

**Applied Industrial Technology & Production  
Line Available for South-South Cooperation**

- ***The First Directory of  
China's Leading Solar Enterprises***



UNIDO Center for South-South Industrial Cooperation (China)

## Applied Industrial Technology & Production Line Available for South-South Cooperation

### ● The First Directory of China's Leading Solar Enterprises

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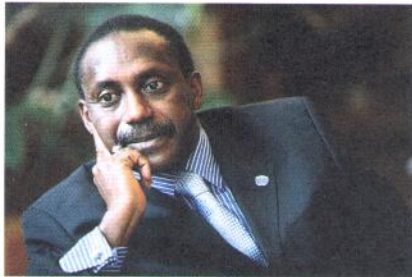
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## FOREWORD



In the global financial crisis facing the world, China and many other developing countries have been the principle engines driving the world economy to recovery and growth. In this connection, it is worth noting that trade and investment flows among developing countries have intensified greatly in recent years. Africa's trade with China has grown tenfold since 2001, for example, reaching over US\$ 100 billion in 2008. Similarly, the relative weight of developing economies as both destinations and sources of global FDI has increased sharply, with the South having absorbed almost half of FDI inflows in 2009, and

accounted for one quarter of global FDI outflows. This trend is expected to continue into the foreseeable future with developing countries leading the FDI recovery and remaining major destinations for foreign investment. The rich diversity of the South provides an excellent opportunity for foreign mutually beneficial partnerships for the common goal of economic growth, industrial development and poverty reduction.

In response to this development, UNIDO is intensifying its efforts to promote South-South cooperation in the field of industry. I am therefore pleased to present this series of brochures, "South-South Industrial Cooperation—Applied Technologies of China", a new product of UNIDO's Centre for South-South Industrial Cooperation in Beijing. These booklets introduce a selection of applied technologies available from leading Chinese companies that are willing to establish business links with partners from the developing world. These booklets will provide the readers with descriptions of technologies or products from China, and will also facilitate the flow of information and encourage the formulation and implementation of sound South-South investment and technology transfer projects. With the support and facilitation of UNIDO's global network, I expect that this will stimulate more effective business cooperation between China and other developing countries, and the Least Developed Countries in particular.

A handwritten signature in black ink, appearing to read "K. Yumkella". The signature is stylized and written in a cursive-like font.

Dr. Kandeh K. Yumkella

Director-General

United Nations Industrial Development Organization



With the acceleration of global industrialization, the excessive energy development and utilization and greenhouse gas emissions have threaten the social and economic sustainable development and the conflict became increasingly prominent among the population, resources, environment and development. Therefore, countries in the world regard the development and utilization of solar and other renewable energy sources as the very important development strategy, as well as a new mode of economic growth, a new and brand-new social civilization and values, an effective way on promotion of green

and low-carbon development and addressing climate change.

After 30 years of research and development, solar energy utilization in China has made great achievements, and its solar thermal utilization (solar water heaters, solar house, solar cookers, solar drying, solar greenhouse, solar thermal power generation, etc.) has been ranked first in the world; solar cell production has been ranked first since 2007 and accounted for more than 50% of the global production in 2010; has developed a number of advanced and mature and appropriate solar technologies and products, including various types of standardized series solar photovoltaic, solar thermal products equipment; Meanwhile, also accumulated much more experience on promotion and utilization of solar technology and products.

To make the world especially in many developing countries to share China's experience, entrusted by related organization of UN and ministries of Chinese Government, ISEC, for the first time, selected over 20 enterprises with advanced technology, good reputation and better quality among 5000 solar PV and thermal companies and introduced their products and technologies to meet the demand of developing countries. It is also a small contribution from Chinese research institutions and enterprises on promotion of South-South Cooperation. We do believe that this book will play an important role in speeding up the global economic and social sustainable development, changing the energy structure and addressing climate change.

We are sorry that there are still more outstanding enterprises are not compiled into this book for our first selection and time limit. In the end, my thanks going to those personnel, organizations, expert and staff who give us more supports.

A handwritten signature in black ink, appearing to read 'Xi Wennua'.

PROF. XI WENNUA

Director-General

UNIDO International Solar Energy Center for Technology Promotion and Transfer

## How to use the Brochure

To promote and facilitate partnerships in technology, investment and trade in the developing world, UNIDO's Center for South-South Industrial Cooperation-China (CSSIS-China) will be compiling a series of brochures on the topic "South-South Industrial Cooperation – Applied Technologies of China". These brochures will start with this brochure on environmentally friendly building materials technologies for cost effective housing. It will be followed by brochures on other "hotspot" technologies for new and renewable energy, agro-industry, consumer electronics, etc.

This brochure provides potential partners from both the public and the private sectors of the developing world an entry point from which to start up mutually beneficial industrial cooperation projects with China. Readers will find brief technical descriptions of a series of technologies with which to make environmentally friendly building material products. They will find information on the best uses, the production capacity of the technology in question, product size, product properties, the manufacturing process, land requirements, raw material and fuel requirements, manpower requirements, the main manufacturing workshops, as well as costs. The costs are not fixed price. They could be adjusted according to market fluctuations.

From our experiences in promoting South-South industrial cooperation, we have found that matching capacities and needs among developing countries is an essential step towards successful cooperation projects. Therefore, we encourage and welcome all our colleagues in the developing world to take advantage of this series of brochures as well as other tools provided by UNIDO's South-South industrial partners in other parts of the developing world.

For those readers who are interested to explore the possibility of establishing partnerships with Chinese technology providers, please do not hesitate to contact us. We have placed at the back of the brochure a set of forms for you to fill out and send to us, so that we can gather basic information of your current situation, your needs, your financial status, and your proposal to materialize the partnership. Please send the completed forms to:

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We look forward to working with you!

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# Anyang Phoenix Photovoltaic Technology Co., Ltd.

- Main Business** Solar polycrystalline ingot, monocrystalline silicon bar, silicon wafer, cell grid connect system; research, made and sales of inverter and wind power; recycling of renewable energy; import and export business of goods and technology.
- Introduction** Located in the industry gathering district, Hua County, Phoenix Photovoltaic Technology Co., Ltd is founded in April 2009 with a 190million Yuan registered capital. In 2010, its sales revenue reached 10billion Yuan; with 20million US export revenue in it.
- The company was awarded the "vice president" title by National Federation of Chamber of Commerce in September 2009, listed in the first one hundred company of Henan Province in 2011. Among the many photovoltaic companies, Phoenix implemented a special strategy to created high polysilicon products from the followed three aspects: introducing advanced equipment of the world, bringing in advanced technology of Taiwan, attracting talents in Phoenix.
- Now there are 1,500 staffs in the company, when the company becomes full production, the staff will reach to 4,000. Phoenix will headed in the photovoltaic industry in Anyang City with the supporting equipments such as cell line, solar cells grid connect system, Aluminum frame, waste mortar recycling system, professional silicon materials recycling facility and so on.
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Add: New District, Hua Country, Anyang City, Henan Province, P. R. China
- Main Product** Solar polysilicon wafer
- Inventions Patent** Method on producing mono-like silicon ingot by coating
- Technology** Coasting monocrystalline silicon



**Product** Solar polysilicon wafer

**Type & Specification** 156 series

#### Brief Introduction

For Solar cell manufacturing

#### Performance Indicator

Conductivity Type: P

Resistivity:  $0.8-3\Omega\cdot\text{cm}$

Product Dimensions:  $156\text{mm}\times 156\text{mm}$

Minority carrier lifetime:  $\geq 1\mu\text{s}$

Carbon content:  $\leq 0.5\times 10^{17}\text{atoms}/\text{cm}^3$

Oxygen content:  $\leq 0.9\times 10^{18}\text{atoms}/\text{cm}^3$

Thickness:  $200\pm 20\mu\text{m}$

Verticality:  $90\pm 0.3^\circ$

Total thickness variation:  $\leq 30\mu\text{m}$

Warpage:  $\leq 50\mu\text{m}$

Chamfer angle:  $45^\circ\pm 10^\circ$

Chamfer dimensions:  $1.5\pm 0.5\text{mm}$

Chipping: length  $\leq 0.5\text{mm}$  depth  $\leq 0.5\text{mm}$   
not more than two

#### Features & Advantage

Low energy consumption, low attenuation, low cost, and high photoelectric conversion efficiency.

**Technology** Coasting monocrystalline silicon

#### Brief Introduction

Because polysilicon cell has the composition of grain boundary, texturing by acid cannot achieve the effect by alkali. In general, compared with mono-like wafer, the polysilicon cell conversion is lower by 1-2%. DSS furnaces can produce mono-like ingots which are by using monocrystalline silicon casting method. In the premise of not increasing the cost clearly, the method can improve the efficiency by more than 1%. Products produced by this method not only have higher efficiency but also low cost, low attenuation. Without the change of silicon material, wafer and grid connection, this casting method can be increased by 10%.

**Practicality** Special Training

#### Features & Advantage

In the premise of not increase the cost clearly, it can improve the efficiency by more than 1%. Products produced by this method not only have higher efficiency but also low cost, low attenuation. Without the change of silicon material, wafer and grid connection, this casting method can increase solar cost by 10%.

#### Inventions Patent

method on producing mono-like silicon ingot by coating

**Patent No.** 201110160798.2

#### Patentee

Anyang Phoenix photovoltaic technology Co., Ltd

#### Brief Introduction

This patent present a polysilicon casting method which is mono-like produce monocrystalline, it involves seed production. The crystal direction is  $\langle 100 \rangle$ , resistivity  $\geq 0.1\Omega\cdot\text{cm}$ , the positive has no limited. Its process are as followed:

< The cylinder monocrystalline's diameter is between 130-250mm.

< The cross-section depth is between 50-350mm.

< Cut into brick by square machine.

< Polishing by mill machine.

< Cutting into 5-50mm brick by cutting machine.

< Polishing the brick by chemical method or mechanical method, removal the surface damage; cleaning ,packing, be-using.

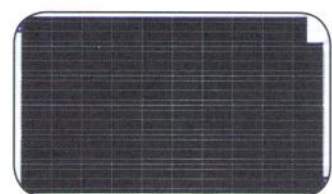
The advantage of this method is that this method can increased the defect caused by seed, and then it can improve the quality of the ingot. The experience has shown that the cell conversion efficiency can be increased by 0.1 percent.



Polysilicon wafer



Quasi-single crystal  
silicon C



Quasi-crystal component C



## Beijing Enpower Solar Energy Industry Co., Ltd.

### Main Business

Manufacture solar vacuum tube, solar collector, solar water heater and accessories, market the own products

### Introduction

Beijing Enpower Solar Energy Industry Co., Ltd is a high-tech company which is engaged in solar collector and other solar product development, production, distribution and installation. The company advocates "talent, innovation, development" as the fundamental of the enterprise development, and is the one of fewer manufacturer in domestic which owns the production capacity and scale from the glass rough tube to solar products series. The company has the annual production capacity of 10 million glass vacuum heating tubes and 0.5 million solar water heaters, with the annual production value reaches to RMB0.2 billion.

The production, installation, service of the all-glass evacuated tube solar water heater and heating project products totally passed international quality certification (ISO9001:2000), the solar products passed national 3C certification, golden sun certification, green environment mark certification, health resident certification, etc. And the company won the honor of "user satisfaction products", "China excellent quality assured brand", "China famous product", "Spark Program Famous Product", China Famous Brand.

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### Main Products

Split Balcony Solar Water Heater Which Combined with the Building  
Close-coupled solar water heater

### Technology

A solar thermal project system with modular design, which can achieve rapid installation.



**Product**

Split Balcony Solar Water Heater Which Combined with the Building

Close-coupled solar water heater

**Type & Specification**

YHYZ-80J-U581812      YHYZ-80J-P1.72  
 YHYZ-100J-U581812      YHYZ-100J-P1.72

HM581814-48-75      HM581816-48-80  
 HM581818-48-80      HM581820-48-80  
 HM581824-48-80      HM581830-48-80

**Brife Introduction**

The solar collector could be installed in outer wall of the high-rise building, storage water tank could be handed in the load-bearing wall of the indoor balcony, solar collector and water tank design in separately, the inner liner of the water tank adopts enamel material which is pressurized, with the built-in electric auxiliary heater, and the outer temperature-controlled automatic controller device, realize the double function of the solar and electric heating, suitable for the integration of the solar products and the building.

The solar water heater could be installed on building which is lower than 12 floors. HM Series solar water heaters are Close-coupled solar water systems of all-glass evacuated tubular collector with water-in-glass manifold, which are ideal for use in small units, houses and other applications where cheap, reliable hot water supply is required. HM series solar water heaters can be used together with the auxiliary electric boost, auto controller. It s integrated electric heat and solar heat functions together, and suitable for solar water heater and residential building integral installation.

**Performance Indicator**

< Typical daily efficiency  $\geq 45\%$   
 < Solar heat gain  $\geq 8.7\text{MJ}/\text{M}^2$   
 < Heat loss coefficient  $\leq 11\text{W}/(\text{M}^3\cdot\text{K})$

< Typical daily efficiency  $\geq 45\%$   
 < Solar heat gain  $\geq 8.7\text{MJ}/\text{M}^2$   
 < Heat loss coefficient  $\leq 10\text{W}/(\text{M}^3\cdot\text{K})$   
 < Evacuated tube: Absorptivity  $\geq 92\%$   
 Emissivity  $\leq 0.06$   
 Vacuum degree  $\leq 5\times 10^{-3}\text{Pa}$

**Features & Advantage**



The split-design of solar collector and water tank is especially suitable for high-rise buildings. The solar collector can be

hanged on fa ade.

The inner liner of the water tank adopts enamel material, system can operate with pressure ( $\leq 0.6\text{MPa}$ ), the lifecycle of the water tank is more than 15 years.

The collector is provided with secondary heat-exchanging design, which is improved in heat transfer area, heat transfer efficiency, and antifreeze performance, resulting in excellent performance under very low temperature.

Close-coupled solar water systems of all-glass evacuated tubular collector with water-in-glass manifold, which could improve the heat efficiency, and don't take any indoor place. It's ideal to use for 12 floors buildings.

The storage tank use SUS304 2B stainless steel for inner tank material, non-pressure operation ( $\leq 0.05\text{MPa}$ ), storage tank life is more than 15 years. The high efficiency and anti-freezing evacuated tubes could normally used at minus 18 centigrade.



**Environmental Friendly**

Split balcony solar water heaters adopt free-fluorine foaming technology in production, which result in superior solar collecting performance, and realizing the double-function of the solar and electric heating. It is easy to operate, has long operation life, with zero pollution emission, which is belong to the energy-saving and environmental protection product.

