

## INDUSTRY OVERVIEW

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Energy resources generated from fossil fuels such as coal, crude oil and natural gas, face a number of challenges including rising prices and growing environmental concerns over the global warming and climate change risks associated with power generation using fossil fuels. As a result of these factors and other challenges facing these energy resources, renewable energy such as solar, biomass, geothermal, hydroelectric and wind power generation have emerged as potential alternatives.

Solar energy is one of the popular renewable energy resources, against others such as biomass, geothermal, hydroelectric, nuclear and wind power generation, and is estimated to continue increasing its importance as a common alternative power source for the global energy consumption. The global temperature is expected to continue to rise, which will give rise to problems associated with global warming. Therefore, one of the environmental keys is to reduce the use of fossil fuels as the main energy sources for power generation globally.

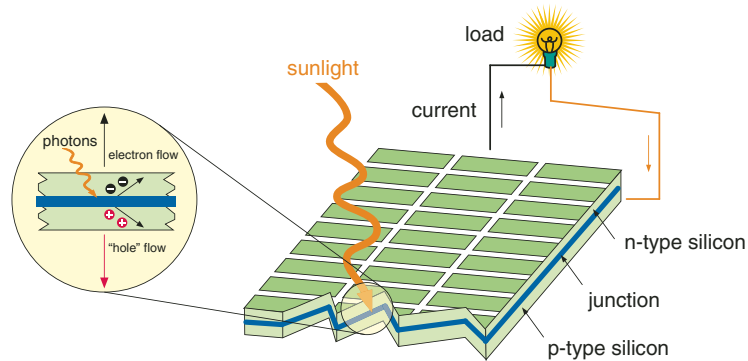
The Kyoto Protocol which entered into force in 2005 amongst participating states promotes the development and usage of renewable energies and calls for a reduction in carbon dioxide emissions to target levels specified for each of the participating countries to the Protocol. At the world Summit on Sustainable Development held in Johannesburg, South Africa on 26th August 2002, participating governments committed themselves to green energy.

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### PHOTOVOLTAIC TECHNOLOGY

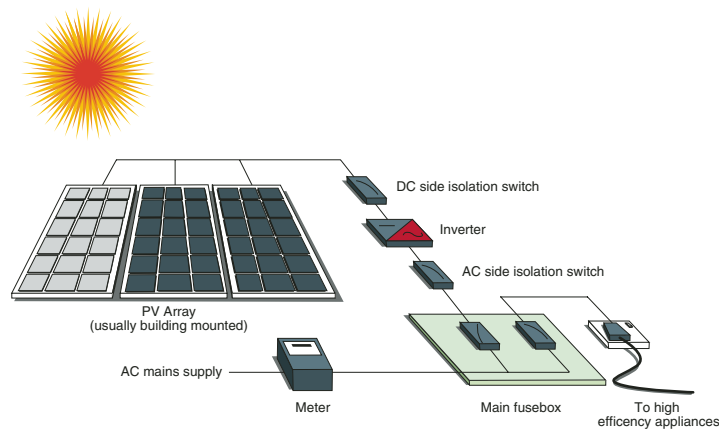
Electricity generated from photovoltaics (PV) technology emits no pollution, produces no greenhouse gases, and uses no finite fossil fuel resources.

Photovoltaic technology involves the direct conversion of electricity from light energy, which is accomplished when solar cells are exposed to light energy. Set out below is a schematic diagram which illustrates the key steps involved in electricity generation from a PV based solar power technology:



Photovoltaics technology is the conversion of light energy into electricity:

- The diagram above illustrates the operation of a basic photovoltaic or solar cell. A thin semiconductor is treated to form an electric field, positive on one side and negative on the other (i.e. p-type and n-type silicon).
- When light energy strikes the cell, electrons are knocked loose in the semiconductor material. If electrical conductors are attached to the positive and negative sides, the electrons can be captured into electricity.
- Electricity generated can then be used to power a load, such as a light or a tool.



PV systems could serve on-grid markets as well as off-grid industrial and residential markets where access to normal power transmission lines is not physically available or not economically possible. The most common baseboard of PV cell is crystalline silicon, which encompasses both monocrystalline silicon and multicrystalline silicon.

