



**Solar PV Rooftop System**

**By  
Thai Solar Way Co., Ltd.**

**Year 2018**

**Akasit W.**

**0851198888**

# Part I

## Project Proposal

## **Introduction**

A solar power generation system is simple, durable and reliable with no moving components. While prices for non-renewable sources continue to increase on long-term considerations, the cost of solar power generation system continues to decrease and its efficiency to convert sunlight to electricity continues to increase. Complementary technologies such as co-generation, storage, efficiency and automation also grow in capability and reduce in costs.

Solar power is now becoming commercially viable and greatly contributes to saving of electricity expenses over 25 years or more once it is installed for self-consumption purpose. Based on this understanding, we, Thai Solar Way Co., Ltd. are pleased to submit our proposal for a rooftop solar power project (“Project”) to be implemented within the premises of customer’s project.

## **Implementation of Project**

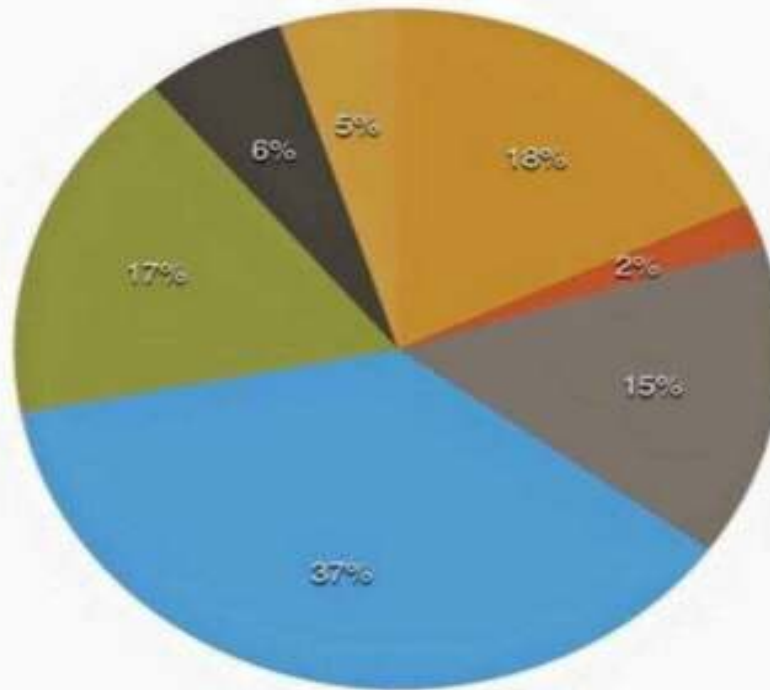
We would like to propose for the Owner's consideration that the following steps be taken for successful implementation of the Project:

- **Step 1** | The Contractor to conduct preliminary site surveys to identify suitable sites within the premises of the Owner and estimate the total capacity and cost of the Project
- **Step 2** | Both parties of the Owner and the Contractor to negotiate and sign a basic agreement on commercial and technical terms and conditions, including indicative prices for each capacity of the Plants
- **Step 3** | The Contractor to conduct detailed site surveys, collect necessary data and information for the final design of the Plants, and quote the cost of the Plants
- **Step 4** | The Owner to issue a P/O (Purchase Order) to the Contractor for each plant in different locations
- **Step 5** | The Contractor to procure materials and equipment, and construct the Plants and hand over the Plants to the Owner

## **Fully Support**

Fully backed up by technically and financially capable partners as the above, we are confident that we can implement the Project in a successful manner. We sincerely hope that we would be given a good chance to demonstrate our capabilities and experiences through the implementation of this prestigious Project.

แนวโน้มค่าไฟฟ้าปี 2558-2579 Avg.=4.59+FT+VAT



ราคาค่าไฟฟ้าตามร่างแผน PDP 2015 (ต่อหน่วย)

พ.ศ. 2558	พ.ศ. 2559	พ.ศ. 2564	พ.ศ. 2569	พ.ศ. 2579
3.75 บาท	3.71 บาท	4.95 บาท	5.26 บาท	5.55 บาท
ราคาเฉลี่ย พ.ศ. 2558 – 2579 อยู่ที่ 4.587 บาทต่อหน่วย				

ที่มา: กระทรวงพลังงาน เมษายน 2558

# SOLAR PV System Performance

- 1KW =1,300 kwh (unit) per year
- 25 years =1,300 \*25= 32,500 units  
40,000 Baht: 1 KW= 1.23 Baht/unit

Real life 1kw=4 kwh (units)per day

1 year = 1,460 units per year

25 years = 36,500 units = 1.09 Baht/unit

# Cost 1 unit of electricity from Solar PV

## INVT Solution

40,000 Baht: 1 KW= 1.09 Baht/ Unit

## Solaredge Solution

45,000 Baht: 1 KW= 1.23 Baht/Unit

# Solar PV On Grid System

กำลังการผลิต	ประหยัดค่าไฟฟ้า		พื้นที่ติดตั้ง	งบลงทุน	จุดคุ้มทุน	จำนวนปี	กำไร
kw	1 เดือน	12 เดือน	ตารางเมตร		ปี	หลังคุ้มทุน	สุทธิ / บาท
100	58,333	699,996	640	4,000,000	5.7	19.3	13,509,923
200	116,666	1,399,992	1,280	8,000,000	5.7	19.3	27,019,846

\*คิดที่ค่าไฟฟ้าเฉลี่ยในค่าพีคของอัตราก้าวหน้า+FT+VAT=5บาทต่อหน่วยใน25ปี

## ระบบที่เราออกแบบและติดตั้งให้

1. มีการรับประกันระบบให้2ปีหลังการติดตั้ง
2. รับประกันสินค้าอินเวอร์เตอร์5ปี แฉง10ปีและประสิทธิภาพ 25ปี
3. อินเวอร์เตอร์ 3 เฟส มาตรฐาน IP 65 กันน้ำ กันฝน กันฝุ่น ติดตั้งนอกอาคารได้

## เลือกลงทุนตามข้อพิจารณา

1. ขนาดพื้นที่หลังคา
  2. ปริมาณไฟฟ้าที่ต้องการประหยัดหรือขาย
  3. งบลงทุน และ การตัดค่าเสื่อม
- เราเลือกแผง อินเวอร์เตอร์ และอุปกรณ์ติดตั้งตามมาตรฐานของการไฟฟ้า โดยทีมวิศวกรและช่างผู้มีความชำนาญ



# BOI : สินปี 2560

ยกเว้นภาษีเงินได้นิติบุคคล 3ปี ร้อยละ50ของเงินลงทุน

BOI

"มาตรการส่งเสริมการลงทุนเพื่อปรับปรุงประสิทธิภาพการผลิต"

สำหรับผู้ประกอบการที่ต้องการลงทุนเพื่อ

(1) ปรับเปลี่ยนเครื่องจักรเพื่อใช้ระบบอัตโนมัติ (พัฒนาสู่ Industry 2.5-4.0)

(2) การประหยัดพลังงาน ลดผลกระทบต่อสิ่งแวดล้อม (เช่นติดตั้งแผงโซลาร์)

(3) การวิจัยและออกแบบทางวิศวกรรมเพื่อเพิ่มประสิทธิภาพ

พร้อมสิทธิประโยชน์ในการลดหย่อนภาษี

รายละเอียดเพิ่มเติม คลิก>> <http://www.fti.or.th/2016/thai/ftigovernmentdetail.aspx?id=1323>

สำนักงานคณะกรรมการ  
ส่งเสริมการลงทุน **BOI**  
เสนอ  
มาตรการส่งเสริมการลงทุน  
เพื่อปรับปรุงประสิทธิภาพการผลิต  
ประเภทข้อ 3 มาตรา 40(ค)

1. มาตรการส่งเสริมการลงทุนเพื่อการประหยัดพลังงาน การใช้  
พลังงานทดแทน หรือการลดผลกระทบสิ่งแวดล้อม  
2. มาตรการส่งเสริมการลงทุนเพื่อการปรับปรุงหรือเพิ่มขีดความสามารถ  
ในการผลิต  
3. มาตรการส่งเสริมการลงทุนเพื่อการวิจัยและพัฒนาและนวัตกรรมทาง  
วิศวกรรมเพื่อปรับปรุงประสิทธิภาพ

สิทธิประโยชน์

1. ยกเว้นภาษีเงินได้ร้อยละ 50  
2. ยกเว้นภาษีเงินได้นิติบุคคล 3 ปี ร้อยละ 50 ของเงินลงทุน  
3. ระยะเวลายกเว้นภาษีเงินได้ 3 ปี จากปีที่เริ่มใช้สิทธิประโยชน์

หมายเหตุ: ตั้งขึ้นสำหรับการส่งเสริมภายใน 31 ธ.ค. 60  
รายละเอียดเพิ่มเติม โทร. 0 2553 8111  
Website: [www.bo.go.th](http://www.bo.go.th) Email: [head@bo.go.th](mailto:head@bo.go.th)

มาตรการส่งเสริมการลงทุนเพื่อ  
ปรับปรุงประสิทธิภาพการผลิตจาก  
BOI

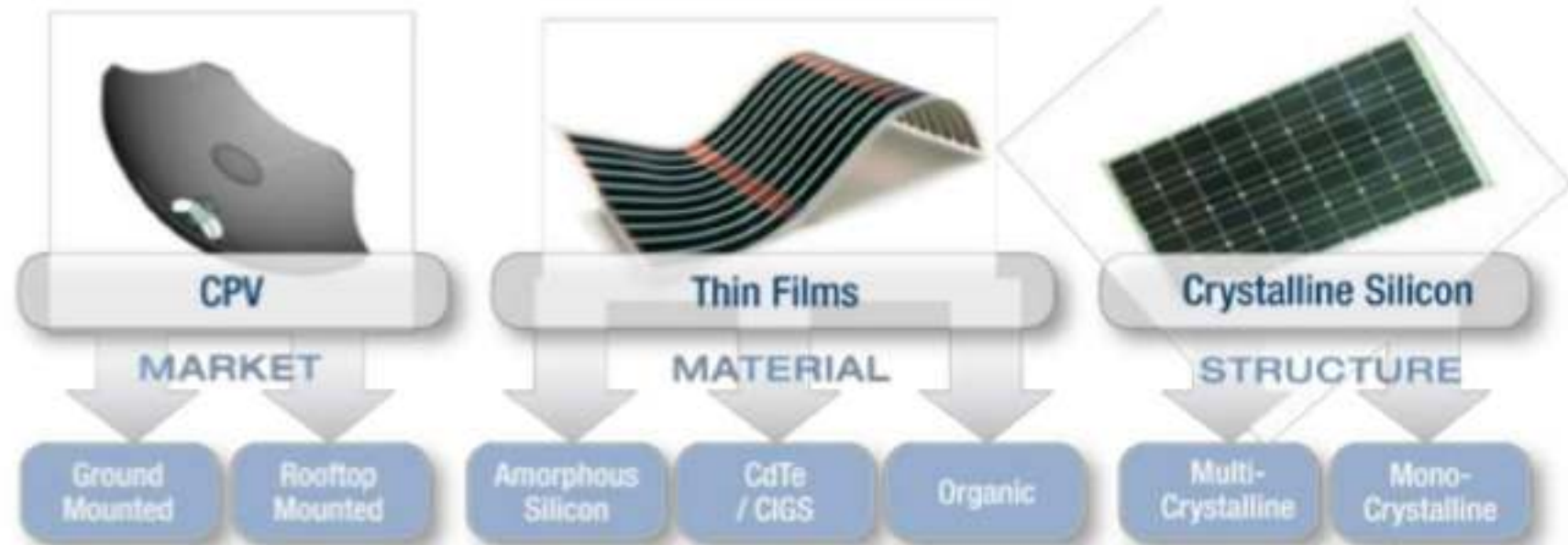
มาตรการส่งเสริมการลงทุนเพื่อปรับปรุง  
ประสิทธิภาพการผลิตจาก BOI

[www.fti.or.th](http://www.fti.or.th)

# **Part II**

## **General Information on Solar Power**

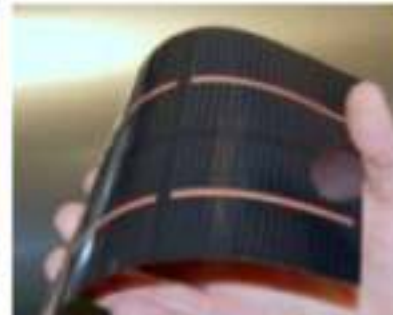
# There are many approaches to making PV cells and experts do not agree on which one is the best



20x-100x



500x



$\text{Cu(In,Ga)Se}_2 \sim 1\text{-}2\text{ }\mu\text{m}$



c-Si  $\sim 180\text{ }\mu\text{m}$



# SOLAR PV



## Standard of Solar PV

IEC 61215 & IEC 61730, UL 1703 & UL 790 & CEC

CE conformity, MCS (EN45011)