The evacuated solar water heater produced by CFC free foaming technology. Superior performance for solar collecting. It have realized both use of solar and electric, and controlled by automatic intelligent controller, which is easy and simple handled. Its zero emission and long service life character decide it belong to energy conservation product.

# Beijing Siji Micoe Solar Energy Technology Group Co., Ltd.

## Main Business

Heat pump technology research, solar technology research, technology transfer & training; Selling electric heaters and accessories, solar water heaters and accessories, machinery and equipment, building materials, metal materials; solar installation, import & export.

## Introduction

Beijing Siji Micoe Solar Energy Technology Group Co., Ltd. is the leader of solar thermal industry in China. It has firstly passed the ISO9001, ISO14001, CCC certificate, and also the first one which has been awarded the many honors such as "Golden Solar certificate", Top China Brand, the LandMark Brand of China Solar energy industry, etc. Micoe implements the "Big Dipper industrial strategy", owning the production bases in Beijing, Shandong, Jiangsu, Henan, Liaoning. Undertaking several national "863" projects, with more than 20 intellectual property rights, Micoe is the High- tech enterprises of Beijing.

Micoe specialized in the R&D, manufacturing and applying of solar thermal products. By maintaining the "Brand Development" to build the world Brand with its quality and service, Micoe Committed to building the most respected brands in solar industry.

As the only "Partner of China Space" in Solar industry, in 2010, Micoe won the bidding and constructed several solar hot water projects of Shanghai World Expo, such as the Information and Communication Center and the American Museum, won the recognition on the world stage.

Micoe Adheres to the concept of technological innovation, develops and promotes the green solar energy products, the renewable energy worldwide, and calls for consumers to choose low-carbon life style, to restore the world with a green color.

## Contact us

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## Products

Solar water heater      Balcony Solar water heater

## Utility Patents

- < Vacuum Tube Pressurized solar water heating system
- < A new model solar collector
- < A remote controlled solar water heater controller

## Technologies

- < Selective absorptive layer and its produced method
- < Split solar water heat system



**Products**

Apsaras solar water heater

Balcony Solar water heater

**Type & Specification**

Φ58\*1800mm Φ58\*1920mm Φ58\*2100mm Φ58\*1600mm  
16, 18, 20, 24, 30, 36 Tubes (106-385L) Capacity

**Brife Introduction**



< Using the intelligent automation, one-button, automatic operation. With the automatic water feeding and heating as well as multiple protection, there is no need for the manual operation. Convenient, and simple. Intelligent life needs only one step.

< This type applied the technology of space tube and Space Insulation Cabin. The space tube achieved a wide wave absorption for a higher solar collecting ability. The Space Insulation Cabin using the aerospace insulation material, as putting a layer of thermal underwear to the water tank to keep the heat from losing. The aerospace double heat technology achieved the double break of heat collection and heat protection, thereby hot water is more abundant.

< By applying the N-ODP technology, and green CFC-free foaming technology, which not only protect the safety of human being, but also no destruction to the Ozone layer, completely say good bye to the Freon which is the normally used item in this field.

< Solar energy is the main energy, energy-saving and environment-friendly, no pollution, safety, low operating cost, one time investment, long-term gains.

< FPC applied the space coating technology, Nano high efficient coating layer, Copper and aluminium core composite absorber plate, the absorption rate reached as higher as 95%. Higher heat collection, more hot water. Using the ultra-white wove glass for the cover, with high transmittance, good heat insulation performance, shock compression, strong and durable. It designed for high pressure. The porcelain inner tank with high closure, strong pressure water to meet the massaging bath and improve bath comfort.

< It designed for high pressure. The porcelain inner tank with high closure, strong pressure water to meet the massaging bath and improve bath comfort.

< Equipped with the intelligent control system, designed for low cost, automatically control and feeding water as well as the shift between electric and solar, 24 hours hot water supplying.

< The water tank and collector are separated, a complete breakdown of the traditional installation limitations, and can be flexibly installed in the bay window, or balcony, without location restrictions, and to achieve the perfect combination with the construction.

**Performance Indicator**

The temperature of the tank when it stop heat collecting is 53°C, 8°C higher than national standard; daily heat gain is 7.8MJ/m<sup>2</sup>, 0.8MJ/m<sup>2</sup> higher than national standard; the average heat loss of the Domestic solar hot water system is 16W/(m<sup>3</sup> • k), 6W/(m<sup>3</sup> • k) lower than national standard.

**Features & Advantage**

Variety of products to meet domestic, commercial, industrial use, easy to install and use.

## Utility Patent

### Vacuum Tube Pressurized Solar Water Heating System

[ZL200720044539.2](#)

## Brief Introduction

The vacuum tube solar water heating system including the water tank and vacuum tube; In the water tank there is electric heater, air vent, and reserved connector. There is also a pressurized inner tank in the water tank for heat transfer, with one end connected to the cold water inlet where there are safety valve and a valve which is normally open; the other end connected to the hot water outlet, which was parallel connected with the tap water pipe to the thermostat valve with its outlet connected to the daily use water pipe. Above the water tank, there is a equipment to feeding water automatically. The water in the water tank is used for heat exchange, which solved the problem of water scale in the tube and affecting the heat efficiency. The daily use water come into the pressurized inner tank from the cold water inlet, and come out off the tank from the hot water outlet, which ensures the sanitary water and high pressure as well as the comfortable water using, therefore raising the freeze resistance of the solar water heater. The thermostat valve ensures a constant water temperature, which is safe and convenient.

### A New Model Solar Collector

[ZL200720041720.8](#)

There are solar collect tube, inner fluid pipe and water pipe,. The inner pipe tube was inserted into the vacuum tube making sure the center is the same with that of the tube, with a water outlet in the bottom of the inner fluid pipe. For the water pipe, there are inner pipe and outer pipe. One end of the inner pipe is used for the cold water inlet, the other end was sealed. One end of the outer pipe is sealed together with the inner pipe, and the other end used for the hot water outlet. Thus, there is a hot water runner between the inner pipe and outer pipe. The upper side of the solar collector is connected with the outer pipe by the tube inserting and adaptor tube, then connected with the hot water runner; the upper side of the inner fluid pipe is connected with the inner pipe. When the cold water is heated in the runner between the inner fluid pipe and the vacuum tube, the hot water will go up and come out from the outlet of the outer pipe. The vacuum tube is with long life span, high collecting efficiency, safe and reliable for using.

### A Remote Controlled Solar Water Heater Controller

[ZL201120003117.7](#)

In the remote controlled solar water heater controller, there is a shell with a integrated control circuit in it and a display and output terminals which are connected to the integrated control circuit. The integrated control circuit is also connected to a SMS module. In this new model, the SMS module can be equipped with SIM card to send all the information to the mobile phone. Thereby, to realize the remote control by SMS of the mobile phone, with the main functions of manual feeding water, turn on the electric heater, control the system temperature, and the water level, ect. With the reasonable design, and simple structure, people can use it very conveniently by remote controlling the solar water heater controller, to meet the diversified life.



**Technology** Selective absorptive layer and its produced methods

Split solar water heat system

### Brief Introduction

Solar selective absorbing layer with low temperature, coated with basic layer composed of  $0.02-0.06 \times 10^{-6} \text{m}$  Al or Cu, on which is infrared aperture area  $0.03 \times 10^{-6} \text{m}-0.15 \times 10^{-6} \text{m}$  Ge-C, and on this layer is Al-N made composite absorbing layer. The new type solar selective absorbing layer applies targets magnetron sputtering technique to increase infrared light aperture area. This layer is able to well absorb sunlights of  $0.3 \sim 2.5 \mu\text{m}$  length, moreover, its basic layer enjoys higher absorptance, letting go infrared lights under  $8 \mu\text{m}$ , but reflecting those above  $8 \mu\text{m}$ , that is to say, when inner tube temperature reaches to  $90^{\circ}\text{C}-100^{\circ}\text{C}$ , the emissivity rises fast to increase heat loss to prevent the system from overheating.

The split solar heat collecting system consists of solar collector, water storage tank and pump station. The pump station is powered with photovoltaic electric panels and equipped on the pipes connected between solar collector and water storage tank. Solar collectors and electric panels lay in parallel, facing to sun. The photovoltaic electric panels directly drive the pump, no need of controller or valve, when sunlights weaken, water inside solar collectors are in low temperature, the electricity from panels stops. When sunlights are strong, temperature inside solar collectors is high, then electric panels yield high electricity, thus the pump rotates faster. No sunlights, no electricity and no rotation of the pump. Therefore, those photovoltaic electric panels and the heat collection system work synchronically, which is effective, reliable and no need of maintenance.

**Practicality** Simple Training

### Features & Advantage

Wisely getting heat with techniques

- < Spaceflight vacuum tube applies spaceflight coating technique, whose unique purple layer absorbs more short lights and collects heat faster.
- < Intelligent control center is automatic and high intelligent. Hot water comes out with only one click.
- < The water tank in polyhedron could preserve energy and inventively integrates heat collection, heat lock and heat preservation.
- < Spaceflight heat in volume is yielded by the water tank in polyhedron, which is able to reduce heat emission area and to break even heat emission so as to reduce heat loss, meanwhile, to enhance heat preservation.
- < Spaceflight heat insulation cabin applies spaceflight heat insulation principle. Inner and outer tank uses ACRI insulation to effectively prevent heat emission.
- < Spaceflight heat lock ends are the tank glands, which applies reinforced thermosetting plastics. It achieves double heat locks so as to strengthen the heat preservation.
- < Spaceflight heat preserving layer uses 360 degrees automatic foaming, which is more abundant and even. The layer inventively uses the thickest layer-70mm to preserve heat so that the heat preserving function gets greatly improved.



## Beijing Tianpu Solar Energy Industry Co., Ltd.

**Main Business** Manufacture solar water heater and the accessories, market the own products.

**Introduction** Beijing Tianpu solar energy group is a large group company which is mainly based on solar water heater production and also extends to the peripheral industries. The group totally passed international quality certification (ISO9000, ISO14000), environment and occupation health safety management system certification (OHSAS18000). It has taken the State 863 Plan, the Construction Project of Beijing 2008 Olympic Games. More than 40 national patents were awarded. It has also passed the certification of golden sun CGC, 3C certification, environment marked certification (ten central authentication) and health resident certification. And it has won the honor of China famous brand, Beijing famous brand, etc. Tianpu devotes herself to be the best developer, manufacturer and service provider in the renewable energy industry.

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**Main Products**

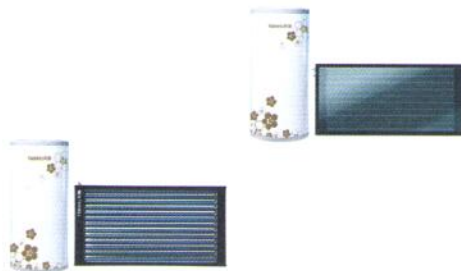
- < Balcony Wall Type Solar Water Heater
- < Split Pressurized Solar Water Heater
- < Close-coupled solar water heater
- < All-glass Vacuum Tube Collector
- < Pressurized solar collector

**Patent** Solar Water Heater insulation tank assembly inlet and outlet

**Technology** A solar thermal project system with modular design,  
which can achieve rapid installation



<b>Product</b>	Balcony Wall Type Solar Water Heater	Split Pressurized Solar Water Heater
<b>Type &amp; Specification</b>	Q-J-F-2-95/1.4/0.7	TPF-200H、TPF-300H
<b>Brife Introduction</b>	<p>The solar collector could be installed in outer wall of the high-rise building. Storage water tank could be handed in the load-bearing wall of the indoor balcony. Solar collector and water tank design in separately. The inner liner of the water tank adopts enamel material which is pressurized, with the built-in electric auxiliary heater, and the outer temperature-controlled automatic controller device, realize the double function of the solar and electric heating. This type is suitable for the integration of the solar products and the building.</p>	<p>Application of solar for collecting and providing heats; widely used in hotels, restaurants, schools, hospitals, residences and some high-rise buildings and villas for hot water supplying.</p>
<b>Performance Indicator</b>	<p>Typical daily efficiency: <math>\geq 40\%</math>  Solar heat gain: <math>\geq 7.8\text{MJ}/\text{M}^2</math>  Heat loss coefficient: <math>\leq 11\text{W}/(\text{M}^3 \cdot \text{K})</math></p>	<p>Typical daily efficiency: <math>\geq 40\%</math>  Solar heat gain: <math>\geq 7.8\text{MJ}/\text{M}^2</math>  Heat loss coefficient: <math>\leq 11\text{W}/(\text{M}^3 \cdot \text{K})</math></p>
<b>Features &amp; Advantage</b>	<ul style="list-style-type: none"> <li>&lt; Solar collector and water tank are designed in separately, the solar collector could be installed in outer wall of the building, suitable for high-rise building.</li> <li>&lt; The inner liner of the water tank adopts enamel material, system can be operated under pressure (<math>\leq 0.6\text{MPa}</math>), the operating life of the water tank is more than 15 years. Collector adopts the second heat exchanger design, has large heat transfer area, and has high heat transfer efficiency, and good antifreeze performance, could be used under very low temperature.</li> </ul>	<ul style="list-style-type: none"> <li>&lt; High heat collection efficiency—with the help of U-pipe vacuum tube collector or flat plate collector, it has high heat absorption efficiency.</li> <li>&lt; Antifreeze and antiscaling—the heat transfer medium is antifreeze and can not get dirt.</li> <li>&lt; Powerful hot water—the water tank is under pressure structure, yielding powerful water, can realize surfing shower. Now it is the home hot water center.</li> <li>&lt; Security—double-loop designing, under pressure operating.</li> <li>&lt; Advanced technology—the principle, design, process, components of the system adopted are all at the international advanced level.</li> <li>&lt; Intelligent control—the system is automatic operation.</li> <li>&lt; It is easy to integrate with the building.</li> </ul>





**Product** Close-coupled solar water heater

All-glass Vacuum Tube Collector

**Type & Specification**  
Q-B-J-1-195/3.2/0.05  
Q-B-J-1-130/2.1/0.05  
Q-B-J-1-245/3.5/0.05

Z-QB/0.06-WF-1.20/12-58  
Z-QB/0.06-WF-4.29/60-47

**Brife Introduction** The solar water heater could be installed in buildings which is lower than 12 floors. The water tank is close-coupled with the vacuum tube, and is in natural circulation way. The inner liner of the water tank adopts stainless steel plate material. HM series solar water heaters can be used together with the auxiliary electric boost, auto controller. It s integrated electric heat and solar heat functions together, and suitable for solar water heater and residential building integral installation.

Collecting and supplying heat; and it is widely used in hotels, restaurants, schools, hospitals, residences, factories and mines, offices and bath centers, swimming pools, and some middle and large units for hot water and warm supplying.



