

# Shinsung E&G Company Profile

2018.10.

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# INNOVATIVE COMPANY

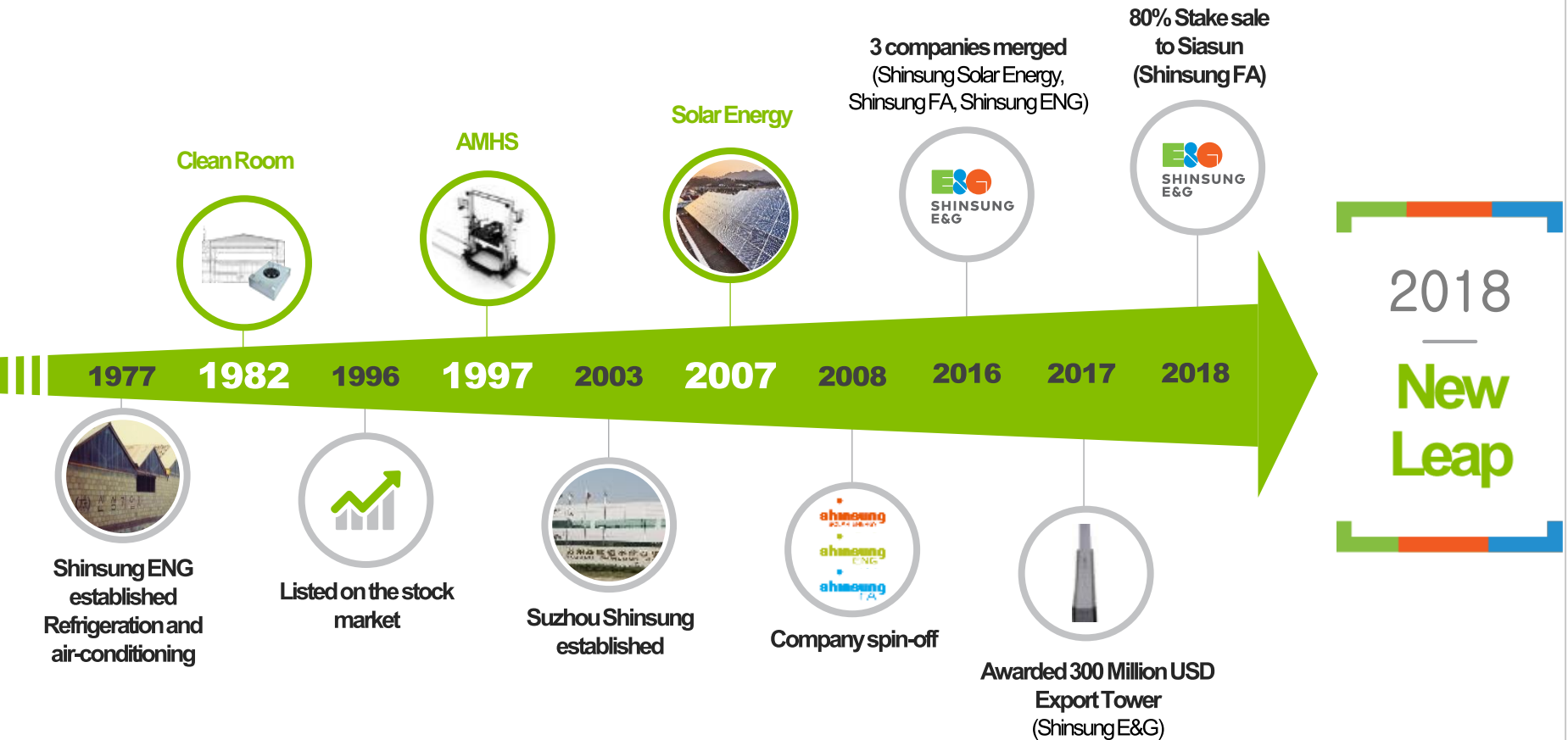
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1. History
2. Main Business Sites
3. Global Network
4. Prospect
5. Solar Business Profile
6. ENG Business Profile

# History

INNOVATIVE COMPANY

Company that leads the future of the 4th industrial revolution based on its technical competence in environment and renewable energy