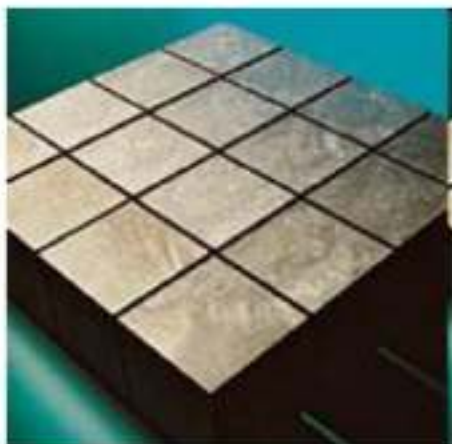
REACH Compliance



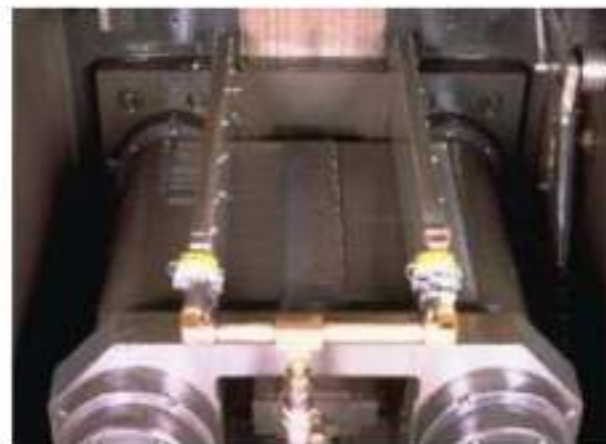
# Silicon PV



Silicon Feedstock



Ingot Growth



Slicing Wafers

Photovoltaic System



Module Encapsulation



Cell Fabrication



# The Three Big Photovoltaic Markets

Residential



Commercial Rooftop

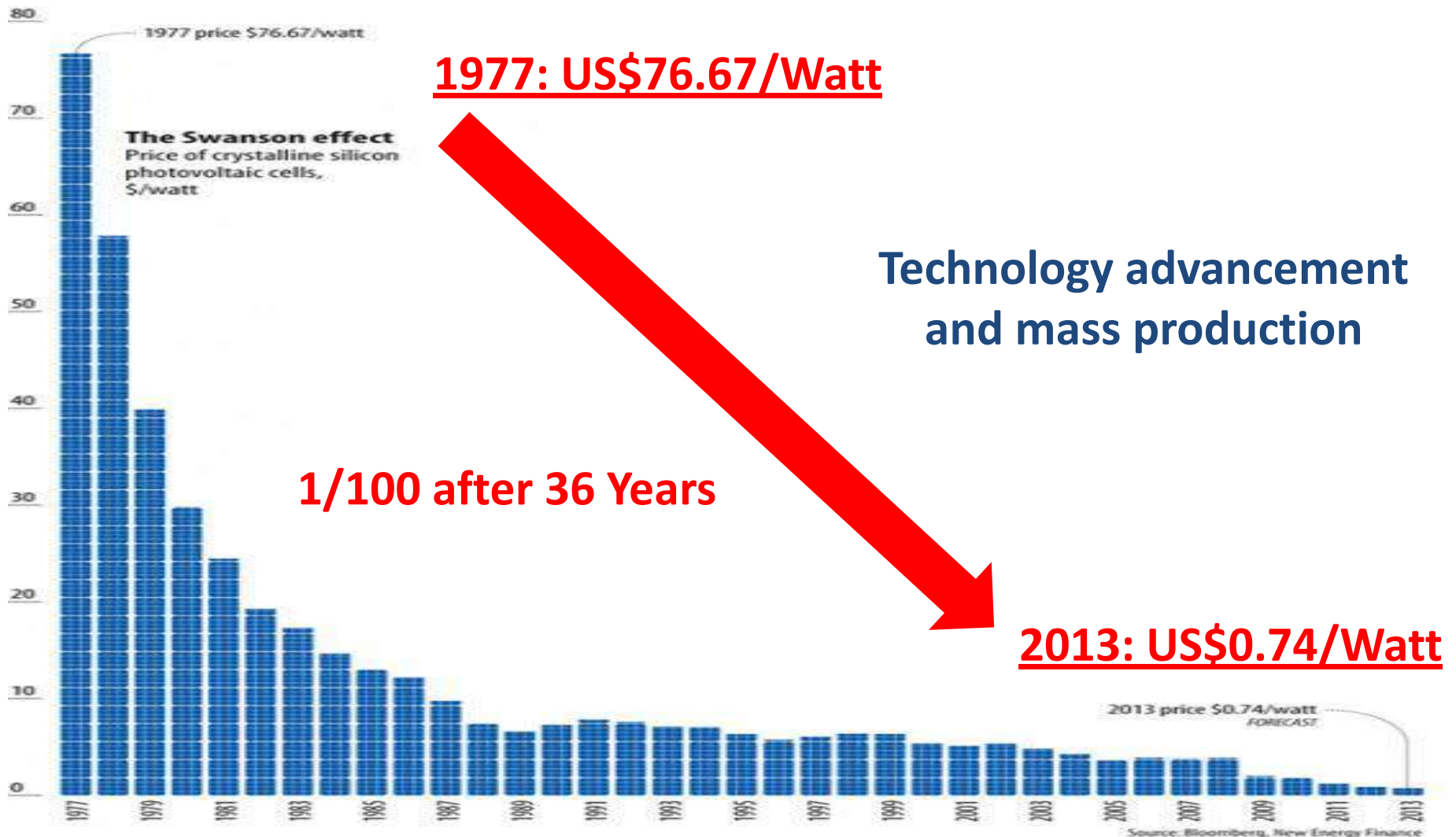


Utility  
scale  
power  
plants

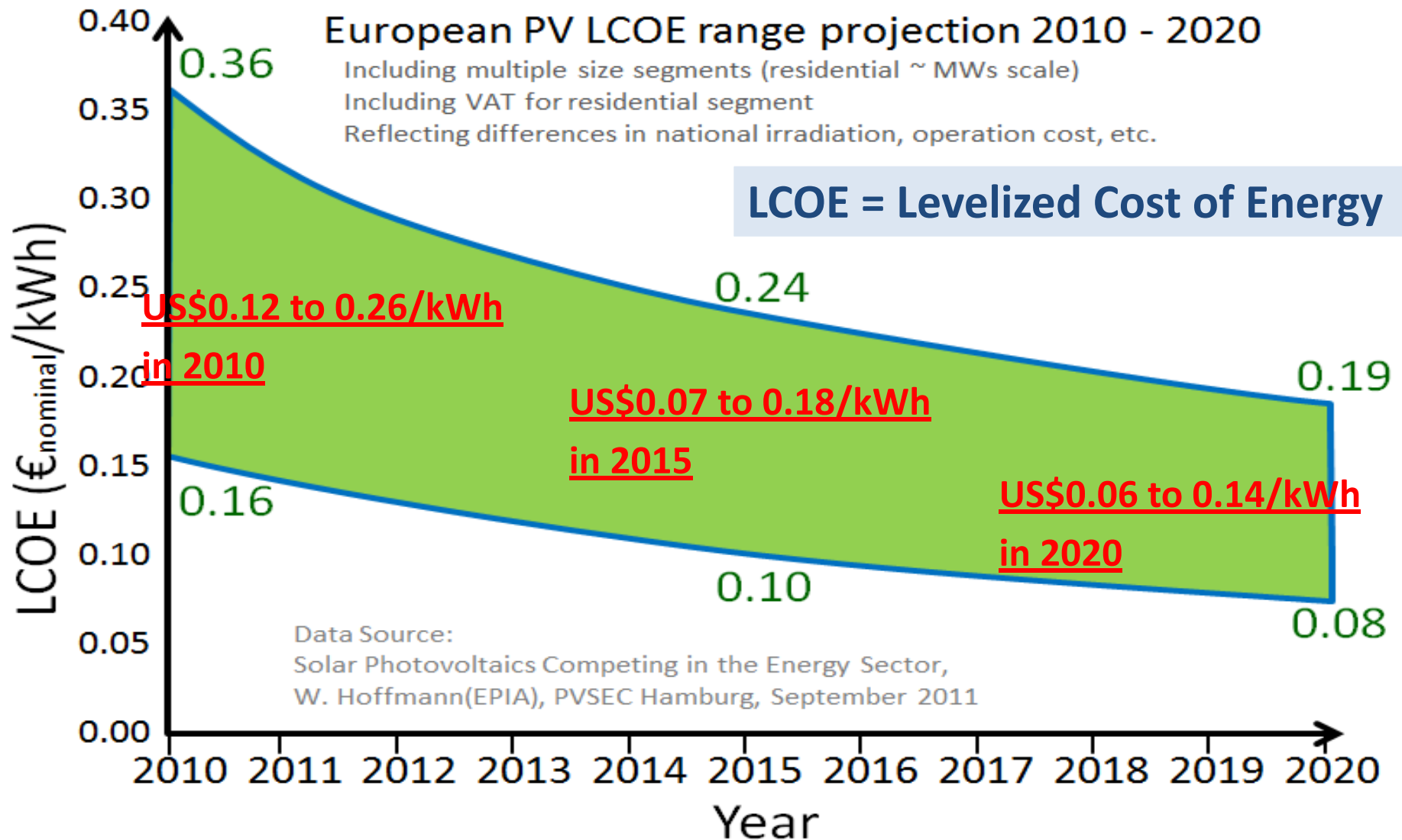




# Declining Trend of PV Cell/Module Price

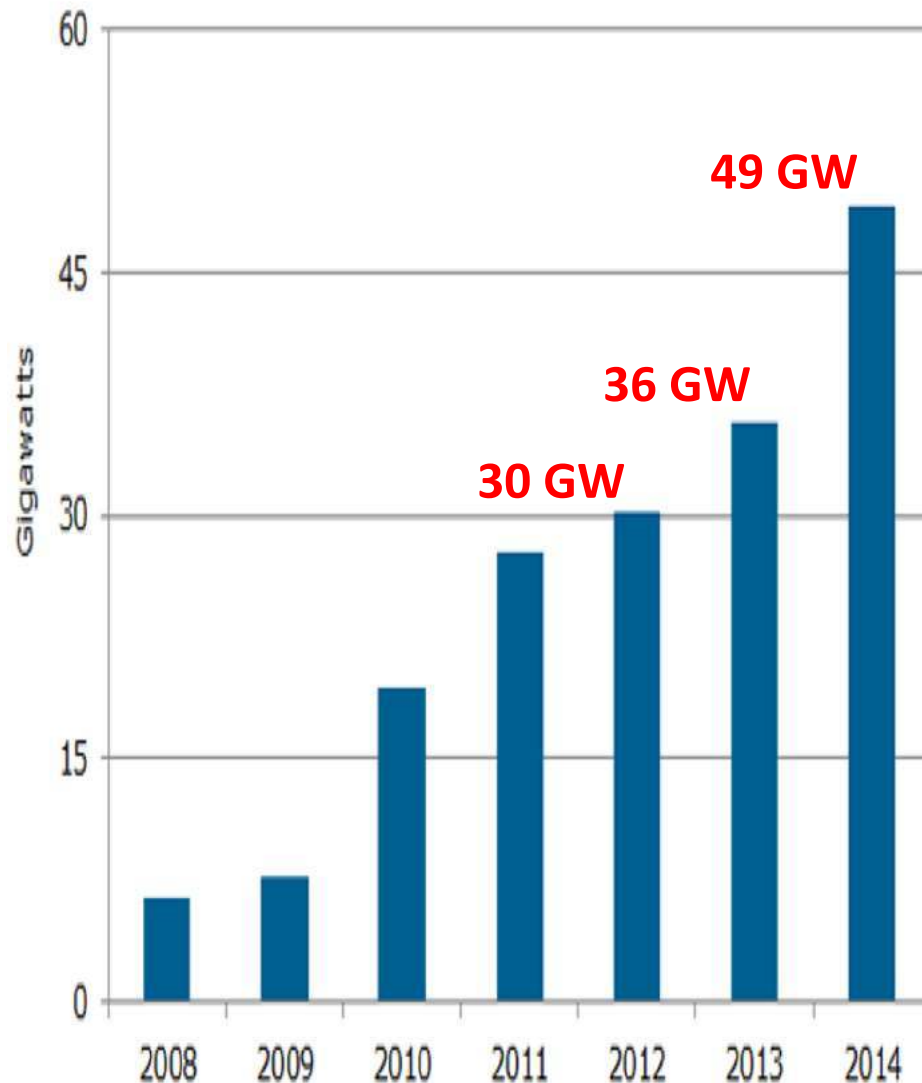


# PV LCOE Projection in 2010-2020



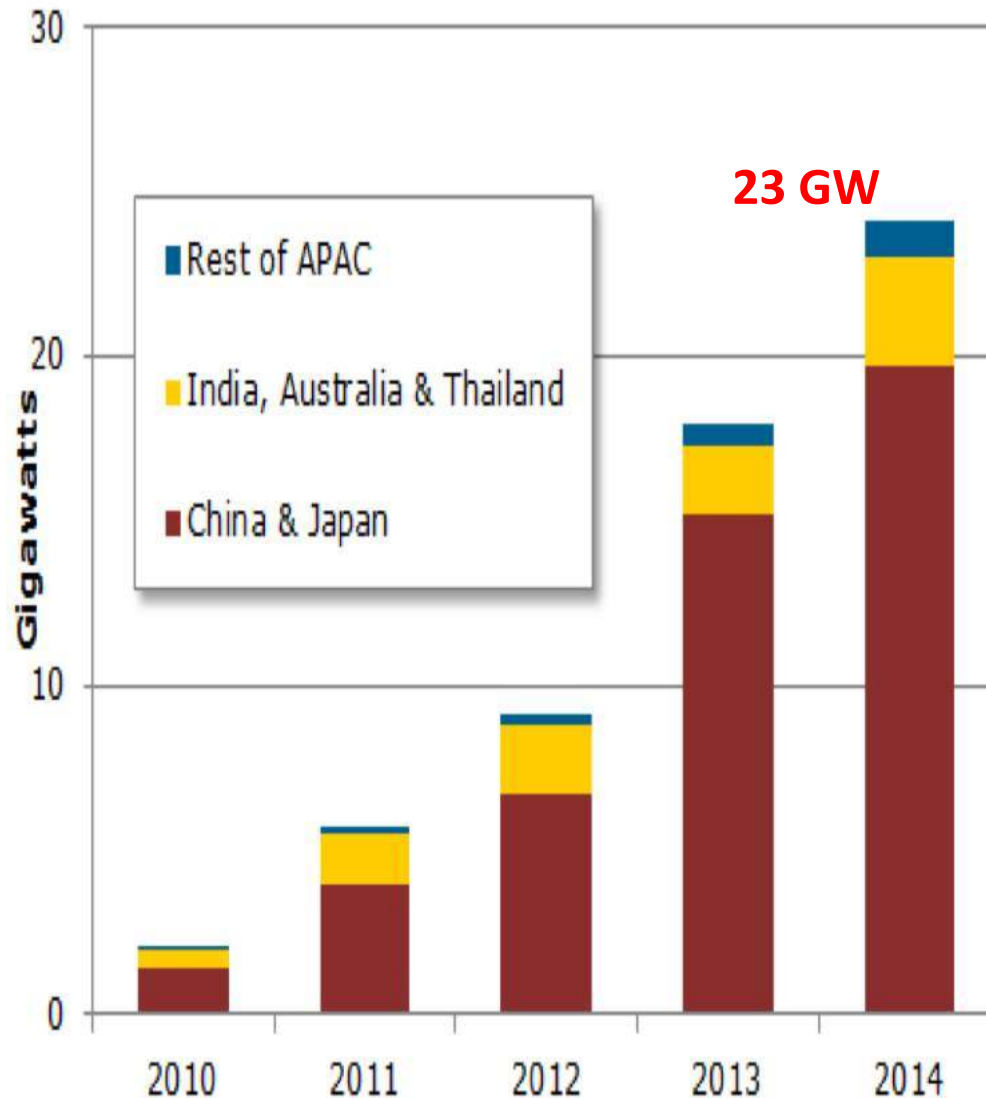


# World PV Demand in 2014



- ❑ Solar PV demand is poised for explosive growth in 2014, and is set to reach 49 GW, up from 36 GW in 2013.
- ❑ Over the 6-month period from Oct 2013 to Mar 2014, the solar PV industry installed almost 22 GW. This 22 GW of demand is equivalent to one new 5 MW solar farm being completed every hour of the day.
- ❑ 2/3 of all solar panels installed in 2013 Q4 was located in China, Japan and the US.

# Solar PV Demand in APAC Region

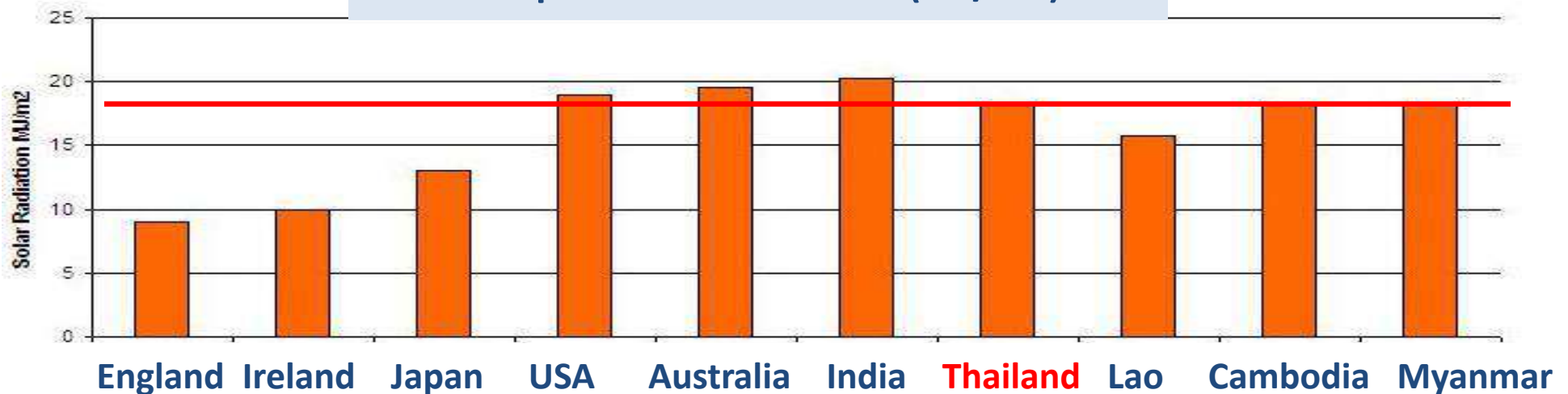


- ❑ Solar PV demand in 2014 will be dominated by APAC region, which will account for 50% of all new PV demand this year.
- ❑ Almost 95% of new PV capacity in APAC region in 2014 will come from five countries: China, Japan, India, Australia, and **Thailand**.
- ❑ APAC countries are forecast to install more than 23 GW in 2014. Supply and demand from APAC will determine the basis of 50 GW global PV industry going into 2015.

# Solar Energy: Changing Energy Market

- ☐ Solar photovoltaic (PV) is reliable and simple with no moving components.
- ☐ Solar PV system costs continue to decrease.
- ☐ Solar PV efficiency continues to increase.
- ☐ Prices for non-renewable sources continue to increase.
- ☐ Complementary technologies (co-generation, storage, efficiency, automation) grow in capability and reduce in costs .

Comparison of Radiation (MJ/m<sup>2</sup>)



# Thailand's intensity of sun for each month

กรมพัฒนาพลังงานทดแทน  
และอนุรักษ์พลังงาน  
กระทรวงพลังงาน



- ค่าเฉลี่ยทั่วประเทศเท่ากับ  $18 \text{ MJ/m}^2/\text{d}$  ( $5 \text{ kWh/m}^2/\text{day}$ ) จัดว่ามีศักยภาพค่อนข้างสูง
- ความเข้มสูงสุด  $20\text{-}24 \text{ MJ/m}^2/\text{d}$
- แผนที่ศักยภาพความเข้มรังสีแสงอาทิตย์วิเคราะห์จากข้อมูลภาพถ่ายดาวเทียม และข้อมูลจากสถานีตรวจวัดรังสี

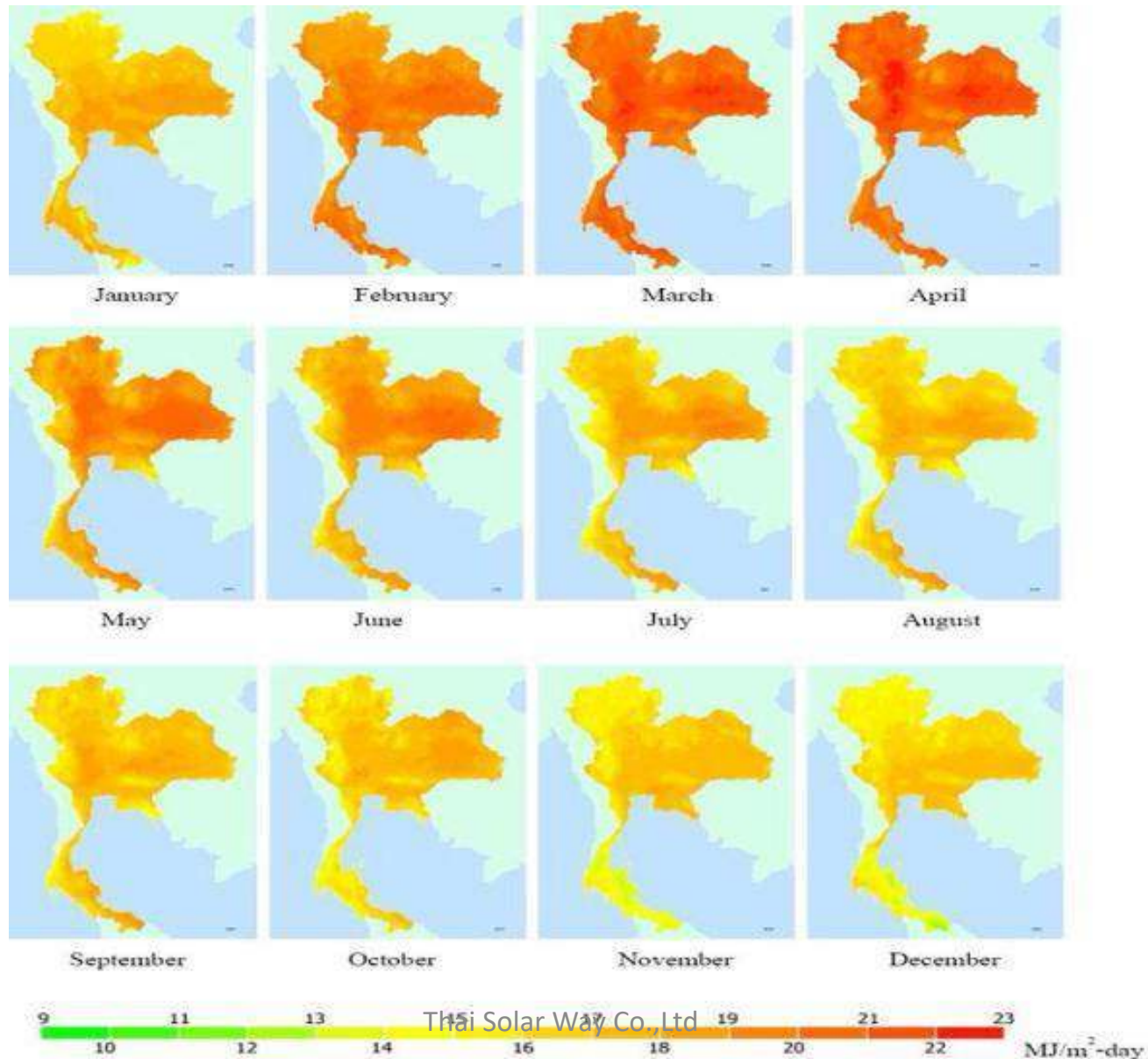
มาตรการสนับสนุนข้อมูลวิชาการ  
จัดทำแผนที่ศักยภาพพลังงานแสงอาทิตย์



สถานีตรวจวัดรังสี เป็นสถานีที่ใช้ในการเก็บข้อมูลรังสีแสงอาทิตย์ ปัจจุบัน พพ. มีสถานีตรวจวัด 38 สถานีกระจายอยู่ทุกภูมิภาคทั่วประเทศ เริ่มติดตั้งตั้งแต่ปี 2545

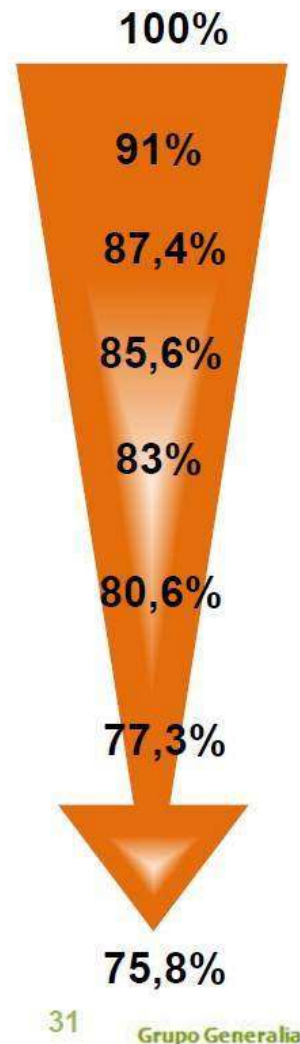
ซึ่งประเทศไทยมีสถานีตรวจวัดมากที่สุดในกลุ่มอาเซียน



# Thailand's intensity of sun for each month





# SOLAR PV System Performance



1. **Temperature.** (9%) +10°C  4% received energy 
2. **Inverter.** We can consider about 6%. New inverters can reach 4%
3. **Cable:** AC, DC & other electric devices: < 2%
4. **Panel tolerance.** It shouldn't be higher than 3%
5. **Pollution, dispersion & reflectance.**
  1. Fixed panel: aprox.3%
  2. Suntracking system: 2%.  
*In urban areas, it should be increased by 2%*
6. **Shadowing.** They should be below 4%. In case of using suntracking systems, a shadowing study might be necessary.
7. **Other losses (incidences, etc).**
  1. Fixed panel: 2%
  2. Suntracking system: 4%.

