A Report on

The Current Scenario Of Developments In Renewable Energy In the PEOPLES' REPUBLIC OF CHINA

August 2008

REEEP author: Shoumyo Majumdar

References used for this report:

1. Proceedings from China Renewable Energy Strategy Workshop

2. The Renewable Energy Development in China by Zhuang Xing, Energy Research Institute

3. Current Status of New and Renewable Energies in China: Introduction of Fuel Ethanol by Chew Chong Siang, Institute of Energy Economics, Japan

4. China's medium to Long term Renewable Energy Development - Promotion of Bio ethanol Introduction and Future Strategic Developments by CHEW CHONG SIANG, Institute of Energy Economics, Japan

5. http://www.wikipedia.com

6. Current Status and Future Expectation of PV in China - China EU Energy Collaboration Forum

7. China Wind Power Report 2007 - China environmental Science Press

8. Article ‘’The development of hydroelectricity in China is in a dilemma’’ - By Kui Jiang

9. Article ‘’China pledges to double reliance on renewable energy by 2020’’ - Jonathan Watts, The Guardian

People's Republic of China
An Overview

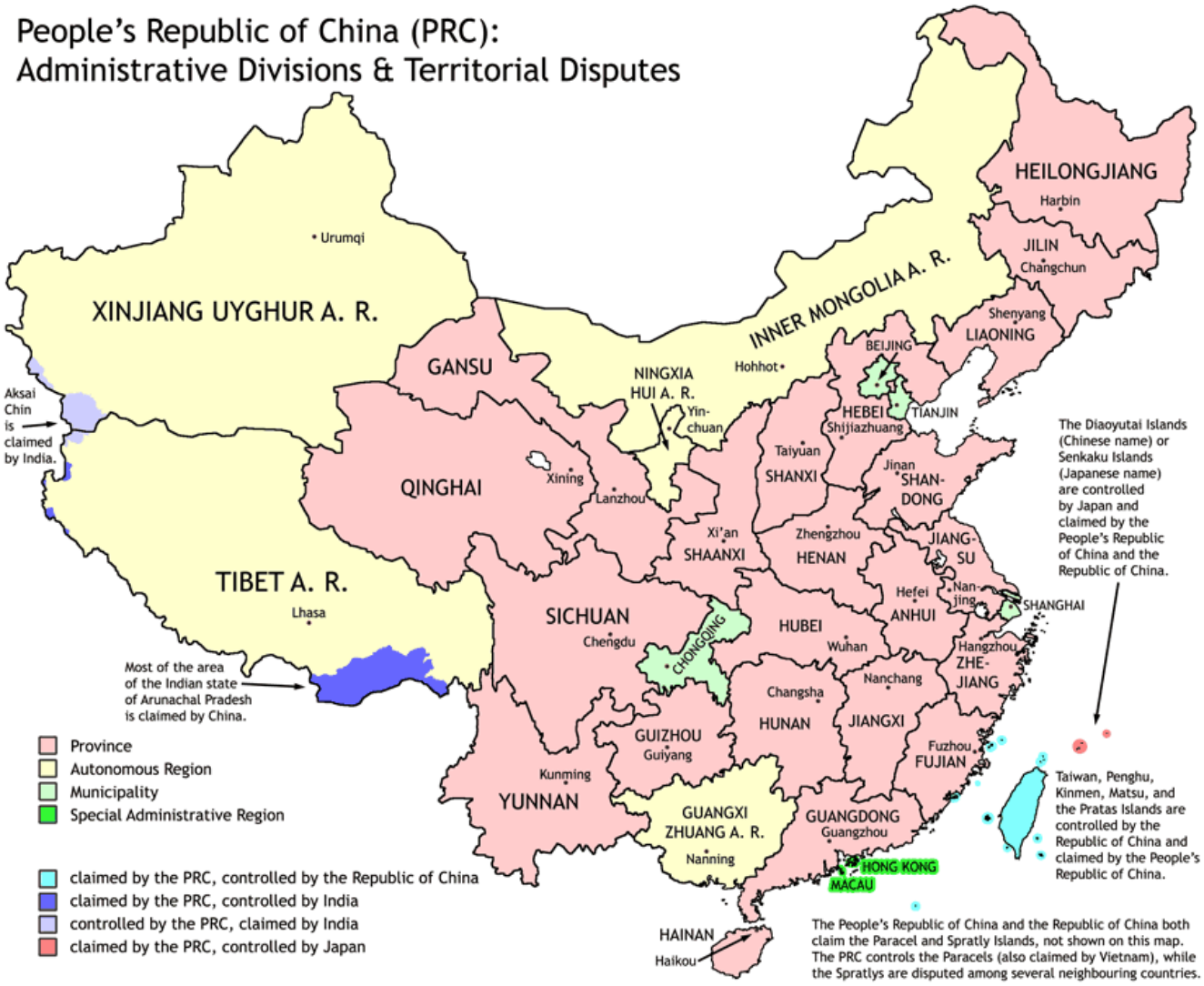
Because of its vast population, rapidly growing economy, and large research and development investments, China is considered an "emerging superpower". It has the **world's fourth largest economy** (second largest in terms of purchasing power parity).