# Main Business Sites

INNOVATIVE COMPANY

Domestic business sites to lead the technical advance in IT and renewable energy



## 1 Head Office



Seongnam-si, Gyeonggi-do

## 2 Smart Factory



Yongin-si, Gyeonggi-do

## 3 Solar Cell & Advanced Module Factory



Jeungpyeong-gun, Chungcheongbuk-do

## 4 Solar Module Factory



Eumseong-gun, Chungcheongbuk-do

# Global Network

INNOVATIVE COMPANY

Developing business points all over the world to be a global company

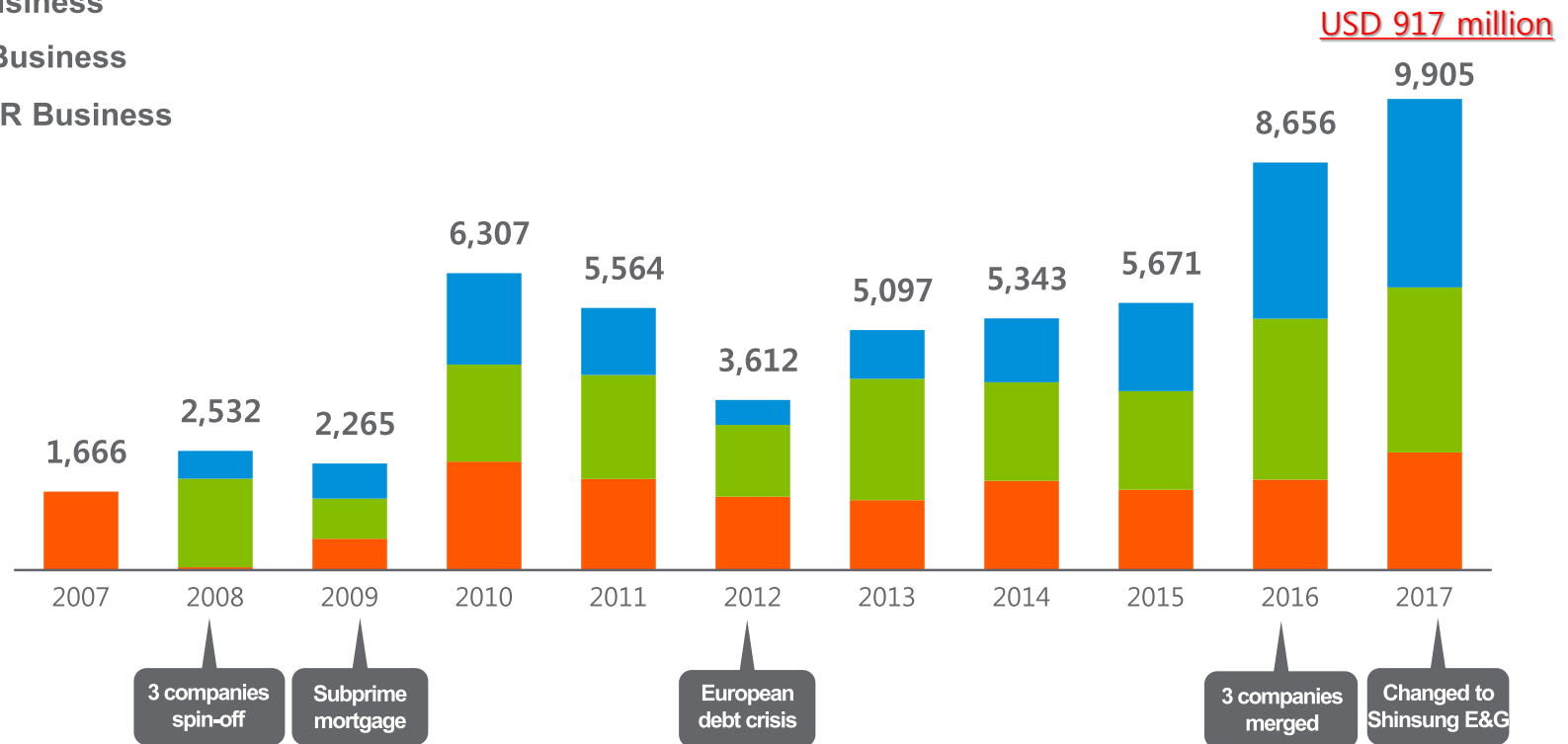


Company with potentials for continued development based on technical competence and customer reliability

## Total Sales Amount

Unit : KRW 100 million

- FA Business
- ENG Business
- SOLAR Business



# Solar Business Profile

LEADING TECHNOLOGY

Solar energy that enables sustainable development for human being



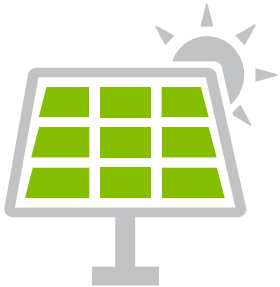
# Solar Business Profile

LEADING TECHNOLOGY

## Trustworthy Brand Value



- Listed as a BNEF Tier 1 PV company
- One of three Korean PV companies (ex. Hanwha Q Cells)



