Saimaa University of Applied Sciences
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MECH

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APPLICATION OF SOLAR ENERGY

Bachelor’s Thesis 2010

ABSTRACT
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Application of solar energy , 23 pages
Saimaa University of Applied Sciences, Lappeenranta
Degree Programme in Mechanical Engineering
Bachelor's Thesis 2010
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The purpose of the project is to learn the principle and application of solar energy and to know the situation of solar energy in China and build a solar farm in China .

In the theoretical part of the project the main issue was to find out how to collect the solar energy and how to store solar energy. The information of the project was collected by using network and books.
This work was completed in the following steps : to search information for the theory part, to analyze the data and to find out the solution of the project .

The result of the project shows that the energy problem is one of the main problems in the world. Solar energy now is the important energy source for human, and it can help human to get out of energy problem.

Keywords: purpose, collect, store, result

CONTENT

1 INTRODUCTION

The sun is responsible for all of the earth energy. Plants use the sun's light to make food. Decaying plants hundreds of millions of years ago produced the coal, oil and natural gas that we use today.

Solar energy is most commonly collected by using solar cells. Of course solar energy can be put to use to heat or light up a room by simply having well placed windows and skylights. We can also use solar energy to dry our clothes in the sun. To use solar energy to power electrical appliances solar cells are used.

With the lack of energy source in the world, energy source is playing an important role in the development of Chinese economy. So the renewable energy source is the best choice for China. We should develop the application of solar farm in China .

2 SOLAR ENERGY - BASIC PRINCIPLES

Solar energy is created by light and heat which is emitted by the sun, in the form of electromagnetic radiation.

With today's technology, we are able to capture this radiation and turn it into usable forms of solar energy - such as heating or electricity.

(http://www.articlesbase.com/technology-articles/solar-energy-basic-principles-649460.html)

Solar energy is the sun's nuclear fusion reactions within the continuous energy generated. Earth's orbit, the average solar radiation intensity is 1367kw/m2. Circumference of the Earth's equator is 40000km, thus we can calculate the energy the earth gets is up to 173,000 TW. At sea level on the standard peak intensity is 1kw/m2, a point on the earth's surface 24h of the annual average radiation intensity is 0.20kw/m2, or roughly 102,000 TW of energy. Humans rely on solar energy to survive, including all other forms of renewable energy (except for geothermal resources) Although the total amount of solar energy resources is ten thousand times of the energy used by humans, but the solar energy density is low, and it is influenced by location, season, which is a major problem of development and utilization of solar energy.

2.1 **Available Solar Resource**

The technical feasibility and economical viability of using solar energy depends on the amount of available sunlight (solar radiation) in the area where you intend to place solar heaters or solar panels.This is sometimes referred to as the available solar resource.

Every part of Earth is provided with sunlight during at least one part of the year. "part of the year" refers to the fact that the north and south polar caps are each in total darkness for a few months of the year. The amount of sunlight available is one factor to take into account when considering using solar energy.

There are a few other factors, however, which need to be looked at when determining the viability of solar energy in any given location. These are as follows:

- Geographic location
- Time of day
- Season
- Local landscape
- Local weather

(http://www.articlesbase.com/technology-articles/solar-energy-basic-principles-649460.html)

Day and night is due to the Earth's rotation generated, but the season is due to the Earth's rotation axis and the Earth's orbit around the sun's axis was 23 °27'angle and generated. the Earth rotate around the "axis" which through its own north and south poles a circuit from west to east every day. Per revolution of the earth cause day and night, so the Earth's rotation per hour is 15 °.In addition, the Earth goes through a small eccentricity elliptical orbit around the sun per circuit per year. The Earth's axis of rotation and revolution has always been 23.5° with the earth orbit. The Earth's revolution remain unchanged when the direction of spin axis always points to the Earth's north pole. Therefore, the Earth's orbit at a different location when the sunlight is projected onto the direction of the earth is different, so it cause the formation of the Earth's seasons changes. Noon of each day, the sun's height is always the highest. In the tropical low-latitude regions (in the equatorial north and south latitude 23 ° 27 'between the regions), sunlight of each year, there are two vertical incidences at higher latitudes, the sun is always close to the equator direction. In the Arctic and Antarctic regions (in the northern and southern hemispheres are greater than 90 ° ~ 23 ° 27 '), in winter the sun below the horizon for a long time.

2.2 **Diffuse and Direct Sunlight**

As sunlight passes through Earth's atmosphere, some of it is absorbed, scattered, and reflected.