<http://www.leonardo-energy.org/training-pv-systems-design-construction-operation-and-maintenance>

Leonardo  
ENERGY 

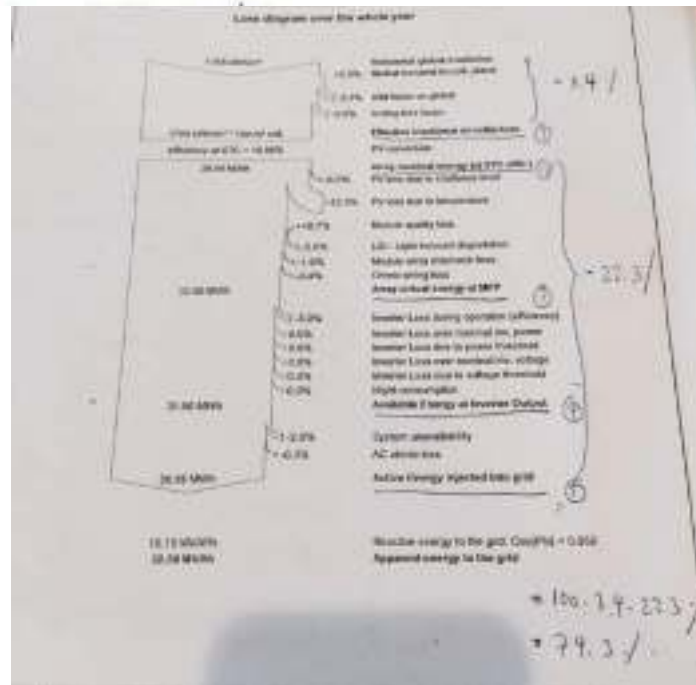
# SOLAR PV System Performance



การไฟฟ้านครหลวง  
Metropolitan Electricity Authority

ประกาศคณะกรรมการกำกับกิจการพลังงาน เรื่อง การรับซื้อไฟฟ้าจากการผลิตไฟฟ้าพลังงานแสงอาทิตย์ที่ติดตั้งบนหลังคาประเภทบ้านอยู่อาศัย

ข้อ ๘ อัตรารับซื้อไฟฟ้าจากผู้ผลิตไฟฟ้าจากพลังงานแสงอาทิตย์ที่ติดตั้งบนหลังคา (Solar PV Rooftop) ให้เป็นไปตามอัตรารับซื้อในรูปแบบ Feed-in Tariff ประเภทบ้านอยู่อาศัย กำหนดให้การไฟฟ้าฝ่ายจำหน่ายรับซื้อไฟฟ้าเข้าระบบในส่วนปริมาณพลังงานไฟฟ้าที่ไม่เกิน Capacity Factor ร้อยละ ๑๔.๘๔ (หรือคิดเป็นปริมาณพลังไฟฟ้า 1299.98 หน่วย/kWp/ปี ในกรณีที่ปีนั้นมี 365 วัน หรือคิดเป็นปริมาณพลังไฟฟ้า 1303.55 หน่วย/ kWp/ปี ในกรณีที่ปีนั้นมี 366 วัน )



# SOLAR PV System Performance

- 1KW =1,300 kwh (unit) per year
- 25 years =1,300 \*25= 32,500 units  
40,000 Baht: 1 KW= 1.23 Baht/unit

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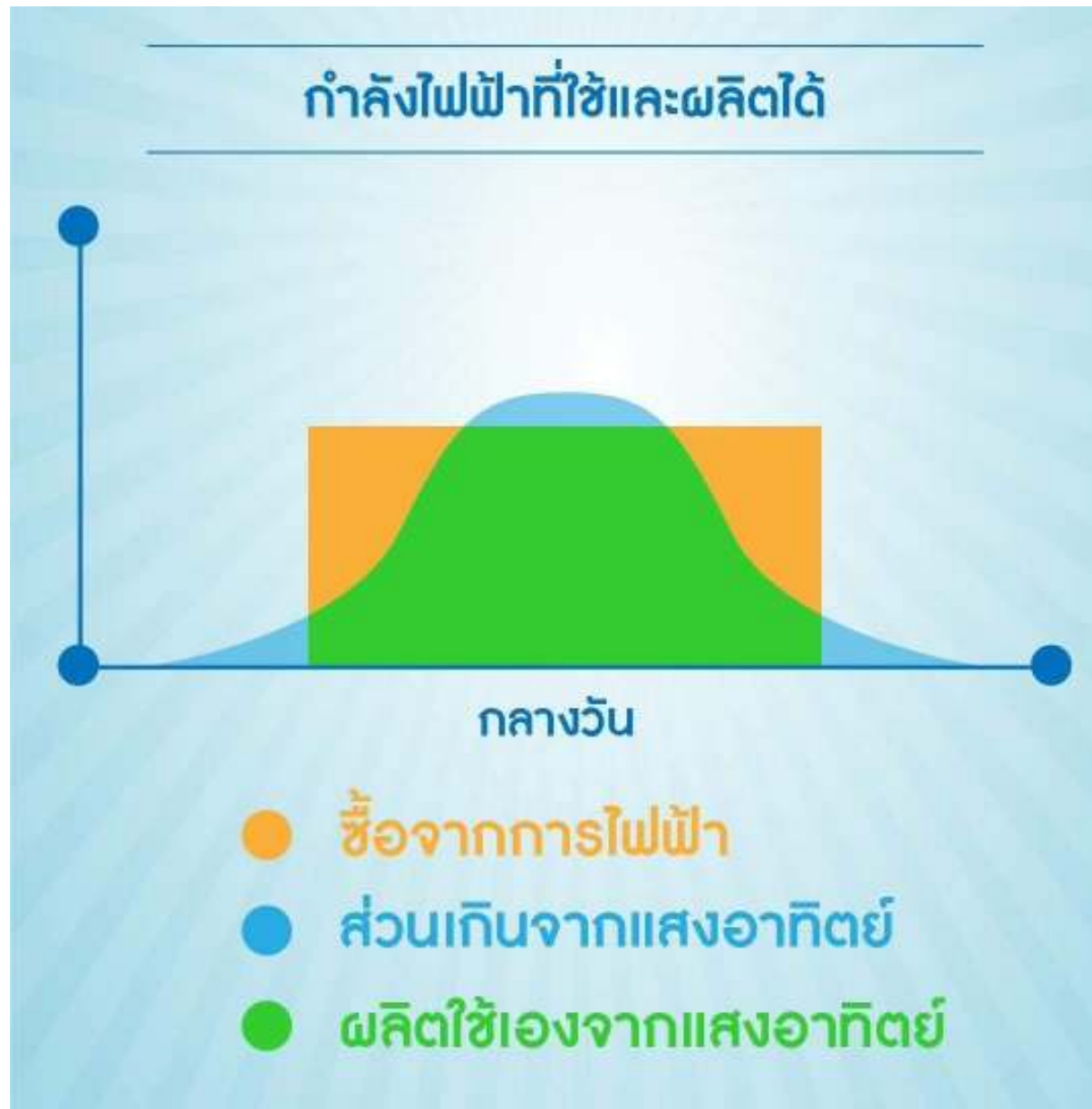


# SOLAR PV System Performance



ช่วงเช้าและช่วงเย็นจะเป็นช่วงเวลา  
ที่ห่างจากดวงอาทิตย์  
ทำให้มีปริมาณแสงอาทิตย์  
ที่สูญเสียในชั้นบรรยากาศมากกว่าช่วงเที่ยง  
ที่อยู่ใกล้ดวงอาทิตย์มากที่สุด

# SOLAR PV System Performance



# SOLAR PV System Performance

สำหรับโรงงาน สำนักงาน  
หรืออาคารที่มีการใช้ไฟฟ้า  
ในตอนกลางวันอย่างสม่ำเสมอ

กำลังไฟฟ้าที่ใช้และผลิตได้



การผลิตจากพลังงานแสงอาทิตย์  
และการใช้พลังงานที่สอดคล้องกัน  
จะสามารถลดปริมาณพลังงานที่ซื้อ  
จากการไฟฟ้าได้  
ในลักษณะนี้ถือว่าคุ้มค่ามากครับ



# **Part III**

## **Thai Solar Way Co., Ltd.**

# Content

- About us
- Overview – Market Segment
- Electric Power Structure
- Technical
- Site Reference

# About us

- Our company has established with a group of engineers and marketers who have knowledge, expertise and experience about renewable energy, Telecommunication, IT and financial.
- The objective of company is a service provider to design, install renewable energy and selling electricity with integrated ICT and financial solution for customers.
- Our products and services are world class standard like UL, IEC, CE, JIS, TIS and others Std.
- Thai solar way has numerous partnerships with renewable energy manufacturers around the world.

# Policy

- We strive to be the best in service renewable energy to our customers both before and after the sale.
- We provide affordable products and equipment with integrated ICT and financial solution that satisfies all of our customers needs in .
- Tend to develop continuously to meet the customer's need



# Solar marketing segment

- การแบ่งส่วนตลาดของระบบผลิตไฟฟ้าเซลล์แสงอาทิตย์ (PV Market Segmentation)





# Rooftop Installation

## Benefit of Roof Top Installation

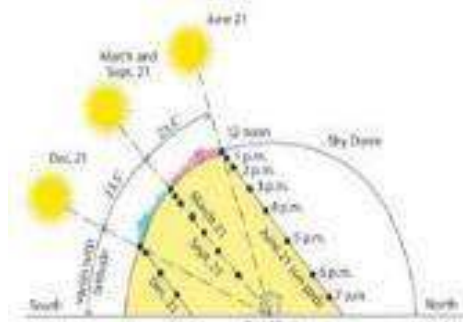
1. Save the space
2. The highest point receive the sun.
3. Extra Benefit.



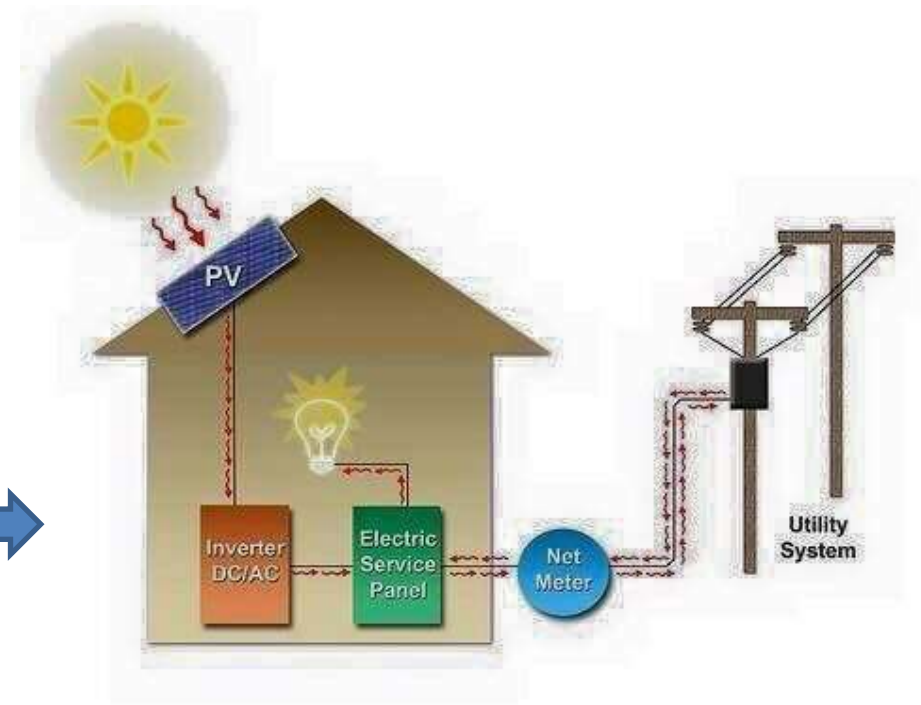
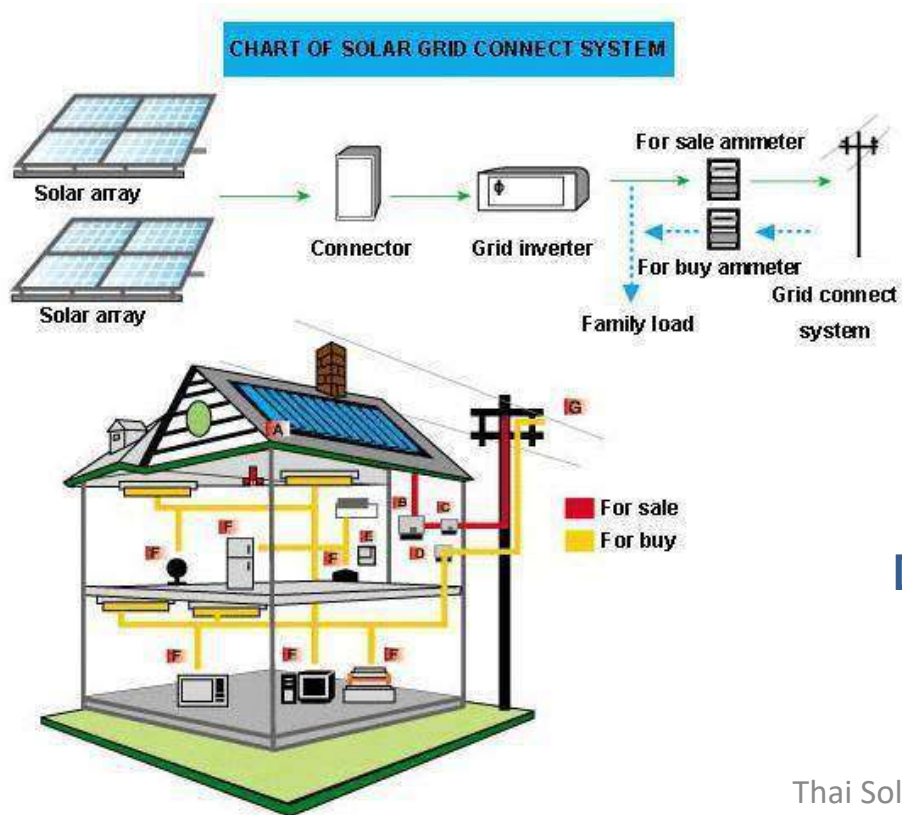
## Concern of installation .

1. Water leak
2. Weight adder 20Kg/m2
3. Grid Tie connection.

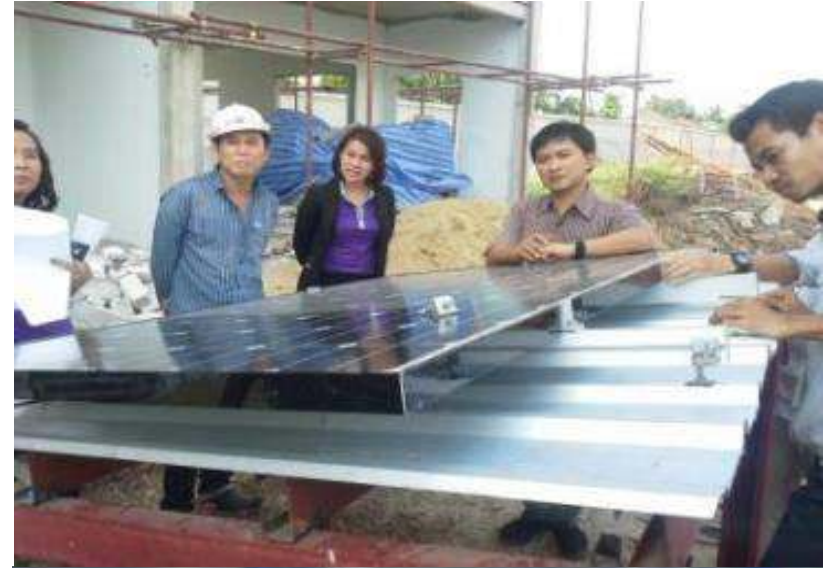
# Home Rooftop



วางแผนไปทางทิศใต้ มุมเงย 15 องศา



# Prinsiri PCL. Prayasuren 24 Road



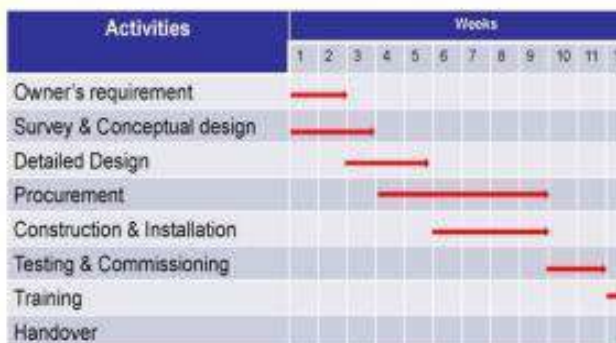


# Rooftop for Commerce Building 20 KW-1MW

## Project Timeline

### Key Dates:

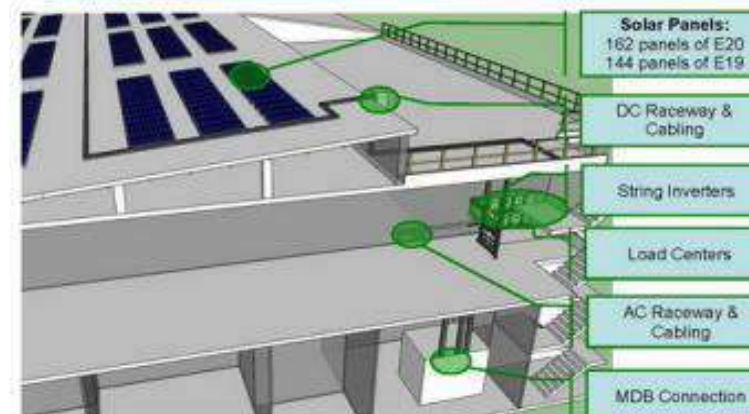
- Total Installed Duration = 90 days (approx. for 100kW DC))



## Solar PV Module Layout



## Solar Rooftop System Overview



## Solar Rooftop System Overview



PV Module    Inverter    Load Center    MDB

Item	Brand	Size	Qty.	Type
PV Module	Sunpower	327W/245W	162/144	St-Mono
Inverter	ABB	8kW/6kW	6/6	String Inverter
Monitoring System	Solarlog	-	1	-

## Examples of Materials & Equipment for Solar Rooftop

### PV Module & Inverter

1. PV Module (Sunpower E20)



2. PV Module (Sunpower E19)



3. Inverter (ABB)



Thai Solar Way Co.,Ltd

## Examples of Materials & Equipment for Solar Rooftop

### Cable, Wireway, Grounding

1. Wireway



2. Ground bar



### Examples of Materials & Equipment for Solar Rooftop

### Module Mounting Structure

- ### 1. P1000T Frame



- ### 3. Z50-BRKT



- ## 2. V750-Hat Connector



4. U50-BRKT



Inverter room



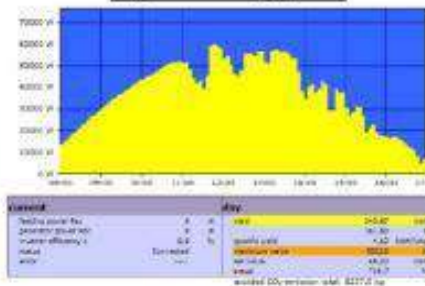
### Examples of Materials & Equipment for Solar Rooftop

### Monitoring system

- ## 1. Solar Log 1000



Measurement	Units
Power (AC)	Watt
Power (DC)	Watt
Eff	%
Energy	kWh
Espe	Wh / Wp
Pmax	Watt



## Testing & Commissioning



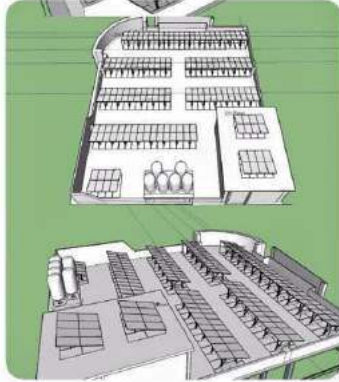
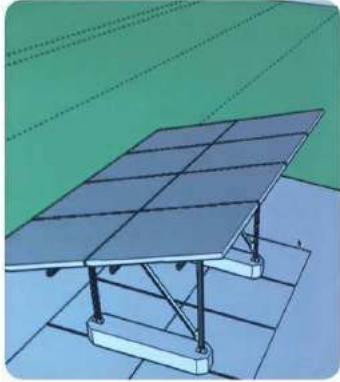
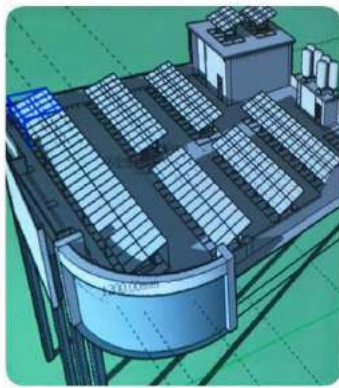




Akasit Wansom added 4 new photos.