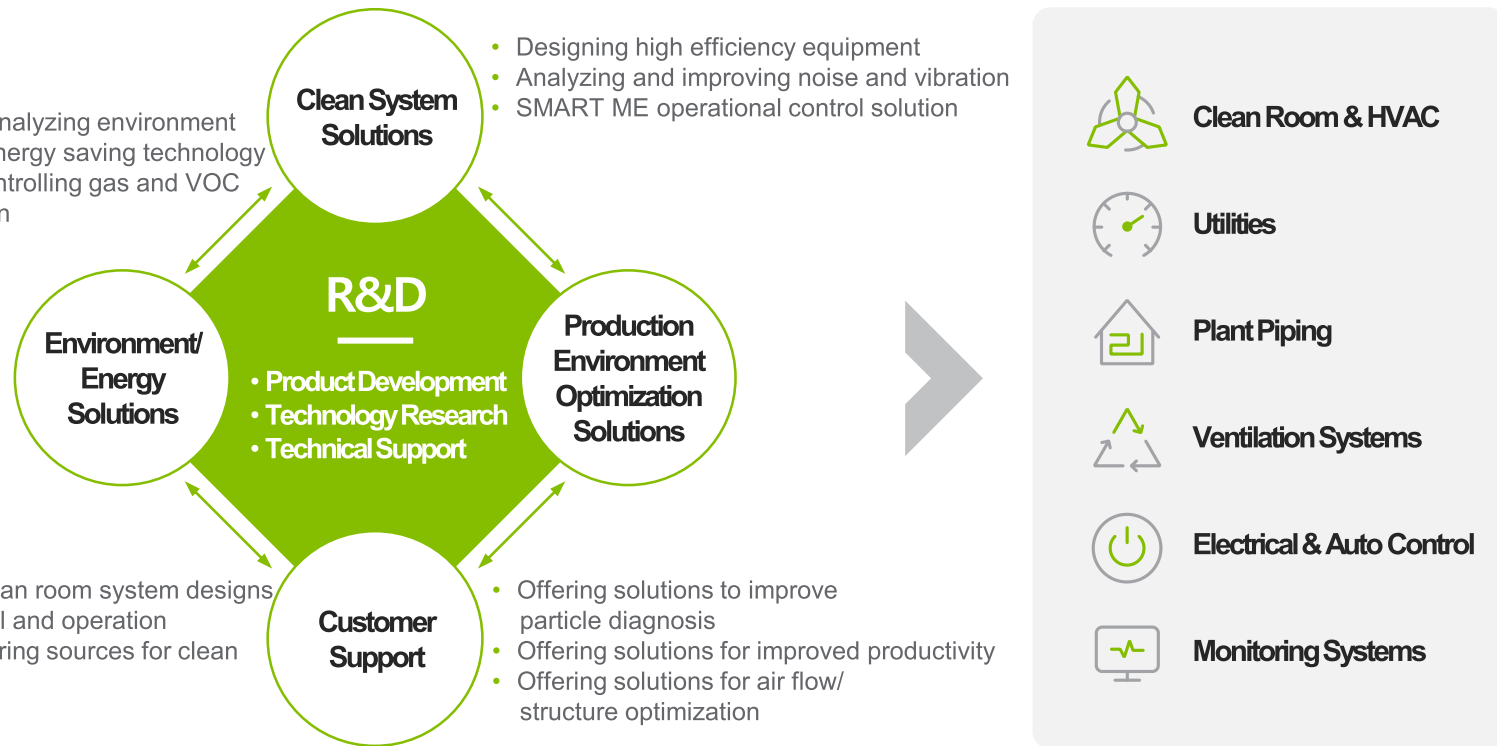
- Participated more than 6 large PV projects over last two years
- Expertise honed by participating in numerous large-scaled PV projects
- Guarantees long-lasting reliability and warranty



# ENG Business Profile

LEADING TECHNOLOGY

System designer that designs and installs clean production environment



**Offering System Technology Solution**  
optimized for semiconductor, FPD, bio and other clean industries

# LEADING TECHNOLOGY

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## **Solar Division**

1. Solar Representative Products
  - Solar Cell
  - Solar Module
  - Products Sales Reference
2. System Business
  - Core Technology
  - Power Plant Reference

# Solar Representative Products

LEADING TECHNOLOGY

Competitive products meeting customer needs

## Mono-crystal solar cells



**4 Bus bar (PERC)**  
Mono crystalline solar cell



**5 Bus bar (PERC)**  
Mono crystalline solar cell

## Solar modules : 280 ~ 430watt

60 Cells 280W		60 Cells 310W		60 Cells 360W	72 Cells 330W		72 Cells 375W		72 Cells 430W
Multi crystalline (5BB)	Mono crystalline (5BB)	SAM / HDM	Multi crystalline (5BB)	Mono crystalline (5BB)	HDM				