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### Types of solar PV technology

Of the different types of solar technology, the most popular are crystalline materials, which have been an established and proven technology for many years. The world PV cell production may be generally categorised into a few different types of technology, being monocrystalline silicon, multicrystalline silicon and thin film. These are basic types of technology which are photovoltaic using a similar structure of cells, panels and arrays as briefly described below:–

	<b>Brief description</b>	<b>Key attributes</b>
Monocrystalline silicon	<ul style="list-style-type: none"> <li>• Cut by wiresaw into wafers from a single silicon ingot and then processed into solar cell</li> </ul>	<ul style="list-style-type: none"> <li>• More expensive to produce than multicrystalline silicon</li> <li>• More efficient and cost-effective in electricity conversion</li> <li>• Module efficiency ratio of about 14.7%, according to Solarbuzz's Crystalline Silicon Module Efficiency Indices at 2006</li> </ul>
Multicrystalline silicon	<ul style="list-style-type: none"> <li>• Cut from an ingot of melted and re-crystallised silicon</li> <li>• Examples:– cast multicrystalline silicon and string ribbon</li> </ul>	<ul style="list-style-type: none"> <li>• Cheaper but less efficient</li> <li>• Module efficiency ratio of about 13.2%, according to Solarbuzz's Crystalline Silicon Module Efficiency Indices at 2006</li> </ul>
Thin film (amorphous silicon, CdTe, CIGS etc)	<ul style="list-style-type: none"> <li>• Alternative technology</li> <li>• Example:– Silicon is deposited as a thin semiconductor layer onto another base material</li> </ul>	<ul style="list-style-type: none"> <li>• Significant drawback in efficiency, despite lower cost</li> <li>• Possible to make more flexible and unusual size panel shape</li> <li>• Module efficiency ratio of about 5-10% according to Solarbuzz</li> </ul>

According to Solarbuzz LLC, an independent international solar energy consulting company, approximately 92% of the world's PV cell manufacturing capacity was in the form of crystalline systems in 2006.

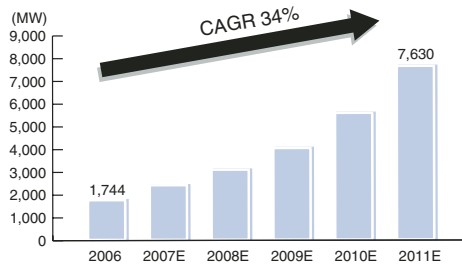
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### GLOBAL SOLAR PV INDUSTRY

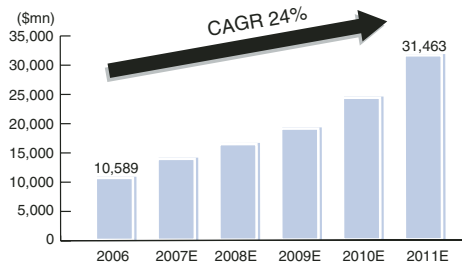
Although solar PV technology has been used for several decades, the solar PV market has only grown significantly in the past several years. According to Solarbuzz, the global solar PV market size, as measured by annual solar PV installations, increased by about 19.45% from 1,460 MW in 2005 to 1,744 MW in 2006.

According to the Production Led Scenario, which is a more optimistic forecast made by Solarbuzz, the revenue and market size of solar PV industry will reach US\$31.5 billion and 7,630 MW respectively by 2011. The chart below sets forth the estimated growth of the global solar PV industry by MW of installations and revenues from 2007 through 2011 by Solarbuzz, based on the Production Led Scenario estimation:

**Global Solar PV Installations**



**Global Solar PV Revenues**

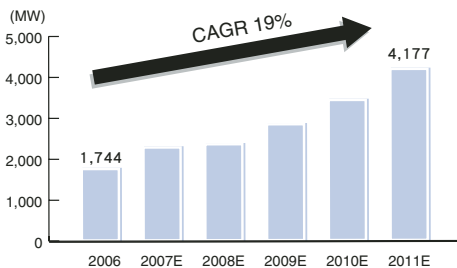


Source: Solarbuzz LLC 2007

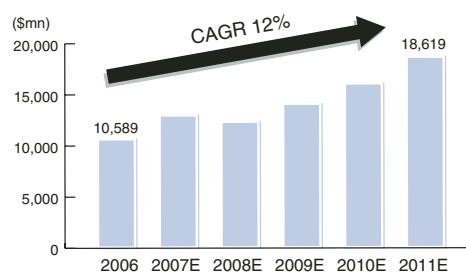
Note: These charts are tabulated based on data set out in Solarbuzz LLC 2007

According to the Balanced Energy Scenario, which is the most conservative forecast made by Solarbuzz, the revenue and market size of solar PV industry will reach US\$18.6 billion and 4,177 MW respectively by 2011. The chart below sets forth the estimated growth of the global solar PV industry by MW of installations and revenues from 2007 through 2011 by Solarbuzz, based on the Balanced Energy Scenario estimation:

**Global Solar PV Installations**



**Global Solar PV Revenues**



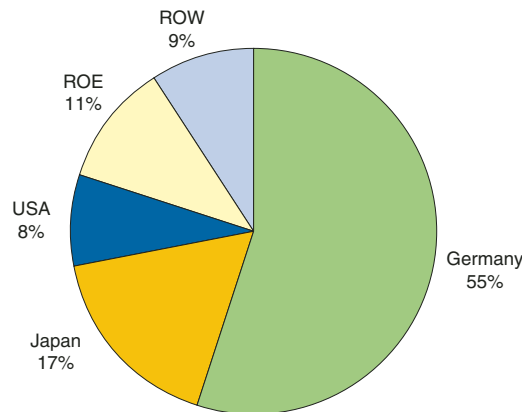
Source: Solarbuzz LLC 2007

Note: These charts are tabulated based on data set out in Solarbuzz LLC 2007

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In particular, the solar PV industry has been experiencing rapid growth over the past years with the forecasting trends continuing to be attractive in accordance with the PV installation estimates made by Solarbuzz. Market mix of solar PV industry is illustrated as follows:

**PV Market by Region in 2006**



Source: Solarbuzz LLC 2007

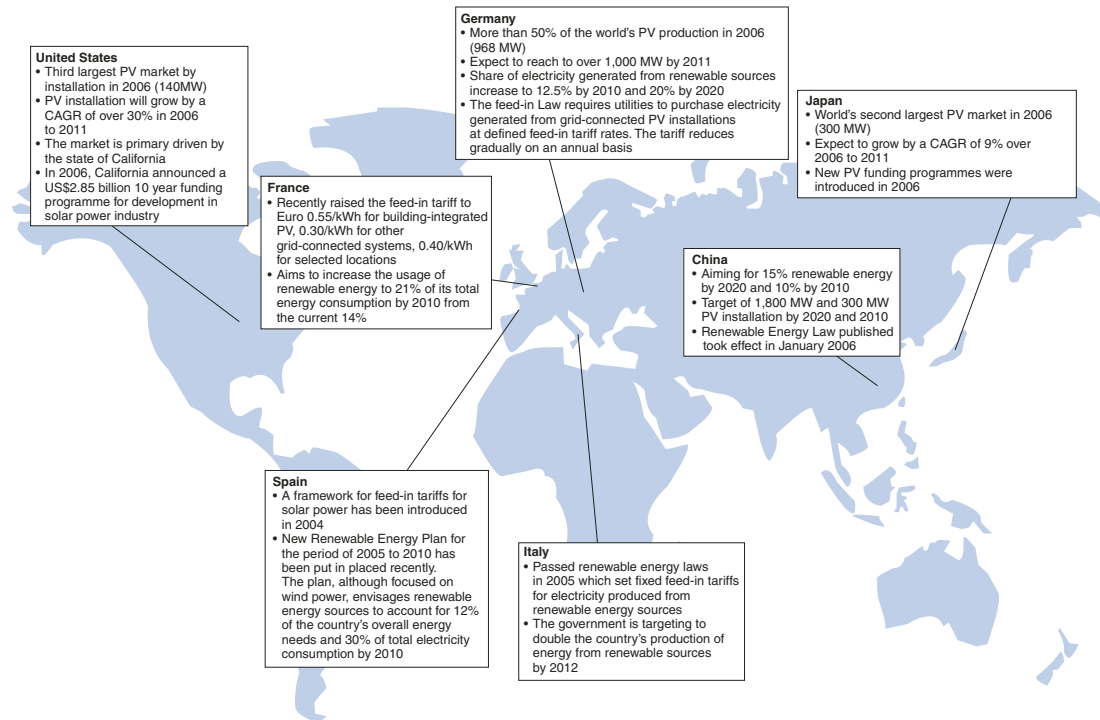
Depending on the forecast scenario, Solarbuzz projects that by 2011, Germany will account for 28–30% of global market demand, Japan will account for 9–11%, the rest of Europe will account for 23–24%, the United States will account for 16–23% and rest of world will account for 16–20%.