ดูโปรเจกต์ - 15

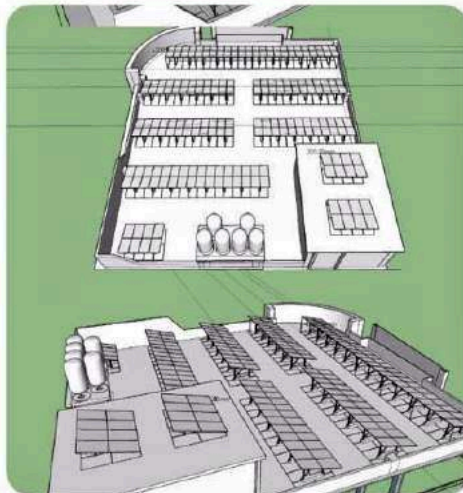
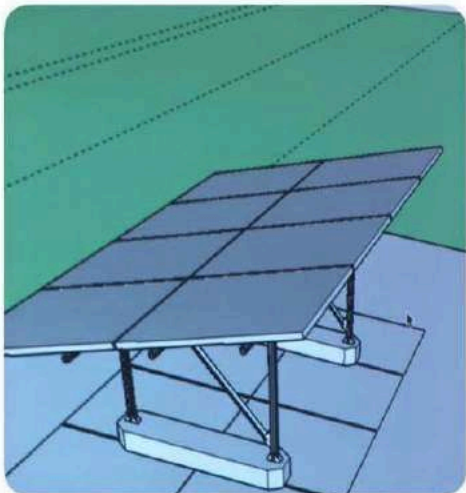
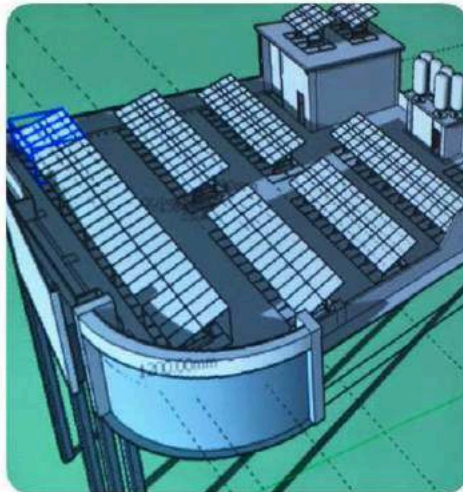
สำรวจออกแบบ และวางแผนงาน ติดตั้งSolar PV system





# Commercial Building

เรืองวา อินดัสทรี จำกัด





# Manufacturing





# Solar Farm



Akasit W.

4 minutes ago

Solar Farm by INVT inverter+smart DC box  
+datalog with 3G modem





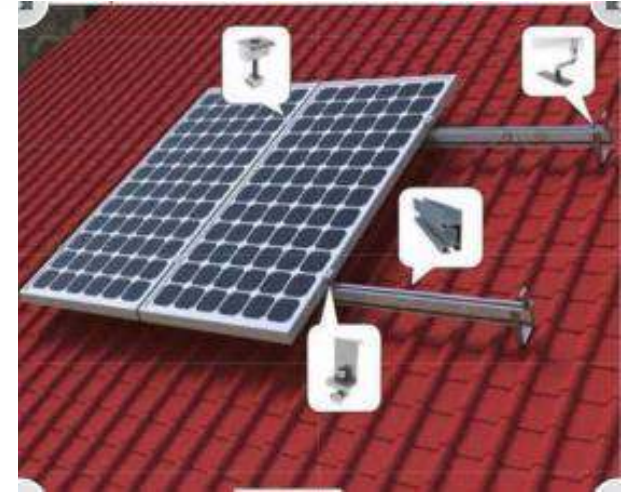
# Solar Pump System





# มาตรฐานการติดตั้ง

 เราใช้ชุดติดตั้งบนหลังคาและทีมงานที่มีประสบการณ์ในการติดตั้งที่มีมาตรฐาน



# การเดินสายที่เรียบร้อยและทั้งหมดผ่านการตรวจรับ ทั้งการไฟฟ้านครหลวงและภูมิภาค

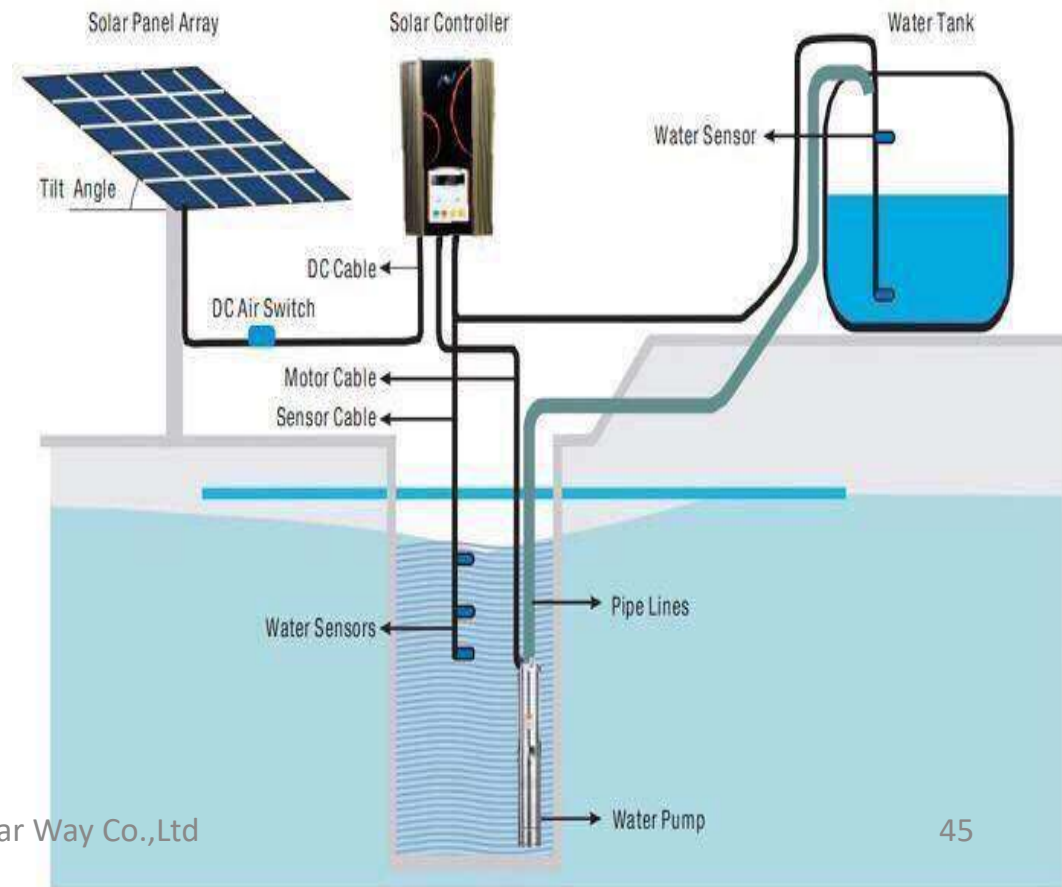
- 🌐 เดินสายไฟทั้งสาย **high Volt DC** และสายไฟ **AC** ระบบ**Grounding** ระบบ**Surge protection** และการเดินท่อร้อยสายทั้งภายในภายนอก ตามมาตรฐานวิศวกรรม และระเบียบของการไฟฟ้า
- 🌐 ผ่านการตรวจรับทั้งการไฟฟ้านครหลวงและภูมิภาคในการอนุญาตเชื่อม**grid** ในการขายไฟฟ้า และรับประกันงานระบบ **2ปี**

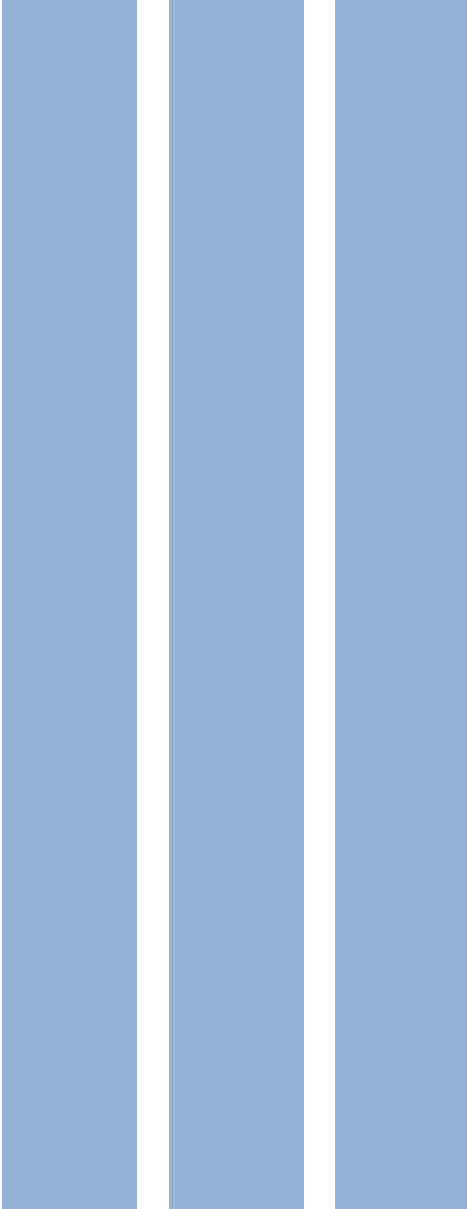




# Site Reference more than 50 sites

[www.facebook.com/thaisolarway](http://www.facebook.com/thaisolarway)  
[www.thaisolarway.com](http://www.thaisolarway.com)





# **Part IV**

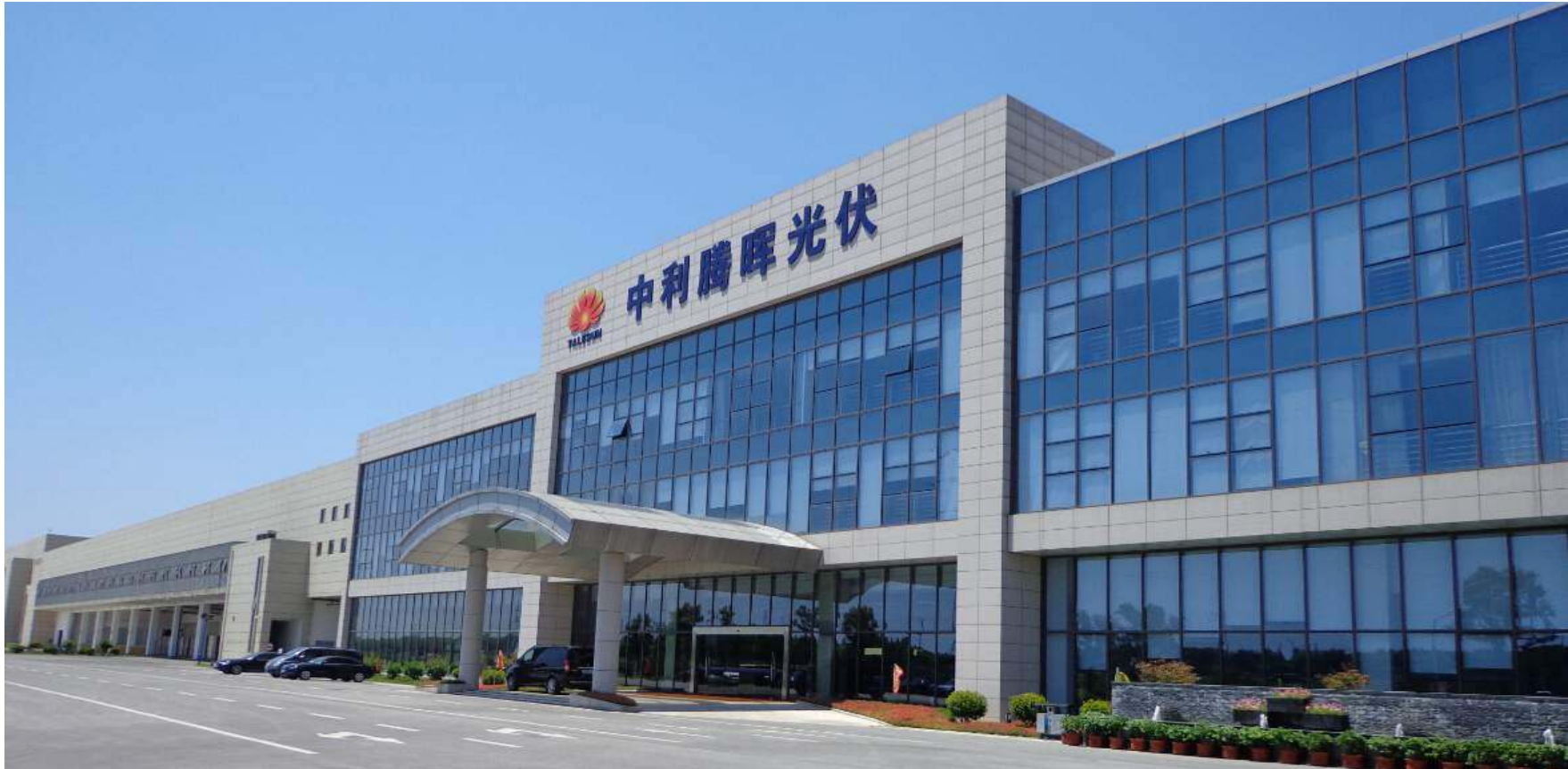
## **Solar Module: Talesun or Schutten**





**Make it Happen.**

# Top Solar Company in The World



## Founded in 2010

Closely affiliated with Zhongli Group (SZ:002309) with 28 years history

## 160 affiliates

Business covers cell, module, project development, EPC and turnkey solutions

## 1,875 million USD assets

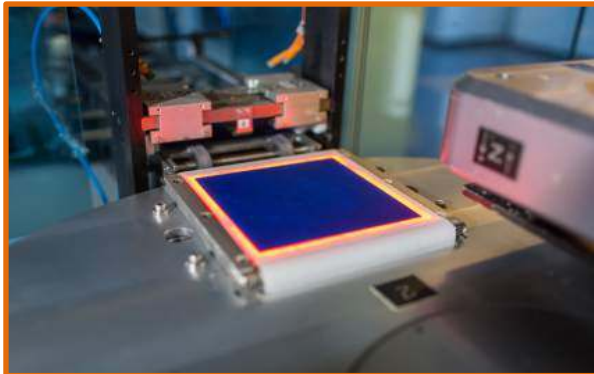
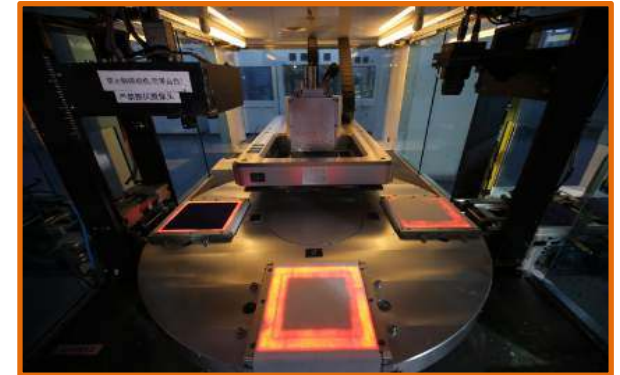
Abundant capital and reliable financial condition

## 3,663 employees globally

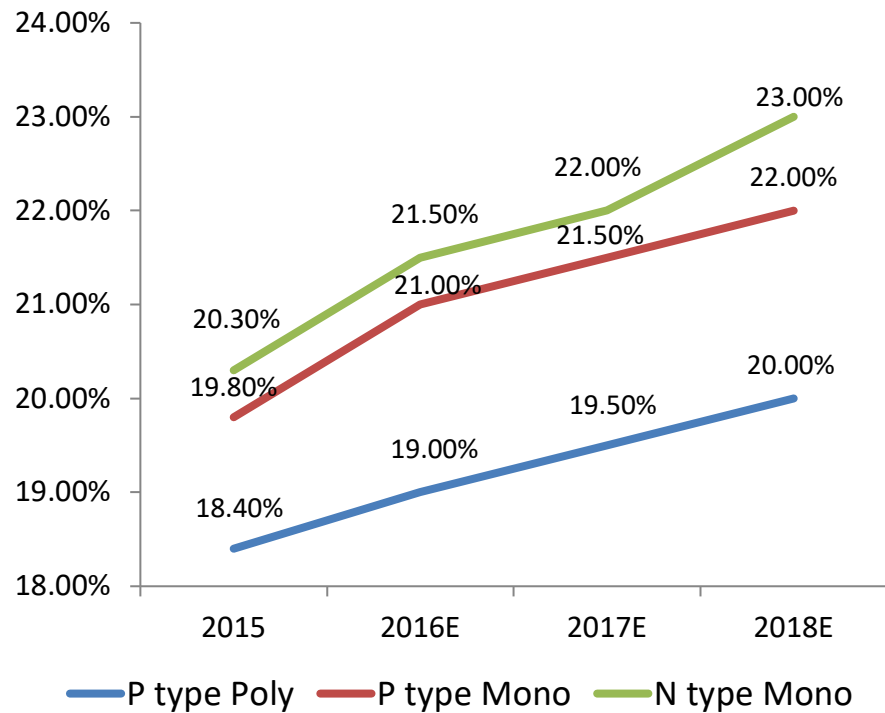
Our employees come from Europe, America, Asia, etc.



