

Zone	kWh/m2	(%)
I	1,750 (	17.4
II	1,400-1,750	42.7
III	1,050-1,400	36.3
IV	(1,050	3.6

Source: NREL, UNEP and SWERA<sup>1</sup>

Solar Insolation: ~1050-2450 kWh/kWp/yr Yearly Average Solar yield  
 ~3.0-7.5 kWh/m<sup>2</sup>/day Average Solar Radiation on collector surface

### Solar Policy Context

**Carbon Intensity**

**Solar Resources**

**Proximity to Parity**

### Grade Breakdown

**Progress to date** 100 MW

**Financial Incentives**

**Regulatory Incentives**

The World Energy Council reports, “An estimated 2/3rds of the country receives solar radiation in excess of 4.6 kWh/m<sup>2</sup>/day. China’s annual solar power potential has been estimated to be 19,536,000 TWh. Capturing 1% of this resource, and utilizing it with 15% efficiency, could supply as much electricity as the whole world currently consumes in 18 months.”<sup>2</sup>

### Installed PV Capacity

Cumulative installed end 2007: 100 MW (95% off-grid)<sup>3</sup>  
 Cumulative installed end 2006: 80 MW (95% off-grid)<sup>4</sup>  
 Cumulative installations growth rate 2005-2006: +14.3%      2006-2007: +25%  
 Annual installations growth rate 2005-2006: +100%      2006-2007: +100%  
 Population: 1,300 M    PV/capita: 0.08 W/capita

*According to the energy revolution scenario, China has the potential as well as the capacity to develop 25 GW (25,000 MW) of solar PV power by 2020.<sup>5</sup>*

### Drivers for Future Development

In 2006, The Chinese Renewable Energy Law provided China with a comprehensive renewable energy policy framework. The law institutionalized a number of policies and instruments for China’s renewable energy development and utilization, covering renewable energy targets, renewable energy planning, entry of renewable energy products to the market, grid connection of renewable power generation project, feed-in-tariffs for renewable power generation, fiscal and taxation measures, renewable energy technology R&D and diffusion, and renewable energy education and training. Unfortunately China’s domestic PV industry is small and fragmented in comparison to other RE technologies and so not all of these policy initiatives are applicable.

### Financial Incentives

**The Renewable Energy Law (2005, in force since 2006)**

**Feed-In Tariff**

- Not PV specific
- The rate for solar is to be fixed by “the responsible pricing department of the State Council according to the principle of reasonable production costs plus reasonable profit.”<sup>6</sup>
- The standard renewable energy feed-in rate (applicable to biomass) is RMB 0.25/kWh (2008 USD 0.035/kWh). Guaranteed for the first 15 years of operation; 2% degression starting 2010.
- For wind the rate is not specified either; the government to provide bidding price guidelines.
- The cost of the feed-in and interconnections are to be redistributed over whole grid electricity price.

## Financial Incentives (continued)

The law also stipulates the tariff should be offered to off-grid systems generators (and the cost borne by grid users). However, according to the China Renewable Energy Development Project (CREDP)'s Report on the Development of the Photovoltaic Industry in China (2006-2007), to date, no funding has been disbursed for such off grid systems.

### Tax Incentives, Subsidized Loans and R&D Support

The details below address the Renewable Energy Law's prescriptions for tax incentives, loans and R&D support for renewable energy in general. However, these articles do not have any solar-specific provision and while details on tax incentives for biomass and wind were found for example, none were found for solar.

Article 24 of the Renewable Energy Law requires that a Renewable Energy Development Fund be established through the government budget to support R&D efforts, demonstration projects, etc.

Article 25 states, "Financial institutions may offer preferential loan with financial interest subsidy to renewable energy development and utilization projects that are listed in the national renewable energy industrial development guidance catalogue and conform to the conditions for granting loans", though the article fails to specify the terms of the subsidy. (The development guidance catalogue was not found).