*Note: SAM / HDM and HDM modules are marked as 'New' in the original image.*

Establishing PERC mass production system

Late 2016 to Late 2019

Producing 500MW PERC mono-crystal solar cells from 2019

Efficiency  
22%

Shifting to automated production lines

September to November, 2016

Shifting existing lines to automated ones

Productivity

150MW

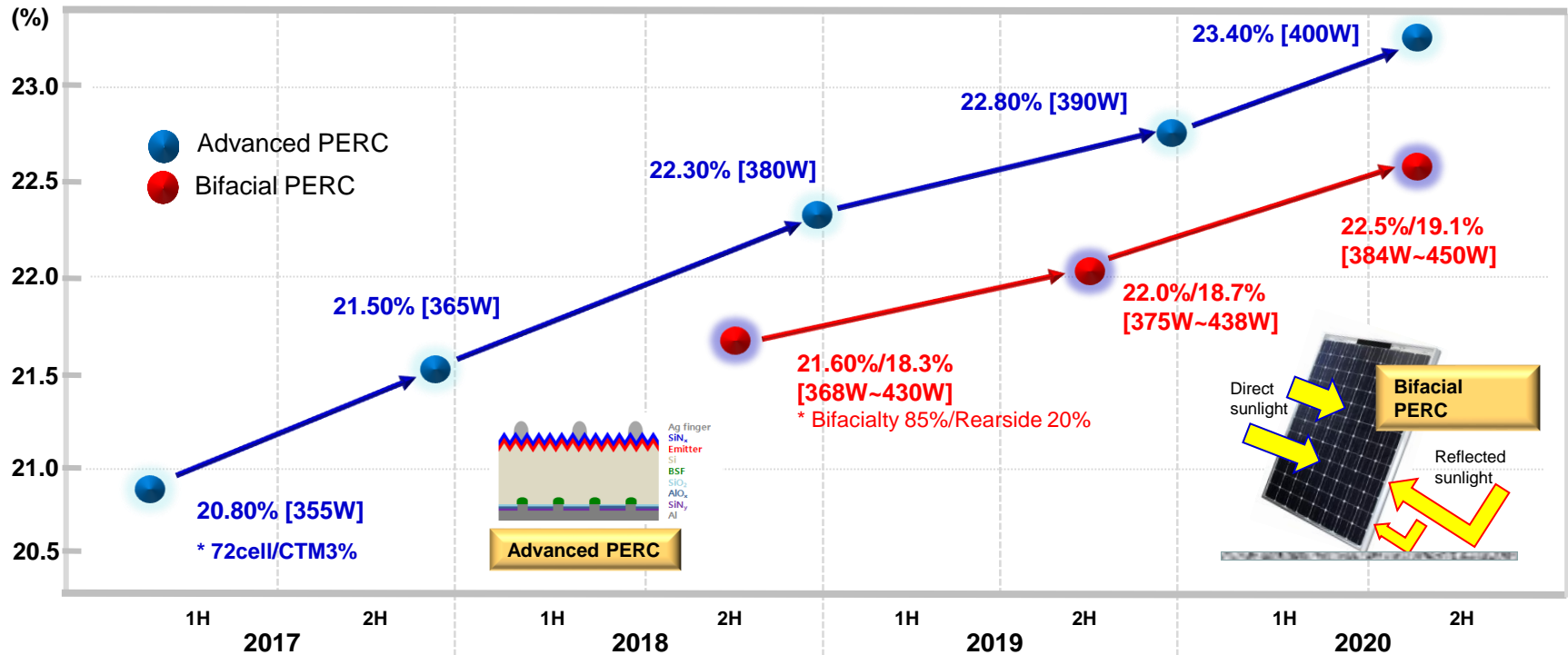
200MW

Building 70MW high-tech production lines

August to September 2018

# Solar Cell – Roadmap

LEADING TECHNOLOGY



## Advanced PERC Technology

Especially efficient Front & Back side Passivation / Design of Local Backside Contact with low resistance