**Performance Indicator**  
Typical daily efficiency:  $\geq 45\%$   
Solar heat gain:  $\geq 8.7\text{MJ}/\text{M}^2$   
Heat loss coefficient:  $\leq 12\text{W}/(\text{M}^3 \cdot \text{K})$   
Vacuum tube: absorptivity  $\geq 92\%$ , emissivity  $\leq 0.06$ , vacuum  $\leq 5 \times 10^{-3}\text{Pa}$

Max. Pressure (MPa): test pressure is 0.05MPa, the system is no leaking;  
Heat performance instantaneous efficiency intercept  $\eta_0$ ,  $a=0.74$ ; total heat loss coefficient  $U=3.0\text{W}/(\text{m}^2 \cdot \text{K})$ ;  
The collector is in accordance with the performance requirement of GB/T17581-2007 of vacuum tube solar collector.  
The operating life is more than 10 years.




**Features & Advantage**

- < Close-coupled solar water systems of all-glass evacuated tubular collector with water-in-glass manifold, which could improve the heat efficiency, and don't take any indoor place. It s ideal to use for 12 floors buildings.
- < The storage tank use SUS304 2B stainless steel for inner tank material, non-pressure operation ( $\leq 0.05\text{MPa}$ ) storage tank life is more than 15 years.
- < The high efficiency, and anti-freezing evacuated tubes could normally used at minus  $18^\circ\text{C}$  temperature.
- < Highly cost effective.

- < Can be installed in a plurality series, or parallel, easy to disassemble and assemble, to achieve the optimal allocation, can meet the needs of different customers.
- < Environmental protection and energy saving;
- < The inner liner of the collector adopts SUS304-2B food grade stainless steel material; the soldering adopts inert gases protecting technology, has strong sealability and corrosion resistance;
- < The insulation material is Polyurethane, has high efficient insulation.



<b>Product</b>	Pressurized solar collector	
<b>Type &amp; Specification</b>	Z-BJ/0.6-WF-1.20/12-58 P-G/0.6-T/HG-1.84	
<b>Brife Introduction</b>	Pressurized collecting and supplying heat; and it is widely used in hotels, restaurants, schools, hospitals, residences, factories and mines, offices and bath centers, swimming pools, and some middle and large units for hot water and warm supplying.	
<b>Performance Indicator</b>	Max. Pressure (MPa): test pressure is 0.9MPa, the system is no leaking; Heat performance instantaneous efficiency intercept $\eta_{0,a}=0.73$ ; total heat loss coefficient $U=2.5W/(m^2\cdot K)$ The operating life is more than 15 years.	
<b>Features &amp; Advantage</b>	<ul style="list-style-type: none"> <li>&lt; Can be installed in a plurality series, or parallel, to achieve the optimal allocation, can meet the needs of different customers;</li> <li>&lt; Easy to disassemble and assemble;</li> <li>&lt; Environmental protection and energy saving;</li> <li>&lt; The hot water system is under pressure operating;</li> <li>&lt; The insulation material is glass wool, can stand high temperature, has high efficient insulation.</li> </ul>	

### Utility Patent

Solar Water Heater insulation tank assembly inlet and outlet

#### Patent No.

200720309490.9

#### Brief Introduction

This functional new type is related to solar water heater insulation tank assembly inlet and outlet, this assembly inlet and outlet is a unit of pipe assembly, the center pipe is vent-pipe, beside the vent-pipe are an overflow pipe and a water pipe. This functional new type insulation tank assembly inlet and outlet combines the function of exhaust, overflow and water supply together. This design could less the opening quantity of the insulation tank, leads to less the radiating area of the insulation tank and improve the insulation performance. This functional new type is in Ingenious conception, reasonable design, simple structure, convenient installation, so in order to provide a good protection of improving the system's working efficiency.

### Technology

A solar thermal project system with modular design, which can achieve rapid installation

#### Brief Introduction

< The system is composed of horizontal type storage water tank, water tank bracket, solar collectors, collector bracket, pipe lines and accessories, electronic heating, full-automatic controllers, etc.

< The horizontal storage water tank is made of stainless steel and sealed by welding. The capacity was designed ranging from 500L to 1000L. The pipes are installed on the side and the bottom of the tank. < The insulation efficiency of this type of tanks are 1.5 times of vertical ones.

< Water tank bracket and collector bracket are made of aluminum alloy for fastening.

< There are several types of evacuated tube collectors available:  $\Phi 47 \times 1500$ 、 $\Phi 47 \times 1600$ 、 $\Phi 58 \times 1500$  and  $\Phi 58 \times 1600$ . There are two inlet/outlet on both top and bottom of the ends of manifold for the connection with pipe lines. Electronic heating is installed inside water tank on the bottom as back-up heat when solar radiation is not sufficient. A full-automatic intelligent controller is installed for controlling water level, electronic heating, antifreezing function, water circulation, etc. It can operate automatically under the customers' settings and show water level and water temperature inside water tank.

**Practicality**      Simple Training

## CEEG (Nanjing) Solar Energy Research Institute Co., Ltd.

### Main Business

The PV power generation system based, covering solar thermal, wind power, hydroelectric power, ground source heat pumps, biomass, tidal energy, including new energy-related products and system development, design, consulting, construction and other services to provide customers with nine new energy system solutions.

### Introduction

CEEG Solar Energy Research Institute (CEEG S.I.) is a comprehensive new energy system solution provider founded by CEEG group, It aims to promote solar power and other new energy power generation technologies worldwide during the global energy revolution.

CEEG SI has Primary laboratories for solar energy application technology, wind energy technology and system integration. CEEG S.I. also has a research team with abundant technical strength and rich work experience lead by Zhizhang Liu who is the chief scientist in new energy application ,and Doctor Jianhua Zhao who owns the world record (25%) in laboratory PV conversion efficiency. CEEG S.I. provides a complete set of system solutions of 9 new energy application areas, and provides the service about system research, design, consultation and construction which mainly focuses on photovoltaic system and also contains new energy relevant products (incl. photo-thermal, wind power generation, water conservancy, group source heat pumps, biomass energy and tidal energy). CEEG S.I. is international training center for solar application in developing countries assigned by ministry of science & technology, institute for the control and PV Technology in Jiangsu province, workstation for post-doctor in Jiangsu province. CEEG S.I. has completed numerous PV projects one after another in recent years such as 10.67MWP on-grid PV system project in Nanjing South Railway Station, the largest single BIVP project in the world, off-grid photovoltaic and photo-thermal integration projects in the UN Hall of the World Expo, etc, and undertaken numerous research projects including the national hi-tech development 863 program of China.

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### Products

- < Solar home systems
- < Photovoltaic pumping systems
- < Controller for street light    Inverter for off-grid system    Inverter for on-grid system
- Inverter for solar plant
- < Solar Emergency Power
- < Solar lighting products

**Product** A solar-grade virgin polysilicon

**Type & Specification**

Solar home systems, including:

1. Stand-alone PV system specifications:

CEEGSI-12HS-40SO	CEEGSI-12HS-100SO	CEEGSI-12HS-200SO
CEEGSI-12HS-300SO	CEEGSI-12HS-600SO	CEEGSI-12HS-1000SO
CEEGSI-12HS-2000SO		

2. Wind and solar system specifications:

CEEGSI-HS24-600WSO	CEEGSI-HS24-1000WSO
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**Brife Introduction**

Stand-alone PV system consists of solar modules, control unit and battery against the build one of three main components, solar modules generate electricity access to the controller input, through the controller to charge the battery, and control the charge current to ensure that the battery will not overcharge; battery power through the inverter into AC 220V/50Hz, AC load for use in battery voltage while the controller to automatically shut down to prevent battery damage due to excessive discharge.

Stand-alone PV system consists of solar modules, control unit and battery against the build one of three main components, solar modules generate electricity access to the controller input, through the controller to charge the battery, and control the charge current to ensure that the battery will not overcharge; battery power through the inverter into AC 220V/50Hz, AC load for use in battery voltage while the controller to automatically shut down to prevent battery damage due to excessive discharge.

Household wind and solar systems is the use of solar modules and wind generators, and then issued by the energy stored in batteries, when the user needs electricity, the inverter DC power stored in the battery into AC for users. Night and rainy day when the sun can be no wind, sunny mainly by solar power, wind in both cases have the sun play a role in both, the power to achieve all-weather capabilities.

User power supply products for mountainous island, pastoralists, border posts and other areas without power or less power and place.

According to customer demand information and local groundwater conditions to determine the system configuration, to determine the price.



**Performance Indicator**

Different requirements and different performance are with different system configurations.

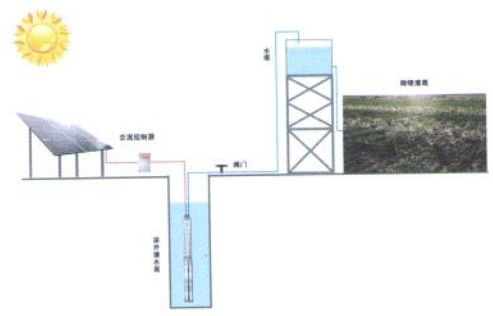
**Features & Advantage**

The Power of the product (including inverters, battery charge controller, battery) is as a whole, integrated in a metal cabinets, with is simple structure, easy to transport.

<b>Product</b>	Controller for street light		Inverter for off-grid system
<b>Type &amp; Specification</b>	SLC-12/24-10A, 10B, 10		SI-SA1K-VA24, VA48 SI-SA1.5K-VA24, VA48 SI-SA2K-VA24, VA48
<b>Brife Introduction</b>	Apply to solar street light, adjust the charge and discharge procedure of the battery. Appli-cance: solar street light, solar garden light and solar lawn light.		Convert DC power to AC power, apply to plateau, island,remote area and other district without enough power supply. Appliance: telecommunication station, advertisement lamp,street light.etc.
<b>Performance Indicator</b>	Over-load protection: 15min. for 1.25 multiply of rated current. 5min. for 5 multiply of rated current.		 Efficiency: 86%, 90%, 86%, 88%, 86%, 87% for 6 different type.
<b>Features &amp; Advantage</b>	Reliable,low poer consumption, single-ship smart control; Over-load, over-voltage,charge and discharge protection.		MPPT Charging, with transformer; smart charging management and long life span.

<b>Product</b>	Photovoltaic Pumping Systems		
<b>Type &amp; Specification</b>	CEEGSI-SPA AC Serie; Pump Power: 1.5KW-30KW CEEGSI-SPD DC Serie; Pump Power: 500W-3000W		
<b>Brife Introduction</b>	DC solar water pump system is driven by a DC brushless motor rotating piston pump, to provide electricity by the photovoltaic modules to supply water, in which the integration of motor and pump efficiency of 85%, higher than the average efficiency of the photovoltaic pumping system, high power density, long life, good maintenance; AC series, including deep-well pump series and surface pumps, by the frequency with maximum power tracking controller, greatly enhance the use of solar energy, to optimize the matching system, improve the efficiency of the system.  Function: water supply. Application: drinking water for no electricity district, agricultural irrigation, livestock grassland, barren hills of governance, brackish water desalination		
<b>Performance Indicator</b>	Different requirements and different performance are with different system configurations.		

- Features & Advantage**
- < No batteries;
  - < Unattended, automatic control;
  - < The whole system self-protection;
  - < Energy saving, long life of 25 years.



**Product** Inverter for on-grid system

**Type & Specification** CEEGSI-TL3000S, 3500S  
CEEGSI-TL4000S, 4600S

**Brife Introduction** Convert DC power to AC power, adopt in state grid. Applcance: small and medium-size power plant.

**Performance Indicator** 95.5%, 96.0%, 96.5%, 97.0% for 4 different type.

**Features & Advantage** Twin channel MPPT control, can be installed at any position. Higher efficiency.



Inverter for solar plant  
CEEGSI-100KT, 500KT, 500KTL

Monitor on-grid power plant data information. Apply to small and medium-size power plant.

Transformer:  
CEEGSI-100KT: 97.0%  
CEEGSI-500KT: 97.5%  
CEEGSI-500KTL: 98.2%

DC&AC over-voltage protection.  
Transformer isolation with TUV AND CGC certification



**Product** Solar lighting products

**Type & Specification** Solar lighting products are solar street lamps, garden lights, lawn, pest-killing lamp series.

**Brife Introduction** Solar lights, garden lights, lawn is Ethernet sunlight for energy, solar panels during the day to recharge the battery, the battery to the load using the night to provide lighting.

Solar insecticidal lamps with solar panels that convert sunlight directly into electricity, providing energy to the device for everyday use, then use insect innate phototaxis, chemotaxis, wave nature of trend color of the physical structure, the use of spectrum frequency technology breakthrough traditional insecticidal lamps using a single optical band limitations, so that a wider range of effective light, trapping pest species and quantity more. Pests have been the night lights of the insect attracted by a special light and the wavelength will be desperate leap, and in light of the periphery have a high voltage power grid, they will be in the flying insect light electric shock killed the process, so as to achieve good insecticidal effect.



**Features & Advantage** Such products do not need complex and expensive pipeline laying, adjustable lighting layout, safety and fuel pollution, no manual work stable and reliable, maintenance-free savings in electricity. Solar light products also reduce insecticide use of pesticides and environmental pollution, to provide mankind with green food

Solar Emergency Power  
CEEGSI-YJ80W  
CEEGSI-YJ100W

Electricity generated by solar cell module access to the controller input, through the controller to charge the battery, and control the charging current to ensure that the battery will not overcharge; battery power through the inverter into 220V/50Hz AC, for AC load use, the battery voltage while the controller to automatically shut down to prevent battery damage due to excessive discharge. The product has a small size, light weight, box packaging, easy to carry and so on. For car carry, mountainous island, pastoralists, marine vessels, fishermen farming, forest fire prevention, border posts, rail and road classes, road no power or less power regions and places.



Suitcase-style design, easy to carry, with overshoot, over discharge, over-voltage, output overload protection features such as multiple.



# Gansu GNERI Solar Power Co., Ltd.

## Main Business

Design, manufacture, installation of solar photovoltaic power plant; lighting system; household solar PV power and scenery complementary power products production and sales; radio, television, communication power and inverter, control system; rural schools, medical equipment using solar photovoltaic power supply; meteorological, hydrological, signal power; solar photovoltaic water pumping system; solar energy, photovoltaic technology consulting, training, design, testing, etc.