Article 26 deals with tax benefits for renewable energy projects but again refers to the catalogue for details.

### China's 11th 5 year plan (2006-2010)

Outlined the first phase of the Village Programme: 250 MW of PV, bringing power to 2 million households. It also plans for 50 MW of rooftop and BIPV systems, as well as a 20 MW demo plant in the Gobi desert.<sup>7</sup>

### Subsidies for PV in rural areas

These subsidies take the form of project subsidies, user subsidies and construction assistance. The funding for this initiative comes from the central government budget, local government budget and international aid. Over the past ten years, there have been numerous such subsidies granted, including:

- From 1996 to 2000, more than ten solar PV power systems were built in Tibet to provide electricity for villages without access to the grid. The power produced by PV covered lighting and other basic residential electricity uses.
- In 1997, the government introduced the "Bright Project", which started with pilot projects in Qinghai, Xinjiang, Inner Mongolia and other provinces. This initiative supported the use of solar PV to provide domestic electricity for peasants and herdsmen. Funding came from international aid and the local government budget. The project distributed solar PV devices to schools, hospitals and local people.
- With the help of the Global Environment Fund, the Chinese government implemented the Renewable Energy Development Programme through the World Bank. The Programme was designed mainly to promote household solar PV systems in the nine provinces of Western China, including Inner Mongolia, Tibet, Qinghai, Gansu, Xinjiang, Shaanxi, Yunnan, Ningxia and the west part of Sichuan.
- From 2002 to 2004, the Chinese government initiated the Township Electrification Programme, which mainly used solar PV. The Programme received 2 billion RMB (~240 million USD) from central government and 1 billion from local government. Electricity supply was introduced to over 700 villages, representing more than 200,000 households and about 1 million people. There have also been many other initiatives by provincial governments to subsidise the use of solar PV for peasants and herdsmen. In Xinjiang and Qinghai, for example, every installation of solar PV could receive between 100 and 200 RMB in subsidy.

### Pilot Programs and Public Procurement

More than 1 million household PV systems, more than 1,000 village PV power stations, over 100 grid-connected roof PV systems and one large 100 kWp grid-connected desert power station have been installed as a result of these policy initiatives.

- Shanghai's "100,000 Solar PV Roof Plan": Shanghai plans to build 100,000 Solar PV on roofs in the five years from 2006 to 2010, with an estimated total installed capacity of 400 MWp.
- Beijing's "Solar Road Lighting Project": Beijing plans to supply road lighting with solar PV power in rural streets and some main roads using government funding. Solar PV was also installed on some of the Olympic venues.
- Jiangsu's "Solar PV Promoting Plan": The Jiangsu provincial government plans to install solar PV at some airports and in landmark buildings in various cities.
- Desert PV Station: The Ministry of Science and Technology has arranged specific funding to build four pilot projects of desert PV stations in Gansu, Tibet, Sichuan and one other location.
- Dezhou in Shandong Province and Baoding in Hebei Province are trying to build a Solar City.

### Regulatory Incentives

#### **Mandatory Market Shares (Renewable Portfolio Standard)<sup>8</sup>**

- 1% of total power generation to come from non-hydro renewable sources by 2010 and over 3% by 2020.
- Power generators with self-owned capacity of over 5 GW will be required to account for 3% of that capacity from non-hydro renewable energy sources in 2010 and over 8% by 2020.

#### **Interconnection**

- As per the “Renewable Energy Law”, priority interconnection for renewable energy systems is mandated. The costs of interconnection are to be redistributed over all ratepayers through the price of grid electricity.
- In case the utilities fail to comply with this mandate, they are liable for compensation, though the price of the fine is not stipulated (article 29).<sup>9</sup>

### Industry Status

In 2007, China increased solar cell production by 138%, overtaking both Europe and Japan to become the world's largest solar cell manufacturer. Its annual production reached 1,088 MW.<sup>10</sup> Suntech remained the industry leader, with a production output of 327 MWp, representing 30.1% of total Chinese production. The Chinese PV industry has increased at an average annual rate of 191.3% since 2002, indicating the success of its combined approach of industry development and capital market development.