POLITICAL DIVISIONS:

It has administrative control over:

- **Twenty-two provinces** (considers Taiwan to be its twenty-third province)
- **Five autonomous regions** (each with a designated minority group)
- **Four municipalities**
- **Two Special Administrative Regions**

[1]



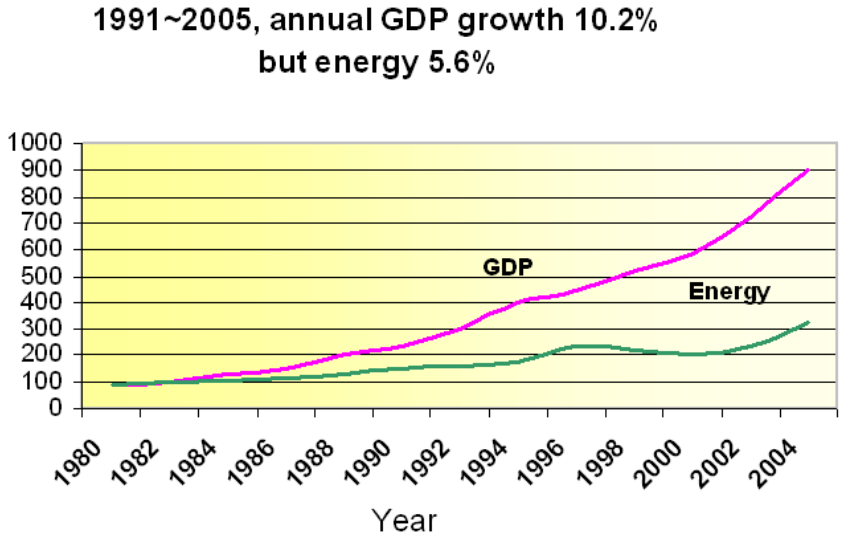
[1] Source: Wikimedia Commons, created by Ran

NAME	POPULATION	AREA	CAPITAL	GDP
Anhui	62,199,000	140,000	Hefei	4,390
Beijing	12,850,000	16,808	Beijing	16,735
Fujian	22,121,000	121,700	Fujian	9,258
Gansu	25,340,000	454,000	Lanzhou	3,137
Guangdong	71,580,000	178,000	Guangzhou	10,428
Guangxi	47,115,000	236,660	Nanning	4,356
Guizhou	36,631,000	174,000	Guiyang	2,215
Hainan	7,560,000	33,940	Haikou	5,698
Hebei	66,283,000	187,700	Shijiazhuang	6,079
Heilongjiang	38,108,000	469,000	Harbin	7,243
Henan	93,916,000	167,000	Zhengzhou	4,430
Hubei	59,677,000	185,900	Wuhan	5,899
Hunan	65,670,000	212,000	Changsha	4,643
Jiangsu	72,562,000	102,600	Nanjing	9,344
Jiangxi	42,158,000	166,600	Nanchang	4,155
Jilin	26,697,000	187,400	Changchun	5,504
Liaoning	42,039,000	146,000	Shenyang	8,525
Neimongol	23,611,000	1,200,000	Hohhot	4,691
Ningxia	5,384,000	66,400	Yinchuan	4,025
Qinghai	5,035,000	720,000	Xining	4,066
Shaanxi	36,269,000	205,600	Xian	3,707
Shandong	89,178,000	156,700	Jinan	7,590
Shanghai	14,913,000	6,340	Shanghai	25,750
Shanxi	31,908,000	156,000	Taiyuan	4,736
Sichuan	116,546,000	570,000	Chengdu	4,240
Tianjin	9,678,000	11,303	Tianjin	13,796
Tibet	2,479,000	1,230,000	Lhasa	3,194
Xinjiang	17,453,000	1,600,000	Urumqi	5,904
Yunnan	41,589,000	394,000	Kunming	4,042
Zhejiang	45,051,000	101,800	Hangzhou	10,515