## Introduction

Gansu GNERI Solar Power Co. Ltd was established in 1990, its under the Gansu Natural Energy Research Institute, and supported by Gansu Natural Energy Research Institute and Asia-Pacific Research Institute and Training Center for Solar Energy, The company engages professionally in research, development, production and marketing of various kinds of PV application products. he company successfully implemented UNDP Projects called "Development of PV system in Western China' and the Sino-American solar domestic systems spreading project and is also selected as one of the implementing agencies of the Global Environment Facility/ the World Bank project by the State Economic and Trade Commission. The company undertakes international solar energy technology training, energy planning designing and exporting of the PV products for a long time. The company is equipped with advanced instruments. There are many excellent research professions, engineers, technicians and complete testing and developing means in the company. It is one of the earliest companies of the developing PV application products in China. It is also one of advanced and new technical companies in Gansu Province.

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## Main Technology

Solar street lights, garden landscape lamp, lawn lamp, solar power station integrated construction project design, construction.



## Utility Patents

< Solar photovoltaic power generation component of oblique / flat single axis tracking device

< Translucent air interlayer insulation of photovoltaic modules



The First Directory of  
China's Leading Solar Enterprises

**Technology** Solar street lights, garden landscape lamp, lawn lamp, solar power station integrated construction project design, construction

### Brief Introduction

Photovoltaic power generation in power market, will replace the conventional energy; photovoltaic power generation can be used as a conventional energy supplement to solve the special application fields, such as communication, signal power and remote areas without electricity demand, it has great significance on environmental protection and energy strategy. Photovoltaic power generation has many advantages, these advantages can not be compared with the other traditional power generation mode and it can be mainly used in:

- < The household solar power: ( 1) small power 10-100W range, used in remote areas without electricity, such as plateau Island, pastoral area, frontier sentries and electricity, such as lighting, television, radio cassette player. ( 2) 3-5K W family rooftop grid-connected generation system. ( 3) photovoltaic water pump: solve the region without electricity for deep well water drinking, irrigation.
- < The traffic: such as navigation, traffic / railway signal lights, traffic warning lights, street lamps, / logo high-altitude obstacle lamp, highway / railway radio booth, unattended road power supply.
- < The communication / communication fields: solar unmanned microwave relay station, cable maintenance station, broadcast / communication / paging power

system; rural carrier telephone system, small communication machine, soldier G PS power supply.

< The petroleum, marine, meteorological fields: oil pipeline and reservoir gate cathode protection solar power systems, oil drilling platform and detection equipment, emergency power supply, marine meteorological / hydrological observation equipment.

< The family lighting power supply : the case of garden lights, street lamps, portable lights, camping lamps, mountain climbing, fishing lights, lamp black light lamp, tapping lights, energy-saving lamps etc.

< The PV power station 10K W - 50M W: independent photovoltaic power station, scenery complementary power station, a large parking lot charging stations.

< Solar energy: solar power and building materials combine, making future large buildings to achieve self-sufficiency in electricity, is a major development direction in future.

< The other fields include: ( 1) and vehicle matching the solar car / electric vehicles, battery charging equipment, automotive air-conditioning, ventilation fans, cold box. ( 2) solar hydrogen production with the regenerative fuel cell power generation system. ( 3) seawater desalination equipment power supply. ( 4) satellites, spacecraft, space solar power station

### Features & Advantage

Safe and reliable, no noise, no pollution, energy is available, without geographical restrictions, no fuel consumption, no mechanical components, low failure rate, convenient maintenance, can be unattended, construction cycle is short, arbitrary size, without transmission lines, can be easily combined with buildings etc.

<b>Patents</b>	Solar photovoltaic power generation component of oblique / flat single axis tracking device	Translucent air interlayer insulation of photovoltaic modules
<b>Patent No.</b>	PN: ZL 2010 2 0112723.8	PN: ZL 2010 2 0062313.7
<b>Brief Introduction</b>	The patent is a solar photovoltaic power generation component of oblique / flat single axis tracking device is controlled by a PLC drive mechanism, hydraulic putt, hydraulic rod, swing liver, supporting rod, photovoltaic bracket and bracket, PLC control driving mechanism is composed of a microprocessor control system and motor drive system. PLC control drive mechanism with hydraulic push rod is connected with drive, hydraulic push rod connecting rod, and the other end of the swing liver solar photovoltaic component connection. The utility model tracking system using active tracking control, to avoid a general use sensors method for a passive solar tracking frame in greater dust or cloudy prone to malfunction problem. The utility model patent is simple in design, convenient to maintenance, it can meet the large scale integration of power station, especially MW-class large desertification photovoltaic power station requirements.	The utility model patent is a translucent air interlayer insulation photovoltaic component. The structural characteristics of semitransparent photovoltaic module back is additionally provided with a layer of sealed air layer in air or sandwich filling transparent polymer materials, the output lead wire and the bypass diode is mounted on a semitransparent photovoltaic component side. The utility model patent technology through the translucent PV air dissection or filled with transparent polymer materials to achieve product insulation effect, both lighting and power, and can be widely used for building walls and roof.



# Henan Ancai Hi-Tech Co., Ltd.

## Main Business

R & D, manufacturing and marketing of the color picture tube blub, the color display tube blub, energy saving lamp, new products of electronic special glass, new display technology, PV glass(solar glass, fine glass, construction glass, flat glass)

## Introduction

Henan Ancai Hi-tech Co., Ltd., hereinafter referred to as Ancai Hi-Tech, listed at Shanghai Stock Exchange (stock code 600207) in 1999 and having Henan Investment Group as its largest shareholder, is a key national high-tech enterprise with the largest scale and the most advanced equipments, owning more than 2,400 employees, the affiliated National Company Technological Research Center and Post-doctoral Workstation.

The company has passed the approvals of ISO9002 Quality Management System, ISO 14002 Environmental Management System and OHSMS18000 Occupational Health and Safety Management System.

From full introduction of the project to independent innovation development, Ancai Hi-Tech masters the core technology of manufacturing color picture tube blub, cultivates a galaxy relented technical and management personnel and forms a complete system of R & D. Via extensive corporation with the domestic scientific research institutes and world-renowned enterprises, Ancai Hi-Tech possess the capacity to expand the new display area and the related industries. Moreover, it is one of the internationally competitive "China electronic information hundred strong enterprises".

Meanwhile, developing efficient and clean energy is also an important strategy for the transformation of Ancai Hi-Tech. The corporation starts the project at a right moment. After the project is put into operation, it will supply clean, efficient and safe high quality fuels to Anyang, the cities around Anyang, the residents, the commerce and the industrial enterprises.



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## Main Product

PV Rolled Glass

## Utility Patent

The solar cell cover glass with patterns structure (retard 70%)

## Product

PV Rolled Glass



## Type & Specification

1574\*802\*3.2mm,  
1644\*985\*3.2mm,  
1636\*986\*3.2mm and other types.

## Brife Introduction

Solar cell modules packing and cover, flat panel solar water heater, internal and external building decoration, high-end office furniture, technology products, bathroom products, greenhouse lighting ceiling and other topper horticultural buildings(the horticultural buildings which require high light transmission rate).

## Performance Indicator

< Glass thickness: 2.5mm-10mm; conventional thickness:3.2 mm、 4.0mm;  
< Glass thickness tolerance: 3.2mm±0.20mm; 4.0mm±0.30mm  
< The biggest glass size: 2250mm×3300mm  
< Sunlight transmittance rate(3.2mmthick): ≥91.6%; 5. iron contents(Fe2O3): ≤120ppm ; 6. Poisson's ratio: 0.2; 7.Density: 2.5g/cc

## Features & Advantage



With high solar transmittance, low absorption, low reflectivity and low iron content and other outstanding features, the most ideal solar photovoltaic, the packaging materials of solar thermal conversion systems, it can

greatly improve the photovoltaic and the efficiency of solar thermal conversion.

Non-toxic formula can fully comply with the environment requirements of European, America and Japan. It is the ideal for packaging materials of solar PV modules and solar thermal components.

## Utility Patent

The solar cell cover glass with patterns structure (retard 70%)

## Patent No.

201020509815.X

## Brief Introduction

The invention refers to a solar cover glass with a pattern. The glass-top surface is flat and the bottom is designed with a continuous distribution of the concave pattern structure.

The pattern is the rectangular cone and the bottom of the cone is formed by four outer curved end to end connected. The four sides of the cone are surface modeling.

Due to the unique and continuous pattern structure, In addition to reducing the reflection of sunlight, It can make multiple reflections refraction of the light occurs on the pattern slope. Thus, this glass can greatly reduce the loss of light energy, increase the transmission and improve the efficiency of the cell conversion.

# Henan OMA PV-Solar Co., Ltd.

- Main Business** Solar photovoltaic products, silicon rods, silicon cutting pieces of manufacturing, sales, project management company import and export business.
- Introduction** Photovoltaic Solar Energy Co., Ltd. Henan Omega was founded in June 2008, is by the Henan Development and Reform Commission approved the establishment of high-tech business photovoltaic projects. Companies located in China's history and culture of the town of Oracle thick, the Shang capital of Anyang City, Henan Province ---- hi-tech Development Zone, west of Beijing-Guangzhou line, east of Beijing-Zhuhai Expressway, the traffic is made. The company occupies 160 acres, now has more than 300 employees, of which more than specialist personnel accounted for 66.8%. With advanced crystal furnace 60, the import profile side machine, cutting machine nine. Currently produce 25MW silicon 150 --- 200 tons of silicon chips 1400 --- 16 million, and annual output value of 360 million. We sincerely welcome friends to visit, guide, cooperation and seek common development.
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Fax: +86-372-3386601 Web: <http://www.omasolar.com>  
Add: High-tech Development Zone, Anyang City, P. R. China
- Main Product** Cut pieces of boron-doped silicon, gallium-doped silicon incision, boron-doped silicon rods
- Technology** 6 software copyrights:  
< Low energy consumption, high output solar grade monocrystalline furnace control system software to improve thermal field.  
< Low attenuation gallium-doped silicon control system software.  
< Mortar with control system software.  
< Solar grade silicon film quality measurement and control system software.  
< High productivity, low-cost monocrystalline silicon cutting control system software.  
< Double-sided grinding machine intelligent control rod system software

**Product** Cut pieces of boron-doped silicon, gallium-doped silicon incision, boron-doped silicon rods

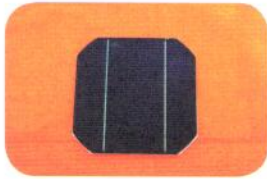
**Type & Specification** P<100>6 P<100>6.5 P<100>8

### Brief Introduction

The monocrystalline silicon products company, with core intellectual property, copyright 6 software has been all for the development of solar silicon, single crystal furnace thermal field improvement, cutting processing of the product. Drawn high yield of single crystal, polycrystalline high conversion, the electrical parameters of silicon have reached the advanced level; wafer processing of the geometric parameters of TV, TTV, Warp have reached the advanced level; this processing of single crystal silicon film solar cells can achieve an average conversion efficiency of more than 18% attenuation of less than 2%.



### Performance Indicator



- < Oxygen content  $<1 \times 10^{18}$  atoms/cm<sup>3</sup> carbon content  $\leq 5 \times 10^{16}$  atoms/cm<sup>3</sup>
- < Minority carrier lifetime  $\geq 3\mu\text{s}$  (bare rod)
- < Resistivity :1-3 $\Omega \cdot \text{cm}$ ; resistivity inhomogeneity  $\leq 15\%$
- < Quasi-square wafers: 125 × 125 mm or 156 × 156 mm ( $\pm 0.3\text{mm}$ )
- < Wafer thickness and tolerance: 200  $\pm$  15 $\mu\text{m}$  190  $\pm$  15 $\mu\text{m}$
- < The total silicon thickness variation (TTV): <30 $\mu\text{m}$
- < Silicon Warp (Warp): <50 $\mu\text{m}$ production process for recycling waste generated in waste

water after the settlement of the indicators have to meet emission standards, solid waste recycling, no pollution to the environment. Line marks the depth: <15 $\mu\text{m}$

- < Processed into solar cell conversion efficiency:  $\geq 18\%$
- < Processed into solar cells light-induced decay: <2%

### Features & Advantage

- < Single crystal yield  $\geq 75\%$  (off weight), the conversion efficiency of polycrystalline high, reaching 1:1.15;
- < A small deviation of the thickness of silicon, is conducive to the consistency of follow-up process;
- < Warp and the total thickness is small, the following process will help improve the yield;
- < A good selection of raw materials, ingredients, excellent structure, drawn within single crystals of good quality, processed into solar cells conversion efficiency  $\geq 18\%$ , light-induced decay: < 2%
- < Clean wafer cleaning a 9-slot, surface cleaner, no residual impurities.

### Environmental Friendly

Production process for recycling waste generated in waste water after the settlement of the indicators have to meet emission standards, solid waste recycling, no pollution to the environment.



### Technology

- 6 software copyrights:
  - < Low energy consumption, high output solar grade monocrystalline furnace control system software to improve thermal field.
  - < Low attenuation gallium-doped silicon control system software.
  - < Mortar with control system software.
  - < Solar grade silicon film quality measurement and control system software.
  - < High productivity, low-cost monocrystalline silicon cutting control system software.
  - < Double-sided grinding machine intelligent control rod system software

### Brief Introduction

- < Hardware: Industrial Computer Dell 248; CPU: 1.6G; Memory: 512M; 64MSDRAM, 10G hard drive, Ethernet card, 36-speed CDROM, 64-bit graphics accelerator
- < Software configuration: Windows 2000/NT workstation 4.0
- < Operating System: The measurement unit must have a 4-20mA output and the implementing agencies must have input 4 - 20mA signal input and output cards and related parts, software, C-like language in addition to providing the basic elements of language, expressions, control operations functions module is loaded, but also to provide control configuration capabilities, multi-tasking multi-threaded, real-time database, Linker, Debugger RS485 communication.

## Henan SUNGEN Solar Fab Co., Ltd.

### Main Business

The mainly engages in is R&D in photovoltaic technology and R&D, production and sales of solar cell, photovoltaic lighting system, solar cell production equipment, electronic devices and electronic special test equipment.

### Introduction

Henan SUNGEN solar fab is a sino-foreign joint ventures high-tech photovoltaic enterprise with R&D, production and sales. The corporation was founded in July 2008 and the first registered capital is \$64,000,000 with \$168,000,000 total investment. The mainly engages in is R&D in photovoltaic technology and R&D, production and sales of solar cell, photovoltaic lighting system, solar cell production equipment, electronic devices and electronic special test equipment. We have 400 employees and 130 technicians, 60% of who at least have junior college educational background. We introduced a high performance production system for amorphous silicon thin film solar cell module from Anwell Group which is developed independently.