In 2006, around 80% of the solar PV installations were located in Germany, Japan and the U.S. where these governments have been actively promoting the use of renewable energy sources, including solar power, through favorable regulatory and financial supports. In 2006, Germany was the fastest growing country with more than triple the installation capacity (968 MW) than that for Japan (300 MW), the world's second largest solar power country in terms of installation capacity in 2006. From 2006 to 2011, U.S., countries in the rest of Europe and rest of the world are forecasted to be the fastest growing countries or regions in accordance with Solarbuzz. Germany and Japan are forecasted to grow steadily with less than 10% CAGR in each case over 2006 to 2011.

Germany and Japan have taken the lead in granting long-term national incentive policies designed to make solar power mainstream. The United States has also been increasingly investing in solar power development with many states introducing solar rebates. Other European markets, such as Spain, France, Greece, Italy and Portugal, also have supporting programs, including tax reductions and feed-in regulations.

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Set out below is a summary of the key geographic PV markets where the use of solar power has been actively promoted based on the Balanced Energy Scenario:



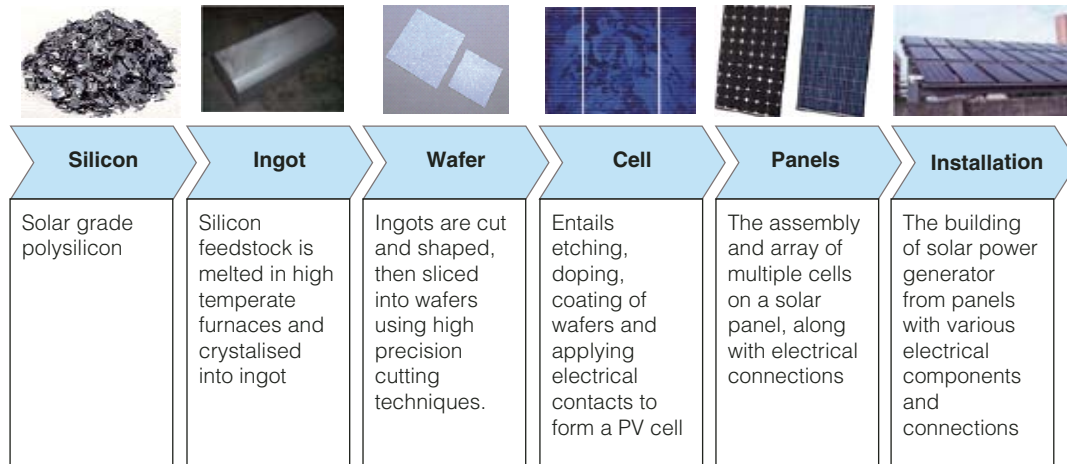
Favorable legislations are being introduced in a number of other countries which is expected to cater for a strong and a visible growth in the sector. China, one of the largest energy consumers in the world, is also starting to pick up in this industry.

