Solar basics

Solar energy is the cleanest and most inexhaustible of all known energy sources. Solar radiation is the heat, light and other radiation that is emitted from the sun. Solar radiation contains huge amounts of energy and is responsible for almost all the natural processes on earth. The suns energy, although plentiful, has been hard to directly harness until recently.

Solar Energy can be classified into two categories, Thermal and Light. Photo-voltaic cells (PV) use semiconductor-based technology to convert light energy directly into an electric current that can either be used immediately, or stored in a battery, for later use. PV panels are now becoming widely used as they are very versatile, and can be easily mounted on buildings and other structures. They can provide a clean, renewable energy source which can supplement and thus minimize the use of mains electricity supply. In regions without main electricity supply such as remote communities, emergency phones etc, PV energy can provide a reliable supply of electricity. The disadvantage of PV panels is their high cost and relatively low energy conversion rate (only 13-15%). Thermal solar on the other hand has average efficiency levels 4-5 times that of PV, and is therefore much cheaper per unit of energy produced.

Thermal energy can be used to passively heat buildings through the use of certain building materials and architectural design, or used directly to heat water for household use. In many regions, solar water heaters are now a viable supplement or alternative to electric or gas hot water production.

Thermal energy obtained from the sun can be used for a number of applications including producing hot water, space heating and even cooling via use of absorption chilling technology.

Using solar and other forms of renewable energy reduces reliance on fossil fuels for energy production, thus directly reducing CO_2 emissions. CO_2 emissions contribute to global warming, an environmental issue which is now of great concern. The average household can reduce CO_2 emissions by as much as 20% by installing a solar collector.

Flat plate thermal solar collectors have been in use for several decades, but only in relatively small numbers, particularly in Western countries. Evacuated tubes have also been in use for more than 20 years, but have been much more expensive than flat plate, and therefore only chosen for high temperature applications or by those with money.

In recent years the production volume of evacuated tubes has exploded, resulting in greatly lower manufacturing and material costs. The result is that evacuated tubes are now similar in price to flat plate, but with the insulating benefits of the evacuated tube, they are set to become the default choice for thermal solar applications worldwide.

Solar collectors

There are basically three types of thermal solar collectors: flat-plate, evacuated-tube and concentrating.

Flat-Plate collectors comprise of an insulated, weatherproof box containing a dark absorber plate under one or more transparent or translucent covers. Water or heat conducting fluid passes through pipes located below the absorber plate. As the fluid flows through the pipes it is heated. This style of collector, although inferior in many ways to evacuated tube collectors, is still the most common type of collector in many countries./h2>

Evacuated Tube solar water heaters are made up of rows of parallel, glass tubes. There are several types of evacuated tubes (sometimes also referred to as Solar Tubes).

Type 1 (Glass-Glass) tubes consists of two glass tubes which are fused together at one end. The inner tube is coated with a selective surface that absorbs solar energy well but inhibits radioactive heat loss. The air is withdrawn ("evacuated") from the space between the two glass tubes to form a vacuum, which eliminates conductive and convective heat loss. These tubes perform very well in overcast conditions as well as low temperatures. Because the tube is 100% glass, the problem with loss of vacuum due to a broken seal is greatly minimized. Glass-glass solar tubes may be used in a number of different ways, including direct flow, heat pipe, or U pipe configuration uses a high efficiency heat pipe and heat transfer fin design to conduct the heat from within the evacuated tube up to the header. For more information about heat pipes, click here.

Type 2 (Glass-Metal) tubes consist of a single glass tube. Inside the tube is a flat or curved aluminum plate which is attached to a copper heat pipe or water flow pipe. The aluminum plate is generally coated with Tin ox, or similar selective coating. These types of tubes are very efficient but can have problems relating to loss of vacuum. This is primarily due to the fact that their seal is glass to metal. The heat expansion rates of these two materials. Glass-glass tubes although not quite as efficient glass-metal tubes are generally more reliable and much cheaper.

Type 3 (Glass-glass - water flow path) tubes incorporate a water flow path into the tube itself. The problem with these tubes is that if a tube is ever damaged water will pour from the collector onto the roof and the collector must be "shut-down" until the tube is replaced.

Concentrating collectors for are usually parabolic troughs that use mirrored surfaces to concentrate the sun's energy on an absorber tube (called a receiver) containing a heat-transfer fluid, or the water itself. This type of solar collector is generally only used for commercial power production applications, because very high temperatures can be achieved. It is however reliant on direct sunlight and therefore does not perform well in overcast conditions.