# Our Equipment



# Industry Leading Cell Technology and Efficiency



Talesun Solar R&D talents continuously improve the cell efficiency. **21.0%** cell efficiency with **PERC** cell technology is what we have achieved by now.

# Global Network for Production, Sales & Service



**More than 3600 employees in 12 countries**

# Third Party Ranking

## Bloomberg New Energy Finance Tier 1 Module Maker List

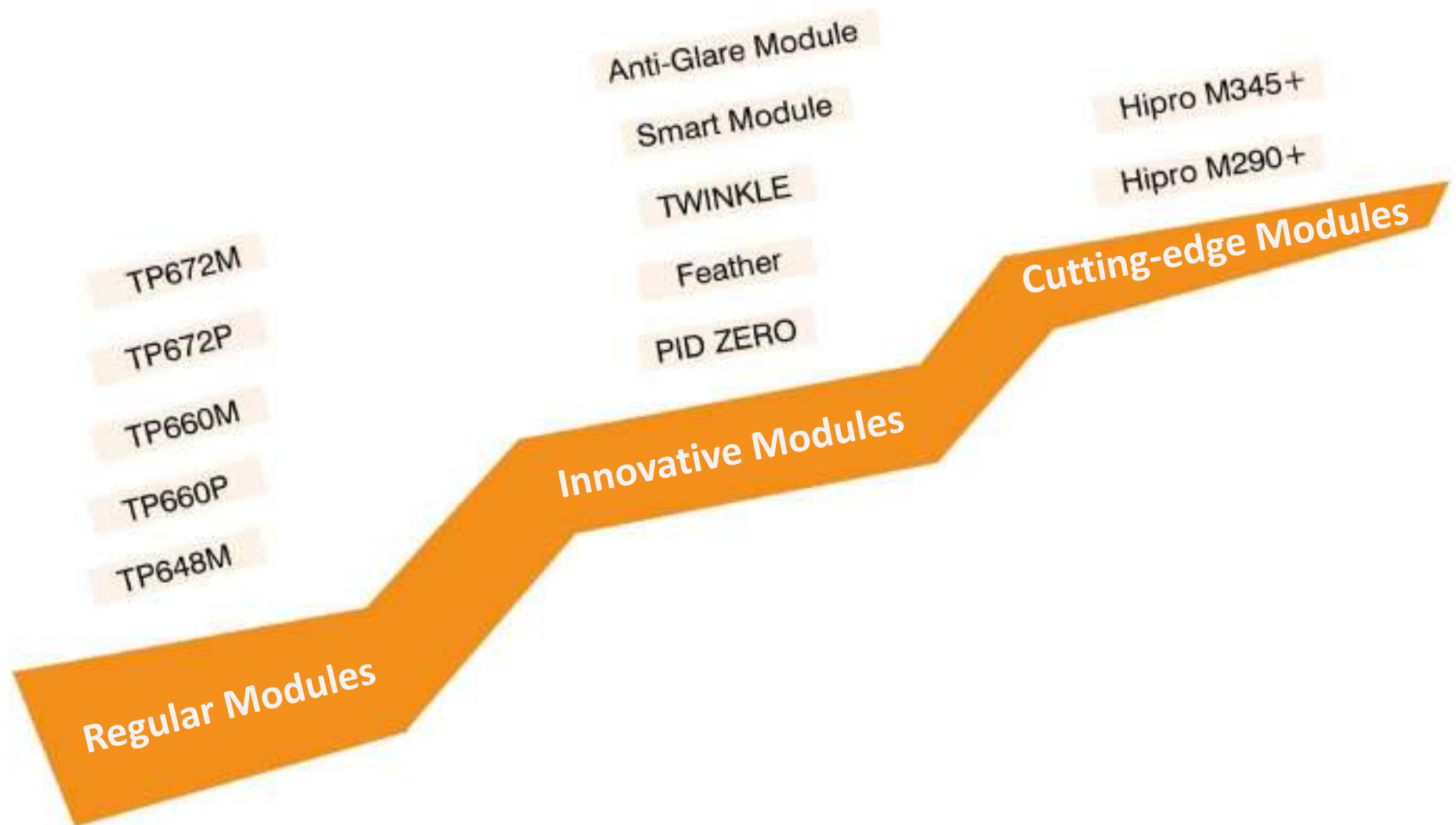
<b>Bloomberg</b> <small>NEW ENERGY FINANCE</small> <b>TIER 1 MODULE MAKER LIST, Q2 2015</b>	
Company	Module capacity (MW/year)
Teva	4000
Yingli	3400
Jinko	3200
Canadian Solar	3000
JA Solar	2800
Suntech/Shunfeng	2400
First Solar	2400
Hanwha Q CELLS	2200
 <b>Zhongli Talesun</b>	<b>2000</b>
SunPower	1200
Weiss Energy	1200
ReneSola	1200
China Sunergy	1100
TaiSheng	1100
Kymore	1000
ET Solar	1000
QPS	1000
Cginy	1000
REC Solar	1000
HT-SAE	700
GoodFish Korea	600
LS Electronics	500
Phosco Solar	400
AUD	375
Sunergy	350
Shen	200
Vicore	150
Holcom	75
<b>Total</b>	<b>38000</b>

<b>Bloomberg</b> <small>NEW ENERGY FINANCE</small> <b>TIER 1 MODULE MAKER LIST, Q4 2015</b>	
Company	Module capacity (MW/year)
Hanwha Q CELLS	4000
Teva	4000
Jinko	4000
Canadian Solar	3000
Yingli	3400
First Solar	2800
 <b>Zhongli Talesun</b>	<b>2800</b>
Suntech/Shunfeng	2400
ReneSola	2100
Kymore	1800
SolarWorld	1500
China Sunergy	1000
SunPower	1000
Phosco	1000
ReneSola	1000
China Sunergy	1100
Sonachem	1100
Solar Frontier	1000
QVD	1000
HT-SAE	1000
Hyundai Heavy	800
Vikram	500
REC Solar	400
Holcom	250
Wabtec	100
<b>Total</b>	<b>45435</b>

<b>Bloomberg</b> <small>NEW ENERGY FINANCE</small> <b>TIER 1 MODULE MAKER LIST, Q1 2016</b>	
Company	Module capacity (MW/year)
Teva Solar	4000
Hanwha Q CELLS	4000
JA Solar	4000
Jinko	4000
Canadian Solar	3000
First Solar	3000
 <b>Zhongli Talesun</b>	<b>2800</b>
Rene Energy	2600
Suntech/Shunfeng	2400
China Sunergy	2000
Ecig	1800
Solar World	1500
REC Solar	1500
SunPower	1300
Sonachem	1200
Holcom	1200
LS	1100
Solar Frontier	1000
ZNShen	1000
ET Solar	1000
QVD	1000
HT-SAE	1000
Hyundai Heavy	800
Sharp	600
Phosco Solar	400
AUD/Band	400
Holcom	250
Wabtec	100
<b>Total</b>	<b>50285</b>



# World Class Product Portfolio

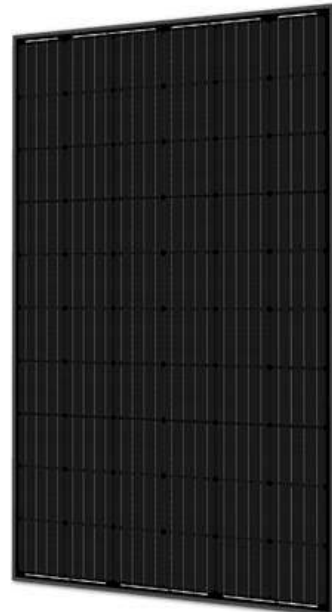


# High-Eff Module for Residential, Commercial and Utility

Mono-Crystalline Solar Module				Poly-Crystalline Solar Module		
Type	TP648M	TP660M	TP672M	Type	TP660P	TP672P
Cell Dimensions	156*156mm (4BB)	156*156mm (4BB)	156*156mm (4BB)	Cell Dimensions	156*156mm (4BB)	156*156mm (4BB)
Cell Arrangement	48 (6*8)	60 (6*10)	72 (6*12)	Cell Arrangement	60 (6*10)	72 (6*12)
Module Dimensions	1324*990*35mm	1640*990*35mm	1960*990*50mm	Module Dimensions	1640*990*35mm	960*990*50mm
Power Tolerance	0-+3%			Power Tolerance	0-+3%	



**All Talesun  
Modules :  
PID FREE**



# Innovative Module for Diversified Customers' Needs

## Light Module Series

### FEATHER 2.5

To adopt 2.5mm ultrathin tempered glass, with light frame, 16kg

**15% lighter** (60 cell series based), but yet still certified to withstand 2400Pa wind load and 5400Pa snow load.

### FEATHER 2.0

To adopt 2.0mm ultrathin tempered glass, with light frame, 14kg

**26% lighter** (60 cell series based), but yet still certified to withstand 2400Pa wind load and 5400Pa snow load.



## Double-glass Series

### TWINKLE 2.5

TWINKLE 2.5 uses two 2.5mm tempered glasses with solar cells laminated in, and adopts high performance encapsulant, which ensures stable power output under extreme climate conditions.

### TWINKLE 2.0

TWINKLE 2.0 uses two 2.0mm tempered glasses with solar cells laminated in, and adopts high performance encapsulant, which ensures stable power output under extreme climate conditions.



# Innovative Module for Diversified Customers' Needs

## PID ZERO Series

PID ZERO module is expected to eliminate system power degradation in high humidity and salty mist shower environment such as coastal areas.

The PID test of PID ZERO module by TUV Rhn shows that the power degradation is no more than 1% under the test condition of 85°C , 85%RH, -1000V for 672 hours.

PI <sup>CHINA</sup> TALESUN MODULE TEST REPORT	
Talesun Module Test Condition (by PI China)	Standard Module Test Condition
85°C , 85% RH, -1000V test for <b>672</b> hours	85°C , 85% RH, -1000V test for <b>96</b> hours
Talesun module test result	standard test result requirement
power degradation ≤ <b>1%</b>	power degradation ≤ <b>5%</b>
PI Photovoltaic Institute (Beifeng) Co., Ltd.	
PI Photovoltaic Institute (Beifeng) PI Module & System Technology Testing Certification Beifeng A, 2400th Road, Suzhou Industrial Park Beifeng, Jiangsu Province P.R.C. Phone: +86 512 86000088 Fax: +86 512 86000122 Web: www.pi-china.cn	
PHOTOVOLTAIC-INSTITUTE <sup>CHINA</sup>	

## SMART MODULE Series

Integrated with module optimizer:

- 100% cloud monitoring
- Up to 20% more power output
- More flexible system design
- Work with any inverter



# Cutting- Edge Product Series

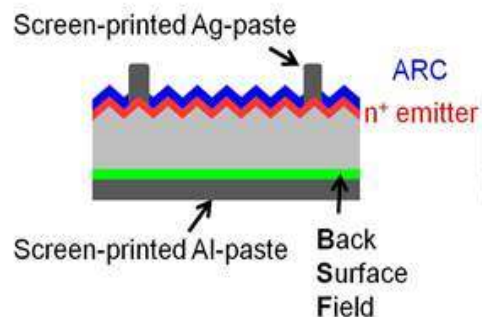
**Hipro M290+**



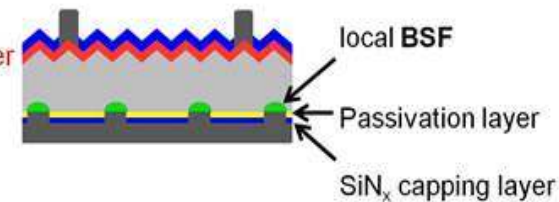
**Hipro M345+**



**Standard solar cell**



**PERC solar cell**



With world's leading PERC cell technology, Talesun Solar has achieved 21.0% cell efficiency in 2015, and will keep improving for sure.

For 60 mono cell series module, the highest power output has reached 290Wp.

For 72 mono cell series module, the highest power output has reached 345Wp.

# Best Product Warranty Backed by Insurance

## Industry Leading Product Warranty

- ✓ 10-year product workmanship warranty
- ✓ 25-year linear power output performance guarantee
- ✓ Guarantee first year power degradation is no more than 2.5% from its nameplate power <sup>①</sup>
- ✓ From year 2 to year 25, the actual power decline will be no more than 0.7% <sup>①</sup>
- ✓ By the end of year 25, the actual power output will be no less than 80.7% of the nameplate power output <sup>①</sup>

<sup>①</sup> To poly-silicon modules

## Backed by Investment Grade Insurance Policy

- ✓ Insurance policy matches Talesun Solar's standard warranty terms
- ✓ Coverage starts immediately and lasts for 25 years
- ✓ Covers worldwide modules sales to any country
- ✓ The policy is non cancelable and allows third party bankruptcy rights (satisfying investor/ banker requirements)





# Quality and Performance Certification

## International Environmental & Quality Management Standards



ISO 9001:2008 Quality Management System



ISO 14001 Environment Management System



OHSAS 18001 Occupational Health and Safety

## International Testing Standards



IEC 61215 & IEC 61730, UL 1703 & UL 790 & CEC



CE conformity, MCS (EN45011)



REACH Compliance



# Reference Projects - China



## Reference Projects - Japan

**50 KW**  
Miyazaki-ken, Japan



**10 KW**  
Miyagi Prefecture, Japan



**45.9 KW**  
Fukuoka Prefecture, Japan



**825 KW**  
Minamisoma, Japan



**499.2 KW**  
Mino, Japan



**185.6 KW**  
Miyagi Prefecture, Japan



**3.5 MW**  
Yamaga, Japan



**600 KW**  
Miyagi Prefecture, Japan



**460 KW**  
Aomori-ken, Japan



**274.2 KW**  
Gifu, Japan



**253.2 KW**  
Ibi-gun, Japan



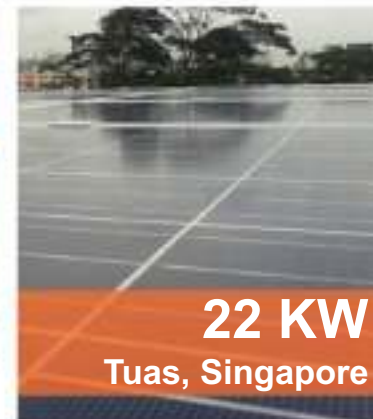


# Reference Projects - Europe





## Reference Projects - ROW



# Schutten Solar Group

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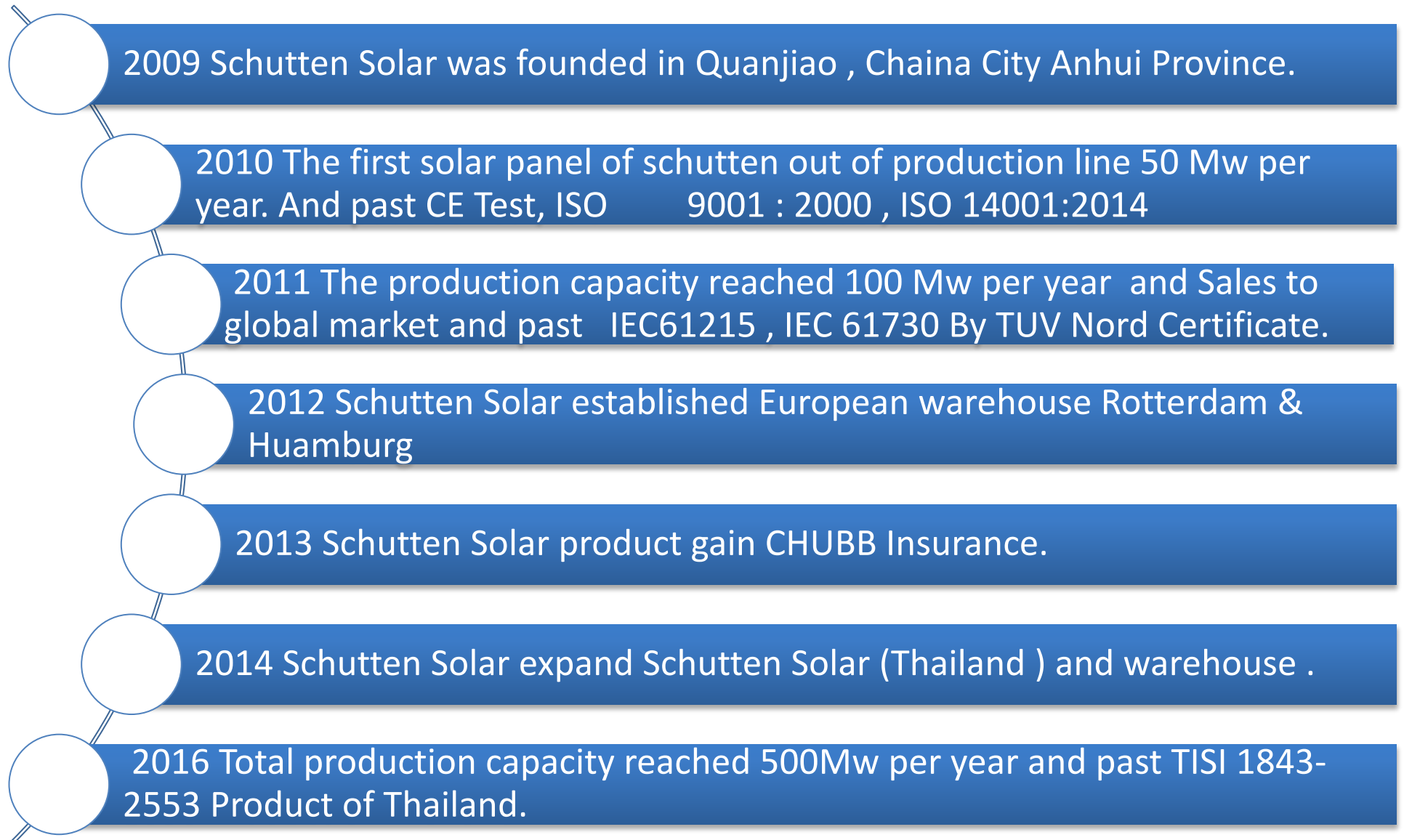
# Schutten Solar Group

- Contents
- Who we are
- What we do?
- Why Schutten Solar
- Global Network
- Project Reference

- ◆ Established by ICBC Quanjiao Branch, Quanjiao Govt & MCL Group in Britain in 2009
- ◆ manufactory in Chuzhou City, Anhui Province, marketing center in Nanjing City, Jiangsu Province.
- ◆ 80,000 square metres manufactory can provide more than 100MW solar panels products every year.
- ◆ More than 25 soldering production lines, 10 automatic laminating machines
- ◆ 100 engineers & 300 workers will provide perfect workmanship products.
- ◆ Stable supply chain with more than 10 reliable suppliers will guarantee delivery in time.