### Renewable Energy Targets

Renewable energy target (including large-scale hydropower): 10% primary energy supply by 2010<sup>11</sup>, 15% (or 360 GW) by 2020.<sup>12</sup>

While there is no official government target for share of electricity generation, the government has set capacity targets by technology (i.e. 2.2 TWh of solar PV by 2020). Based on these, renewable energy targets for share of electricity generation (including large-scale hydropower) have been estimated at 10% by 2010 and 21% by 2020.<sup>13</sup>

Renewables accounted for 17% of electricity generated in 2006<sup>14</sup>, up from 16% (or 0.1% excluding hydro) in 2005.<sup>15</sup>

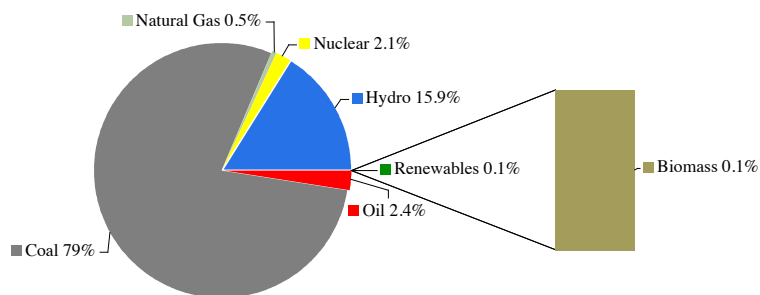
The 2007 “Medium and Long-Term Development Plan for Renewable Energy in China” mandates a renewable portfolio standard for major national power companies to generate or purchase 1% by 2010 and 3% by 2020. Additionally, for power producers with capacities greater than 5 GW, actual ownership of non-hydro renewable energy facilities will need to amount to 3% of their total generating capacity by 2010 and 8 percent by 2020.”<sup>16</sup>

### Solar Target

Solar PV targets: 300 MW (50 MW grid-tied) by 2010 and 1,800 MW (1,000 MW grid-tied) by 2020.<sup>17</sup>

Solar provided ~0% of electricity production in 2006. (0.08 GW out of a total electricity generating capacity of 620 GW for 2006.)

### Electricity Generation by Fuel (2005)<sup>18</sup>



### Energy Subsidies

China's total energy subsidies have been estimated at over \$10 billion a year.<sup>19</sup>

The International Energy Agency reported a 58% drop in energy subsidies in 2006 from 2005 levels. Oil products received \$3 billion in 2006, coal more than \$4 billion and natural gas about \$2.5 billion. Around \$1.2 billion were allocated to electricity.<sup>20</sup>

It should be noted that consumption subsidies related to transport fuels have now been largely eliminated.

Another study<sup>21</sup>, which referred to the above IEA numbers as being consistent with its results, noted, “Subsidies to electricity in 2006 reached an all time high of \$385.44 million and from January through mid-year 2007 were about \$215.88 million.” It also reported that, “Subsidies to natural gas in 2005 reached an all time high of \$91.78 million and from January through 2007 mid-year, because of the supply problems, the loss of subsidies amounted to approximately \$27.51 million.”

Finally, the IEA's 2006 World Energy Outlook reported that Chinese consumption subsidies expressed as percentages of 2005 reference prices, amounted to 45% for Natural Gas and 17% for coal.<sup>22</sup>

Figures cited in a Worldwatch Special Report on China relate that, “Renewable Energy R&D spending in the 10th Five-Year Plan (2001-05) reached 1 billion RMB over the five years, equivalent to \$25 million per year.”<sup>23</sup>

### Solar PV R&D

The government has provided various support schemes for the research and development of solar PV. These include:

- Basic R&D Support Scheme, that supports future solar PV technologies, including backing for the technical and theoretical development of thin-film and dye sensitized solar cells.
- High-tech R&D Support Scheme, that supports solar PV technologies which are about to become commercialized, including basic equipment and materials for solar power, cadmium telluride, copper indium germanium selenium and thin film silicon solar cells.