PID Free Triple Passivation Layer

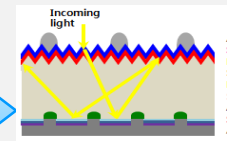
Selective Emitter Technology

Light Trapping Technology

Fine line Metal Contact Design

Local BSF Quality Control

Multi-Busbar Design



## Bifacial PERC Technology

Up to 20% more Power due to the well-proven bifacial technology

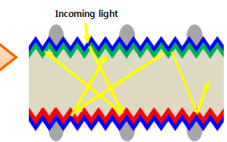
Both side Light trapping Technology

Metal Contact Design

Bulk Si Quality Control

Simulation & Loss Analysis

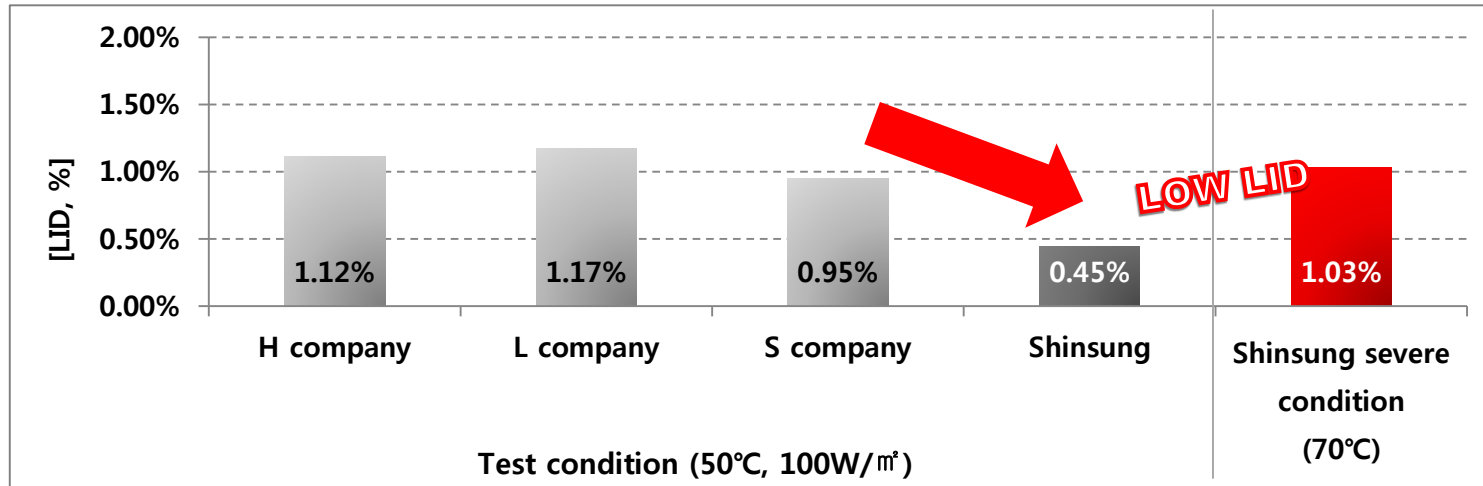
Improved Local Back Surface Field & Rear Metal Contact



# Solar Cell – Low LID (Light Induced Degradation)

LEADING TECHNOLOGY

## Outstanding LID improvement via regeneration process



Under the same condition, not only Shinsung exhibits a better LID loss of about 0.5% compared to other competitors, but also a higher overall system output as well.



# Solar Module – Products (1/6)

LEADING TECHNOLOGY

The best quality and cost competitiveness in Korea

## 60 Cells Module

60 Cells 280W **PERC** 60 Cells 310W



Multi Crystalline(5BB)



Mono Crystalline(5BB)

## 72 Cells Module

72 Cells 330W **PERC** 72 Cells 375W



Multi Crystalline(5BB)



Mono Crystalline(5BB)

**Development of specific products according to client's request.**  
**Providing numerous options for distributors by various product development**

# Solar Module – Products (2/6)

LEADING TECHNOLOGY

## New Product Line of Shingled Module

- ✓ Leading Power, “15~20%” More than Conventional Modules
- ✓ The True “BLACK” Designed with Ribbon-less and Solder-free
- ✓ “Lower LCOE” along with “Higher Revenue and Profit”, “Lower BoS Expenses”

### SAM / HDM Residential 360W



### SAM / HDM Commercial 430W



## What's Shingled Module?

- ✓ Cell – Strip – String – Module Process



New



# Solar Module – Products (3/6)

LEADING TECHNOLOGY

## Why Shingled Module?

- ✓ Over-supplying market of conventional PV modules and severe competition for the price
- ✓ Need the innovative PV modules which are NOT relying on general technology
- ✓ Need the most cutting-edge product among Half-Cut, Multi-Wire, Bi-Facial and Shingled



**Conventional Module**

Case 1) 18pcs x 280W = 5.04kW

Case 2) For 10kW : Need 36pcs Module



**Shingled Module**

Case 1) 18pcs x 360W = 6.48kW "28.6%↑"

Case 2) For 10kW : Need 28pcs Module

"8pcs Module & Installation Price↓"