The following is a general list of materials which cause the sunlight to become diffused:

- Air Molecules
- Water vapor
- Clouds
- Dust
- Pollutants

(http://www.articlesbase.com/technology-articles/solar-energy-basic-principles-649460.html)

Sunlight is composed of two parts - direct sunlight and diffuse sunlight. Solar radiation goes through the atmosphere and reaches the ground, due to the atmosphere air molecules, water vapor and dust, such as solar radiation absorption, reflection and scattering, not only reduction of the intensity of radiation, but also to change the direction of radiation and radiation of the spectral distribution. Therefore, the actual solar radiation reaching the ground is usually caused by direct and diffusion of two parts. Direct sunlight is the radiation directly from the sun and the direction of the radiation has not been changed; diffusion is the reflection and scattering by the atmosphere changed after the direction of the solar radiation, which consists of three parts: the sun around the scattering (surface of the sun around the sky light), horizon circle scattering (horizon circle around the sky light or dark light), and other sky diffuse radiation. In addition, the non-horizontal plane also receives the reflection of radiation from the ground. Direct sunlight, diffuse and reflected sunlight shall be the sum of the total radio or global sunlight. It can rely on the lens or reflector to focus on direct sunlight. If the condenser rate is high, you can get high energy density, but loss of diffuse sunlight. If the condenser rate is low it can also condense parts of the solar diffuse sunlight . Diffuse sunlight has a big range of variation, and when it’s cloudless, the diffuse sunlight is 10% of the total sunlight. But when the sky is covered with dark clouds and the sun can not be seen, the total sunlight is equal to the diffuse sunlight. Therefore, poly-type collector is collecting the energy usually far higher than the non-poly-type collector. Reflected sunlight is generally weak, but when there is snow-covered ground, the vertical reflection sunlight can be up to 40% of the total sunlight

2.3 **Measuring Sunlight and Solar Energy**

Scientists measure the amount of sunlight available in specific locations during the different times of year. They are then able to estimate the amount of sunlight which falls on similar regions at the same latitude with similar climates and conditions.

Measurements of solar energy are normally expressed as "total radiation on a horizontal surface", or as "total amount of radiation on a surface tracking the sun". In the latter case, the assumption is that one is using a solar panel that automatically tracks the sun. In other words, the solar panel would be mounted on a tracking device so that the panel would remain at right angles to the sun throughout the day. This system is primarily used for industrial setups, when it is used at all.

2.4 **Solar Energy Measurements**

Radiation data (the amount of solar energy available at a given location) for solar electric (photovoltaic) systems is often represented as kilowatt-hours per square meter (kWh/m2). Direct estimates of solar energy may be expressed as "watts per square meter" (W/m2).

Radiation data for solar water heating and space heating systems is usually represented in British thermal units per square foot (Btu/ft2).

(http://en.wikipedia.org/wiki/Solar_thermal_energy)

3 SOLAR PANEL

A solar panel is a device that collects and converts solar energy into electricity or heat. Solar photovoltaic panels can be made so that the sun's energy excites the atoms in a silicon layer between two protector panels. Electrons from these excited atoms form an electric current, which can be used by external devices. Solar panels were in use over one hundred years ago for water heating in homes. Solar panels can also be made with a specially shaped mirror that concentrates light onto a tube of oil. The oil then heats up, and travels through a vat of water, instantly boiling it. The steam is created and then it turns a turbine for power.

How Solar Panels Work

The basic element of solar panels is pure silicon. When stripped of impurities, silicon makes an ideal neutral platform for transmission of electrons. In silicon's natural state, it carries four electrons, but has room for eight. Therefore silicon has room for four more electrons. If a silicon atom comes in contact with another silicon atom, each receives the other atom's four electrons. Eight electrons satisfy the atoms' needs, this creates a strong bond, but there is no positive or negative charge. This material is used on the plates of solar panels. Combining silicon with other elements that have a positive or negative charge can also create solar panels.

For example, phosphorus has five electrons to offer to other atoms. If silicon and phosphorus are combined chemically, the results are a stable eight electrons with an additional free electron. The silicon does not need the free electron, but it can not leave because it is bonded to the other phosphorous atom. Therefore, this silicon and phosphorus plate is considered to be negatively charged.

A positive charge must also be created in order for electricity to flow. Combining silicon with an element such as boron, which only has three electrons to offer, creates a positive charge. A silicon and boron plate still has one spot available for another electron. Therefore, the plate has a positive charge. The two plates are sandwiched together to make solar panels, with conductive wires running between them.