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### Main Product

Amorphous silicon thin film solar modules

**Product** Amorphous silicon thin film solar modules

**Type & Specification** 1.1 × 1.4M SG-NH-GS Series 80W/85W/90W/95W/100W

**Brife Introduction**

- < Amorphous silicon thin film solar cells
- < Amorphous silicon thin film solar modules
- < Product Specifications: 1.1m \* 1.4m \* 0.0064m / film
- < Power output: 100W / film
- < Main materials: TCO glass, silane, borane, phosphine, methane, hydrogen, nitrogen trifluoride, argon, nitrogen, oxygen, EVA film.
- < Main equipment: PECVD gas chemical deposition, sputtering, laser etching, cleaning, milling, annealing, welding, laminating, packaging and other equipment.
- < Main use: grid-connected photovoltaic systems, off-grid photovoltaic systems, solar roofing systems for residential, commercial rooftop photovoltaic system, photovoltaic system ground

**Performance Indicator**

Maximum power temperature coefficient of -0.19% K  
 Open-circuit voltage temperature coefficient -0.31% K  
 Short-circuit current temperature coefficient 0.07% K  
 Maximum system voltage 1000V  
 Operating temperature -40 °C ~ +85 °C

#### Features & Advantage



Compared with crystalline silicon, silicon thin film has the best performance per watt performance, per unit of silicon thin-film crystalline silicon than 10-20% of electricity per year, direct benefits include: for the same per watt investment, return on investment than the silicon film 10-20% more crystalline silicon; silicon film extra generating capacity to cover its interest rates, maintenance and operating costs; this "more" in return

will continue its 25-year life cycle.

- < Silicon thin-film battery components than the price of crystalline silicon cell module price is low, so the whole application system costs will be relatively low;
- < Silicon thin-film battery components of the system to absorb more of the scattered light, reflected light and low light, and the tilt angle of the roof toward the less demanding, suitable for home roof;
- < Silicon thin-film battery components for power generation caused by the shadow of a sharp decline in blocking the buffering capacity is relatively strong component of traditional crystalline silicon cells, obscured by shadows on the surrounding environment requirements are not demanding crystalline silicon cell module, and thus its broader scope;
- < Silicon thin-film battery components with low temperature coefficient, the same amount of installed photovoltaic applications, silicon thin film photovoltaic systems at high temperatures than the crystalline silicon cell components can generate more electricity.

**Environmental Friendly**

Wastewater project, the total displacement of 60 cubic meters of sewage / hour. Non-toxic cooling circulating water, can be directly discharged into the sewer; process water treated by simple carved discharge; sewage through septic tanks after discharge. Production plant in the production of waste generated in the process part of the process, can be recycled.

The project mainly for the noise source device electrical equipment, auxiliary fans, compressor and so on.

## Lanzhou Keneng New Technology Development Co., Ltd.

### Main Business

Research , product development and technical services in field of solar thermal technology. Development and application of energy-saving technology and products. The design and installation of solar building and solar water heating system, technical assistance, plan preparation, project evaluation, technical consulting and product testing, etc.

### Introduction

Lanzhou Keneng new technology development Co. Ltd relies on the platform of Gansu Natural Energy Research Institute/International Solar Energy Center for Technology Promotion and Transfer possessed tremendous scientific research strength and extensive international exchanges. With the principle of creative concept and credible service,the company are dedicated to convert achivement in scientific research into productive force for a long time. Mostly produce have stainless steel solar water heaters, copper and aluminum composite flat plate solar heat collector, vacuum tube solar water heater, Multi-function control instrument of solar water heaters, low-temperature radiant floor heating water segregator, heat pipe evacuated tubular solar collector, etc. The company enjoys definite capabilities of new product development in many fields,such as solar cooker, solar drying, solar building, heat pump technology, rural energy and traditional energy power-saving technology. Especially, there is obvious advantage in solar heated swimming pool and active solar space heating.

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### Technology

Heat pipe evacuated tubular solar collector

### Patent

An Auto-controlling Mode of the Initiative Solar Heating System



## Inventions Patent

An Auto-controlling Mode of the Initiative Solar Heating System

### Patent No.

201110022444.1

### Brief Introduction

An auto-controlling mode can be used for initiative solar heating systems, so that the solar energy will be collected and utilized at the largest limit and the assistant conventional energy will be used up at the lowest limit, meeting the demands on the building thermal environment. The characteristics of the auto-controlling mode are:

< It can discriminate variations of the weather automatically during a day, and then commands the system supplies heating-energy to the building at the corresponding conditions.

< The solar energy will be used for heating building prior to assistant conventional energy. When it is impossible for using solar energy to heat the building, the assistant conventional energy will be used for heating the building at once.

< The mode gives us a series of controlling parameters and the methods of their logical operations.

< The latitude, longitude and above sea level are used for inputting controlling parameters so that the mode is able to control the initiative solar heating system established in various areas.

An Application by Demonstration of The Mode

Place of the Demonstration: A one floor building in "Ganseng 330KV transformer substation", 260Km from Gerermu City, Qinghai province, China.

The Heated Area: 526.84m<sup>2</sup>.

Aperture Area of Solar System: 189.28 m<sup>2</sup>.

Type of Heating System: floor radiation-heating system.

Assistant Conventional Energy: electricity.

Period of Heating the Building per Year: 240 days.

Range of the Temperature of Thermal Water: 32–50 °C.

Temperature of the Rooms in the Building: 18.2–22.8 °C.

The Lowest Ambient Air Temperature: -27.3 °C.

Conventional Energy Saving Percentage by Solar Energy: 66%.

## Technology

Heat pipe evacuated tubular solar collector

### Brief Introduction

Heat pipe evacuated tubular solar collector achieve heat transfer using phase transition of working medium having characteristic of gravity circulation and reverse reversible. Heat pipe divides into bottom evaporation section and upper condensing section. The conducting working medium lies in the bottom evaporation section. Heat pipe is made of red copper with fully sealed structure, and the interior of the tube is evacuated. Working medium vaporize rapidly by the action of vacuum when the temperature of evaporation section is higher than the temperature of condensing section and phase transformation temperature. Vapor reaching condensing section is condensed, and releases heat in the process. Heat pipe enjoys very high heat transfer efficiency. Collector consist of heat pipe, heat-absorbing wings, vacuum glass tube and connecting manifold. Absorption ratio of heat-absorbing wings sparing with selective absorbing coating layers is greater than 0.93, and emission ratio is less than 0.08.

### Features & Advantage

Because of using the principle of heat pipe, the solar water heating system composed with heat pipe collector possesses characteristics such as, there is no water in the vacuum tube, so the tube will not break in Winter. anti- precipitation, anti-freezing, it works well even at an ambient temperature of -45°C, pressure capability, stability and security, long lifespan, etc.



## Linzhou Zhongsheng Semiconductor Silicon Material Co., Ltd.

### Main Business

Productions and sales of semiconductor silicon materials used in PV industry; related equipment import and export trade

### Introduction

Linzhou Zhongsheng Semiconductor Material Co, Ltd. is a manufacturer of semiconductor silicon used in solar photovoltaic industry. Founded in August 2007 with registered capital of 210 million RMB and assets of more than three billion. From April to December 2008 the company produced 206 tons of polysilicon and made a net profit of 167 million yuan. In order to further reduce our energy consumption and increase the market competitiveness, in 2010, we built two new production lines for process improvement. An advanced project was completed in June 2011 transformed into production with the design capacity of 1,500 tons. Two projects will be completed in late 2011 to reach the design production capacity of 10,000 tons.

We plan to diversify and develop to involved in more products of the PV industries, like to make monocrystalline silicon, polycrystalline casting, slicing, polishing, and assembly of polysilicon solar panels.

With the expansion in production, we will establish sales network in Shanghai, Tianjin, Guangdong, Shenzhen. We are also looking forward to working with strategic partners in North America and Europe to establish an international sales network to contribute our productions in the world-wide PV markets.

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### Product

A solar-grade virgin polysilicon



**Product** A solar-grade virgin polysilicon

**Type & Specification** N,  $\Omega \cdot \text{cm} \geq 50$  P-type resistivity,  $\Omega \cdot \text{cm} \geq 500$

**Brife Introduction** Polysilicon is an essential raw material for PV industries.

**Performance Indicator**  
Oxygen  $< \text{at}/\text{cm}^3 1.0 \times 10^{17}$   
Carbon  $< \text{at}/\text{cm}^3 \leq 2.5 \times 10^{16}$   
N-type minority carrier lifetime  $\geq 100 \mu\text{s}$   
Base metal impurities (ppmw) Fe, Cr, Ni, Cu, Zn, Ca, Mg, Al, TMI  $\leq 0.05$

**Features & Advantage**

- < Can be installed in a plurality series, or parallel, to achieve the optimal allocation, can meet the needs of different customers;
- < Easy to disassemble and assemble;
- < Environmental protection and energy saving;
- < The hot water system is under pressure operating;
- < The insulation material is glass wool, can stand high temperature, has high efficient insulation.

**Environmental Friendly** Power consumption in reactor 59.5 kWh / kg, silicon tetrachloride recycling rate 99%, recycling rate of 99% hydrogen chloride, total power consumption of 99.5 kWh / kg, water recycling rate of 97%



# Shandong Sangle Solar Energy Co., Ltd.

## Main Business

New energy application technology development, services, transfer, consulting; New energy products and energy saving products, electronic product development, manufacturing, sales, installation services; Household appliances development, manufacturing, sales, installation; Mechanical and electrical equipment installation; Cities and road lighting engineering design, the installment construction; The solar energy light heat, and photovoltaic equipment design, production, installation, construction, marketing; Goods and technology import and export (unless prohibited by laws and regulations).

## Introduction

Shandong Sangle Solar Energy Co., Ltd. was founded in 1987, Shandong Province Academy of Sciences for the technical support, is the high-tech enterprises in Jinan City, has become the research, development, production as one of the large-scale professional manufacturer of solar. Alliance is currently vice chairman of China's solar industry units, unit director of Shandong Solar Energy Society.

Sangle is set up based on an average growth rate of nearly 50% of the speed of the rapid development of ten consecutive years, Shandong solar market, production scale among the forefront of the domestic industry. The company now has the biggest most professional solar water heater production base with annual output up to 1 million units.

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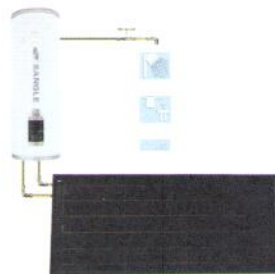
Add: No.19 Keyuan Road, Jingshi Road, Jinan, P. R. China

## Products

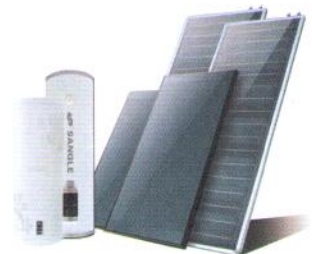
Evacuated Tube Collectors  
Solar Water Heater



Flat Panel Collector Solar  
Water Heater



Balcony Mounted Solar Water  
Heater



**Products** Evacuated Tube Collectors Solar Water Heater

**Type & Specification** SL-HH-1.8-18 1800mm\*Φ58,18pcs/unit  
 SL-HH-1.8-20 1800mm\*Φ58, 20pcs/unit

**Brife Introduction** Our products are surely able to provide the solutions for heating system at home and aboard, including hotels, schools, swimming pool, hospitals and enterprises, ect.

**Performance Indicator**

- < Inner tank: High anti-corrosion stainless steel by auto welding& thickness: 0.5mm;
- Outer tank: Color steel coated anti-corrosion layer &thickness:0.4mm;
- < Insulation layer: Imported polyurethane foamed with overall high pressure equipment &thickness:50~60mm;Density:42~45KG/m<sup>3</sup>;
- < Vacuum tube: SS-AlN/Cu high selective coating tube &thickness: over 2.0mm
- < Freeze protection:-25
- < Hair resistance: 25-35mm
- < Bracket: hot galvanized steel painted with anti-corrosion layer &thickness:1.5mm;
- < Freeinstalled on inclined or flat roof; Wind stress: 183.5km/h without damage

Flat Panel Collector Solar Water Heater **Products**

SL-CFS-150 & 2m<sup>2</sup>×1, 150 L, 70/79.4 (KGs) **Type & Specification**

Our products are surely able to provide the solutions for heating system at home and aboard, including hotels, schools, swimming pool, hospitals and enterprises, ect. **Brife Introduction**

**Performance Indicator**

- Inter-tank: High anti-corrosion stainless steel by auto welding& thickness: 0.4~0.5mm
- Outer-tank: Color Steel painted with corrosion layer &thickness: 0.5mm
- Insulation: 50~60mm Polyurethane foam (heat preservation 72hrs)
- Working pressure: 0Mpa(Testing pressure: 0.05Mpa)
- Flat collectors: Black chrome coating plate / Titanium(or Tinox) coating plate (Copper Connection: Φ22mm, 3/4")
- Bracket : Bracket: Hot galvanized steel painted with anti-corrosion layer & thickness:1.5mm

**Products** Balcony Mounted Solar Water Heater

**Type & Specification** SL-II-2.0D/T & 2000\*1060\*80mm

**Brife Introduction** Our products are surely able to provide the solutions for heating system at home and aboard, including hotels, schools, swimming pool, hospitals and enterprises, ect.

**Performance Indicator**

- < Operating pressure: 6bar
- < Absorptance: ≥ 97%±2%
- < Emittance: ≤ 5% ± 2%
- < Absorber material & thickness: copper T2, = 0.15mm

# Shanghai Topsolar Green Energy Co., Ltd.

## Main Business

Shanghai Topsolar has been devoted to the development and application of the solar energy with products well sold in Europe, America and East Asian regions. With the booming solar energy industry in both domestic and international market, Shanghai Topsolar not only faces challenges, but also enjoys more extensive platform and unprecedented opportunities for development. Topsolar will, as ever before, stick to the "devoted and enterprising" corporate spirit and will make more outstanding contributions to new energy area.

## Introduction

Shanghai Topsolar Green Energy Co., Ltd is a high and new-tech enterprises mainly engaged in R&D, production, sales and service of photovoltaic cells, photovoltaic modules and photovoltaic power generation system.

Topsolar has focused its R&D efforts on industrialized high-efficient crystalline silicon solar cell technology, thin-film solar cell technology, design of independent/interconnected power generation system and development of new solar energy application products and has obtained various titles and awards such as Shanghai Science and Technology Advancement Award and Municipal Level Enterprise Technical Center.

