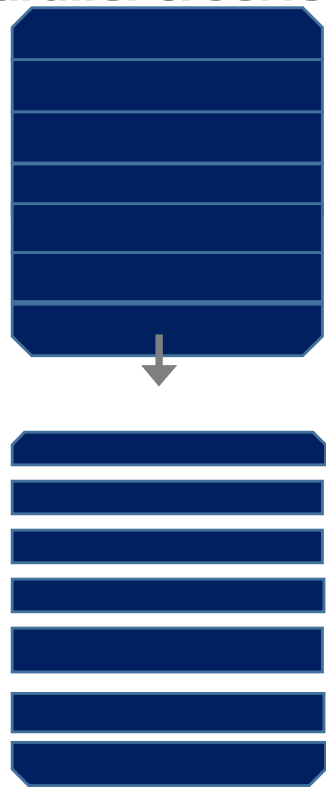
Previous Rating

Financial Strength: 5A
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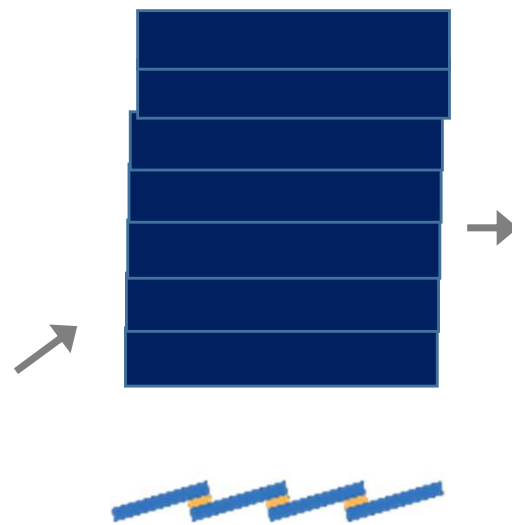
New PV module Technology



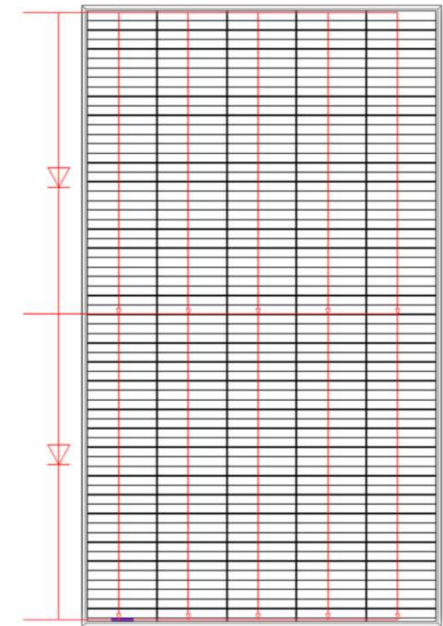
- **Shingled** technology is an innovation process of manufacturing for PV Modules.
 - 1) Utilizing more space in a PV module → **Higher module efficiency and power**
 - 2) Using ECA instead of soldering ribbon → **Higher reliability**
 - 3) Parallel & series connection → **Better shading performance**



Laser Cutting



ECA Overlap



String assembly to **shingled** module
(In Portrait)

Hyundai Shingled PV Module



- Hyundai offers shingled module for more efficiency and higher reliability
- Hyundai provides **25 years product warranty** on the shingled module (Europe/Australia distribution channel only)



Mono PERC module
(Module Efficiency: ~19.4%)

25 Years Product Warranty



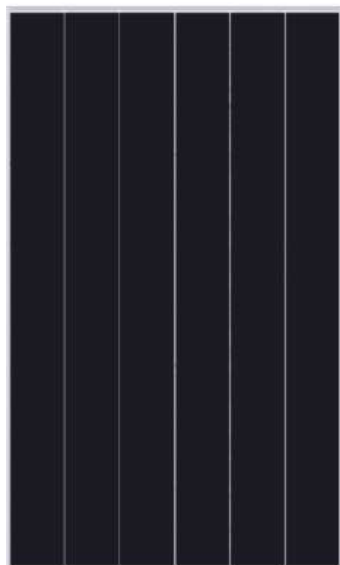
Mono PERC shingled module
(Module Efficiency: ~21.1%)