Photons bombard the silicon/phosphorus atoms when the negative plates of solar cells are pointed at the sun. Eventually, the 9th electron is knocked off the outer ring. Since the positive silicon/boron plate draws it into the open spot on its own outer band, this electron does not remain free for long. As the sun's photons break off more electrons, electricity is then generated. When all of the conductive wires draw the free electrons away from the plates, there is enough electricity to power low amperage motors or other electronics, although the electricity generated by one solar cell is not very impressive by itself. When electrons are not used or lost to the air they are returned to the negative plate and the entire process begins again.

(http://www.articlesbase.com/technology-articles/solar-energy-basic-principles-649460.html)

4 SOLAR THERMAL ENERGY

Solar thermal energy (or STE) is a technology for harnessing solar energy for heat. Solar thermal collectors are characterized by the US Energy Information Agency as low, medium, or high temperature collectors. Low temperature collectors are flat plates generally used to heat swimming pools. Medium-temperature collectors are also usually flat plates but are used for creating hot water for residential and commercial use. High temperature collectors concentrate sunlight using mirrors or lenses and are generally used for electric power production. This is different from solar photovoltaic which converts solar energy directly into electricity.

4.1 Low-temperature collector

Sunlight passes through the glazing and strikes the absorber plate, which heats up, changing solar energy into heat energy. The heat is transferred to liquid passing through pipes attached to the absorber plate. Absorber plates are commonly painted with "selective coatings," which absorb and retain heat better than ordinary black paint. Absorber plates are usually made of metal typically copper or aluminum because the metal is a good heat conductor. Copper is more expensive, but it is a better conductor and less prone to corrosion than aluminum. In locations with average available solar energy, flat plate collectors are sized approximately one-half- to one-square foot per gallon of one-day's hot water use.

The main use of this technology is in residential buildings where the demand for hot water has a large impact on energy bills. This generally means a situation with a large family, or a situation in which the hot water demand is excessive due to frequent laundry washing.

Commercial applications include car washes, military laundry facilities and eating establishments. The technology can also be used for space heating if the building is located off-grid or if utility power is subject to frequent outages. Solar water heating systems are most likely to be cost-effective for facilities with water heating systems that are expensive to operate, or with operations such as laundries or kitchens that require large quantities of hot water.

Unglazed liquid collectors are commonly used to heat water for swimming pools. Because these collectors need not withstand high temperatures, they can use less expensive materials such as plastic or rubber. They also do not require freeze-proofing because swimming pools are generally used only in warm weather or can be drained easily during cold weather.

While solar collectors are most cost-effective in sunny, temperate areas, they can be cost-effective virtually anywhere in the country so should be considered.

4.2 High-temperature collector


(http://en.wikipedia.org/wiki/Solar_thermal_energy)

In order to reduce the Flat-plate collector heat loss and to improve the collect temperature, the international community in the 70s had a successful development of vacuum tube, its heat-absorbing body is enclosed in a high vacuum inside the glass vacuum tube, greatly improving the thermal performance. The number of branch vacuum tube assembly together, shall constitute a vacuum tube collector, the collection in order to increase the amount of sunlight, some in the vacuum tube in the back is also fitted with reflectors. Vacuum collector tube can be roughly divided into two: all-glass evacuated collector tubes (glass-U-tube vacuum collector tubes), and Metal heat-pipe vacuum tubes (straight-through vacuum collector tubes and stored thermal vacuum collector tube).

Condenser collector mainly by the condenser, absorber and tracking system has three major components. Accordance with the principle of distinction between condenser, condenser collector can be divided into reflection and refraction condenser two categories, each category in accordance with the condenser can be divided into a number of different kinds. In order to meet the requirements of solar energy utilization like simplify tracking agencies, improve reliability, reduce costs, by development of condenser collector in this century, there are many kinds of condenser collectors, but the promotion of condenser collector is less than flat-plate collector, and lower degree of commercialization. In the reflective concentrator collectors, rotating parabolic mirror condenser (point focus) and the parabolic troughlike mirror condenser (line focus) is more applied. The former can get hot, but two-dimensional tracking; the latter can get the temperature, as long as for one-dimensional tracking. The two condenser collectors are applied at the beginning of this century and after decades to carry out a number of improvements, such as reflective surfaces to improve machining accuracy, development of high reflective materials, development of high-reliability tracking agencies, at present, these two kinds of parabolic trough collectors are fully capable to meet a variety of high-temperature solar energy utilization requirements, but the high cost of these two kinds of parabolic trough collectors limits their wider application.