Topsolar products have been extensively exported to European and American markets and have won good reputations among customers from German, Spain and other countries, thus having a place in the international market. Today, Topsolar applies its international market experience to the domestic market and aggressively participates in the World Bank project, national bright project, country-through program and green Olympics program, and with the ever-increasing influence in the domestic market, Topsolar products have been widely used in communication, television and broadcast, transportation, petrol, illumination and military industries

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## Product

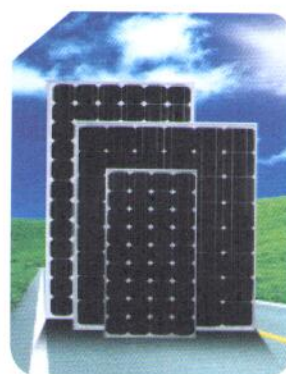
Solar Cell      Solar Module

## Solar Cell

Cell Type	Spec.		Thickness	Surface passivation and anti-reflecting film	Screen printing
	a	R			
Single Crystal Silicon	125mm×125mm±.05mm	150mm	200±10μm	SiN-plated PECVD film	Full auto printing
	125mm×125mm±0.5mm	165mm			
	156mm×156mm±0.5mm	200mm			
	156mm×156mm±0.5mm	203mm			
Multiple Crystal Silicon	125mm×125mm±0.5mm	165mm			
	156mm×156mm±0.5mm	210mm			

## Solar Module

Type	Cell Side	Module Dimensions	Weight	Max Output Power Under STC	Open circuit voltage	Max power voltage	Short circuit current	Max power current	Max system voltage
TSM96-125M	125 x 125	1602 x 1061 x 50	20KG	260W	5.10A	47.05V	5.56A	58.40V	1000V
TSM72-125M		1580 x 808 x 40	17KG	195W	5.00A	36.00V	5.45A	44.5V	
TSM72-125M-G		1574 x 802 x 8	28KG	180W	5.00A	36.00V	5.45A	44.5V	
TSM60-156M	156 x 156	1652 x 994 x 50	20KG	230W	7.45A	29.50V	8.15A	36.05V	700V
TSM48-156M		1334 x 994 x 40	17KG	180W	7.58A	23.75V	8.35A	29.70V	
TSM-75M	125 x 125	1191 x 538 x 40	9.2KG	85W	4.72A	18.0V	5.28A	22.35V	
TSM-50M	125 x 78	758 x 538 x 40	5.9KG	55W	3.07A	17.9V	3.32A	22.1V	
TSM-40M	125 x 62.5	620 x 538 x 40	4.9KG	45W	2.51A	17.9V	2.71A	22.1V	
TSM-30M	125 x 47	541 x 473 x 28	3.3KG	30W	1.69A	17.75V	1.88A	21.9V	
TSM-10M	62.5 x 34	367 x 285 x 28	1.4KG	10W	0.57A	17.5V	0.64A	21.0V	
TSM-5M	62.5 x 25	285 x 280 x 28	1.2KG	5W	0.29A	17.0V	0.32A	20.5V	



## Solar Energy Architecture Design Institute (SEADI) of Gansu Academy of Science

**Main Business** Power (New Energy Power Generation)

### **Introduction**

The Solar Energy Architecture Design Institute of Gansu Academy of Science was established in 1979, and it is based upon Gansu Natural Energy Research Institute (GNERI) and UNIDO International Solar Energy Center (UNIDO-ISEC). It is a professional new energy enterprise engaging in the research, design and promotion of solar architecture and new energy power generation in China, and it is one of the first enterprises developing solar building and the sole professional solar building design enterprise, issued design qualification of construction engineering and new energy power generation by Gansu provincial department of construction. It is one of member of the Gansu Survey and Design Association, Gansu Province Solar Energy Wind Energy Association executive director, Gansu Provincial Construction Technology and Building Energy Association executive director. And it had obtained low-carbon economic contribution of awarded second prize in 2010 by the UNIDO International Solar Energy Center and the Shanghai Expo Pavilion United Nations Forum and Exhibition Organizing Committee.

The Institute has a professional strong and technical team whose members have engaged in solar building design and research for long times. It has ten seniors, fifteen intermediate researchers and two juniors. Three seniors received entitlement of State among of them. The finished research subjects has obtained several provincial and ministerial awards. Mainly engaged in the construction of solar photovoltaic power station, solar street lamps and others, technical consulting, installation, construction services, personnel training and other technical capabilities.

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**Main Technology** Technology of Passive Solar Building

**Patent** Plug-in Solar Air Collector

**Technology** Technology of Passive Solar Building

**Practicality** Special Training



#### Brief Introduction

Passive solar building is defined as: through building orientation and rational arrangement of the surrounding environment, the clever processing for internal space and external form, the appropriate choice of building materials, structures and construct, it can be collected solar energy in winter, keeping, storage and distribution of heating of buildings so as to solve building heating.

Meanwhile, in the summer, according shielding solar radiation, dissipation interior heating, so the building become cool in summer and heat in winter.

< Main properties of passive solar building

- (1) low cost
- (2) cool in summer and heat in winter
- (3) high energy saving efficiency
- (4) requiring auxiliary heating.

According different way of collecting, passive solar building can be divided into the following categories:

- direct gain
- Thermal storage wall
- Attached sunspace
- Thermal storage roof
- Convective loop

< Main indicators of passive solar building

- (1) Usually, the energy saving efficiency of passive solar building is above 75%.
- (2) Passive solar building must be set floor insulation, heat storage and moisture-proof layer, meanwhile, we should set insulation material which must be not less than 0.45 m, thermal resistance is greater than  $0.86 \text{ m}^2 \cdot ^\circ\text{C} / \text{W}$  on the edge of basis.
- (3) The light material of collector component should use surface roughness, thickness uniformity.
- (4) Requirements of economic indicators: increased investment in the local construction should be less than cost 20%, of course, in cold region 25% relatively.

#### Features & Advantage

The biggest advantages of passive solar building are simple construction, low cost, easy maintenance and management. However, passive solar house also has its drawbacks, which mainly include indoor temperature fluctuations, poor comfort, and requiring auxiliary heat to maintain indoor temperature at night, the lower outdoor temperature and when it is cloudy or continuous.

Passive solar building is an economical, effective using solar to heat, an important area of solar thermal, which has important economic and social benefits. It is conducive to save conventional energy, protect the natural environment, reduce pollution, and urging harmonious development between human beings and natural environment.

**Utility Patent** Plug-in Solar Air Collector

**Patent No.** ZL 2009 2 0143992.8

**Patentee** Solar Energy Architecture Design Institute (SEADI) of Gansu Academy of Science

#### Brief Introduction

An external plug-in solar air collector, characterized by: from the outside to the back of the steel frame with double glass, corrugated shape absorber plate, rock wool. Into back surface of steel frame there are two air vents which fixed on the top and bottom. Besides, corrugated absorber plate has vent as well.

The patent has double-layer hollow glass as light transmission in order to, greatly, reduce the heat leaked and improve the insulation performance. Using corrugated absorber plate, to increase heat-absorbing area, enhance heating collection efficiency, accelerate air flow, we can achieve rapid heat transfer from inside and outside and improve the efficiency of solar energy using. It is very easy to get material, to process and the structure is simple, safe, reliable, environmental resistance performance, longer life.

This patent can give us perfect solutions: combination of solar energy products and building, application problems in large and different areas. It also can reduce the cost of wall, decrease maintenance, raise life when building integrated with solar energy.





## Sunrain Solar Energy Co., Ltd.

### Main Business

As a professional enterprise, which is an innovation-driven renewable energy enterprise, specialized in researching and developing the application of solar energy, manufacturing and marketing campaign, Devoting to provide the hot water solutions for thousands of families worldwide. The company's business scope: all the glass vacuum collectors and flat solar plate, solar heating.

### Introduction

Sunrain, as China environmental protection partner, which is the professional supplier of solar water heater and solar water system, As a professional enterprise, which is an innovation-driven renewable energy enterprise, specialized in researching and developing the application of solar energy, manufacturing and marketing campaign, Devoting to provide the hot water solutions for thousands of families worldwide.

Sunrain, China the solar energy light heat industry leaders, adhering to "customer creatively providing valuable service for customers" , make the new energy industry many breakthrough: China's first won the international solar energy industry, " Hottor " award; In 2009, the gold 102.8 million CCTV advertising resources, open a new energy industry first; Exclusive sponsor 2008 Paralympic support group; Earthquake relief, Martin disaster area first solar energy bathroom, first seismic spring buds primary school. To Chang An signed the 10000 car designed for red sun to boost "solar energy fields"; Successful push solar fields, realize the 31 provinces, cities and autonomous regions all the winning; Donated 10 million set up China's first public charity funds new energy industry--Sunrain charity foundation; In 2010, Sunrain become "2010 Shanghai world expo" life the sunshine aquarium love partners, Guangzhou and love went partners, and actively practice of ecological public welfare ideas; In 2011, Sunrain become China's environmental protection business partners for implementation of the China association of social workers, Sunrain charitable fund "sunshine hot water action" project, plan for 50 Midwest hope primary school and other public institutions provide daily life water solution.

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### Products

Solar water heater

### Utility Patents

- < Pressure-medium flat panel solar collector (invention)
- < A split solar water heater system (utility)
- < A solar water heater (utility)
- < Low-temperature solar energy selective absorbing coating and its preparation (utility)
- < A high-temperature solar energy collector tube (utility)

### Technologies

The hot wall technology, ITC intelligent the thermal technology, water guards, ITW testing technology

**Product** Solar Water Heater

**Type & Specification**  $\Phi 58 \times 1800\text{mm}$   $\Phi 58 \times 1920\text{mm}$   $\Phi 58 \times 2100\text{mm}$   $\Phi 58 \times 1600\text{mm}$

**Brife Introduction** Using natural energy to heat energy source sunshine, solve city residential, hotel, bath center and other public facilities of life, and business of hot water; Rural shower, wash dishes, laundry and other living hot water, and animal husbandry breeding, modern agriculture hot water.

**Performance Indicator** Store the end product hot hot water for water temperature  $53\text{ }^{\circ}\text{C}$ , higher than the national standard  $8\text{ }^{\circ}\text{C}$ ; Th useful to heat is  $7.8\text{ MJ}/\text{m}^2$ , higher than the national standard  $0.8\text{ MJ}/\text{m}^2$ ; Home solar hot water system average heat loss factor  $16\text{ W}/(\text{m}^3 \cdot \text{k})$ , is lower than the national standard  $6\text{ W}/(\text{m}^3 \cdot \text{k})$ .

**Features & Advantage** Product diversification, meet domestic, commercial and industrial use, easy to install and use.



**Patents** Pressure-medium flat panel solar collector (invention)

A split solar water heater system (utility)

**Patent No.** ZL200710022358.4

ZL200920038911.8

**Brief Introduction** Pressure of medium plate of solar energy collector is a kind of traditional solar energy collector will improve plate, that can work for water to medium traditional ways to use the solar energy water heater, and be able to refrigerants as medium straight with type solar energy heat pump evaporator use, the upper part of the solar collectors for glass cover plate, in the glass cover plate the lower part of the transparent cover plate for polycarbonate, in the polycarbonate transparent cover plate under the surface of connected with small fin-root, in transparent polycarbonate cover board for absorption of the lower part of the core board, in the absorption of core board on the surface of a cellular structure materials, in the absorption of core board for the bottom of the insulation layer in the bottom of the insulation layer has confined pipe. The solar energy collector flat structure in not set tank to and the buildings were very good in combination to building integrated.

A fission type solar energy water heater system, including solar energy collector and hot water storage tank, solar energy collector and hot water storage tank through the circulation piping connections, in solar energy collector and hot water storage tank of the circulation line between a photovoltaic panels drive dc circulating pump. Solar photovoltaic panels collectors, parallel set, is located in the same light plane. Photovoltaic panels with direct drive of the dc circulating pump, without control instrument and control valve, the sun weak, collector of low temperature within, the current panels and weak, circulating pump rotation speed is also low, strong sunlight when water temperature of the high panel in the collector current is strong, circulating pump rotation speed is high also, no light, no panels current to produce, circulating pump will automatically stop, such photovoltaic cells and set the heat cycle completely in sync, high efficiency and reliable performance, no maintenance.

**Patents** A solar water heater (utility)

**Patent No.** ZL200420079480.7

**Brief Introduction**

A kind of solar water heater, involving a heat pressure type solar energy water heater, it has store hot water tank, and store hot water tank of connected in storage, specification of hot water inside the case heat coil, heat coil with one end of the cold water inlet connect, the other end and export into hot water. Its advantage is: store water in hot water tank normally only as a store hot medium, thus solved the vacuum tube appear scale, the thermal efficiency of the influence, need not often give solar energy water heater sheung shui, also reduce the vacuum tube sheung shui Fried tube happens, increase the service life of the vacuum tube; Use water from the cold water inlet into heat coil, from the hot water export outflow, the water clean health, the confined water use high pressure, use comfortable; Because is the heat water, hot water in the reservoir is almost always full of hot water, greatly improving the water heater in cold area of frost resistance; After the shutdown, still can guarantee a certain hot water for use.

Low-temperature solar energy selective absorbing coating and its preparation (utility)

ZL200710190483.6

A low temperature solar selective absorption coating, including in glass surface preparation thickness  $0.02-0.06 \times 10^{-6}m$  Cu Al or as the basic unit, in this grassroots on deposition thickness  $0.03 \times 10^{-6}m-0.15 \times 10^{-6}m$  Ge-C as infrared increase through layer, increase through the layer in the infrared again above preparation Al-N composite absorption material layer. The invention to target magnetron sputtering preparation of new solar absorbing coatings, increased the infrared increase through layer, the coating has the wavelength of 0.3-to 2.5  $\mu m$  within the scope of the sun long spectrum excellent absorption characteristics, the more important is the absorbing coatings of the basic level high absorption rate,  $\mu m$  above 8 of far infrared are good for the reflection action, but to 8  $\mu m$  the following of far infrared has high through the sexual, and that is when the temperature rise in the vacuum tube to  $90^{\circ}C-100^{\circ}C$ , the launch of membrane layer than would rise fast, increase collector to heat loss, prevent the system from overheating.

**Patents** A solar water heater (utility)

**Patent No.** ZL200620125800.7

**Brief Introduction**

A high temperature decreasing in solar energy, it in the glass tube coating substrate layer in turn have: a solar energy by copper sputter selective absorption coating, stainless steel metal group comprises clusters SS-C composite metal ceramic layer consists of the absorption layer, by excluding of amorphous metal containing hydrogen carbon film ( $\alpha C: H$ ) a reduction in the layer by layer,  $Al_2O_3$  composed of reducing the outside layer. Choose a kind of common low prices of the stainless steel to form a composite metal ceramic film of the new structure, adopt two layers of minus the layer to improve the performance of the specification, the coating of solar spectrum has excellent choice absorption sex and very low emission than performance. High temperature stability, anti-aging, to the sun full-color spectrum absorption rate: 94%, total emission rate 5% or less, can be in more than  $350^{\circ}$  temperature perennial use. The reduction of the usually shoot process can complete and low production cost, facilitate product large-scale production and promotion.