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### PV VALUE CHAIN

In this section of this prospectus, the PV value chain refers to the purification and crystallisation of silicon, cutting of crystallised silicon (or ingot) into wafers, processing of wafers into cells, assembling the cells into modules, and the overhead energy use for the manufacturing building. Most solar cells and modules sold today are crystalline silicon based, which are either monocrystalline or multicrystalline silicon.

The following diagram illustrates the value chain for the manufacture of crystalline silicon-based solar power products.



Silicon reclaimed from discarded portions of silicon ingots, pot scraps and broken silicon wafers may also be used as for the ingot crystallisation process.

### Solar ingot and wafer (monocrystalline silicon versus multicrystalline silicon)

PV cell is primarily manufactured in the form of monocrystalline and multicrystalline silicon, which takes up roughly over 90% of the PV cell market in 2006, according to Solarbuzz.

Comparing the use of monocrystalline silicon and multicrystalline silicon for solar ingot/wafer production, the ratio split between these two silicon wafer types is about 1:1.16 in 2006, compared with 1:1.77 in 2004 and 1:1.51 in 2005, reflecting that the use of monocrystalline silicon products has increasingly become more popular over the past three years.

Set out below are the historical growth rates for the PV cell production by technology over 2002 to 2006. Due to higher conversion efficiency for monocrystalline solar products, the historical growth of this type of PV technology have been at a much higher pace than less efficient multicrystalline solar products, albeit the production cost for the latter is generally lower. According to Solarbuzz, crystalline based solar power products represented approximately 92% of the market in 2006, compared with 8% for the thin-film-based solar power products.

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### World's PV cell production by technology 2002-2006

	2002		2003		2004		2005		2006		CAGR (02-06)
	MW	% Total	MW	% Total	MW	% Total	MW	% Total	MW	% Total	
Monocrystalline silicon	165	33.9%	216	31.7%	391	34.1%	620	37.5%	934	42.4%	54%
Multicrystalline silicon	292	60.0%	426	62.4%	692	60.3%	937	56.6%	1,087	49.3%	39%
Thin film	30	6.1%	40	5.9%	64	5.6%	98	5.9%	184	8.3%	57%
<b>TOTAL</b>	<b>487</b>	<b>100.0%</b>	<b>682</b>	<b>100.0%</b>	<b>1,147</b>	<b>100.0%</b>	<b>1,655</b>	<b>100.0%</b>	<b>2,205</b>	<b>100.0%</b>	<b>46%</b>

Source: Solarbuzz LLC 2007

As the industry moves toward thinner silicon wafers and improves conversion efficiency, the amount of silicon required for each watt of output should be reduced. One advantage of monocrystalline silicon over multicrystalline silicon has always been that the efficiency ratio of monocrystalline silicon is always higher than multicrystalline silicon.

Monocrystalline module efficiencies increased from around 13.0% in 2002 to around 14.7% in 2006, and multicrystalline module efficiencies increased from around 12.2% in 2002 to around 13.2% in 2006. The efficiencies gap between the two types of crystalline silicon modules is between 0.9%-1.5% in the past five years.

### Raw Materials for solar ingots and solar wafers

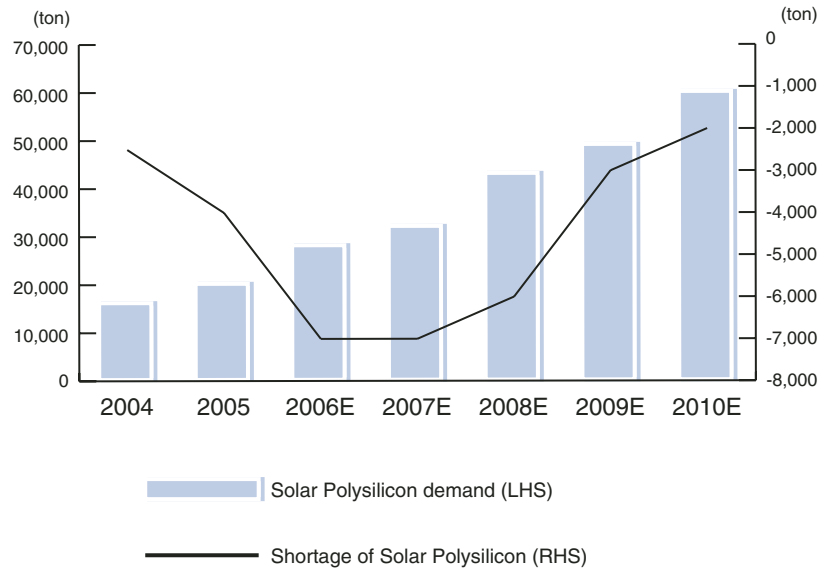
The major raw materials used to produce solar ingots and solar wafers include polysilicon and auxiliary raw materials such as graphite, crucibles, etc. The amount and the quality of these raw materials contained in any individual solar ingots and solar wafers varies depending on the specifications of the specific product.