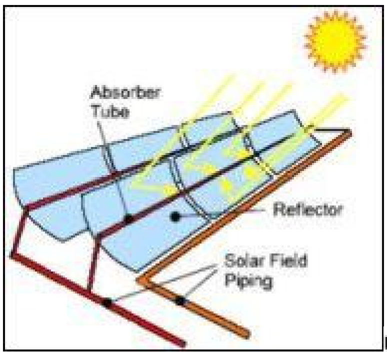
In the 1970's, "compound parabolic concentrator mirror collector" (CPC) appeared into the international market. It consists of two parabolic mirrors, CPC do not need to track the sun,they only need to make adjustments according to the season change then it can collect the sunlight and get a higher temperature. The rate of condense is below 10 normally, when the condense rate is below 3 it can be fixed to install, no need for adjustment. At that time, many people give high evaluation to CPC, and even think it is a big breakthrough to solar thermal utilization technologies and it will be widely applied. However, decades later, CPC has been applied to only a small number of demonstration projects, and did not like the flat-plate collector and vacuum tube collector be widely used.

Other reflective mirror concentrators are conical, spherical mirrors, bar mirrors, bucket-type trough mirrors, flat and Parabolic mirror concentrators, etc.. In addition, there is an application in a tower solar power plant called heliostat. Heliostats consist of a number of flat mirrors or curved mirrors, under the computer control these mirrors reflect the sun's rays to the same absorber, the absorber can reach very high temperatures,and get powerful energy.

According to the principle of the use of refraction of light, the refraction-type condenser can be made. Some people use a set of lenses and flat mirrors to assemble a high-temperature solar boiler. Clearly, the glass lens is too heavy, manufacturing process complex and high cost, so it is difficult to make it big. Therefore, the refraction-type condenser is no long-term development. In the 1970s, the international development of large Fresnel lens was an attempt for the production of solar concentrating collectors. Fresnel lens is a plane of the condenser lens, light weight, low prices, and also has bit focus type or line focus points type , generally made of plexiglass or other transparent plastic, but also useful for glass production, mainly for solar concentrators power generation systems. The optical fiber condenser, which consists of fiber-optic lenses and optical fiber connected to the composition of the sun through the optical lens focusing the use of office after the fiber spread. The other is the fluorescence condenser, which is actually a fluorescent pigment to add a transparent plate (usually PMMA), it can absorb sunlight and fluorescent wavelength of the same part of the absorption band, and then a longer wavelength than the absorption band emit fluorescence. Emit fluorescent has total internal reflection within the plate-driven flat-panel edge face due to plate and the surrounding medium differences. The rate of condense depends on the ratio of flat area and the edge area, it is easy to reach 10 100, this flat-panel can absorb the sunlight from different directions, but it also can absorb the scattered light and does not need to track the sun.

5 SYSTEM DESIGNS

During the day the sun has different positions. If the mirrors or lenses do not move, then the focus of the mirrors or lenses changes. Therefore it seems unavoidable that there needs to be a tracking system that follows the position of the sun (for solar photovoltaics a solar tracker is only optional). The tracking system increases the cost. With this in mind, different designs can be distinguished in how they concentrate the light and track the position of the sun.



Sketch of a parabolic trough design. A change of position of the sun parallel to the receiver does not require adjustment of the mirrors.(http://en.wikipedia.org/wiki/Solar_thermal_energy)

5.1 Thermal energy storage

1.Sensible heat storage

The use of sensible heat energy storage materials is the easiest method of storage. In practice, water, sand, gravel, soil, etc. can be considered as materials for energy storage, in which the largest heat capacity of water, so water is used more often. In the 70's and 80's, the use of water and soil for cross-seasonal storage of solar energy was reported. But the material's sensible heat is low, and it limits energy storage.

2. Latent heat-storage

Latent heat-storage units are storing thermal energy in latent (= hidden, dormant) mode by changing the state of aggregation of the storage medium. Applicable storage media are called "phase change materials" (PCM).. Commonly salts crystal is used in low-temperature storage, such as sodium sulfate decahydrate / calcium chloride, sodium hydrogen phosphate 12-water. However, we must solve the cooling and layering issues in order to ensure the operating temperature and service life. Medium solar storage temperature is generally higher than 100 ℃ but under 500 ℃, usually it is around 300 ℃. Suitable for medium temperature storage of materials are: high-pressure hot water, organic fluids, eutectic salt. Solar heat storage temperature is generally above 500 ℃, the materials currently being tested are: metal sodium and molten salt. Extremely high temperature above 1000 ℃ storage, fire-resistant ball alumina and germanium oxide can be used.