# Schutten Solar Group





# Schutten Solar Group



# Schutten Solar Group

**Schutten**  
solar  
blue sky . green life

## Strengths

- +5 Tolerance 0~+5
- High transmission, low Iron Tempered Glass
- Plug&Play Connectors
- Bypass Diodes Protection
- Salt Mist And Ammonia Resistance Test

## Warranty

- 12 Manufacturing 12 Years
- Power Production 90% 12years 80% 25years

## Insurance

Insured  
By CHUBB

## Certificates



**STP6-XXX/72 Series**  
STP6-310W, STP6-305W, STP6-300W,  
STP6-295W, STP6-290W

Polycrystalline  
photovoltaic  
Module

Three-Busbar Cell



TIS 1843-2553  
TIS 2550 and 2-2555



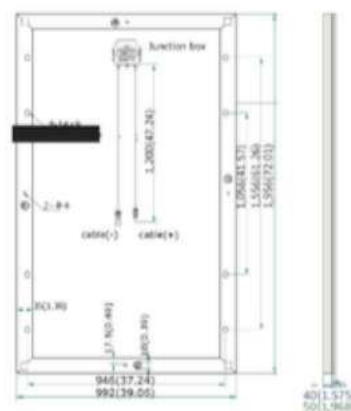
## STP6-XXX/72 Series

STP6-310W, STP6-305W, STP6-300W, STP6-295W, STP6-290W

### Electrical Characteristics

Module Type	Unit	STP6-310/72	STP6-305/72	STP6-300/72	STP6-295/72	STP6-290/72
Rated Power at STC (P <sub>mp</sub> )	W	310	305	300	295	290
Power Tolerance	W (-3%, +5%)	(-3%, +5%)	(-3%, +5%)	(-3%, +5%)	(-3%, +5%)	(-3%, +5%)
Power Maximum at STC	W	310	305	300	295	290
Cell Efficiency (%)	%	18.2-18.5	17.9-18.2	17.7-17.9	17.4-17.7	17.1-17.4
Minimum Module Efficiency (%)	%	15.9-16.1	15.7-15.9	15.5-15.7	15.2-15.5	14.9-15.2
Open Circuit Voltage (V <sub>oc</sub> )	V	44.7	44.6	44.5	44.4	44.3
Short Circuit Current (I <sub>sc</sub> )	A	9.17	9.05	8.92	8.78	8.65
Maximum Power Voltage (V <sub>mp</sub> )	V	36.1	36.0	35.8	35.6	35.4
Maximum Power Current (I <sub>mp</sub> )	A	8.60	8.47	8.35	8.22	8.10
Maximum System Voltage	V	1000 (72V), 600 (60V)				
Maximum Series Fuse Rating	A	15				

STC: Irradiance 1000W/m<sup>2</sup>, module temperature 25°C, AM=1.5;



- All Dimensions in mm (inch)
- The above drawing is a graphical representation of the product. For engineering quality drawings please contact **SCHUTTEN**



**Schutten Solar**  
http://www.schutten-solar.com

**Schutten**  
solar  
blue sky . green life

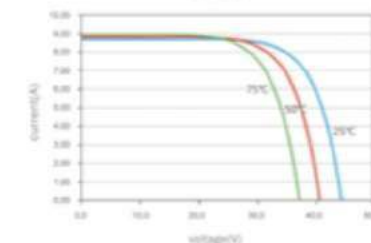
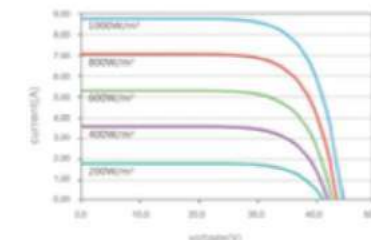
### Temperature Characteristics

P <sub>max</sub> Temperature Coefficient	%/°C	-0.41
V <sub>oc</sub> Temperature Coefficient	%/°C	-0.33
I <sub>sc</sub> Temperature Coefficient	%/°C	+0.03
Operating Temperature	°C	-40 ~ +85
Nominal Operating Cell Temperature (NOCT)	°C	45±2

### Mechanical Specifications

External Dimensions	1956 x 992 x 40 mm
Weight	24kg
Solar Cells	Polycrystalline 156 x 156mm (72pcs)
Front glass	3.2 mm tempered glass, low iron
Frame	Anodized/ Electroplastic aluminum alloy
Junction Box	IP67
Output Cables	4.0 mm <sup>2</sup> , symmetrical lengths 900mm
Connector	MC4 Compatible
Maximum Snow Load	55kg/m <sup>2</sup>
Maximum Wind Load	200km/h
Halfstone Impact Test	80km/h for 25mm ice ball

### Current-Voltage & Power-Voltage Curve [STP6-300/60]



Temperature dependence of I<sub>sc</sub>, V<sub>oc</sub> and P<sub>max</sub>  
Irradiance dependence of I<sub>sc</sub>, V<sub>oc</sub> and P<sub>max</sub>  
(cell temperature: 25°C)



# Schutten Solar Group

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Products – Completed Operation Liability  
Network Technology Errors Or Omissions Liability



IEC 61215 : 2005  
IEC 61730-1 : 2004; EN 61730 -1 : 2007  
IEC 61730-2 : 2004; EN 61730 -2 : 2007  
CE TEST  
Australian CEC List



12

Manufacturing  
12 Years



Power Production  
90%:12years 80%:25years



The thirty party credit insurance provide the capital supporting.  
Your company will have open accounting from 30 days to 120 days



# **Part V**

## **Solar Inverter:**

### **Solaredge**



# solar**edge**

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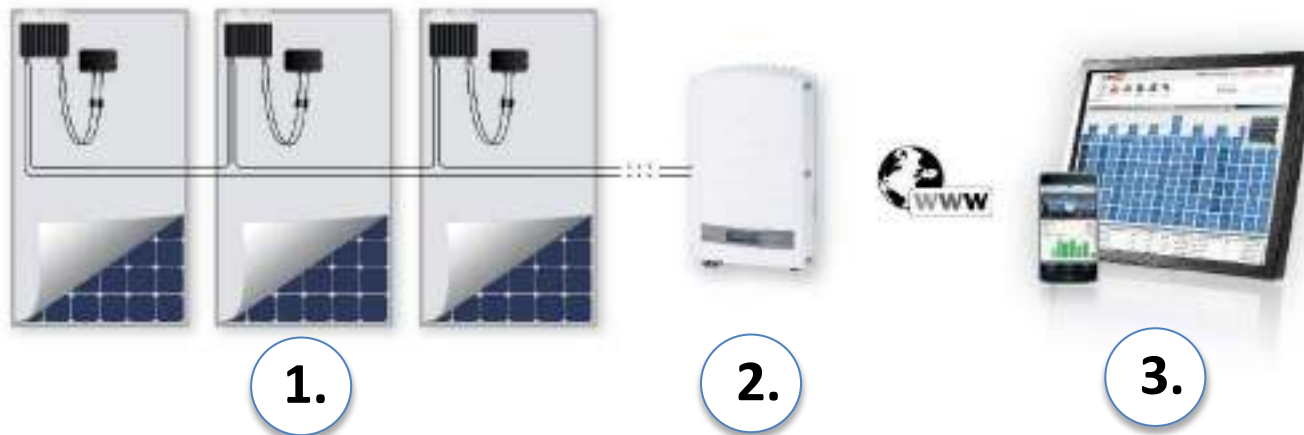
# Proven results

- 2.9GW of our systems shipped worldwide
- Over 11 M power optimizers and over 450,000 inverters shipped
- 230,000 monitored systems around the world
- 69 awarded patents and 107 additional patent applications
- Over 550 employees and presence in 13 countries
- A publicly traded company on NASDAQ (SEDG)





# The SolarEdge Solution



## 1. Power Optimizer

By connecting a SolarEdge power optimizer to a PV panel it becomes a smart panel.

**This allows:**

- To perform MPPT per panel
- Constant feedback on the performance of each panel
- Automatic shutdown of each panel for maximum safety in case of emergency

## 2. Inverter

The SolarEdge inverter is simpler and more reliable:

- Responsible only for DC to AC conversion, as all other functions are handled separately for each panel by the power optimisers
- Small and aesthetic

## 3. Monitoring Portal

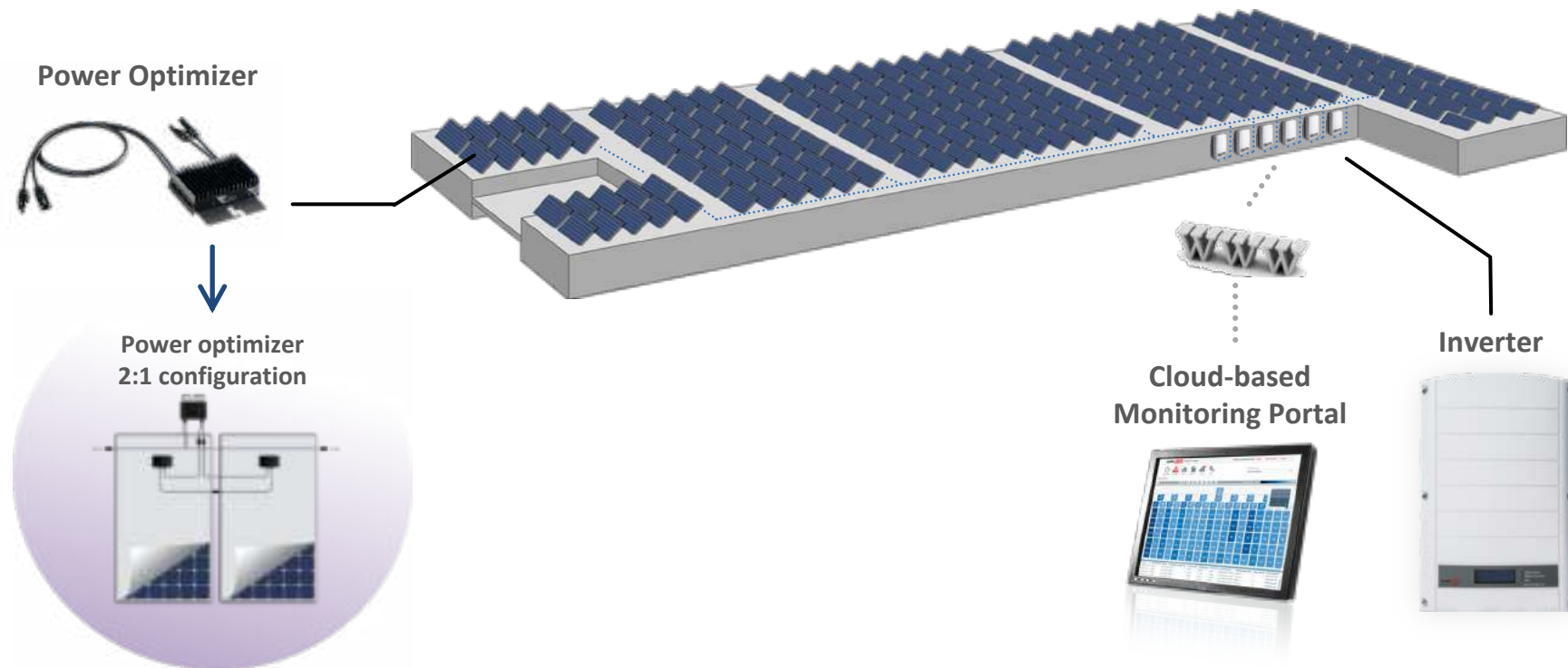
By displaying real-time performance data, the monitoring portal allows:

- Full visibility of your system performance
- Automatic alerts on system issues
- Easy access from a computer, smartphone, or tablet



# DC Optimized Inverter Solution

Maximizing System Output while Minimizing Additional Cost



- Each panel is connected to a power optimizer
- Power optimizers are electronic converters that maximize energy from each panel individually
- A simplified inverter converts DC to AC
- Monitoring platform visualizes performance of each panel

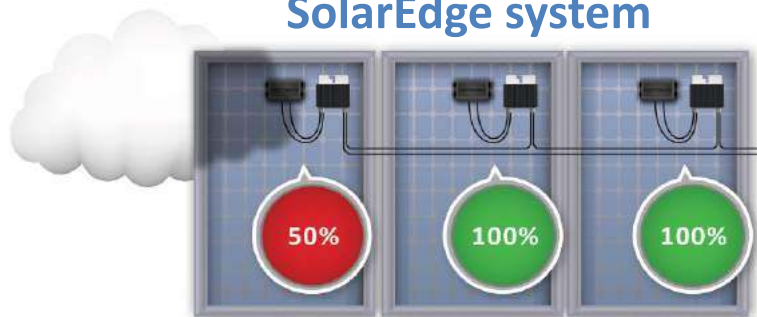
# Eliminating Power Mismatch Losses

- By performing panel level MPPT, energy losses due to panel mismatch are eliminated
- The more mismatch there is in a string, the more energy you save

**Traditional system**



**SolarEdge system**



*NREL PVWatts modeling report showing 2% more energy calculated due to panel mismatch*

## PVWatts System Losses and Inverter Efficiency

Table 1. Recommended PV Watts System Losses and Inverter Efficiency with Microinverters or Power Optimizers

System Loss Type	PV Watts Default	Distributed Power Electronics Recommended Value	Notes
Soiling	2%	No Change	Soiling often mostly uniform, but may have regional differences at some sites. In these cases some losses may be mitigated.
Shading	3%	For near obstacles (not horizon blocking): Shade Loss% * (1-SMF) Default SMF=0.33	If shade loss% assumed to vary linearly with area of array shaded, SMF=0. Else SMF ranges = 0.25-0.4.
Snow	0%	No Change	
Mismatch	2%	0%	2% value for microinverters accounts for increased AC and decreased DC losses.
Wiring	2%	No Change	
Diodes and Connections	0.5%	No Change	
Light Induced Degradation	1.5%	No Change	
Nameplate Rating	1%	No Change	See manufacturer's datasheet
Age	0%	No Change	Microinverters and power optimizers may mitigate age-related losses caused by increased mismatch.
System Availability	3%	No Change	If system repair is performed promptly for any failures, losses may be reduced to 1-2%.
Inverter Efficiency	98%	Microinverters: use CEC efficiency DC Power Optimizers: multiply CEC efficiencies (optimizer * central inverter)	If no CEC efficiency available for power optimizer, use 0.99 for 2012 and newer, else 0.975.

Modeling Microinverters and DC Power Optimizers in PVWatts;  
2/2015

# SolarEdge Monitoring Platform

- Monitor the technical and financial performance of PV sites
- Full visibility of system performance & remote troubleshooting
  - Monitoring at the panel level
  - Fault detection pinpointed on a virtual site map
  - Automatic alerts on system issues
  - Easy access via web browser from computer or mobile device

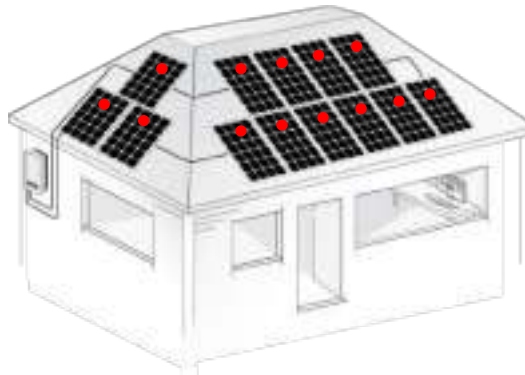


# SolarEdge Innovative Solution

Safe  
DC



Power  
Optimizer



Fixed Voltage  
Inverter



Cloud-based  
Monitoring  
Platform



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✓ Enhanced Safety Solutions

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✓ Higher Power Yield

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✓ Design Flexibility

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✓ Lower O&M Cost, Efficient Monitoring



# INVT SOLAR INVERTER

## Content

About INVT solar

MG Series Solar Inverter

Anti-feedback Solution

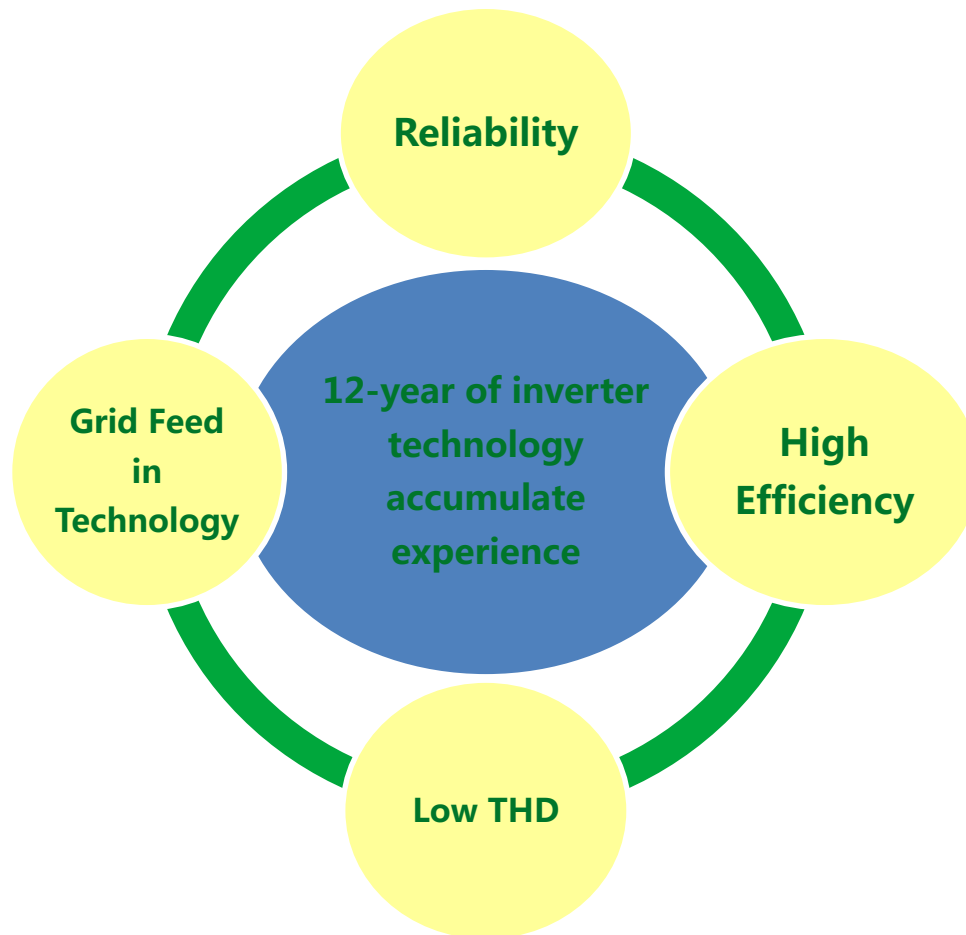
Monitoring System Solution

Applications

## About INVT Solar

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Solar inverter business is an important part of INVT' s Strategic development.