Product Line-up



210(G12) Shingled Module

Utility



DJ 655Wp+
Bifacial
Dual Glass
72-cell size



KN 545Wp+
Monofacial
Single Glass
72-cell size

Residential,
&
Commercial



HG 435Wp+
60-cell size
Black Frame



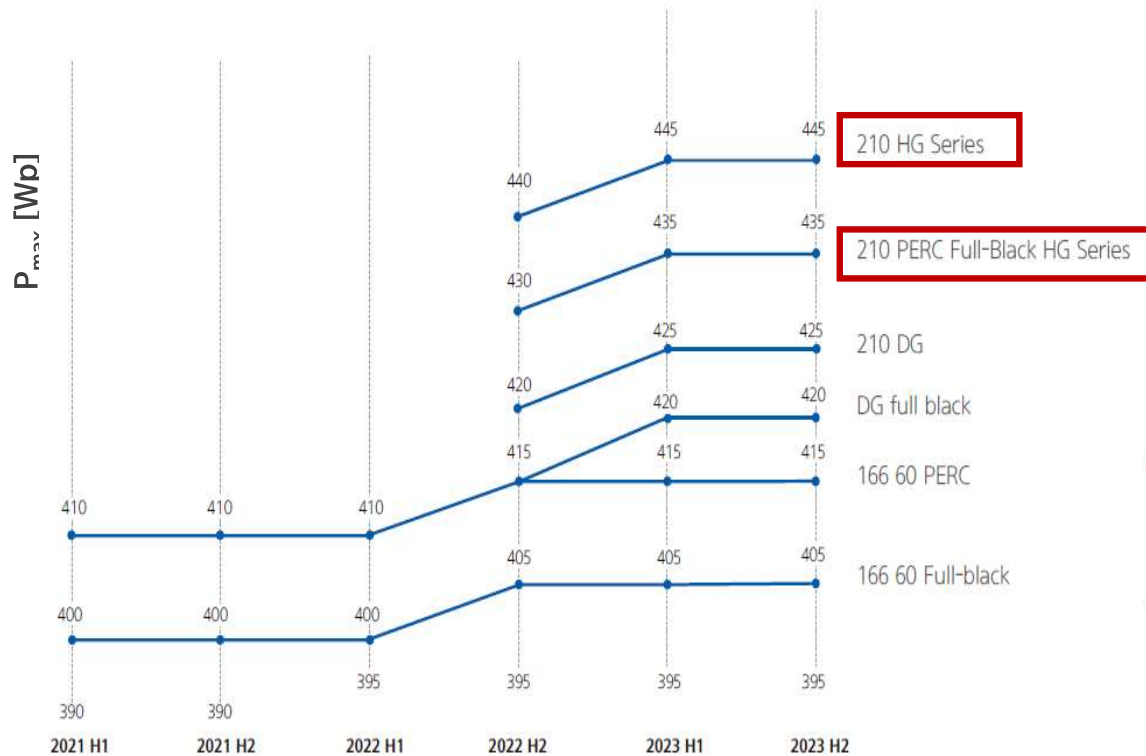
HG 430Wp+(FB)
60-cell size
Full Black

Product Road Map in 2022

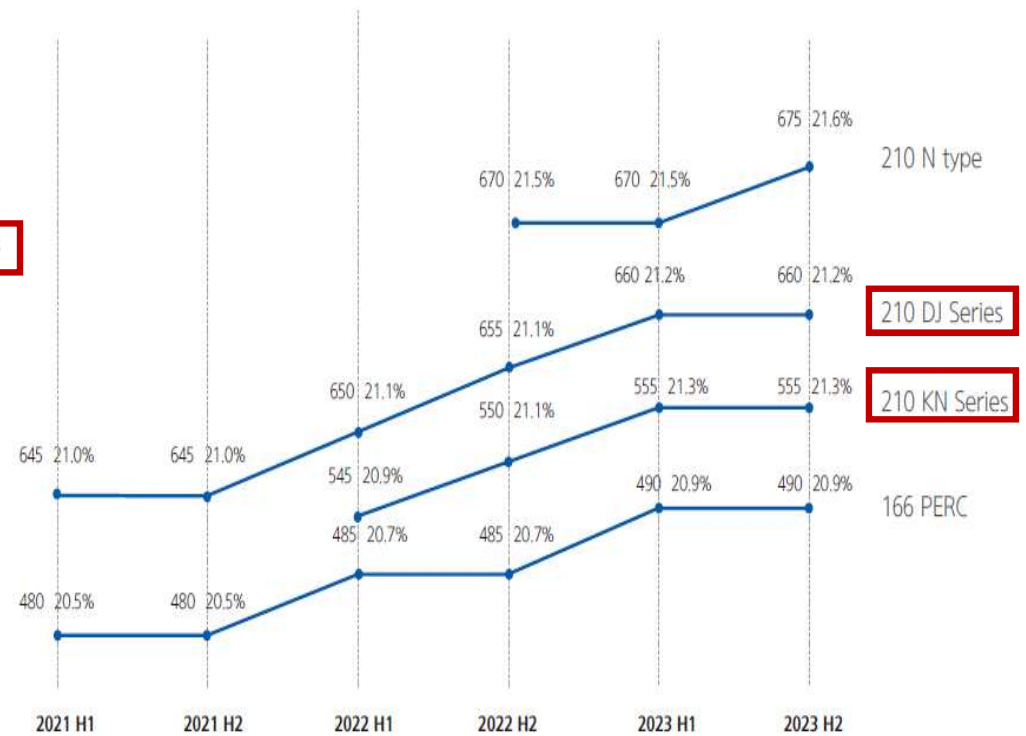


The main product is G12 (210 mm) HG Series PERC shingled module and the power output will be constantly improved (440Wp for Black Frame, 435Wp for Full Black in Q3 2022)