3. Chemical, thermal energy storage

Thermal energy storage is making the use of chemical reaction to store heat. It has the advantage of large amount in heat, small in volume, light in weight. The product of chemical reaction can be stored separately for a long time. It occurs exothermic reaction when it is needed. it has to meet the needs of below conditions to use chemical reaction in heat reserve: good in reaction reversibility, no secondary reaction, rapid reaction, easy to separate the resultant and reserve it stably. Reactant and resultant are innoxious ,uninflammable, large in heat of reaction and low price of reactant. Now some of the chemical endothermic reaction could meet the needs of above conditions. Like pyrolysis reaction of $Ca(OH)_2$, Using the above endothermic reaction to store heat and release the heat when it is necessary. But the dehydration reaction temperature in high atmospheric pressure is higher than 500 degrees. I t is difficult to use solar energy to complete dehydration reaction. We can use catalyst to decrease the reaction temperature, but still very high. So it is still in testing time of heat reserve in chemistry.

4. Plastic crystal thermal energy storage

In 1984, the U.S. market launched plastic crystal materials for home heating. Plastic crystal's scientific name is Neopentyl Glycol (NPG), it and the liquid crystal are similar to three-dimensional periodic crystals, but the mechanical properties are like plastic. It can store and release thermal energy in the constant temperature, but not to rely on solid-liquid phase change to store thermal energy, it stores the energy through the plastic crystalline molecular structure occurring solid - solid phase change. When plastic crystals are at constant temperature 44c, it absorbs solar energy and stores heat during the day, and releases the heat during the night.

5. Solar thermal energy storage tank

Solar pond is a kind of a certain salt concentration gradient of salt ponds, and it can be used for acquisition and storage of solar energy. Because of its simple, low cost, and it is suit to large-scale applied so it has attracted people's attention. After the 60's, many countries have started study on solar pond, Israel has also built three solar pond power plants.

5.2 Levelized cost

Since a solar power plant does not use any fuel, the cost consists mostly of capital cost with minor operational and maintenance cost. If the lifetime of the plant and the interest rate is known, then the cost per kWh can be calculated. This is called the levelized cost.

The first step in the calculation is to determine the investment for the production of 1 kWh in a year. For example, the fact sheet of the Andasol 1 project shows a total investment of 310 million euros for a production of 179 GWh a year. Since 179 GWh is 179 million kWh, the investment per kWh a year production is 310 / 179 = 1.73 euro. Another example is Cloncurry solar power station in Australia. It produces 30 million kWh a year for an investment of 31 million Australian dollars. So, this price is 1.03 Australian dollars for the production of 1 kWh in a year. This is significantly cheaper than Andasol 1, which can partially be explained by the higher radiation in Cloncurry over Spain. The investment per kwh cost for one year should not be confused with the cost per kwh over the complete lifetime of such a plant

In most cases the capacity is specified for a power plant (for instance Andasol 1 has a capacity of 50MW). This number is not suitable for comparison, because the capacity factor can differ. If a solar power plant has heat storage, then it can also produce output after sunset, but that will not change the capacity factor, it simply displaces the output. The average capacity factor for a solar power plant, which is a function of tracking, shading and location, is about 20%, meaning that a 50MW capacity power plant will typically provide a yearly output of 50 MW x 24 hrs x 365 days x 20% = 87,600 MWh/year, or 87.6 GWh/yr.

Although the investment for one kWh year production is suitable for comparing the price of different solar power plants, it doesn't give the price per kWh yet. The way of financing has a great influence on the final price. If the technology is proven, an interest rate of 7% should be possible. However, for a new technology investors want a much higher rate to compensate for the higher risk. This has a significant negative effect on the price per kWh. Independent of the way of financing, there is always a linear relation between the investment per kWh production in a year and the price for 1 kWh (before adding operational and maintenance cost). In other words, if by enhancements of the technology the investments drop by 20%, then the price per kWh also drops by 20%.