Types of Solar Water Heating Systems

Solar water heating systems (SWHS) can be either active or passive. An active system uses an electric pump to circulate the fluid through the collector; a passive system has no pump and relies on thermo-siphoning to circulate water. The amount of hot water a solar water heater produces depends on the type and size of the system, the amount of sun available at the site, installation angle and orientation. SWHS are also characterized as open loop (also called "direct") or closed loop (also called "indirect"). An open-loop system circulates household (potable) water through the collector. A closed-loop system uses a heat-transfer fluid (water or diluted antifreeze) to collect heat and a heat exchanger to transfer the heat to the household water. A disadvantage of closed looped system is that efficiency is lost during the heat exchange process.

Active Systems

Active systems use electric pumps, valves, and controllers to circulate water or other heat-transfer fluids through the collectors. They are usually more expensive than passive systems but generally more efficient. Active systems are often easier to retrofit than passive systems because their storage tanks do not need to be installed above or close to the collectors. If installed using a PV panel to operate the pump, an active system can operate even during a power outage.

Open-Loop Active Systems

Open-loop active systems use pumps to circulate household potable water through the collectors. This design is efficient and lowers operating costs but is not appropriate if water is hard or acidic because scale and corrosion will gradually disable the system. Open-loop active systems are popular in regions that do not experiences subzero temperatures. Flat plate open-loop systems should never be installed in climates that experience sustained periods of subzero temperatures. The TM AP solar water heater can be installed in an open loop in areas that experience sub-zero temperatures as long as the solar controller has a low temperature function.

Closed-Loop Active Systems

These systems pump heat-transfer fluids (usually a glycol-water antifreeze mixture) through the solar water heater. Heat exchangers transfer the heat from the fluid to the water that is stored in tanks. Double-walled heat exchangers or twin coil solar tanks prevent contamination of household water. Some standards require double walls when the heat-transfer fluid is anything other than household water. Closed-loop glycol systems are popular in areas subject to extended subzero temperatures because they offer good freeze protection. However, glycol antifreeze systems are more expensive to purchase and install and the glycol must be checked each year and changed every few years, depending on glycol quality and system temperatures.

Drain back systems use water as the heat-transfer fluid in the collector loop. A pump circulates the water through the solar water heater. When the pump is turned off, the solar water heater drains of water, which ensures freeze protection and also allows the system to turn off if the water in the storage tank becomes too hot. A problem with drain back systems is that the solar water heater installation and plumbing must be carefully positioned to allow complete drainage. The pump must also have sufficient head pressure to pump the water up to the collector each time the pump starts. Electricity usage is therefore slightly higher than a sealed closed or open loop.

Solar collectors are ideal for use in active (open or closed) systems.

Passive Systems

Passive systems move household water or a heat-transfer fluid through the system without pumps. Passive systems have the advantage that electricity outage and electric pump breakdown are not issues. This makes passive systems generally more reliable, easier to maintain, and possibly longer lasting than active systems. Passive systems are often less expensive than active systems, but are also generally less efficient due to slower water flow rates through the system.

Thermosiphon Systems

A thermosiphon system relies on warm water rising, a phenomenon known as natural convection, to circulate water through the solar absorber and to the tank. In this type of installation, the tank must be located above the absorber tubes/panel. As water in the absorber heats, it becomes lighter and naturally rises into the tank above. Meanwhile, cooler water in the tank flows downwards into the absorber, thus causing circulation throughout the system. This system is widely used with both flat plate and evacuated tube absorbers. The disadvantages of this design are the poor aesthetics of having a large tank on the roof and the issues with structural integrity of the roof. Often the roof must be reinforced to cope with the weight of the tank.