Data Source : The State of China Atlas by Stephanie Donald & Robert Benewick © Copyright Myriad Editions 1995, 2005.

Development of Renewable Energy In China

China has one of the largest and fastest growing economies in the world. Hence, it relies greatly on foreign oil and petroleum, which apart from continuing on increasingly becoming more expensive is also putting a lot of pressure on the environment, and resulting in power shortages through out the country. Thus, to obtain energy security as well as facilitate a steady rise in its economy, it is necessary for China to find alternative energy sources, such as renewable energy. It is very evident by the figures that though China's industries are growing at an unbeatable pace, its growth in energy production is much slower.

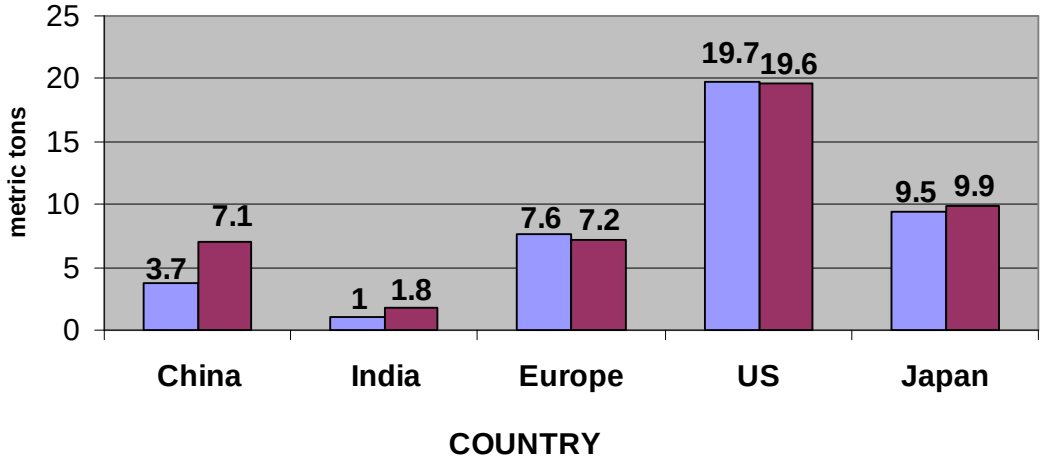


China is also the second largest emitter of greenhouse gasses in the world, following only the United States of America. It must work quickly to prevent further damage to the environment. This would mean that the country must switch from the nonrenewable energy – crude oil and coal - to renewable energy. China realized this soon enough, and rapidly performed legislations to come up with a Renewable Energy Law for the People's Republic of China in 2005. By 2006 China's total renewable energy output equaled 8% of non-renewable energy generation or 200 million MT of coal equivalents, though coal generated power consumption continued to account for 69% of total energy consumption in China. China's goal is for renewable energy to account for 10% of all energy consumption by 2010. In the medium term China plans to develop 120,000 MW's of renewable energy by the year 2020; this would account for 12% to 16% of China's total installed energy producing capacity that year. In the long term China has set an objective of having 30% or more of its total energy requirements satisfied by renewable sources by 2050. China's ambitious growth target for renewable energy production will require an investment of approximately 2 trillion Yuan (~$263 billion U.S.D.) by 2020.