G83/G59 C10/11 TF3.2.1 LVRT  
IEC62109 IEC61727 MEA PEA

## Why INVT ?

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### Integrated Product Development

- 10 R&D centers
- 10% sales revenue on R&D
- One of 7 national standard makers in inverter industry
- Shenzhen Inverter Technology Engineering Lab
- Access to National CNAS laboratory qualification
- Passed TUV SUD internal audit and qualified as the witnessed test laboratory

## Why INVT ?

### Strict Product Quality Control



- R&D, production and Management system by TUV ISO9001:2008
- TUV : OHSAS18000 Certification
- TUV : ISO14000 Certification
- All series models compliance with the CE certifications



## Why INVT ?

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### Professional Technical support



## Why INVT ?

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### Prompt delivery

- Production bases located in Shenzhen, Shanghai, Suzhou, and Xi' an.
- Integrated supply chain, comprehensive quality management system, efficient operation and production.



### Outstanding service

- 24 hours Service hotline
- Quick service response
- Products Liability Insurance by CHUBB



## Product Family

### iMars Grid-tied solar inverter



MG1K1TL  
MG1K5TL  
MG2KTL  
MG3KTL  
MG4KTL  
MG4K6TL  
MG5KTL  
MG4KTL-2M  
MG4K6TL-2M  
MG5KTL-2M



BG4KTR  
BG5KTR  
BG6KTR



EG4KTL  
EG4K6TL  
EG5KTL  
EG4KTL-2M  
EG4K6TL-2M  
EG5KTL-2M



BG20KTR  
BG25KTR  
BG30KTR  
BG40KTR



BG1K5TL  
BG2K2TL  
BG3KTL  
BG4KTL  
BG5KTL  
BG6KTL



BG8KTR  
BG10KTR  
BG12KTR  
BG15KTR  
BG17KTR



BG40KTR



BPD0K7TN  
BPD1K5TN  
BPD2K2TN



JTPV-CB8  
JTPV-CB8  
JTPV-CB10



Residential  
1.5-5KW



Commercial  
4-50KW



Plant



Other

## Product Family

### Monitoring system and software

#### Product



HMI



ENET 200

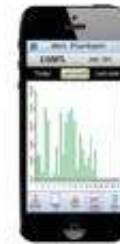


Wifi 200

#### Software



WinExpert



PhoneExpert

#### Platform



InfoExpert

### JTPV Combiner box



### PV System Design Software





# Content

About INVT solar

New Generation Solar Inverter

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## INVT's second generation solar inverter

- Compact Design
- Smaller and Lighter
- Core Technology from Germany



## MG Series Solar Inverter

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SIZE:W300XH280XD130

BPD Series



SIZE:W300XH280XD130

MG0K7TL  
MG1KTL  
MG1K5TL  
MG2KTL  
MG3KTL



SIZE:W360XH350XD140

MG4KTL  
MG4K6TL  
MG5KTL



SIZE:W360XH400XD140

MG4KTL-2M  
MG4K6TL-2M  
MG5KTL-2M

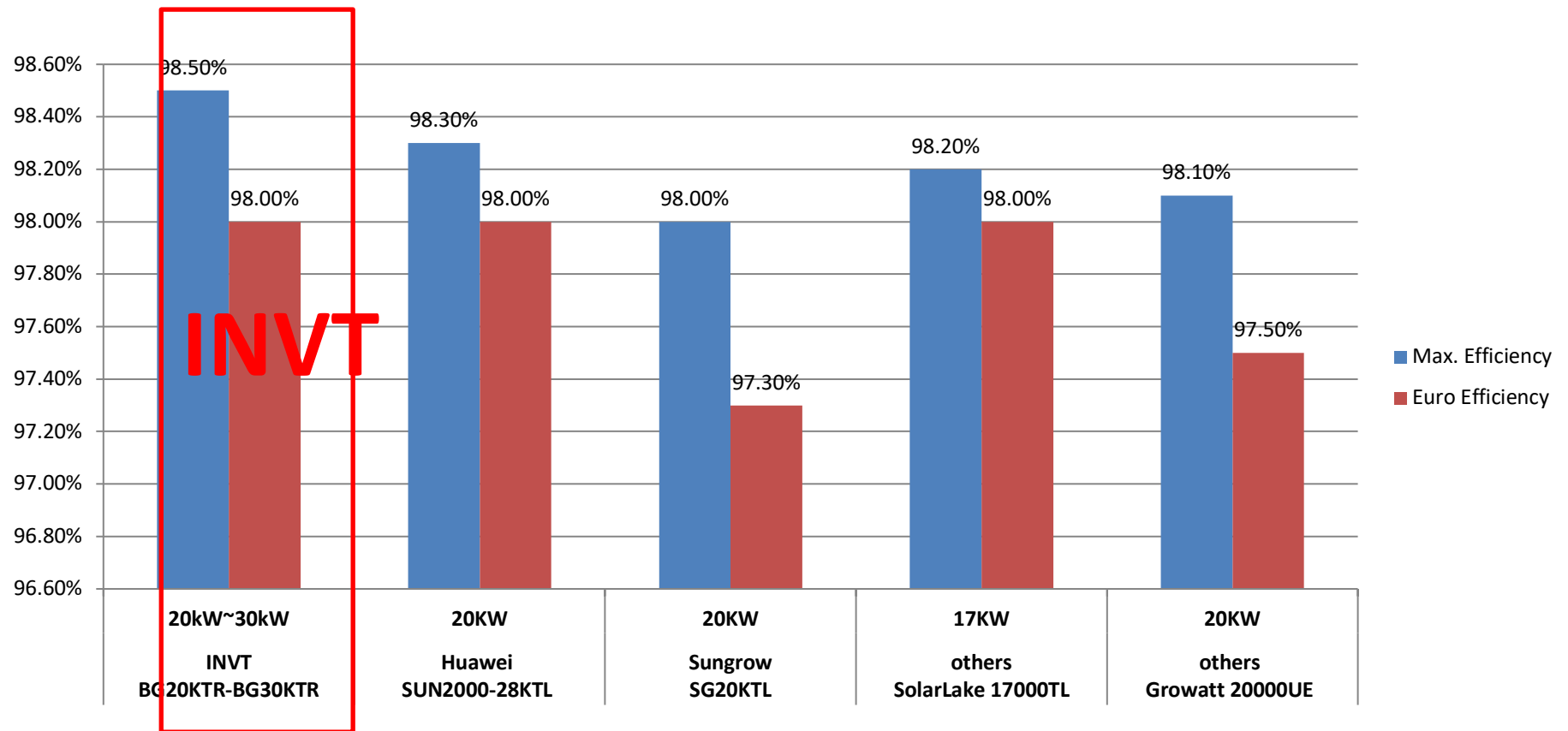
## New BG Series Solar Inverter Three phase





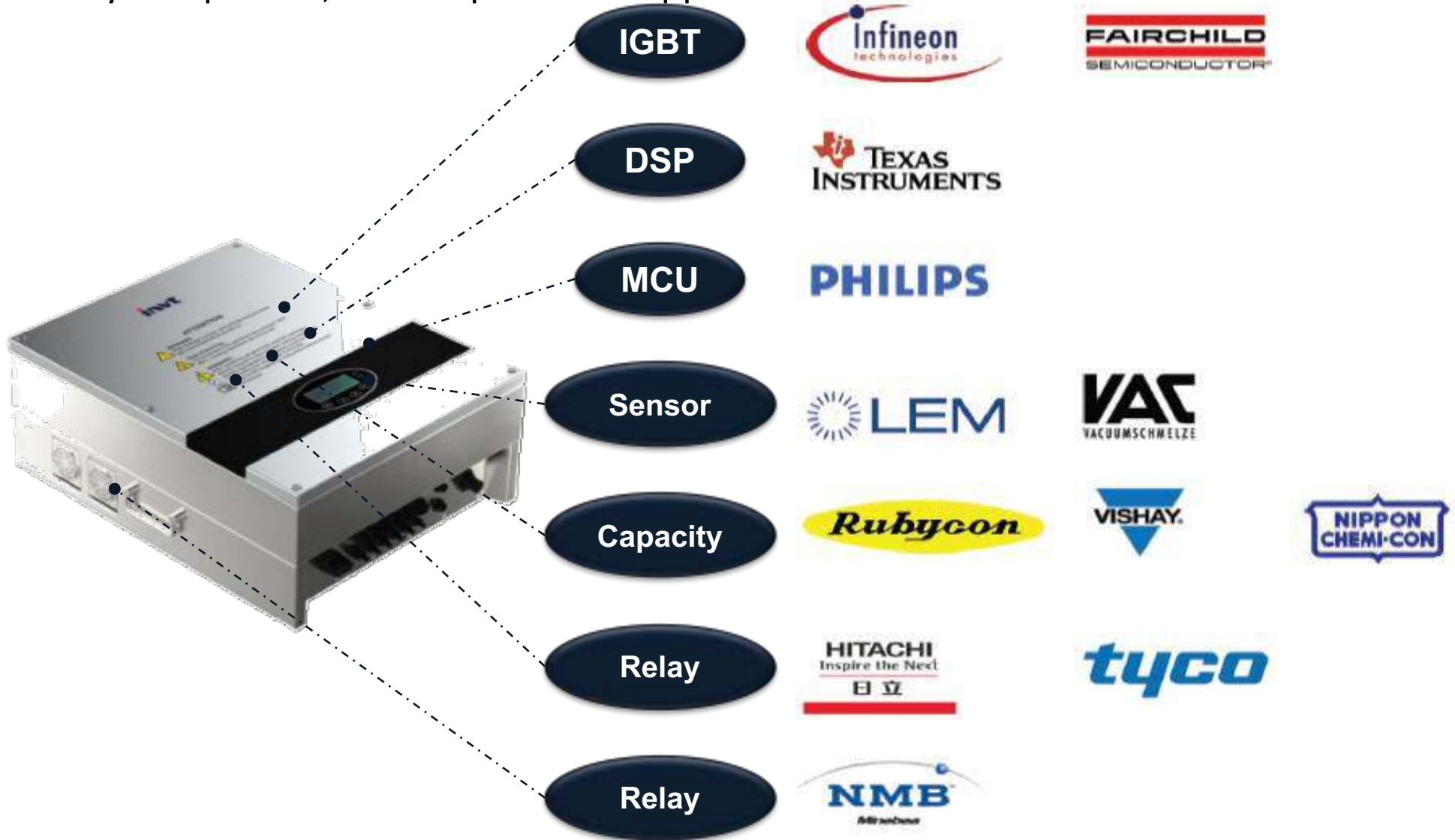
## What is the difference ?

Efficiency, do you know which inverter is better ?

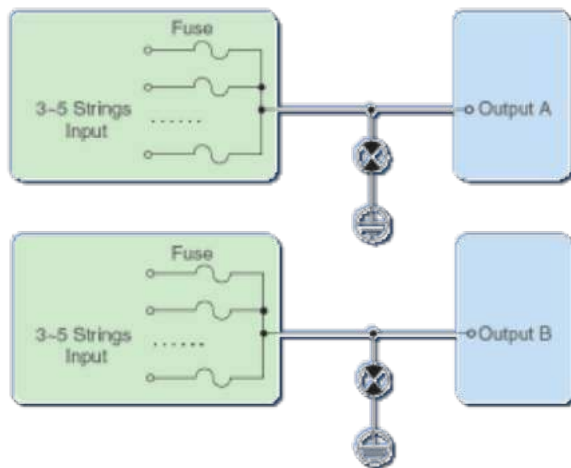
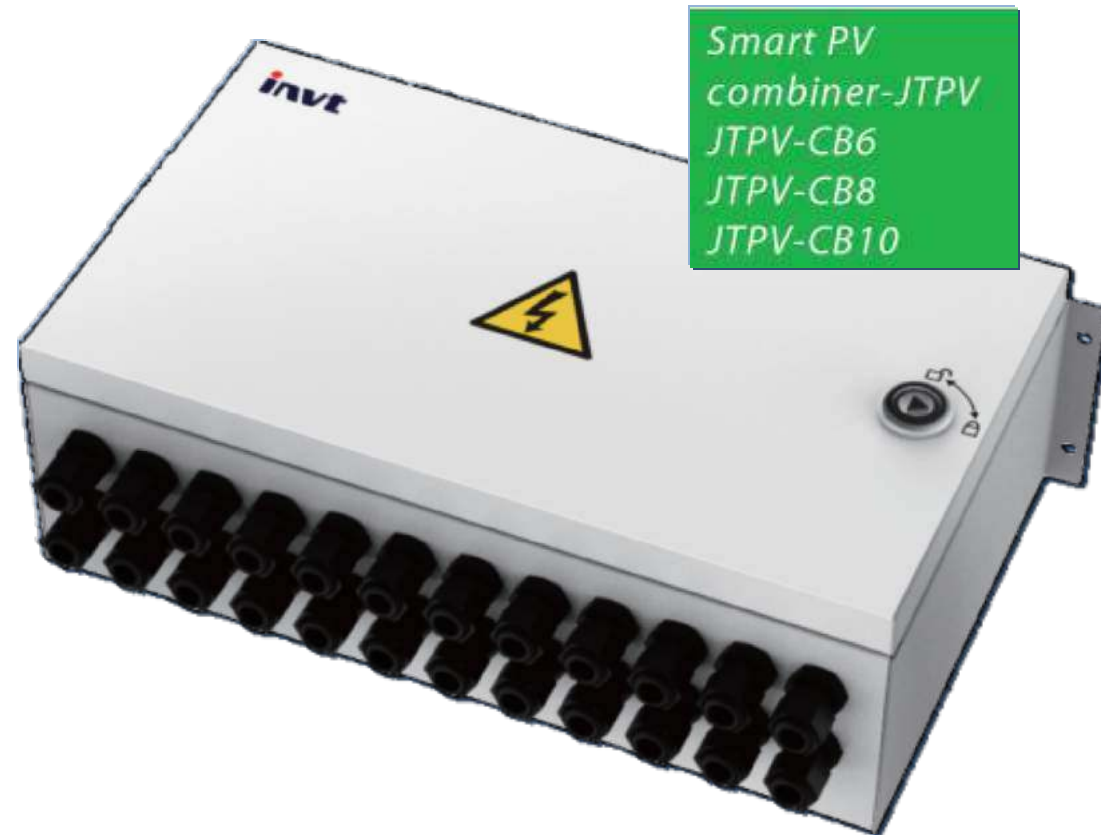


## What is the difference ?

Key component, from Top brands suppliers



## New Smart Photovoltaic Combiner Box



- Integrating DC lightning protection module and fuse, enhance input protection class
- Monitoring string current, voltage and operation status
- Acting to smart grid dispatching signals
- Setting output power and time interval via monitoring software
- RS485 communication interface

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## Anti-feedback Solution

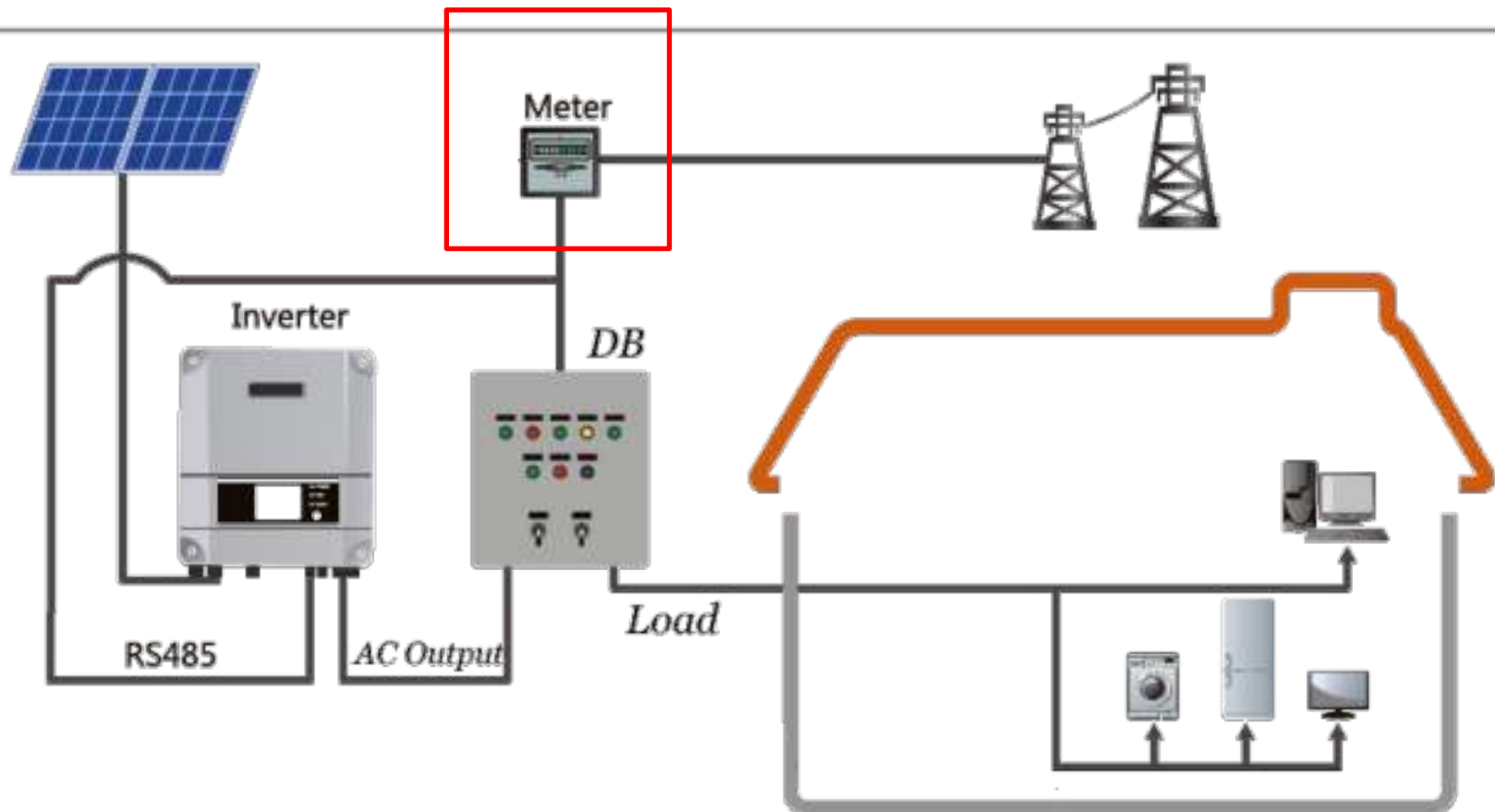
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The solution provides a solar power system to generate all power for self-consumption without feeding to grid by introduction an independently developed anti-feedback controller by INVT to control solar inverter's output power.