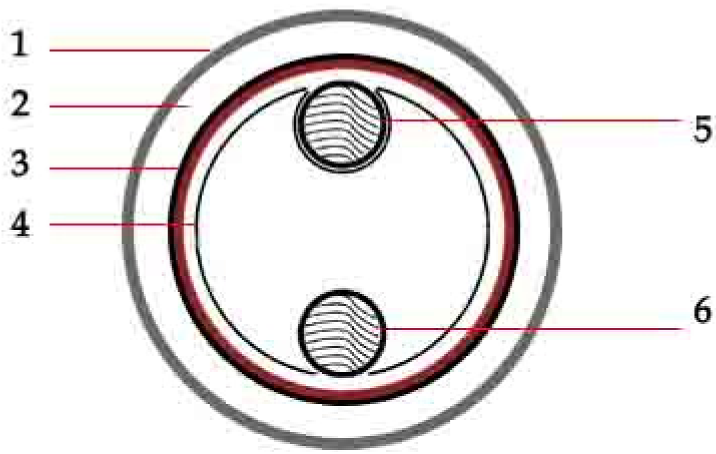
Batch Heaters

Batch heaters are simple passive system consisting of one or more storage tanks placed in an insulated box that has a glazed side facing the sun. Batch heaters are inexpensive and have few components, but only perform well in summer when the weather is warm. Evacuated tube solar collectors are now an affordable and much more efficient alternative to either batch or flat plate collectors.

Pressure type

U pipe solar collector

In each vacuum tube there is a U pipe with direct flow-through that is connected to the header pipe inside manifold. This U pipe is seamed in an aluminum heat transfer fin in the interior of vacuum tube that transmits the heat from the interior tube to the U pipe. Solar radiation permeates the outer glass tube and is captured on the outside of inner glass tube by highly selective sputter layer. The captured solar radiation is transmitted to flush-contact aluminum shield and then copper pipe filled with heat transfer fluid. The 360¡ãaluminum heat transfer fin assures the fastest energy transfer.



1.Outer glass
2.Vacuum
3.Selective coating
4.Aluminum heat transfer fin
5.U pipe(Hot terminal)
6.U pipe(Cold terminal)

Solar Glossary

Solar Water Heater is a complete operating system that uses energy from the sun to produce hot water and comprises one or more collectors, one or more hot water storage tanks and all necessary interconnecting pipes and functional components.

Here is a list of some terms you may encounter when reading through our web site.

We have tried to make explanations as easy to understand as possible, if you are still un-clear please feel free to contact us.

A-B-C-D-E-F-G-H-I-P

A

Aperture

Area that unconcentrated solar radiant energy is admitted to the absorber. For evacuated tubes this refers to the cross-sectional surface area of the outer clear glass tube measured using the internal diameter, not the outside diameter.
(E.g. 0.0548m x 1.72m = 0.094m2). 1.72m is the exposed length of the evacuated tube.

Absorber

The part of the collector that actively absorbs the light rays. For solar tubes this is defined as the cross-sectional area of the inner tube (selective coated) measured using the outside diameter. (E.g. 0.047 x 1.72m = 0.08m2) This value is used when calculating efficiency values. For solar tube collectors with reflective panels, the entire circumferential surface area of the inner tube is often used when calculating absorber area, as the reflective panel is supposed to reflect light onto underside of the evacuated tube. The AP solar collector does not use reflective panels, learn why by clicking here.

B

BTU

BTU - Stands for British Thermal Units. This is an imperial unit of measurement for heat widely used in the US and also in the UK. The conversion to the metric unit kWh is: 1 kWh = 3412Btu, and for surface area values, 1kWh/m2/day = 314Btu/ft2/day

C

Collector

Device that contains or incorporates an absorber and a means for transferring thermal energy from the absorber to a fluid passing through the collector.

A solar collector is not really a solar water heater. A solar water heater is a system which may include a tank, pump, controller and solar collector panel. A solar collector is that part of the system which absorbs the sun's energy and converts it into heat. The AP model is separate from the tank as so is a solar collector.

Celsius

The metric unit for temperature measurement. Convert as follows:
Fahrenheit = (oC x 1.8) + 32
Celsius = (oF - 32)/1.8

For Delta-T measurements the relative temperature difference is needed.
Eg. Delta-T = 7oC turn pump on, Delta-T 2oC turn pump off. How much is that in oF??
The conversion from Fahrenheit to Celsius is simple:
Fahrenheit = oC x 1.8
Celsius = oF / 1.8

D

Delta-T Controller: Delta-T refers to the difference in two temperatures. This term is often use in relation to a solar controller. In such case the Delta-T is the difference between the solar collector temperature and the temperature of the water in the solar storage tank. A Delta-T controller can be configured to turn on the pump when the Delta-T difference exceeds a certain level (Eg.7oC / 12.7oF) and off again when the temperature difference drops below another setting (Eg. 2oC / 3.6oF). The controller turns on the pump when there is heat potential in the manifold. A Delta-T controller can also be used to provide freeze protection by circulating warm water from the tank through the manifold when the manifold temperature drops below 5oC.