Conventional energy sources of China, apart form crude oil, petroleum, coal and other fossil fuels, also includes hydropower. In fact, due to the vast network of rivers that flow through China, its gross installed hydropower generating capacity exceeded 100 million kw (in 2004), making up one quarter of gross installed electric power capacity and providing some 20 percent of the country's total electric power.

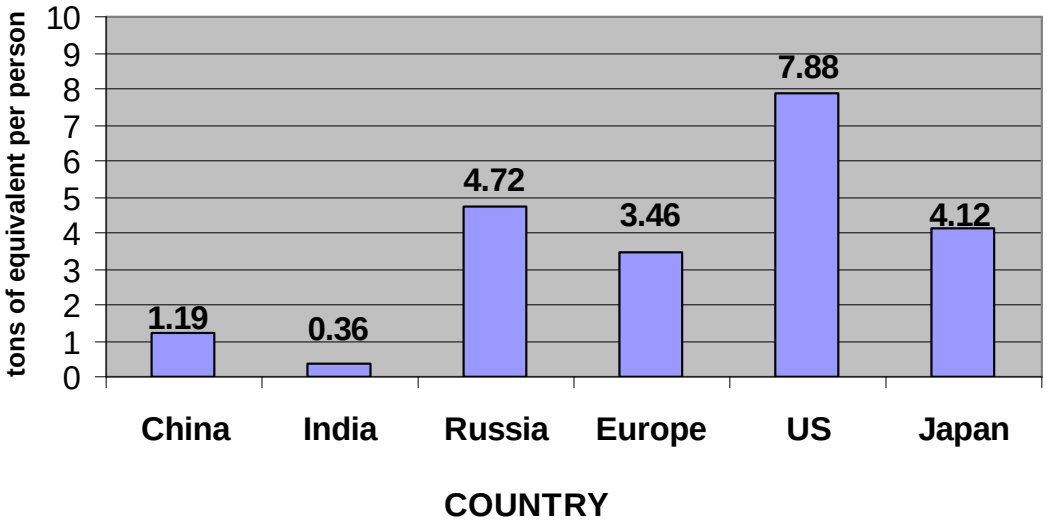
It is interesting to note here, that though China is one of the largest emitters of greenhouse gases, its per capita emission is still far behind most developed countries. Similarly, the per capita energy demand is also low in China (as per graph) as compared to other developed countries.

Current and Projected Per Capita CO2 Emissions (Metric Tons)



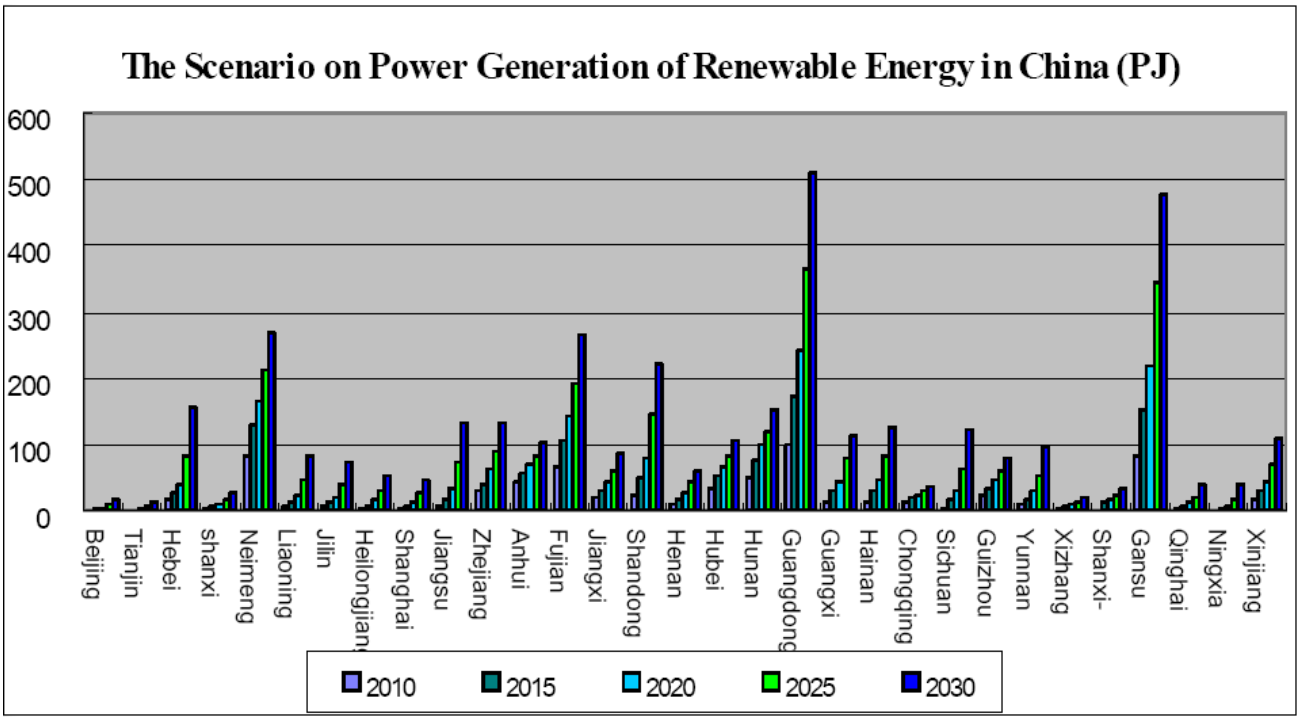
Source: EUI data and forecasts from the IEA World Energy Outlook. 2006