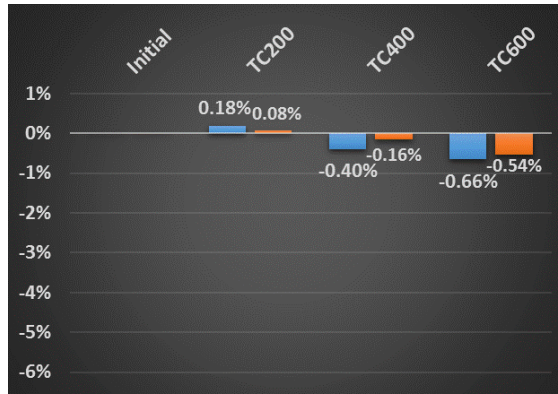


# Solar Module – Products (4/6)

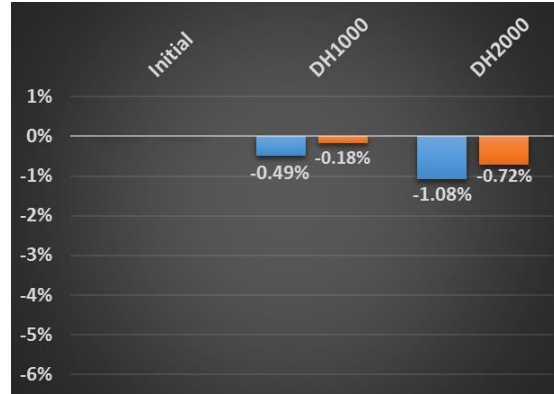
LEADING TECHNOLOGY

## Still, Why Shingled Module?

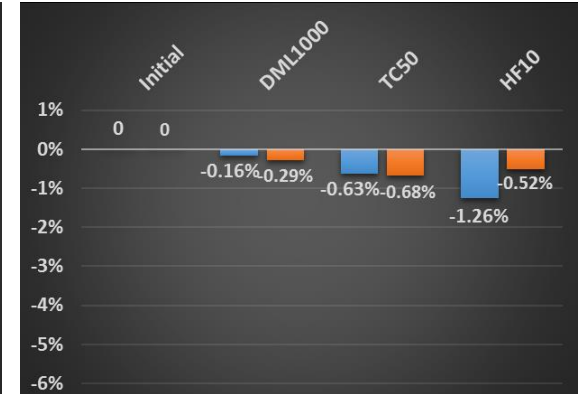
- ✓ Excellent Reliability Test Results from 3<sup>rd</sup> Party Agency



Thermal Cycle

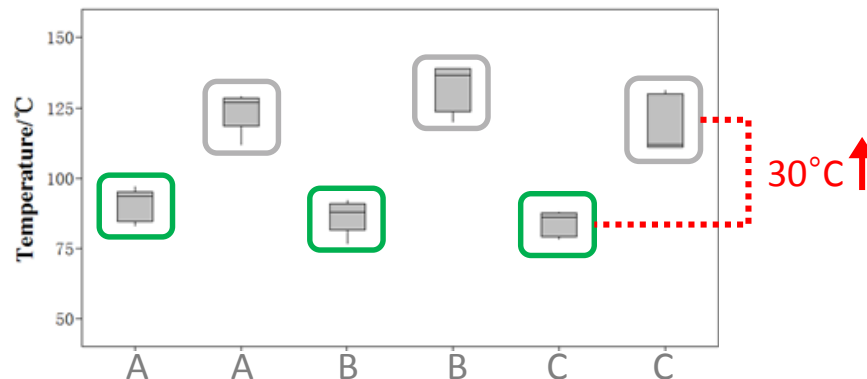


Damp Heat



Dynamic ML + TC + HF

- ✓ Improved Shading and Hot Spot Performance



Hot Spot Temperature

- Shingled Module
- Conventional Module
- A : Shading ¼ Cell
- B : Shading ½ Cell
- C : Shading ¾ Cell

# Solar Module – Products (5/6)

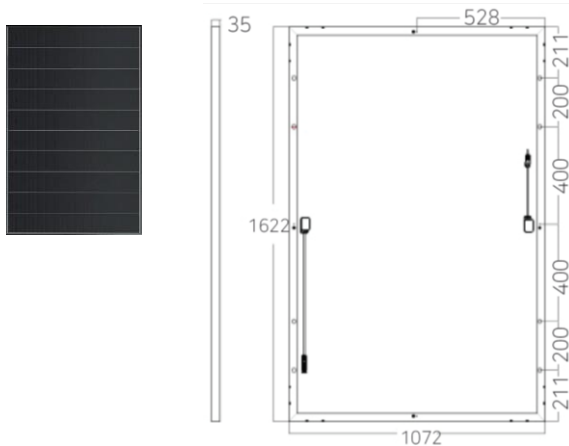
LEADING TECHNOLOGY

## Shingled Module Solution by SHINSUNG E&G

- ✓ Guarantees All New Technology with SAM & HDM Products
- ✓ Protects from IP Litigations
- ✓ More than 15 Patents awarded and filed in US, China, Taiwan, Japan, Korea and EU