E

Efficiency

Solar collector efficiency is usually expressed as a percentage value, or in a performance graph. When assessing a collector's performance make sure it is based on the correct surface area values. Eg. If performance values are based on gross area, then the gross area must be used when determining total heat output. IAM values have a significant influence on actual heat output throughout the day, and should be considered. Looking at just the percentage efficiency value will not give a true indication of daily heat output.

Efficiency testing is usually completed by testing bodies such as SPF, SRCC and other government approved testing bodies.

Tm* is the x axis value on performance graphs for solar collectors.

Tm* is calculated as:

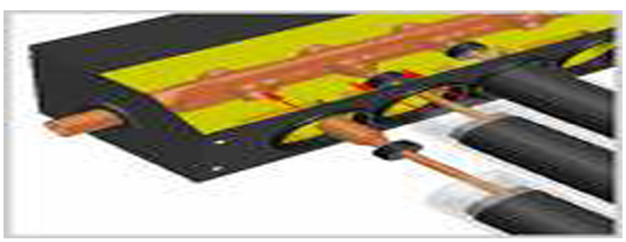
(water temp - ambient temp)/Insulation

E.g. (44oC - 20oC)/800Watts = 0.03

F

Fluid channels

Channels in a solar water heater through which heat transfer fluid flows.



Flow Rate

The volume of water flowing through plumbing in a given period of time. Usually measured in volume/minute or volume/hour. 1 Litre/min = 0.264 US Gallon/min

G

Gross Area

The total surface area of the collector including the frame, manifold and absorber. This area is often used when comparing collectors, but a better comparison to use is value for money. Roof size is not usually a limiting factor for domestic solar water heating installations, so the size of the collector is not really that important.

H

Hot water storage tank

A hot water storage tank is intended to be installed on the outside or inside of a building, the main function of the hot water storage tank is to store and keep hot water for user. This tank should be effectively protected.

products protect the hot water storage tank by means of a steel outer casing, that can resist against the effect of rain,wind,hailstone and other elements. Seams on the outer casing and the entry holes for pipe connections are effectively sealed to make a permanent watertight closure. All exposure piping or fittings (or both) which form part of the storage tank are non-corrosive material or protected against corrosion.

Heat transfer fluid

Medium, such as air, water or other fluid that passes through a collector and carries absorbed thermal energy from the collector to the water to be heated.

Heat Pipe

An evacuated rod or pipe used for heat transfer.

I

Insolation

Don't confuse this with insulation - the one letter change makes a big difference. Insolation refers to the amount of sunlight falling on the earth. Click here to learn more

Insulation

The ability to protect against transfer of heat/cold. solar collectors use compressed glass wool to insulate the header from heat loss. Glass wool has excellent insulation properties, is very light and can withstand high temperatures, making it an ideal choice for a solar collector. It is made from at least 80% old glass bottles and can be recycled so is very environmentally friendly.

The thermal insulation should fit the follows requirements:

a) it does not unduly compress after installation.

b) when in contact with a metal, it does not cause corrosion of the metal.

c) it does not react or decompose in the presence of heat in a manner that will produce corrosive salts or vapors.

d) it is dimensionally stable under dry conditions at the maximum expected temperatures likely to be reached in the collector or when exposed to the effects of UV radiation, and

e) it is dimensionally stable under wet or damp conditions and does not absorb water.

Irridance, Irridation

Basically the same as Insolation - explained above.

Incidence Angle Modifier (IAM)

Refers to the change in performance as the sun's angle in relation to the collector surface changes. Perpendicular to the collector (usually midday) is expressed as 0o, with negative and positive angles in the morning and afternoon respectively. Collectors with a flat absorber surface, which includes some types of evacuated tubes, only have 100% efficiency at midday (0o), whereas solar tubes provide peak efficiency mid morning and mid afternoon, at around 40o from perpendicular. This results in good stable heat output for most of the day.

P

Pressure

Refers to the water pressure in the system. The conversions for the most commonly used units are: 1 bar = 1.02kg/cm2 = 14.5psi = 100kPa = 0.1Mpa = 10m water head

A solar water heater shall be designed for a certain working pressure as zero(non-pressurized type system),100kPa,200kPa,300kPa,400kPa or so on, as required. The design and construction of any component or system shall be such that, when the component or system is under testing there is no failure that could affect the acceptable operation of the component or system.