## Solar Energy Policy Context (continued)

- Pillar R&D Support Scheme in 2006, which has helped lay down the foundations for commercialisation of solar PV in China.
- Commercialisation Support Scheme, which provides funding for the development of solar industries.

### Energy Efficiency Measures

Within its 11th Five-Year Period, China plans to reduce the energy consumption of residential and public buildings by 50%.<sup>24</sup> Current energy efficiency policies vary for different regions of China, however a national energy efficiency building code is expected to be issued this year. This national code is being developed by the Central Ministry of Construction. The implementation and enforcement of the program will be the responsibility of regional governments.<sup>25</sup>

China has a green Building Rating System but is also establishing a labeling system for buildings to help ensure the efficiency of new buildings and the visibility of energy efficiency in the market place.<sup>26</sup>

Energy efficiency in new buildings in China is crucial; according to the Ministry of Construction, more than 2 billion m<sup>2</sup> are constructed in China every year, which accounts for more than 40% of all new constructions in the world.<sup>27</sup>

## Summary of PV Support Measures in China

<b>PV Support Measures</b>	
Feed-in tariffs	Yes but Not PV specific. No set rate for PV.
Direct capital subsidies	Not mandated, project-specific.
Renewable portfolio standard	1% of total power generation to come from non-hydro sources by 2010 and 3% by 2020. Power generators with self-owned capacity of over 5 GW required to account for 3% of that capacity from non-hydro renewable energy sources in 2010 and over 8% by 2020.
PV requirement in RPS	No
Solar Renewable Energy Certificates	No
Tax credits	No
Subsidized Loans	No
Net metering	No
Interconnection	Mandatory

## Conclusion

Although China's Renewable Energy Law denotes an aggressive stance on RE and seems to have all the necessary ingredients, it remains non-committal on PV. It establishes rules for feed-in tariffs, tax credits, subsidized loans but stops short of defining specific terms for PV.

Given the country's great solar resources and the tremendous social, economic and environmental benefits to be gained, the government would be well served by supporting solar more aggressively.

For example, the China Renewable Energy Development Project (CREDP) Report on the Development of the PV Industry in China (2006-2007) notes the dramatic increase in employment in the PV industry from 13,800 jobs in 2005 to 82,800 in 2007. And this growth reflects China addressing the international market. China's domestic market remains untapped (only 20 MW of the 1088 MW produced were installed in China, 90 to 98% of Chinese production being exported to European markets).

The CERDP authors also report a major hurdle to the success of the feed-in tariff for PV: "For safety and other concerns, PV generated electricity is not allowed transfer to main high voltage (10 kv) electricity power grid through power transformer". They conclude, "to realize true "Feed-in tariff" according to "cost and profit" direction and fully accept PV generated electricity, there are still great efforts that need to be done by government and electricity companies."

Indeed without firm government support behind PV, utilities are unlikely to embrace the technology. Efforts should be made to mandate interconnection and promote education about solar and the benefits of its integration.

China could redirect the billions spent on fossil fuel subsidies to fund incentives for PV. It would also be helpful for the long term development of a domestic solar market that China continue to reduce electricity subsidies, so that solar electricity may become competitive.

## Endnotes

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- <sup>11</sup> Eric Martinot and Li Junfeng "Powering China's Development: The Role of Renewable Energy" Worldwatch Special Report, November 2007.
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- <sup>13</sup> Ibid.
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- <sup>18</sup> International Energy Agency, IEA Energy Statistics 2007, “China Electricity Generation by Fuel 2005”, <http://www.iea.org/textbase/pm/JRECPIC/Electricity%20Generation%20by%20Fuel%202005%20-%20China.gif>
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