## Technologies

The hot wall technology, ITC intelligent the thermal technology, water guards, ITW testing technology

## Practicality

Simple Training

## Features & Advantage

Microcomputer navigation, special human nature intelligent control operating system, intelligent adjust the solar energy water heater system water temperature, USES the international leading "unsteady heat efficiency" calculation method, realize the volume, and the collection hot area of thermal properties of the best ratio, operating more relaxed, hot water is more convenient.

### ***Advanced science and technology to escort the quality guarantee***

And the German national ITW monitoring center cooperation, warmth in China takes the lead in a perfect industry, professional, accurate testing system. The first domestic the introduction of Germany, the original solar testing lines, maximum limit simulation of the worst solar outdoor environment test, the test items covering raw materials, components and the machine, inspection standard and inspection technology to achieve international laboratory professional level, make solar energy product can adapt to bad outdoor environment, to ensure that the quality.

### ***The insurance of solar energy to heat the wall had in winter***

The hot water tank/vacuum tube system system the hot/pipeline system the hot

The hot wall is a with national patent solar water heater system the thermal technology standards, including the hot water tank, the heat, the pipeline vacuum hot three system the hot technology, solve the problem of heat easily lost, the thermal performance increase 50%, by national authoritative testing institutions appraisal, have no sunlight conditions 100 hours water temperature constant 40 degrees.

### ***3 D conversion living water energy SPA***

Antiscale guards higher heat efficiency/guard more comfortable living water bath/water purification guards wash bath more healthy

Sunrain unique "water guard system, passing on British advanced" living water purification "technology, using 3 D magnetic frequency conversion technology, improve water substructure, activation water quality, effective inhibition, soften, increase the water dissolved and this moisture, hot water is more clean, more dynamic, bath more comfortable, more elastic skin, like skin SPA.

# Trina Solar Energy Co., Ltd.

## Introduction

Inspired by the growth of global solar PV industry and the United States' 'Million Solar Roofs' initiative in particular, Trina Solar was established in December of 1997 by Chairman Jifan Gao, along with a small group of scientists during the infancy of the Chinese solar PV industry.

Since then, the company has experienced outstanding growth and has become a leader in the global PV industry. Today, our high-quality modules provide clean and reliable solar electric power in on-grid and off-grid residential, commercial, industrial and utility-scale systems. With local sales offices and downstream partners all over the world, we are committed to improving the competitiveness of solar energy and to developing a sustainable solar industry.

## Contact us

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## Product

- < Mono Series TSM-DC80.08
- < Mono Series TSM-DC01A
- < Multi Series TSM-PC05
- < Multi Series TSM-PC05.08
- < TSM-PC14: Utility Scale Solar Module
- < Trinamount I - For tile roof
- < Trinamount II - For pitched roof
- < Trinamount III - For flat roof

### Mono Series TSM-DC80.08

The TSM-DC80.08 is the latest addition to Trina Solar's product portfolio. Utilizing the latest in-house "Quadmax" technology - high efficiency square-shape monocrystalline cells - the module's power output is boosted by up to 8% when compared to conventional modules. With the TSM-DC80.08's outstanding features, Trina Solar continues to provide our residential and commercial customers with the best \$/kWh solar value.



#### General Specifications

- Efficiency: **up to 16.4%**
- Years warranty: **25**
- Wattage: **up to 210W**

#### Mechanical Data

- Solar cells: Monocrystalline 125 x 125mm (5 inches)
- Cells orientation: 72 cells (6x12)
- Module dimension: 1581 x 809 x 40mm (62.24 x 31.85 x 1.57 inches)
- Weight: 15.6kg (34.4lb)
- Glass: High transparency solar glass 3.2mm (0.13 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connector: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 900mm (35.4 inches), MC4.

### Multi Series TSM-PC05.08

Currently Trina Solar's most popular panel. Versatile and adaptable, with power output ranging from 225 to 245Wp, the TSM-PC05.08 is perfect for largescale installations, particularly ground-mounted and commercial rooftop systems. Using reliable and carefullyselected components that are tested at the Trina Solar Center of Excellence, this panel comes with a 25-year performance guarantee of 80% power production.



#### General Specifications

- Efficiency: **up to 15.0%**
- Wattage: **up to 245W**
- Years warranty: **25**

#### Mechanical Data

- Solar cells: Multicrystalline 156 x 156mm (6 inches)
- Cells orientation: 60 cells (6x10)
- Module dimension: 1650 x 992 x 40mm (64.95 x 39.05 x 1.57 inches)
- Weight: 19.5kg (43.0lb)
- Glass: High transparency solar glass 3.2mm (0.13 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connector: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 1000mm (39.4 inches), MC4/H4

### Multi Series TSM-PC05

Currently Trina Solar's most popular panel. Versatile and adaptable, with power output ranging from 225 to 245Wp, the TSM-PC05 is perfect for large-scale installations, particularly ground-mounted and commercial rooftop systems. Using reliable and carefullyselected components that are tested at the Trina Solar Center of Excellence, this panel comes with a 25-year performance guarantee of 80% power production.

#### General Specifications

- Efficiency: **up to 15.0%**
- Years warranty: **25**
- Wattage: **up to 245W**



#### Mechanical Data

- Solar cells: Multicrystalline 156 x 156mm (6 inches)
- Cells orientation: 60 cells (6x10)
- Module dimension: 1650 x 992 x 40mm (64.95 x 39.05 x 1.57 inches)
- Weight: 19.5kg (43.0lb)
- Glass: High transparency solar glass 3.2mm (0.13 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connectors: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 1000mm (39.4 inches), MC4/H4

### Mono Series TSM-DC01A

The optimized corners of the cells used in our TSM-DC01A enlarge the module's energy generating surface by 4.2%. Additionally, each cell now has 54 gridlines on the top surface, which improves energy flow.



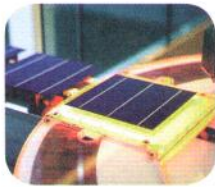
Through these improvements, this module now generates up to 195W. It is the perfect size for residential and small commercial installations.

#### General Specifications

- Efficiency: **up to 15.2%**
- Years warranty: **25**
- Wattage: **up to 195W**

#### Mechanical Data

- Solar cells: Monocrystalline 125 x 125mm (5 inches)
- Cells orientation: 72 cells (6x12)
- Module dimension: 1581 x 809 x 40mm (62.24 x 31.85 x 1.57 inches)
- Weight: 15.6kg (34.4lb)
- Glass: High transparency solar glass 3.2mm (0.13 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connector: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 900mm (35.4 inches), MC4



### TSM-PC14: Utility Scale Solar Module

The NEW TSM-PC14 is the newest addition to Trina Solar's premium portfolio of multicrystalline modules. With power outputs ranging from 265 to 285 Watt, the modules are designed specially

for utility-scale installations. Along with the rest of Trina Solar's module portfolios, the PC14 provides the highest Quality and power output to our utility-scale customers.

#### General Specifications

- Efficiency: **up to 14.7%**
- Years warranty: **25**
- Wattage: **up to 285W**

#### Mechanical Data

- Solar cells: Multicrystalline 156 x 156mm (6 inches)
- Cells orientation: 72 cells (6x12)
- Module dimension: 1956 x 992 x 46mm (77 x 39.05 x 1.81 inches)
- Weight: 28kg (61.7lb)
- Glass: High transparency solar glass 4.0mm (0.16 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connectors: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 1250mm (49.2 inches), MC4

### Trinamount II - For pitched roof

Combining PV module expertise with a highly innovative mounting system solution, Trina Solar is introducing Trinamount—the fastest, easiest and least expensive way to mount PV modules onto



residential and commercial rooftops. With a series of drop-in and quarter-turn connections on a specialized module frame, this mounting solution installs up to 5 times faster than conventional mounting systems. Trinamount connects directly to the module frame, eliminating the need for long rails. General Specifications

Efficiency: **up to 14.7%**

Wattage: **up to 240W**

Years warranty: **25**

#### Mechanical Data

- Solar cells: Multicrystalline 156 x 156mm (6 inches)
- Cells orientation: 60 cells (6x10)
- Module dimension: 1650 x 992 x 40mm (64.95 x 39.05 x 1.57 inches)
- Weight: 19.5kg (43.0lb)
- Glass: High transparency solar glass 3.2mm (0.13 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connectors: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 1000mm (39.4 inches), MC4/H4

### Trinamount I - For tile roof

Combining PV module expertise with a highly innovative mounting system solution, Trina Solar is introducing Trinamount—the fastest, easiest and least expensive way to mount PV modules onto residential and commercial rooftops. With a series of drop-in and quarter-turn connections on a specialized module frame, this mounting solution installs up to 5 times faster than conventional mounting systems. Trinamount connects



directly to the module frame, eliminating the need for long rails. By drastically reducing the number of parts, cost of materials and installation time, Trinamount offers the optimal solution for residential and commercial installations.

#### General Specifications

- Efficiency: **up to 14.7%**
- Years warranty: **25**
- Wattage: **up to 240W**

#### Mechanical Data

- Solar cells: Multicrystalline 156 x 156mm (6 inches)
- Cells orientation: 60 cells (6x10)
- Module dimension: 1650 x 992 x 40mm (64.95 x 39.05 x 1.57 inches)
- Weight: 19.5kg (43.0lb)
- Glass: High transparency solar glass 3.2mm (0.13 inches)
- Frame: Anodized aluminum alloy
- J-Box: IP 65 rated
- Cables/connectors: Photovoltaic technology cable 4.0mm<sup>2</sup> (0.006 inches<sup>2</sup>), 1000mm (39.4 inches), MC4/H4



# TBEA SUNOASIS Co., Ltd.

## Main Business

Design, Installation, Debugging of Solar PV system and the relevant management activity; Design, Manufacture, Service of home power supply product, power supply controller and the relevant management activity; Manufacture, Service of Monocrystalline silicon Ingot, Monocrystalline silicon wafer, polycrystalline silicon wafer, solar module and the relevant management activity.

## Introduction

TBEA Xinjiang Sunoasis Co., Ltd. is a national hi-tech enterprise specializing in the solar energy application technology research, product development and utilization. The company implements the construction and operation surrounding the R&D, production and system integration of the solar grade silicon wafer, solar module, and charger and inverter system, establishes good strategical partnership with the top 500 world enterprises such as BP, Shell, and sets up two big production bases in xinjiang and xi'an. The company has come to be one of the biggest solar energy system intergrators in China. The company has built over 3000 off-grid and on-grid solar PV power stations in such fields as railway, communication, informationalization, traffic, petroleum, military, tourism, desert virescence, etc.

The company possesses reliable, green and efficient PV industrial chain, engaging in the R&D and production of off-grid and on-grid PV inverter and charger, solar module, bid-diameter solar mono(poly) crystal silicon wafer, and other high-precision, high-powered, low-cost solar PV products. The company unites with the BP Solar Co. to establish the BP Sunoasis Co., Ltd. by joint venture in Xi'an city, which is able to provide high-quality, high-efficiency, low-cost solar module on the basis of the faithfully-united, factualistic, innovative hi-tech R&D team and the internationally-advanced high-performance solar module product line. The company possesses, the stable worldwide marketing channel created throught the world-famous trademarks as TBEA, BP solar, and the supply chain formed by the global integration of various forms between poly-crystalline silicon, silicon wafers and solar cells.

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## Product

- < TBEA Solar Module
- < Grid-connected PV Inverter

## InventionsPatent

- < A Single-phase Non-isolated PV Inverter and Control Methods
- < Non-isolation Grid-connected PV Inverter and its Control Methods
- < Inverter's Phase-lock Control System and Phase-lock Methods
- < PV Array Combiner Box
- < Null Current Flow Compensation Method and Device for Grid-connected PV Inverter
- < Single Phase Non-isolation Grid-connected PV Inverter and its Control Methods
- < A Grid-connected PV Inverter and its AC Output Filtering Method
- < Three-phase Four-bridge-wall Inverter and Its Grid-connected Generation System



<b>Product</b>	TBEA Solar Module
<b>Type &amp; Specification</b>	TBEA485/TBEA4185 /TBEA3230/TBEA3270/TBEA4300
<b>Brife Introduction</b>	<ul style="list-style-type: none"> <li>&lt; High transformation efficiency based on world-leading PV technology to realize excellent and efficient perfect combination.</li> <li>&lt; Endurable of extreme temperature changes in different regions.</li> <li>&lt; Customizable to satisfying customers' special demands.</li> <li>&lt; The products pass TUV &amp; CE &amp; UL certification.</li> <li>&lt; They can be used in the public on-grid system, commercial roofing on-grid system, off-grid groundwork system, etc.</li> </ul>
<b>Performance Indicator</b>	<p>12 years limited warranty of 92% power output;          25 years limited warranty of 85% power output;          5 years limited warranty of materials and workmanship.</p>
<b>Features &amp; Advantage</b>	<p>Advanced solar module production capability          Reliable technology workmanship          Exceclent module production equipment          Advanced module test capability          Advanced testing lab          QA above industry standard</p>



Grid-connected PV Inverter **Products**

TBEA-GC-250KTL **Type & Specification**

**Brife Introduction**

TBEA-GC-250KTL Grid-connected Inverter converts DC electricity generated by PV arrays from sunlight to sine-wave current of the same frequency and phase with the grid, and feed it into the grid, with output power of 250kW. The inverter has MPPT function that can trace max. output power of solar PV modules in real time, low voltage running through function, and perfect LCD and LED display function that can display all system operation parameters and operation status in real-time and can provide history data and fault conditions on line. Moreover, the inverter has Grid-connected passive protection function and alarming function. Therefore, when there are grid over/under voltage, system over/under frequency, input/output short circuit, overload, IGBT overheating, passive protection can be provided to insure stable and reliable operation of the system. LVRT (low voltage running through) function can ensure that the system can sustain certain degree of low voltage in case of the grid voltage dip. The active and passive islanding testing technology can achieve reliable anti-islanding control. RS232/485 and Ethernet can achieve long-distance data collection and monitoring.



**Performance Indicator**

In case of fault from inverter system, arrays and grid, the system shall break with the grid through contact switch.

With over current protection and short circuit protection, and UL1741-1999 testing standard. When Grid-connected current harmonic is with rated load, THD < 3%. Various order harmonic waves are in compliance with international standard: IEEE Std 929-2000 and IEEE-1547-2003.

Anti-islanding testing function, with its testing standard UL1741-1999, IEEE Std 929-2000, and IEC62116;

Grounding fault monitoring function, achieving real-time monitoring of array leakage current. DC component of Grid-connected current <0.5%, with its testing standard UL1741-1999.