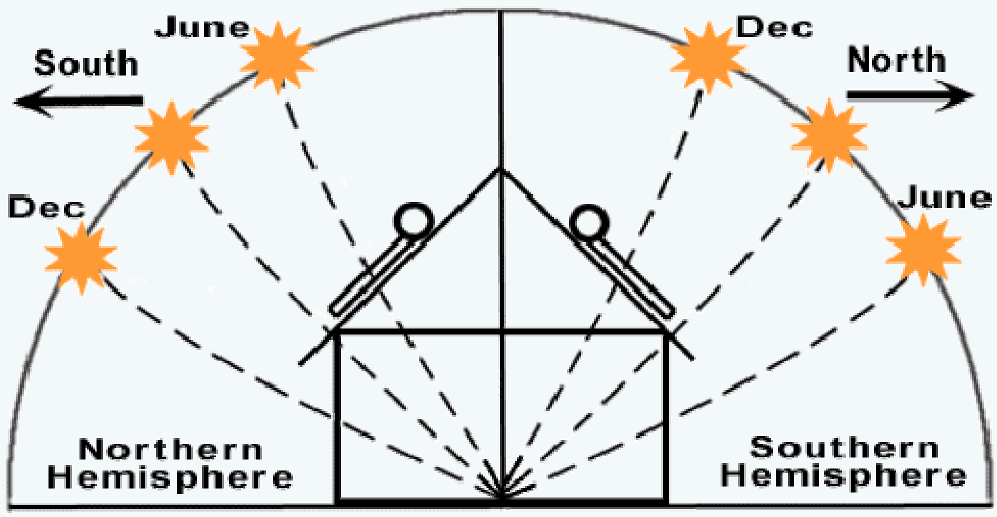
If there are any words that you think we should add to this glossary, please let us know

Installation

When choosing a solar collector, selecting the correct size is important. To find out what size collector you need please click here. Once you have determined what size collector suits your needs, the next question is where to install it.

Deciding the Direction and Angle of Installation

The angle and direction of installation is also of great importance as it will effect the efficiency of the solar collector. Naturally you want the collector to receive the maximum amount of sunlight each day and throughout the year. As a general rule if you are in the Northern Hemisphere then the collector should face South and if you are in the Southern Hemisphere then the collector should face North. See diagram below.



The angle at which you mount the collector should roughly correspond to the latitude of your location. For example:

- Melbourne, Australia has a latitude of 37o South - the collector should therefore face north at a 37o angle.
- London, UK has a latitude of 51o North - the collector should therefore face south at a 51o angle.

You do not have to be too careful about mounting the collector at the exact angle suggested. If your roof angle is within 10o+/- of your desired angle you can just mount the solar collector flush against the roof surface. The added trouble of adjusting the collector to a precise angle is not warranted as it will not result in a great improvement in efficiency.

Seasonal Changes in Heat Output
How to prevent excessive summer heat output

If you are using the solar collector for space heating as well as hot water production, or if you just want a larger solar contribution, you will need a system that will greatly surpass heat requirements in the summer. Generally in the summer heating will not be required, in contrast cooling is. Unfortunately, at present solar cooling for domestic applications is not yet economically viable, so what to do with the additional heat? If you have a swimming pool or spa, the excess heat can be used to supplement heating. Turning off the pump and letting the collector stagnate is not ideal as high pressure and temps, and large volumes of vented steam may result (wasted water).

If you do not have an additional means of using the excess heat, then adjusting the angle of the collector can help to reduce summer heat output. As can be seen by the diagram above, the sun is low in the sky during the winter and high in the summer. Solar smart house designs will take advantage of this by having big North or South (depending on your location) facing windows allowing maximum absorption of winter sun, with large eves or veranda to block out the summer sun.

By increasing the vertical angle of the collector by about 20o more the location?s latitude (ie. 60o instead of 40o), greater winter performance will be experienced. This is because the collector is "facing" the sun (perpendicular - longitudinal angle). Due to the higher location of the sun in the sky during the summer, the collector will be around 40o from perpendicular and as such heat output will be reduced as the collector is not fully "facing" the sun. This simple solution alone can reduce peak summer output considerably, thus reducing problems associated with excessive summer heat production.

The above photo shows an ideal example of an installation angle that optimizes winter, spring and autumn heat output, while minimizing summer output. The high angle not only maximizes expose to the direct winter sun, but also allows the sunlight reflected off the snow to be absorbed. In the summer when the sun is high overhead the exposed surface area is small, especially with the overhanging roof which would partially shade the collector. In areas without snow fall (and a latitude range of 30-40o) an angle lower than that shown above would be suitable.