If a way of financing is assumed where the money is borrowed and repaid every year, in such way that the debt and interest decreases, then the following formula can be used to calculate the division factor: (1 - (1 + interest / 100) ^ -lifetime) / (interest / 100). For a lifetime of 25 years and an interest rate of 7%, the division number is 11.65. For example, the investment of Andasol 1 was 1.73 euro, divided by 11.65 results in a price of 0.15 euro per kWh. If one cent operation and maintenance cost is added, then the levelized cost is 0.16 euro. Other ways of financing, different way of debt repayment, different lifetime expectation, different interest rate, may lead to a significantly different number.

If the cost per kWh may follow the inflation, then the inflation rate can be added to the interest rate. If an investor puts his money on the bank for 7%, then he is not compensated for inflation. However, if the cost per kWh is raised with inflation, then he is compensated and he can add 2% (a normal inflation rate) to his return. The Andasol 1 plant has a guaranteed feed-in tariff of 0.21 euro for 25 years. If this number is fixed, it should be realized that after 25 years with 2% inflation, 0.21 euro will have a value comparable with 0.13 euro now.

Finally, there is some gap between the first investment and the first production of electricity. This increases the investment with the interest over the period that the plant is not active yet. The modular solar dish (but also solar photovoltaic and wind power) have the advantage that electricity production starts after first construction.

Given the fact that solar thermal power is reliable, can deliver peak load and does not cause pollution, a price of US$0.10 per kWh starts to become competitive. Although a price of US$0.06 has been claimed with some operational cost a simple target is 1 dollar (or lower) investment for 1 kWh production in a year.

(http://encyclopedia.thefreedictionary.com/Solar+farm)

6 SOLAR ENERGY IN CHINA

6.1 Energy situation

There is coal-based energy production and consumption in China. In China's energy production and consumption structure, coal's share in primary energy production accounted for 75.6% in 1998. According to UNEP and the World Resources Report UNDP1995, in the global energy consumption structure, the world is: Liquid 37.1%, gas 23.7%, solids 29.2%, a power of 9.9%; developed countries: 36.7% liquid, gas 27.4%, solids 24.1% , primary electrical energy 11.7%; in developing countries: Liquid 37.3%, gas 14.1%, solids 43.7%, a 3.8% energy; and China: Liquid 17.5%, gas 1.6%, solid 75%, electrical energy 5.9%.

6.2 The situation of solar energy

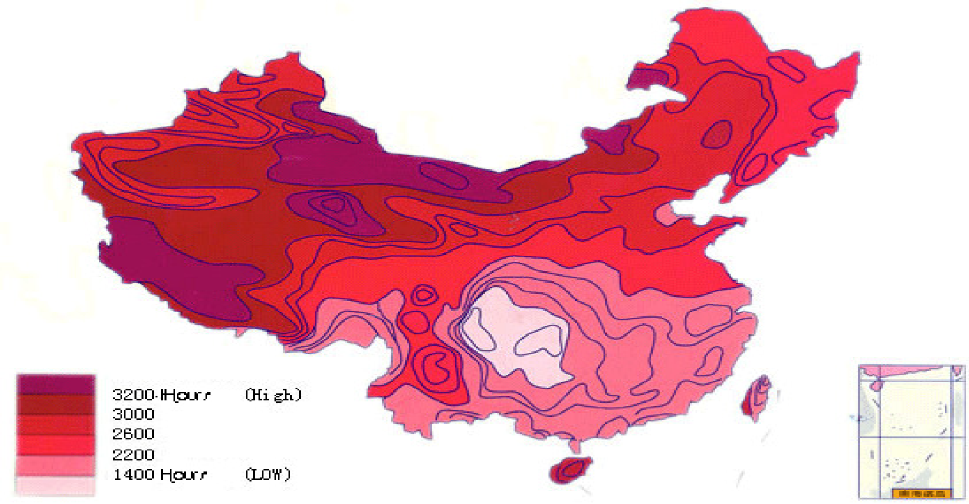
China PV industry, starting in 70's, after 30 years of effort, has been ushered in a new stage of rapid development. Due to the "Bright Project" pilot projects and "send electricity to the township" projects of national projects and the powerful driving force in the world PV market, China had a rapid development of photovoltaic power generation industry. In the end of 2007, the country's total installed capacity of PV systems reached 10 million kilowatts. In 2008 solar cell production reached 200 million kilowatts.

After years of development, China solar water heater industry has formed a relatively complete industrial system. 2008 China's solar water heater industry had a steady and rapid development. Among them, output value reached 43 billion, exports amounted to 100 million U.S. dollars.