Per Capita Energy Demand (2005)



Source: BP Statistical Review and economist Intelligence Unit (EIU)

Renewable Energy over the Provinces



Source: Presentation on 'Renewable Energy Development' in China by Zhuang Xing, Energy Research Institute

Given above, is a graph that represents the expected growth of the renewable energy sector in China, according to province. It may be noted that some provinces, such as Guangdong, and Gansu are much further ahead with their estimated projections than certain other states. This is due to many factors, such as agreements or programs that the various individual provinces take part in. It also may be due to the vast renewable energy resources available in the region or province.

One such example of this is the Guangdong Energy Efficiency and Environment Improvement Investment Program, which is a Financing agreement between the People's Republic of China and the Asian Development Bank, for implementation of Energy efficiency through the province.

Various Categories of Renewable Energy

The renewable energy sector can be divided into the various categories:

1. Solar Power

Solar energy is the utilization of the radiant energy from the Sun. Earth receives 174 PW of incoming solar radiation at the upper atmosphere, of which, around 30% is reflected back to space while the rest is absorbed by the atmosphere, oceans and land. The total solar energy absorbed by Earth's atmosphere, oceans and land masses is approximately 3,850 zettajoules (ZJ) per year. In contrast, worldwide electricity consumption was approximately 0.0567 ZJ in 2005,and total worldwide primary energy consumption was 0.487 ZJ in the same year.

2. Wind Power

Wind power is the conversion of wind energy into a useful form, such as electricity, using wind turbines. Wind power is generally converted to the form of electricity; large-scale wind farms are connected to electrical grids to supply energy. Individual turbines can provide electricity to isolated locations. In windmills, wind energy may be also used directly as mechanical energy for pumping water or grinding grain.
Wind energy is available freely, is renewable and clean and produces no greenhouse gas emissions.

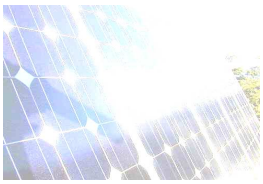
3. Hydro Power

Hydro Power is another source of renewable energy that converts the potential energy or kinetic energy of water into mechanical energy in the form of watermills, textile machines etc., or as electrical energy (i.e. hydroelectricity generation).
There are various types –

- Hydroelectricity
- Tidal Energy
- Wave Energy
- Waterwheels

4. Biomass/Biofuels

Plants use photosynthesis to grow and produce biomass. Also known as biomatter, biomass can be used directly as fuel or to produce liquid biofuel. Agriculturally produced biomass fuels, such as biodiesel, ethanol and bagasse (often a by-product of sugar cane cultivation) can be burned in internal combustion engines or boilers. Typically biofuel is burned to release its stored chemical energy. Research into more efficient methods of converting biofuels and other fuels into electricity utilizing fuel cells is an area of very active work.