Please note: For the solar water heater, optimal heat pipe performance is achieved in the angle range of 20-70o. Although your locations may have a latitude of less than 20o, this basic installation guideline should be adhered to. Horizontal angles of +/- 5o are acceptable and may be appropriate if the manifold needs to be drainable (end port models only).

Toolbox

Using this energy calculator you may determine how much energy an xianke solar collector will produce each day/month/year. The way you utilize this energy is up to you. You can heat water for showering and washing clothes, or central heat a building. If fact one integrated system can both these functions.

You can also use these values to help you calculate how much energy you can save by using an solar collector.

In order to calculate energy output you must input the following variables:

Insolation Level - Before you calculate your energy output, you must know your solar insolation level. This are available from the insolation page. Take note of your max and min levels throughout the year as well as the annual average value. When assessing potential energy savings, input annual average insolation, and take note of the "per year" energy output value.

Energy must be input in the unit kWh/m2/day. **1 kWh/m2/day = 317.1 Btu/ft2/day**

Collector Size - You must enter the collector size in absorber surface area.

The absorber surface area of the various tubes sizes are as follows:

- 58/1800 = 0.08m2 per tube. Therefore an AP 20 tube = 1.6m2 absorber area
- 58/1500 = 0.067m2 per tube

Energy Cost - Enter cost per kWh in your local currency

(may need to convert from m3 or Therms)

1 therm = 29.3kWh = 100,000Btu = 105.5MJ

Natural Gas is 39MJ/m3 = 10.83 kWh/m3

LPG Propane (liquid) = 25.3MJ/L = 7kWh/L

LPG Propane (gas) = 93.3MJ/m3 = 25.9kWh/m3

Please note: - Collector peak efficiency is only achieved when ambient temperature and water temperatures are the same. During normal use, this is only likely to happen for a short period of time each day, and usually only when ambient temperatures are high (summer). Therefore during normal use, the solar collector can not always perform at such a high level of efficiency. This is true for all evacuated tube and flat plate collectors, not only collectors. In order to provide more realistic figures, the above calculations are based on "normal" operating conditions under which the difference between ambient temp and manifold water temp is around 30-40oC.

- When making comparisons with other products please take the above point into consideration. Do not simply use the peak efficiency values for energy output, as this will provide inflated figures. IAM values also play an important role in determining total energy output from a solar collector. Please click here to learn more about how to interpret IAM figures.

- Monthly and annual values are calculated using 28 days and 336 days respectively to account for days of very low solar radiation.

- Energy output values are approximations. Actual energy output and overall system efficiency will depend upon installation location, climate, insulation, system configuration and many other factors. On rainy or heavily overcast days energy output will be greatly reduced.

- Energy is produced in the form of heat. In transporting and converting this energy, such as for air conditioning or central heating, some energy (heat) will be lost, as no system or insulation is 100% efficient.

Insolation

Home<Insolation

What is solar insolation?

The amount of electromagnetic energy (solar radiation) incident on the surface of the earth. Basically that means how much sunlight is shining down on us.

Why is knowing the insolation level useful?

By knowing the insolation levels of a particular region we can determine the size of solar collector that is required. An area with poor insolation levels will need a larger collector than an area with high insolation levels. Once you know your region’s insolation level you can more accurately calculate collector size and energy output.

What units are used to express Insolation levels?

The values are generally expressed in kWh/m2/day. This is the amount of solar energy that strikes a square meter of the earth’s surface in a single day. Of course this value is averaged to account for differences in the days? length. There are several units that are used throughout the world.

The conversions based on surface area as follows:

1 kWh/m2/day = 317.1 btu/ft2/day = 3.6MJ/m2/day

The raw energy conversions are:

1kWh = 3412 Btu = 3.6MJ = 859.8kcal

Is my region's insolation level low, moderate or high?

The following scale is a basic guide for insolation levels. Although a value of 5 is not considered very high during the summer months, as an average annual value this is very high. You will see that in central Australia, which is a hot, sunny place, the annual average insolation is 5.89.

You may compare you location to the following two extreme locations.

Average annual insolation levels:

Central Australia = 5.89 kWh/m2/day - Very High

Helsinki, Finland = 2.41 kWh/m2/day - Very Low

How it works

http://www.sunstar-solar.com/pressuretype.html
is it possible to get the whole thing,just remove sunstar

shentai solar catalogue.pdf

This is the product catalogue