Since the second half of 2008, the financial crisis is threatening China, so that PV companies are seriously affected. Polysilicon price has reduced. This financial crisis is far-reaching, but the unique advantages of solar power decide its trends, and it can not be changed. The financial crisis to the development of solar energy is not necessarily a bad thing, but to promote the rapid industrial upgrading has practical significance. In addition some of the central authorities to implement measures aimed at stimulating domestic demand and stimulate rural economic development and stimulate the development of SMEs, it is very helpful to solar energy heat utilization industry.

In the financial crisis situation, in March 2009 China promulgated the "Solar Roofs Plan". July 21, 2009 Ministry of Finance, Ministry of Science, the National Energy Board jointly announced the official launch of China's "Golden Sun" demonstration project. In 2009 the policy was adopted which will boost the domestic solar power market development in China under the guidance of government strong policies. The photovoltaic industry is not only to allow domestic companies see the opportunity, it has attracted world's attention. 2009 solar water heaters "countryside" is a solar water heater industry, a major event, marking the solar water heater to be national accreditation, China's solar water heater industry has entered a new era.

6.3 China Solar Energy Resources Distribution




Tibet Yangbajing 100kWp desert grid demonstration power plant

 Xinjiang Railway Communication unmanned solar power

Tibet 4kW scenery hybrid generating system

Shandong tubule island scenery complementary 30kW demonstration power plant
(http://www.bjdiamond.cn/fgny.asp)

6.4 Solar energy building

(http://newenergy.nengyuan.net/2009/1124/7067.html)

Solar building in China has experienced several decades of development. China's first solar building(the sun room) was built in the 50’s and 60’s, the main use of passive technology, through passive design to meet the people's basic needs. Now, solar energy technologies is not only passive technology, also a proactive technology, which is mainly manifested in the use of solar thermal and solar photovoltaic use of two aspects. The use of light and heat is mainly used for heating and cooling, according to the use of high and low temperature are divided into high-temperature use, the use of medium temperature and low-temperature use. Engineering high-temperature heating is mainly the use of solar energy, the daily life of the hot water supply is mainly low-temperature use. Solar photovoltaic technology is using single crystal silicon or polysilicon to turn solar energy into electricity, and it’s generally used for space shuttles, space stations, or remote areas. The use of photovoltaic solar building is mainly used to achieve solar lighting.

Solar thermal technology is widely used in China. It has a good basis for industrialization and commercialization. The solar photovoltaic technology, because of its high cost, it is not so popular as solar thermal energy.

China Solar Energy building development environment is getting good. May 29, 1998 China signed the "Kyoto Protocol". December 1, 2006 government approved implementation of "Renewable Energy Law". August 31, 2007 government issued "China's renewable energy and long-term development plan". 2008 April 1 government implemented the "Energy Conservation Law". October 1, 2008 began implementing the "Building Energy Conservation Regulations". "Energy-saving emission reduction," "energy province" has become to the highest click rates of words in the construction industry. All this is made clear to the people: China's housing construction and energy issues have

become global problems of Chinese society, solar energy built on China's development is gradually being widespread concern in all sectors of society.
At present, Jiangsu, Shandong, Hebei, Hainan, Yunnan and other provinces, Beijing, Shanghai, Shenzhen, Dalian and other cities have been following in the new 12-storey residential buildings and office buildings, schools, hospitals, hotels and other public buildings to begin mandatory solar hot water system. Therefore, the use of solar hot water system can become a national level, building energy-saving mandatory requirement, so that 50% or 65% of building energy-saving targets contain more meaning.

6.5 Solar farm

Location
The Inner Mongolia Autonomous Region is situated 97"12"-126"04" east longitude and 37"24"-53"23" north latitude with an area of 1.183 million square kilometers, taking up 1/8 of that of the country and ranking the 3rd in China. Inner Mongolia has not only a large area but also geographical advantages, bordering Heilongjiang, Liaoning, Jilin, Hebei, Shanxi, Shaanxi, and Gansu provinces as well as Ningxia Hui Autonomous Region in the east, south and west. It spans the northeast, north and northwest of China and borders Russia and Mongolia in the north with a boundary line as long as 4,221 kilometers, thus becoming am important frontier for China's opening to the outside world.
Climate
(http://www.imu.edu.cn/nmg/north_1.htm)

Inner Mongolia, with a temperate continental monsoonal climate, has a cold, long winter with frequent blizzards and a warm, short summer. Except for the relatively humid Greater Hinggan Mountain Area, the greater part of Inner Mongolia is arid, semi-arid and semi-humid from west to east. It has a mean annual temperature of -1℃-15℃ -- the hottest month, July, averaging 15-25℃ and the coldest month, January, -30-10℃ -- and a mean annual precipitation of 100-500 mm. The difference of temperature between day and night is great. In inner Mongolia, solar energy resources are very abundant in most parts, sunshine hours are greater than 2700 hours, in Alashan Plateau in the western region up to 3400 hours or more in one year.