Solar Energy/PV In China

The development of PV industry is very fast recent years in China pushed by world PV market. The share of PV prodution reached 8% in 2005 from 1% of few years ago, only less than Japan and Europe, China has become one of the most important PV prodution countries. However, The development of PV market is very slow in China.
This is because China has faced many obstacles in its development in the Solar Sector. This includes lack of a nationwide comprehensive photovoltaic (PV) plan, the lack of updated facilities and sufficient financial resources to support PV research at research institutes, the lack of sufficient facilities and resources at companies manufacturing PV products, the failure of companies to be able to produce high quality, reliable and low cost PV products and the relatively weak educational and training opportunities in China for PV science and technology.

China has vast land resources and thus has tremendous potential in solar energy. There are two ways to tap into the vast and infinite solar energy resources – Solar thermal applications such as water heating systems, or Photovoltaics (PV), which deals with the conversion of solar radiation to electrical energy using semiconductors.

Solar Thermal Energy

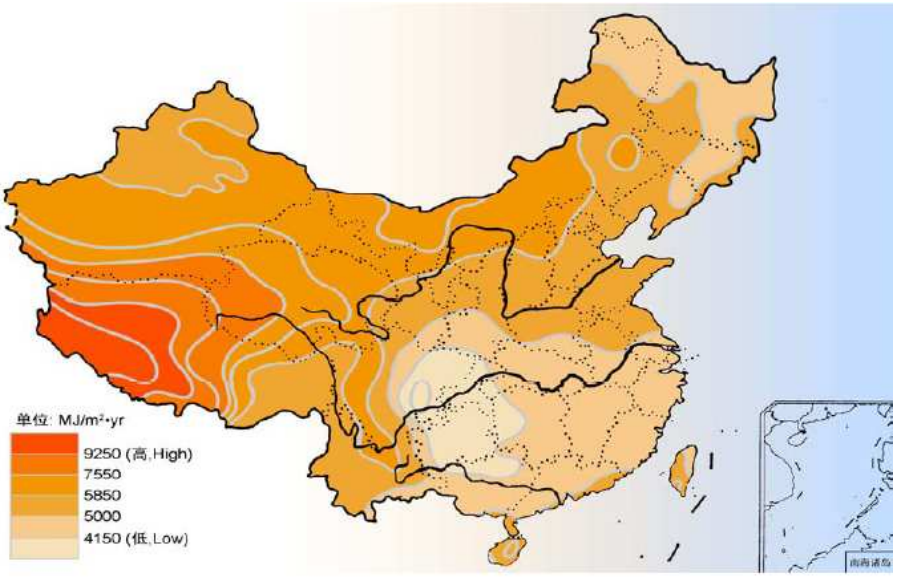


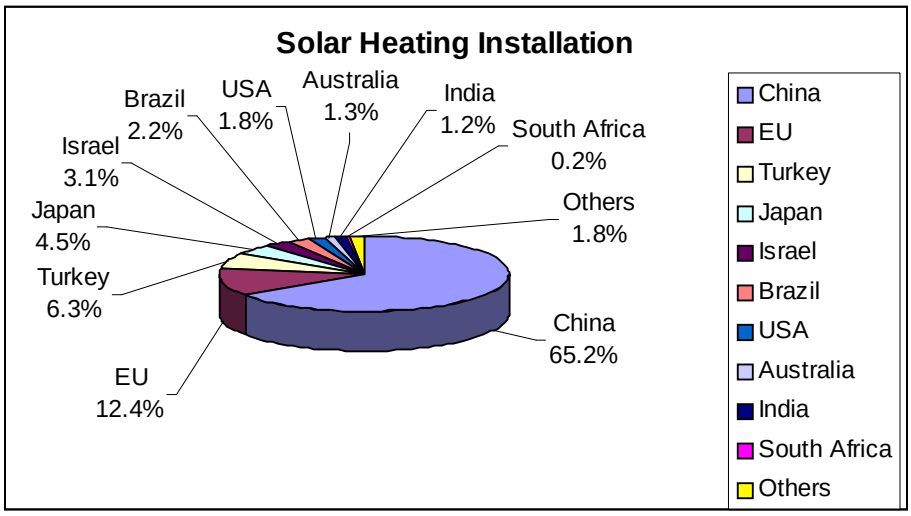
FIGURE 5 CHINA SOLAR ENERGY RESOURCE DISTRIBUTION

Given above is a map of China and the Solar Energy Resource Distribution, according to the average amount of solar energy that falls on Metre Square of land in the region per year.