According to ResearchInChina (水清木華研究中心), an independent research house, there has been a shortage of solar polysilicon supply resulting in a supply-demand gap in the past years. While this gap will remain beyond 2010, the price level of solar polysilicon is expected to reduce in or about 2008 with more supply coming on line.



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### Demand and Shortage of Polysilicon Raw Material



Source: ResearchInChina dated January 2007 (水清木華研究中心)

According to ResearchInChina (水清木華研究中心)<sup>(Note 1, 3)</sup>, China's spot price for solar polysilicon suitable for manufacturing of solar ingot and wafer was below US\$40/kg in 2004. Spot price for incremental supplies of solar polysilicon, i.e., those quantities produced and not committed through intermediate and long-term contracts, has reached around US\$300/kg in 2006 according to Solarbuzz LLC 2007<sup>(Note 2, 3)</sup>. In accordance with Solarbuzz, some scrap silicon, such as broken wafers, was trading at levels around US\$50/kg in 2006, pot scrap at up to around US\$70/kg, while some virgin polysilicon were trading in the range of US\$100–200/kg.

Presented below are the historical average long-term contract prices for solar polysilicon over 2004–2007:

Delivery	US\$/kg
2004	28–32
2005	35–40
2006	50–55
2007	60–65

Source: Solarbuzz LLC 2007

Notes:

- (1) ResearchInChina is a research and consulting company in the PRC, with senior professional analysts and experienced market investigator, as well as senior consultants who are authoritative expert. It provides research support for more than 20 major industries and has been recognised as a leading China independent research house in polysilicon industry.
- (2) Solarbuzz is an international solar energy research and consulting company, staffed by members drawn from some of the largest companies in the solar energy industry today. Data in the report is based on a combination of published information, personal communication and estimates made by Solarbuzz.
- (3) Neither ResearchInChina nor Solarbuzz have been commissioned by the Directors, the Company or the Sponsor.

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### CHINA SOLAR PV INDUSTRY

#### Development of Solar PV Industry in China

The development of China's solar PV industry, with solar cells as the initial driver in the development of the whole industry value chain can be categorised into the following phrases:

##### *Incubation and Primary Formation Phrase (mid 1980s)*

- Some civil semiconductor device factories started to manufacture techniques and process solar cells by utilizing discarded monocrystalline silicon wafers and p-n junction diode processes.
- Companies in China started to import full sets of solar cell manufacturing lines for solar cells manufacturing.
- China's solar cell industry production capacity at about 4.5 MW per annum.

##### *Stable Development Phrase (1990s)*

- Improvement in the manufacturing techniques and processes of solar cells.
- During this period, the development of China solar PV industry came from importation, digestion, absorption and innovation of the manufacturing techniques and process of solar cell.

##### *Rapid Development Phrase (the 21st century)*

- In 2005, the production capacity of solar cells was more than 300 MW per annum, and the production yield reached 145.7 MW per annum.
- Solar crystalline silicon cells and amorphous silicon solar cells accounted for 133 MW per annum and 12.7 MW per annum, respectively.
- Consequently, a relatively complete solar PV industry chain was fostered, including the manufacture of polycrystalline silicon feedstock, the production of silicon ingot/silicon wafer, the manufacture of solar cells, module capsulation, and integrated applications of solar PV systems.