### Shinsung Advanced Module (SAM)

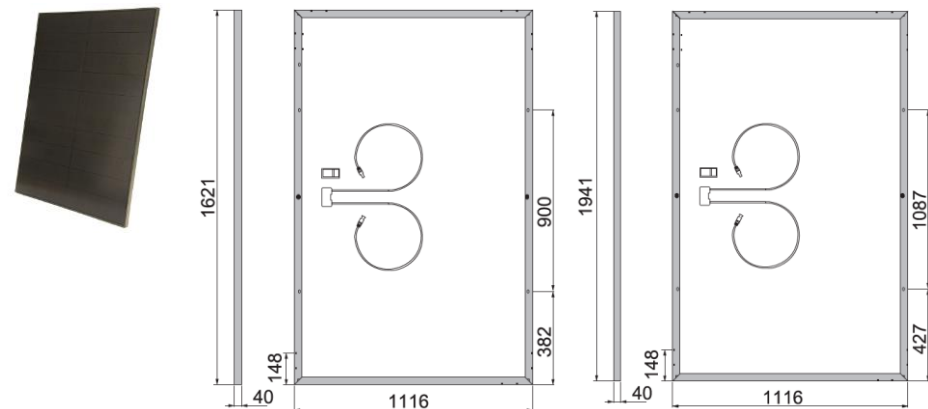
- 330~340W CSA/VDE Certified



- 19.0~19.6% Efficiency
- Certified to UL 1703 / IEC 61215 / IEC 61730
- 10 years warranty for materials and workmanship
- 25 years linear power warranty at STC

### High Density Module (HDM)

- 340~360W (60C), 405~430W (72C) UL/TUV Certified



- 18.8~19.4% (60C), 18.7~19.4% (70C) Efficiency
- Certified to UL 1703 / IEC 61215 / IEC 61730 / CEC
- 25 years limited power warranty : 80%

# Solar Module – Products (6/6)

LEADING TECHNOLOGY

## SAM VS HDM



	SAM	HDM
Appearance	Full Black, Ribbon-less Design	Full Black, Ribbon-less Design * More uniform
Dimensions	1622 x 1072 x 35	1621 x 1116 x 40 1941 x 1116 x 40
Power Range	330 ~ 340W	340 ~ 360W 405 ~ 430W
Production Base	South-East Asia (40MW/Year)	Korea (70MW/Year + $\alpha$ )
Certificate	CSA / VDE	UL / TUV
OEM Availability	O	-
Lead Time (40' Container)	7 days	3 days

# Solar Module – High Durability, PID Free

LEADING TECHNOLOGY

Excellent reliability achieved by PID Test proved by Fraunhofer ISE

# REPORT FUE13172

## Potential Induced Degradation - Test

### 2 Results

#### 2.1 Performance measurement

##### 2.1.1 Performance measurement of the modules of test condition 1

In this chapter, the results of the STC-measurement are given. Table 2.1 shows the results of the initial measurement before the PID-Test. Table 2.2 shows the results of the measurement after the PID-Test. The mono crystalline solar cell based modules M01 and M02 did not show any changes in terms of power.

# REPORT FUE13172

## Potential Induced Degradation - Test

Table 2.1: Initial performance measurement

Ref	Isc / A	Uoc / V	Imp / A
M01	8,92	37,9	8,37
M02	8,98	38,1	8,4

#### 2.1.2 Performance measurement of the modules of test condition 2

##### 2.1.2 Performance measurement of the modules of test condition 2

Table 2.4 shows the results of the measurement after the PID-test at test condition 2 (25°C, aluminum foil on plating, -1000V DC, 168h) as absolute values and in relation to the initial measurement (100%). The reference values are shown in table 2.3. As for test condition 1, the mono crystalline solar cell based modules did not show any degradation.

Table 2.2: Performance measurement after PID-Test

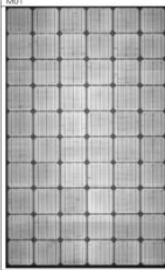
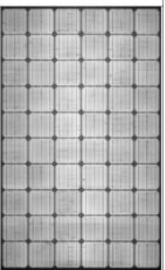
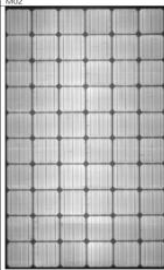

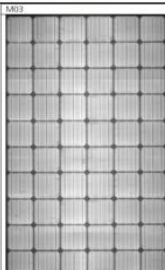
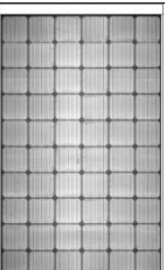
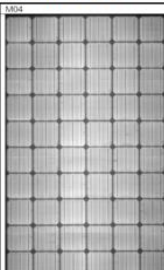
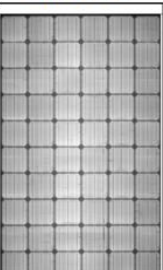
96h	Isc / A	Uoc / V	Imp / A
M01	8,94	37,96	8,38
96/Ref	1,0022	1,0016	1,0012
M02	9	38,08	8,42
96/Ref	1,0022	0,9995	1,0024