Normal grid-connection when unbalancedness of three-phase grid is less than 5%.

MPPT precision can reach 99% and above.

Self-recovery from fault; it can automatically recover to grid-connection condition when the system shuts down and faults are removed.

<b>Inventions Patents</b>	A Single-phase Non-isolated PV Inverter and Control Methods	Non-isolation Grid-connected PV Inverter and its Control Methods
<b>Patent No.</b>	201110047538.4	201110098675.0
<b>Brief Introduction</b>	<p>This invention is about a single-phase non-isolated Grid-connected PV inverter and control method. The inverter is comprised of full-bridge circuit, control circuit and follow-current diode. The said control circuit excises control over break over and cutoff of switching tubes in full-bridge circuit so that the full-bridge circuit shall convert DC voltage from PV arrays to sine wave voltage suitable for grid connection. The said follow-current diode shall give follow-current loop so that the input side and the grid can break completely. The Grid-connected PV inverter can effectively suppress common-mode current (ie. Leakage current) from single-phase non-isolated inverter, thus improving the inverter's efficiency of electricity conversion.</p>	<p>This invention is about a non-isolation Grid-connected PV inverter, in which there are full-bridge circuit and control circuit. The full-bridge circuit is an asymmetric H6 topological structure composed of 6 switching tubes. The control circuit sends control signal to switching tubes so that the full-bridge circuit converts DC voltage generated by PV array to sine-wave voltage suitable for grid connection. Moreover, the asymmetric H6 topological structure of the full-bridge circuit can have follow current loop that disconnects from the DC side, thus effectively curbing the generation of common-mode current and improving reliability of Grid-connected PV inverter because of small switch power-consumption and even allocation. In addition, the invention presents corresponding control methods.</p>
<b>Inventions Patents</b>	Inverter's Phase-lock Control System and Phase-lock Methods	PV Array Combiner Box
<b>Patent No.</b>	201110108506.0	201110162461.5
<b>Brief Introduction</b>	<p>The invention is about a phase-lock control system for inverter. The control system is comprised of the following units. 1. Frequency Modulation Unit that adjusts the frequency difference between target signal and output signal to get the first regulating quantity. 2. Phase-lock Unit that adjusts the fundamental wave phase difference between target signal and output signal to get the second regulating quantity. 3. Phase-measurement Unit that adds the first and second regulating quantity together to get the total phase adjustment quantity, and accumulates the total phase adjustment quantity to the present phase angle of the output signal in order to get the adjusted phase angel of the output signal. 4. Output Unit that gets fundamental wave sinusoidal quantity and cosine quantity of the output signal based on the adjusted phase angel of the output signal, and feeds them back into Phase-lock Unit. The invention also provides the corresponding phase-lock methods. The phase-lock control system and its phase-lock methods in this invention can achieve reliable phase-lock even when the grid distortion arises or the sampling interferes the operating conditions.</p>	<p>The invention is a kind of PV array combiner box, including two aspects. First, the multi-channel DC input branch, the positive and negative input of each of the DC input branches was connected to the positive and negative input of the PV array so that the positive and negative output of each DC input branch was converged into a positive and negative output, connecting to the positive and negative input of the inverter. Besides, every DC input branch includes the Max Power Tracking Unit used for tracking the Max Output Power of the PV array of the branch. Second, the controlling unit, used for confirming the Max Output Power of every DC input branch of the PV array, controls the corresponding Max Output Power tracked in every DC input branch. This invention of combiner box helps the PV array to always keep a Max Power, enabling each branch of the PV array to offer electricity for the backward stage so that it improves the utilization of the solar power in the PV power system.</p>

# United Nations Industrial Development Organization International Solar Energy Center for Technology Promotion & Transfer



ISEC, jointly established by UNIDO and the Chinese Government with the signing ceremony at Vienna on 1st December 2005, is the sole body for the promotion and transfer of solar energy technologies and products.



## Objective

- ISEC aims at facilitating the promotion and transfer of solar and other renewable energy technologies. It also helps to improve energy structure, to increase energy conservation and reduce pollution emissions, to address climate change and protect the environment. It promotes the South-South cooperation and economic and social sustainable development of the whole world, and the developing countries in particular.
- Working together with the people of the developing countries and the whole world, ISEC strives to eliminate poverty, realize the Millennium Development Goals, to increase energy security, promote peace, development and human prosperity.

*A partner for promoting the development  
of solar enterprising in the world  
A promoter for addressing the global climate change*

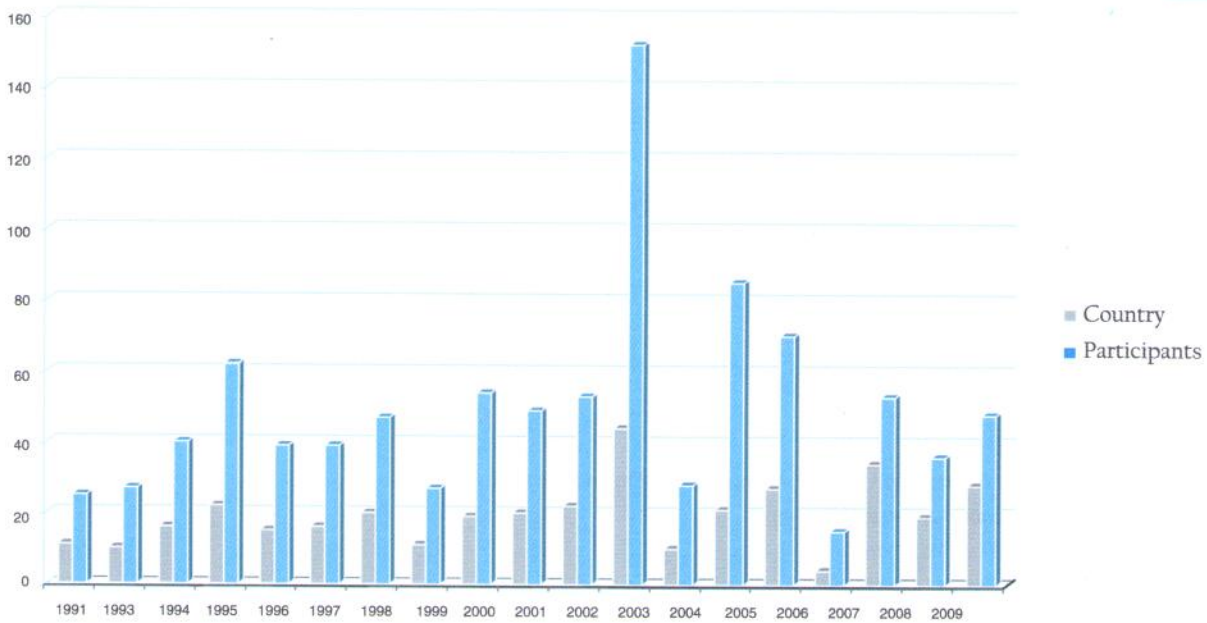
## Mission

- To promote the transfer of mature, appropriate and advanced technologies and products of solar and other renewable energies in the world, particularly in developing countries;
- To sponsor and organize training classes on appropriate solar and other renewable energy technologies in an effort to upgrading technology levels and enhancing the capacity-building of the public sector, enterprises and individuals in developing countries in utilizing solar energy technologies;
- To sponsor and organize regional and international conferences, forums and exhibitions on solar energy to provide a platform for the transfer of technology and exchange of product information, thereby promoting international cooperation and exchange on the utilization of solar energy products from developing countries so as to speed up the South-South cooperation and South-North cooperation;
- To establish R&D bases for solar technology industrialization, testing centers and demonstration programmes with regional or international standards in selected regions and enterprises in the world, particularly in developing countries;
- To set up solar and other renewable energy database or directory on technology, products, standard, policy, resources, market, human talents, research institutions and enterprises, together with the cooperation of government agencies, non-governmental organizations, research institutions and enterprises;
- To jointly publish annual report on solar research and application with relevant international agencies and non-governmental organizations;
- To implement technology research projects and joint projects with relevant research institutions and enterprises to address current and future solar and other renewable energy problems;
- To jointly investigate the problems and difficulties in solar and other renewable energies faced by many countries, particularly developing countries in areas such as R&D, application, testing methods, standards, preferential policies, talent and funding.



With the support from the Chinese Ministry of Commerce, Ministry of Science and Technology, Ministry of Foreign Affairs, the United Nations and other international organizations, ISEC has, since 1991, held 32 "International Training Workshops" and trained nearly 1000 solar technical personnel from 105 countries worldwide.

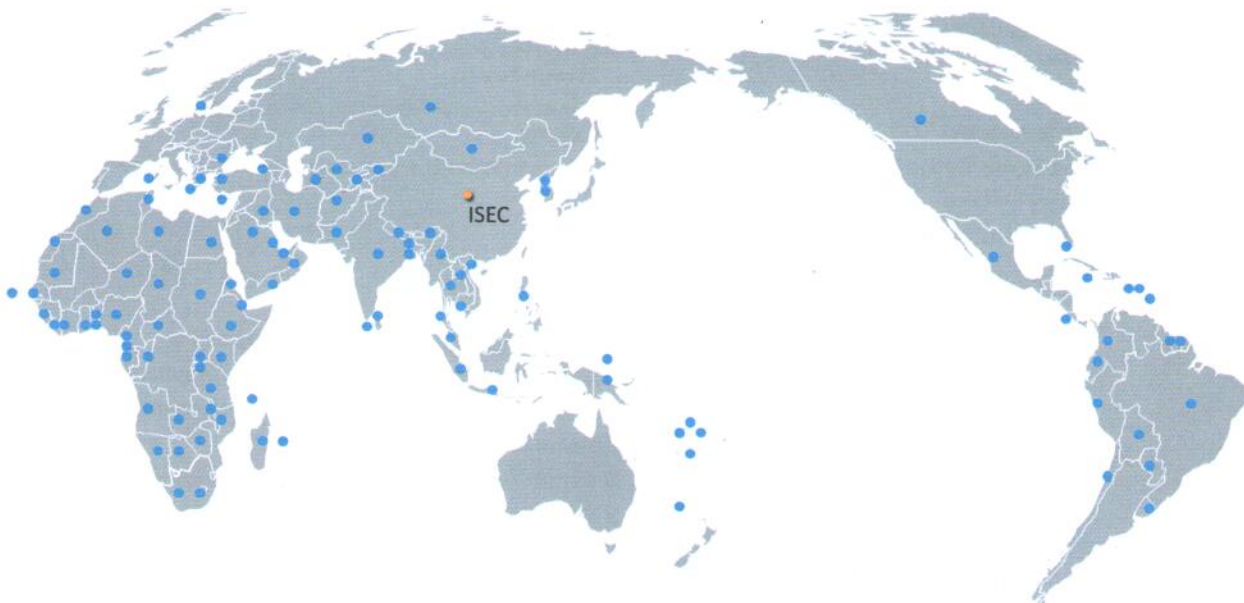




Statistics of International Solar Energy Training Workshops

**Trainees from:**

Afghanistan, Albania, Angola, Bahrain, Palestine, Bangladesh, Barbados, Benin, Botswana, Brazil, Burundi, Cape Verde, Cambodia, Central Africa, Gambia, Colombia, Cameroon, Congo-Brazzaville, Congo-Kinshasa, Costa Rica, Côte d'Ivoire, Cuba, Cyprus, North Korea, Dominica, Djibouti, East Timor, Ecuador, Egypt, Eritrea, Ethiopia, Fiji, Gabon, Georgia, Ghana, Guinea Bissau, Equatorial Guinea, Guyana, Guinea, India, Indonesia, Iran, Iraq, Jamaica, Kenya, Kiribati, Korea, Kyrgyzstan, Laos, Lesotho, Libya, Liberia, Lithuania, Micronesia, Macedonia, Madagascar, Malaysia, Maldives, Mali, Malta, Morocco, Mauritania, Mauritius, Mexico, Mongolia, Mozambique, Myanmar, Namibia, Nepal, Niger, Nigeria, Oman, Pakistan, Papua New Guinea, Peru, Philippines, Romania, Russia, Rwanda, Samoa, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, South Africa, Sri Lanka, Sudan, Suriname, Syria, Tajikistan, Tanzania, Thailand, Tonga, Togo, Tunisia, Turkey, Uganda, Uruguay, United Arab Emirates, Uzbekistan, Vanuatu, Vietnam, Yemen, Yugoslavia, Zambia, Zimbabwe, Antigua and Barbuda, etc.



# UNIDO International Solar Energy Center for Technology Promotion & Transfer

### Administration Organs

- Administration office
- Division for International Cooperation for Technology Promotion and Transfer
- Division for Technology Consultation and Training
- Division for Research and Development
- Division for Finance and Assets Management

### Research and Development Organs

- Solar Building Design Institute
- Division of Solar Thermal Technology
- Division of Solar Photovoltaic Technology
- Division of Solar Water Treatment
- Division of Biomass Energy Technology
- Division of Wind Energy Technology
- Division of Rural Energy Technology
- Division of Energy-Saving Technology
- Division of Renewable Energy Development Strategy and Policy
- Network Center for Solar Energy Information

### Laboratories

- Laboratory of Solar Thermal Technology
- Laboratory of Solar Photovoltaic Technology
- Laboratory of Solar Thermal Equipment
- The Optical Parameters Laboratory
- Sky Radiation Laboratory
- Chemical Laboratory
- Laboratory of Biomass Technology
- Laboratory of Wind Energy Application Technology
- Laboratory of New Energy Material
- Laboratory of Energy-Saving Technology

### Academic Organizations

- Academic Committee
- Title Evaluation Committee
- Senior Experts and Senior Advisor Committee
- Chief Engineer Office

### International, National and Provincial Organization

- UNDP (Lanzhou) Solar Heating and Cooling Experiment and Demonstration Base
- Asia-Pacific Research and Training Center for Solar Energy  
United Nations University (China) Association Institution
- China Ministry of Science and Technology "International Science and Technology Cooperation Base"
- Gansu Provincial Solar Energy Technology Research Center
- Gansu Provincial Key Laboratory of Solar Photovoltaic
- Gansu Provincial Demonstration and Promotion Base of Drawing on Foreign Talents
- Gansu Provincial Promotion Office of Green and High-Efficient Lighting
- Solar and Wind Energy Association of Gansu Province

### Testing, Consulting and Development Entities

- Solar Building Design Institute
- Solar Products Evaluation and Testing Center
- Gansu Renewable Energy Technology Consultation Center
- Lanzhou Keneng New Technology Development Corporation
- Gansu GNERI Solar Power Co., Ltd
- Gansu China-solar Energy-Saving Construction Material Co., Ltd
- Gansu Solar New Energy Engineering Technology Co., Ltd