〈60-cells〉



〈72-cells〉




Quality Assurance




Certificates

Fire Class One


1 (UNO)
1 (ONE)




IEC 61215
IEC 61730 & CE




KS C 8561




PID
IEC TS 62804-1




Salt Mist Corrosion
IEC 61701



Dust and Sand
IEC 60068-2-68



Ammonia Corrosion
IEC 62716



Hyundai Test Standard

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



[Hyundai test laboratory]

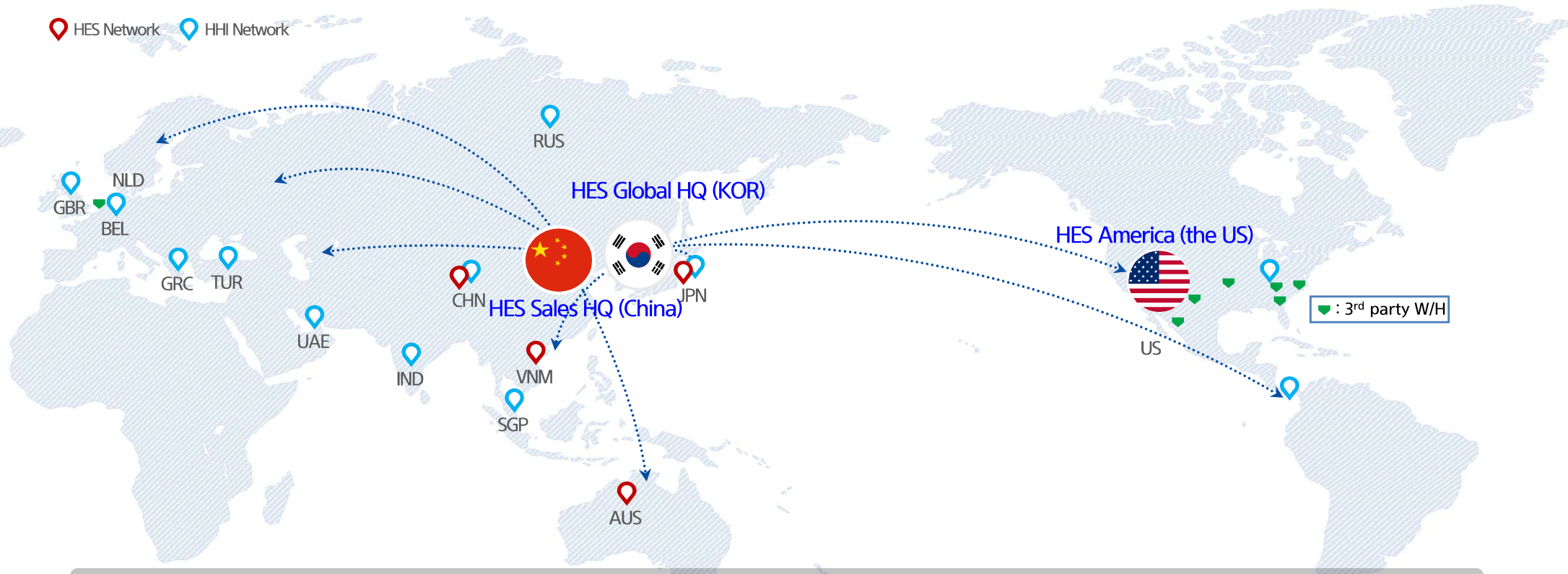
Elegant Appearance



Global Networks



- 1 The worldwide networks of Hyundai Energy Solutions (HES) and Hyundai Heavy Industries (HHI)
- 2 Operating the 3rd party local warehouses in EU (Rotterdam) and the US



Global HQ

- Global Headquarter in Seong-nam, Korea
- Manufacturing facility in Eum-seong, Korea

Sales HQ

- Global Sales Headquarter in Shanghai, China

US Corp.

- US Sales Headquarter in Newport beach, CA

Hyundai Project References



142MW



Maricopa, AZ, USA



32MW



Bordeaux, France

CONERGY 15MW



North Carolina, USA



8.5MW



Murcia, Spain



7.7MW



Meldorf, Germany



7MW



Albacete, Spain



3.5MW



Caceres, Spain



3.3MW



Jihomoravský, Czech