Table 2.3: Initial performance measurement

Ref	Isc / A	Uoc / V	Imp / A	Umpp / V	Pmpp / W	FF / %	eta / %
M03	9,01	38,0	8,43	31,1	262,09	76,5	16,1
M04	9,01	38,0	8,43	31,1	261,96	76,5	16,1

Table 2.4: Performance measurement after PID-Test @ test condition 2

168h	Isc / A	Uoc / V	Imp / A	Umpp / V	Pmpp / W	FF / %	eta / %
M03	8,98	37,99	8,4	30,95	259,9	76,18	15,94
168/Ref	0,9967	0,9997	0,9964	0,9952	0,9916	0,9958	0,9901
M04	9,02	37,99	8,42	30,95	260,55	76,03	15,98
168/Ref	1,0011	0,9997	0,9988	0,9952	0,9946	0,9939	0,9925

	M01		M02	
	PID Test 전	PID Test 후	PID Test 전	PID Test 후
				
	M03		M04	
	PID Test 전	PID Test 후	PID Test 전	PID Test 후
				

**PID-Test Condition 1**  
(60°C, 85% rh, -1000V DC, 96h)

**PID-Test Condition 2**  
(25°C, aluminum foil on glazing, -1000V DC, 168h)



High efficiency solar cell 21.9%  
High module output 310W



Certified high output  
under -40 and 85°C



High strength test passed  
(550kg/m<sup>2</sup>)

# Products Sales Reference

LEADING TECHNOLOGY

Company recognized for a variety of performances and technical competence

Type	Regional	Volume (MW)	Year
Cell (Mono)	USA	1,100	2015-2017
	Europe	100	2015-2017
Type	Regional	Volume	Year
Module (Poly)	USA	8	2014-2017
Module (Poly)	JAPAN	25	2015-2017
Module (Mono)		6	2015-2017



# System Business

LEADING TECHNOLOGY

Offering complete One-Stop Services for solar generation businesses of customers



# System Business – Core Technology

LEADING TECHNOLOGY

Leading the industry through product development based on innovative technology

- Efficient generation system design
- Electrical licenses and qualifications
- Design licenses and qualifications
- Sufficient number of experts and technicians

## Engineering

## Procurement

- Securing competitive materials
- Strategic partnerships in Korea and other countries
- Network of specialized installation partners

- Real-time operational monitoring
- Early response to malfunctions or breakdowns
- Operating A / S division and personnel
- Offering trainings

## O&M

## Construction

**Solar**

From Design  
To A/S Service

# Power Plant Reference

LEADING TECHNOLOGY

Company recognized for a variety of performances and technical competence

Hyundai Motors Asan Factory  
10MW








Yeongam F1 Stadium  
13MW



Samcheonpo 1st Coal landfill  
10 MW



Plant	Location	Period	Descriptions	
 Samcheonpo 1 <sup>st</sup> Coal landfill	Samcheonpo	2016.09 ~ 2017.02	System	10.5 MW
 Gunsan Sewage disposal plant	Gunsan	2014.09 ~ 2014.12	System	3 MW
 Solar power plant	Gwangmyeong	2014.08 ~ 2014.09	System	1.4 MW
Muhansolar Solar power plant	Mokpo	2014.06 ~ 2014.09	System	3.3 MW
Jeju sunlight plant Solar power plant	Jeju	2014.02 ~ 2014.05	System	1.7 MW
Korean green railroad Solar power plant	Taebaek, Cheorwon	2013.11 ~ 2013.12	System	3.5 MW
D-solar energy Yeonggwang site	Yeonggwang	2013.10 ~ 2013. 11	Module	11 MW
KS Solar power plant 3,5,8~14 Stages	Chungcheongbuk -do	2013.09 ~ 2013.12	System	3MW
 Hyundai Motors Asan Factory	Asan	2013.06 ~ 2013.12	Module	10 MW
 Yeongam F1 Stadium	Yeongam	2012.05 ~ 2012.12	Module	7.2 MW
Yeongnam Logistics Center	Chilgok	2012.02 ~ 2012.04	System	3 MW



# **RELIABLE** PARTNER

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# Certificates

RELIABLE PARTNER

Company with technical competence recognized for a variety of technology

Certificates	Products	Approved By
New & Renewable equipments	PV Module	KEMCO(South Korea)
UL / CUL	PV Module	C/UL (U.S.A)
ISO14001 : 2004	Environment Management System	TÜV Rheinland
ISO9001 : 2008	Quality Management System	TÜV Rheinland
CERTIFICATE OF INSURANCE	PV Module	CHUBB (Korea)
IEC 61215, IEC 61730	PV Module	TÜV sud



# Major Clients

RELIABLE PARTNER

Company recognized by a variety of global companies



ENG Business  
Solar Business



# THANK YOU