Material selection

Phenolic foam (Phenolic Foam, referred to as PF), is based on phenolic resins and emulsifiers, foaming agents, curing agents and other additives and other substances made by the scientific formula of closed-cell foam cured-type rigid foams.

Properties:

1. excellent thermal insulation properties of thermal conductivity <0.03W / m * K
2.high temperature phenolic foam can be -200 ℃ ~ 160 ℃ (to allow instantaneous 250 ℃) long-term work, no shrinkage.
3. excellent durability under long-term exposure to high temperatures, good thermal insulation properties, will not release any possible barrier solar radiation, volatile substances.

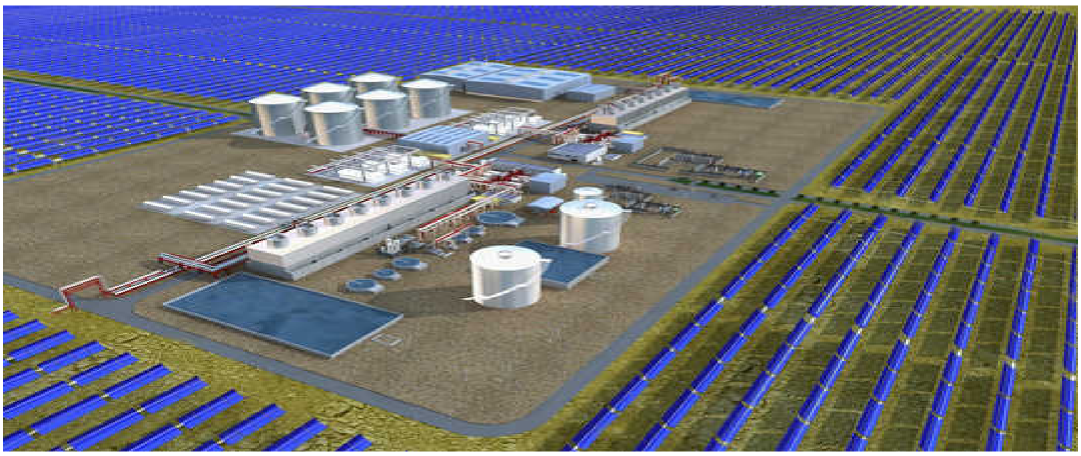
Norbornadiene

Norbornadiene is an organic compound. This bicyclic hydrocarbon is the most stable diolefin derived from the norbornane and norbornene. Norbornadiene is primarily of interest as a ligand in homogeneous catalysis, but it has been heavily studied due to its high reactivity and distinctive structure property of being a diene that cannot isomerize.

Quadricyclane, a valence isomer, can be obtained from norbornadiene by a photochemical reaction when assisted by a sensitizer such as acetophenone. The norbornadiene-quadricyclane couple is of potential interest for solar energy storage when controlled release of the strain energy stored in quadricyclane back to norbornadiene is made possible.

Design and cost

The solar project in Ordos will be built over a multi-year period. Phase 1 will be a 30 megawatt demonstration project that will begin construction by June 1, 2010 and be completed as soon thereafter as practicable. Phases 2, 3 and 4 will be 100 megawatts, 870 megawatts, and 1,000 megawatts. Phases 2 and 3 will be completed in 2014 and Phase 4 will be completed by 2019. The cost is between $5 billion and $6 billion.



7 SUMMARY

Through this report you can know the principle of solar energy . We can collect the sunlight by different collectors. Application of solar energy can be divided into different types. The solar thermal application is commonly used, it turn solar energy into thermal energy, it uses the chemical material to store the thermal energy. The other uses the silicon panel to change the solar energy into electricity power.

The energy situation in China is not good, the government now has the plan to create more green energy farms, like solar energy farm and wind energy farm, and more and more people use the solar energy in their normal life .
In the future, we can see we can not live without solar energy , without green energy .

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