#### Crystalline Silicon Ingot Manufacturing Industry in China

The total production capacity of monocrystalline ingots and multicrystalline casting ingots was more than 4,000 tons in 2005. According to the report on the Development of the PV Industry in China (2004-2005) commissioned by the NDRC. The Global Energy Fund and the world Bank under the project entitled "China Renewable Energy Development Project", the Group ranked the second largest monocrystalline silicon ingot producer in China in 2005 in terms of annual production capacity.

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According to the report, a large number of China's crystalline silicon manufacturers are monocrystalline based. China is relatively mature in the solar wafer manufacturing know-how and process, in particular, the production of monocrystalline silicon. China's solar ingot/wafer markets have been dominated by the production of monocrystalline silicon products. This also represents a strength of China within the global segment of renewable energy. The ability to manufacture monocrystalline pullers domestically also strengthens the China solar ingot/wafer markets.

### **PRC Renewable Energy Law**

The Renewable Energy Law of the PRC was promulgated in February 2005 and became effective in January 2006, and promotes cleaner energy technologies.

Under the new Renewable Energy Law:

- A renewable energy development fund will be established to support R&D and resource assessment.
- The on-grid electricity prices for electricity generating projects using renewable energies shall be determined and adjusted on a timely manner by the local administrative bureau of the State Bureau of Commodity Prices in accordance with a number of factors including:
  - the principles that can help and promote the development and utilization of renewable energies;
  - principles of economy and rationality;
  - characteristics of electricity generation using different types of renewable energies;
  - renewable energy source's utilisation technology; and
  - conditions of different regions in the PRC.
- The government of the PRC shall adopt a tax preferential policy for projects that are listed in regenerable energy industry development guidance catalogue.

### **PRC Government Funding and Plans**

In addition, the Ministry of Finance has decided to increase funding of projects involved in developing alternative energies between 2006 and 2010. The scope of the projects includes solar, bio-energy and wind etc.

Market projections put China's cumulative installed PV capacity at 300 MW by 2010 and 1800 MW by 2020 (from a cumulative level of 70 MW at the end of 2005).

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The government plans to build 10,000 resource-efficient villages in 500 counties during the 11th Five Year Plan period (2006-2010). One of the recommended clean energies included solar power. The central government would offer funding support to those projects as “seed money”.

The largest segment of the domestic PV market, with over 40% share, remains the electrification of rural areas, for which a so-called “Lighting Project” is considered to provide a master umbrella. This program has the goal of providing electricity to over 20 million residents in more than 20,000 rural villages, with completion planned by 2010. Some 10 million of these residents in the western provinces of China. Some 43% of the installations were in Tibet, and 25% in Qinghai province. Tibet now has over 9 MW of installed PV capacity, including over 300 PV installations with capacities ranging from 3 to 5 kW. Within Tibet, Lhasa has established solar PV stations with capacities ranging from 10 to 100 kW in its seven neighboring counties and has total PV electricity generation system capacity of 5.4 MW.

Furthermore, the Information Office of the PRC State Council published in December 2007 a white paper titled “China’s Energy Conditions and Policies” setting out in more details, amongst others, strategy and goals of energy development of the PRC. It is also reported that medium-term and long-term programs for renewable energy development have been released to put forward the goal of increasing renewable energy consumption to 10 percent of the total energy consumption by 2010 and 15 percent by 2020. It is intended that China will spread the latest technologies for the utilization of solar energy and other renewable energy sources and increase their market shares and encourage research in developing basic technology for large-scale utilization of renewable energy.

### KEY GROWTH DRIVERS IN SOLAR ENERGY INDUSTRY

Solar power generation is one of the fast growing renewable sources of electricity in recent years. The Directors believe that the following factors have driven and will continue to drive the growth of the global solar energy industry:

- Global warming and environmental concerns whilst electric power demand continues to grow;
- Government incentives and renewable energy laws for solar power;
- The customers and end-users to switch towards solar power as a main source of renewable energy; and
- Declining cost of PV modules resulted from technology advancement, economies-of-scales arise from increasing scale of production, etc. have contributed to the usage of solar power becoming more affordable.