## Anti-feedback Solution

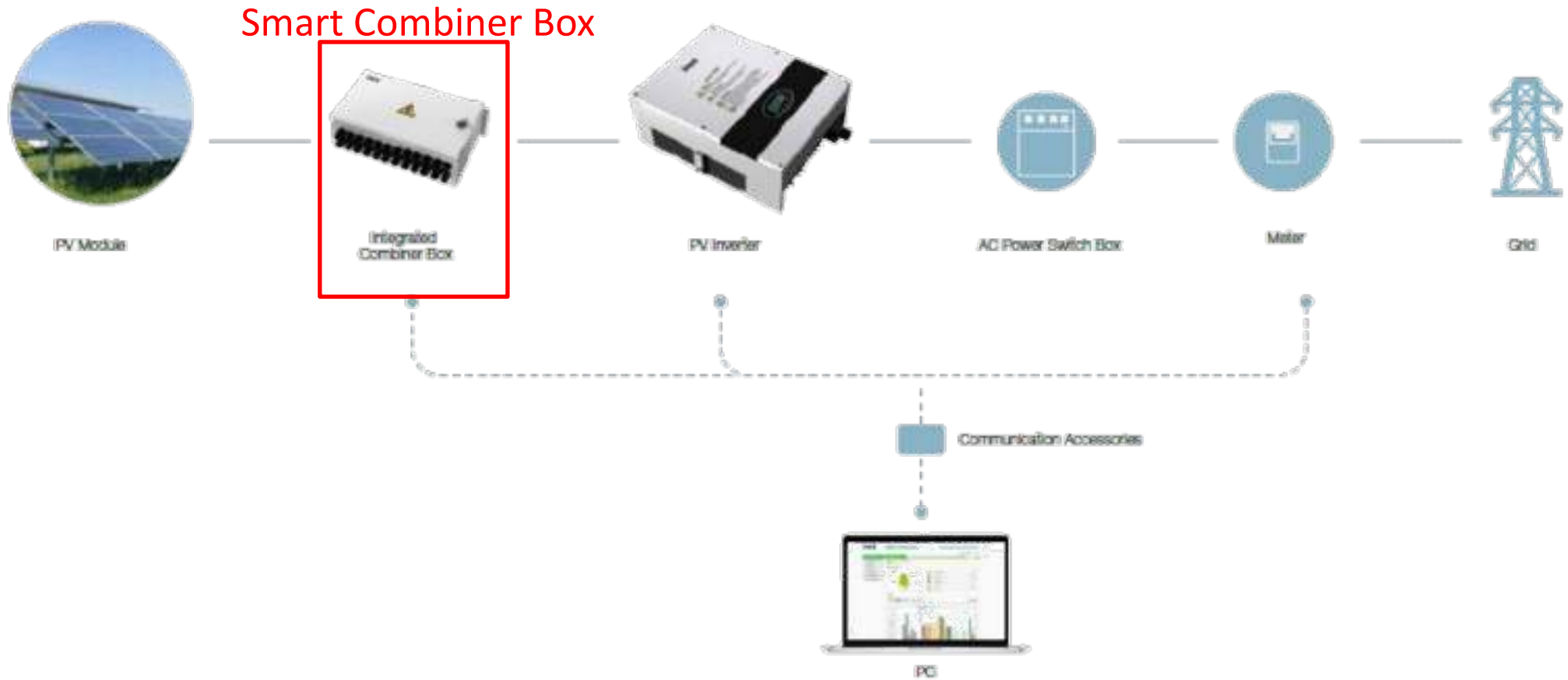
- Single Phase

Smart meter



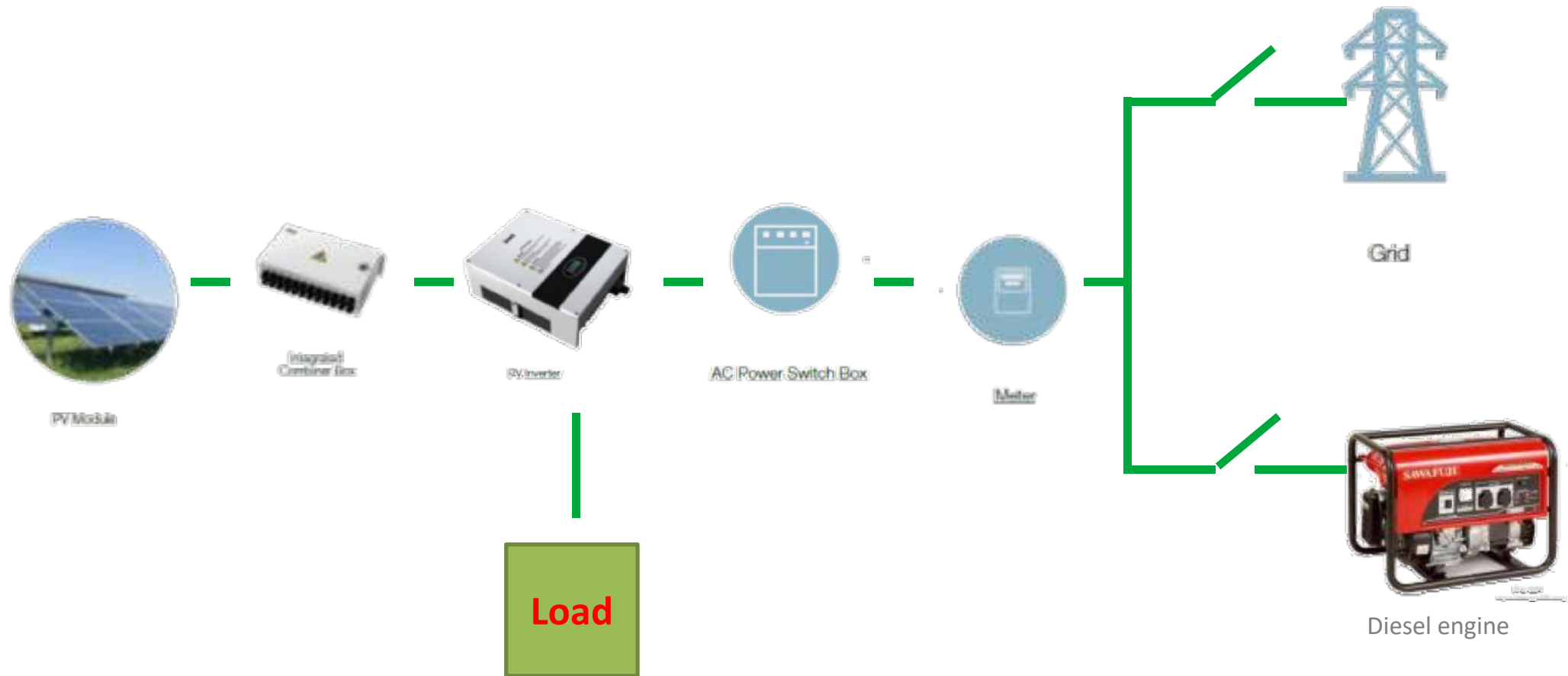
## Anti-feedback Solution

- Three Phase



## Anti-feedback Solution

- Working with Diesel engine





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## Monitoring System Solution

iMars WIFI200 / ENET200  
Communications Server



## iMars APP is Coming

Search iMars in App Store Immediately or Scan the Code to Experience  
the One-stop Service from INVT.

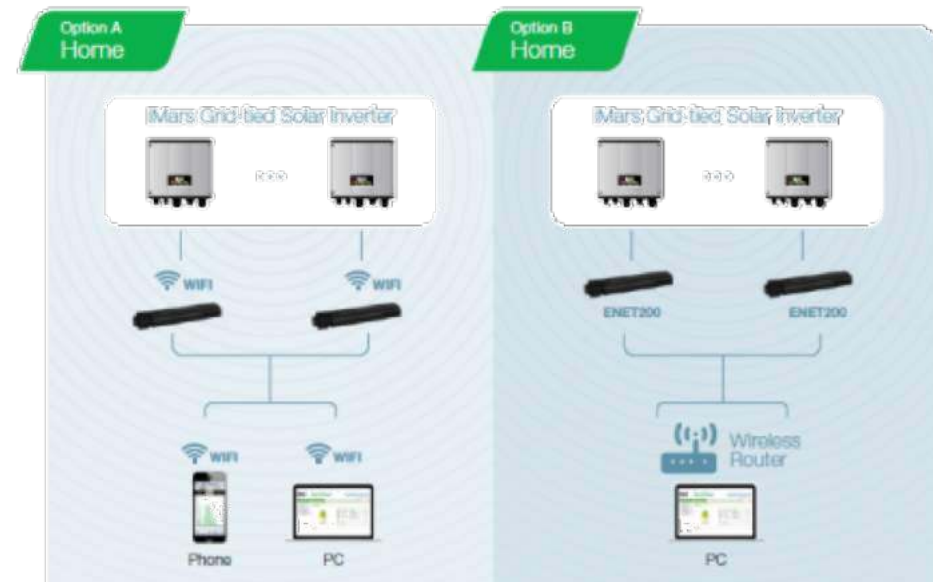
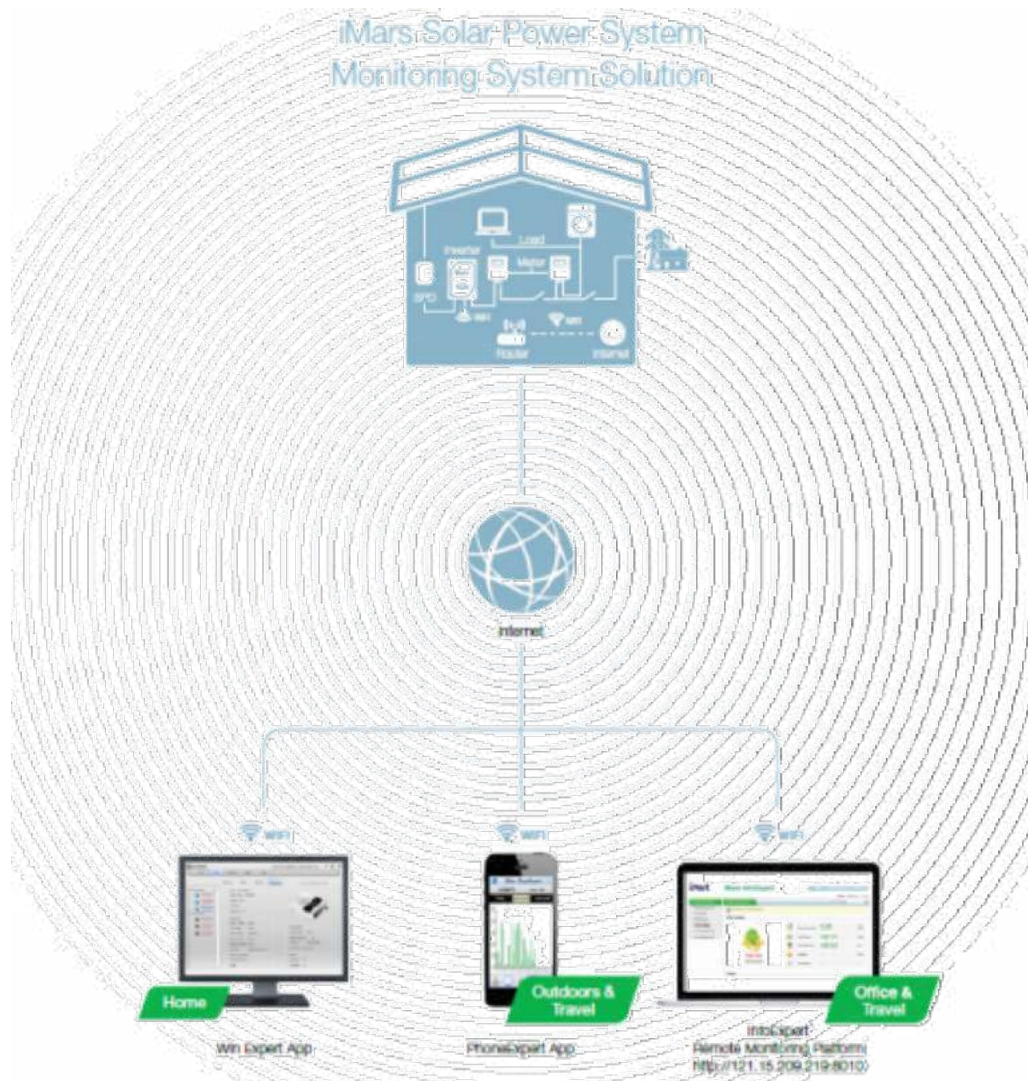


Android iMars  
PhoneExpert



iMars PhoneExpert  
for iOS

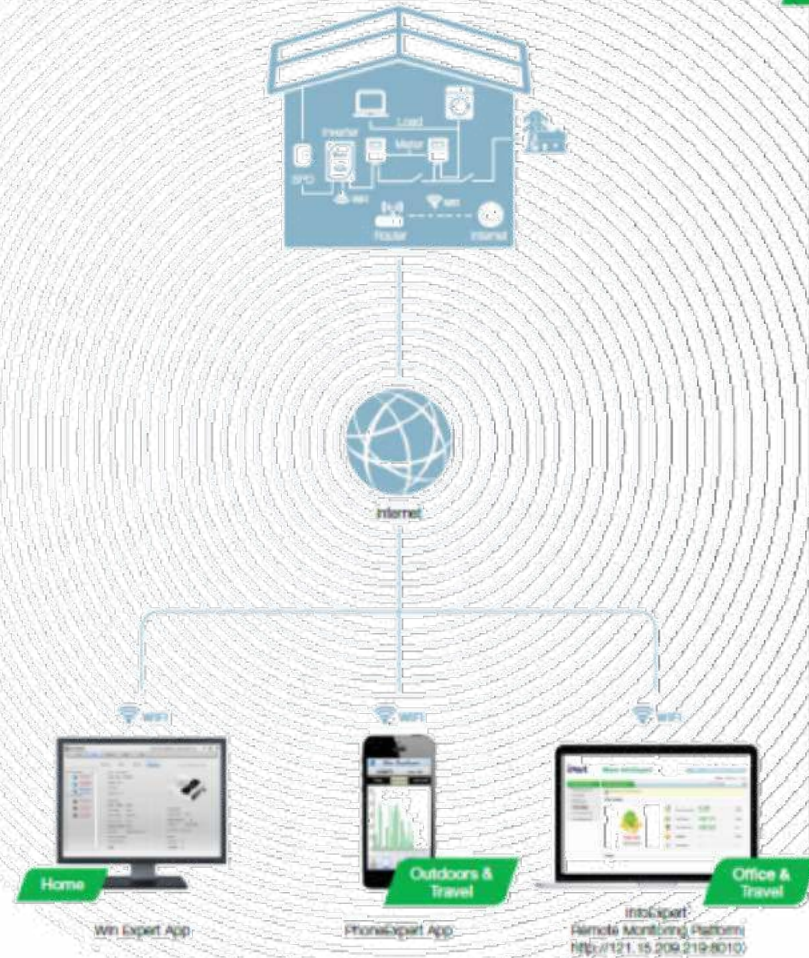
# Monitoring System Solution



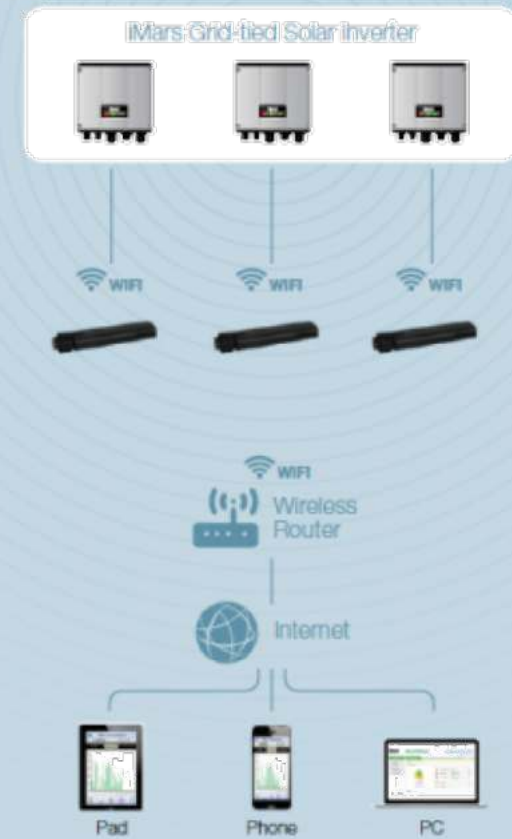


# Monitoring System Solution

## iMars Solar Power System Monitoring System Solution



## Option C Outdoors & Travel





# Content

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## Applications

**Shenzhen 5KW**



**Netherlands 30KW**



**India 60KW**



**India 30KW**



**Australia 3KW**



**Turkey 24KW**



**Brazil 15KW**



**Austria 30KW**



**Shanghai 2.2KW**



**Ukraine 10KW**



**Greece 15KW**



## Applications

### ➤ Application

**Commercial Project, Shell Petrol Station**

**System Size: 45kW**

**Country: Australia, Victory**

**Inverter Model: iMars BG15KTR x 3**

About system

There are over 2190hrs illumination each year in Australia. The system was installed on the factory rooftop with 180 pcs of 250W mono solar panels, total size is 45kW, and estimate of annual power generation is 98550 kWh



### ➤ Application

**Commercial Project, Factory Rooftop**

**System Size: 60kW**

**Country: India**

**Inverter Model: iMars BG15KTR x 4**

About system

There are over 2100hrs illumination each year in India. The system was installed on the factory rooftop with 240 pcs of 250W poly solar panels, total size is 60kW, and estimate of annual power generation is 105590 kWh.



## Applications

### ➤ Application

**Commercial Project, Office rooftop**

**System Size: 60kW**

**Country: Belgium**

**Inverter Model: iMars BG10KTR x 6**

About system

There are over 716hrs illumination each year in Belgium. The system was installed on the factory rooftop with 240 pcs of 250W mono solar panels, total size is 60kW, and estimate of annual power generation is 42960 kWh.



### ➤ Application

**Residential , Rooftop**

**System Size: 3kW**

**Country: Queensland, Australia**

**Inverter Model: iMars BG3KTL x 1**

About system

There are over 2190hrs illumination each year in Australia. The system was installed on the factory rooftop with 16 pcs of 190W mono solar panels, total size is 3kW, and estimate of annual power generation is 6658 kWh.





## Applications

### ➤ Application

**Commercial Project, Factory Rooftop**

**System Size: 135kW**

**Country: India**

**Inverter Model: iMars BG15KTR x 9**

About system

There are over 2100hrs illumination each year in India. The system was installed on the factory rooftop with 540 pcs of 250W poly solar panels, total size is 135kW, and estimate of annual power generation is 283500 kWh.



### ➤ Application

**Commercial Project, Ground**

**System Size: 10kW**

**Country: Brazil**

**Inverter Model: iMars BG10KTR x 1**

About system

There are over 1300 hrs illumination each year in Brazil. The system was installed on the factory rooftop with 40 pcs of 250W mono solar panels, total size is 10kW, and estimate of annual power generation is 13000 kWh.



# Thank You

**Thai Solar Way Co., Ltd.**