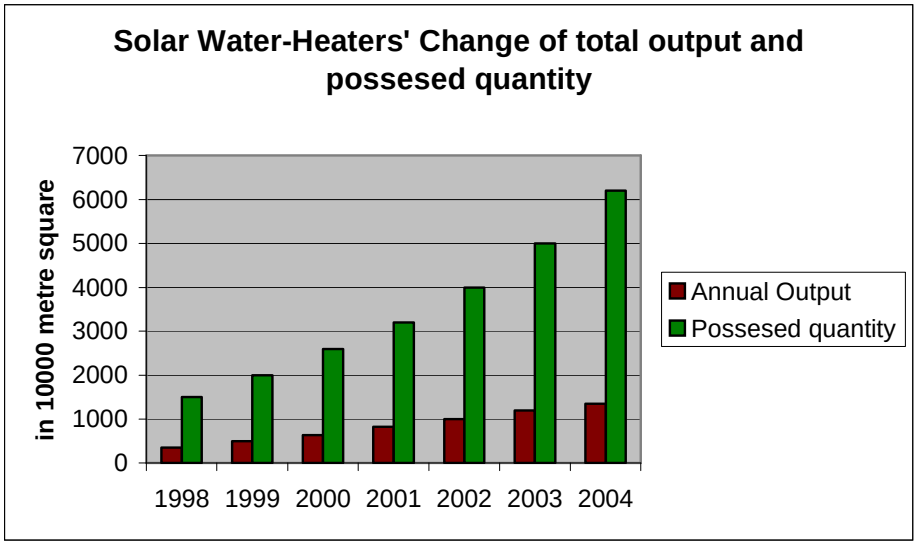
China is a world leader in the Solar Thermal Energy. Since much earlier in the decade, its market for solar water heating systems has been expanding considerably. By 2004, China's cumulative installations surpassed 60 million square metres, more than 70% of the total world market. However, owing to its large

population, the per capita installation is still much smaller to many countries, which points to the fact that there is still a huge market for it.
The Renewable Energy Law will give dependable legal assurance to the development of such renewable energy technologies. However, it does not provide any relief for enterprises dealing with solar water heating, thus the government does not provide any benefit policy or subsidy for these companies. Most of these companies happen to be private enterprises, and this builds further competition in an already fast growing market, apart from the obvious effects of the Chinese society's increasing awareness of environmental issues.

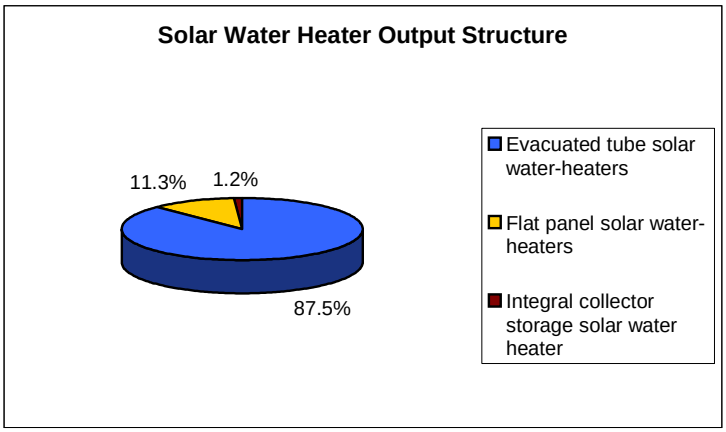
Comparing China with the other countries in terms of Solar heating Installation, i.e. direct use of the thermal radiations form the solar energy for heating purposes, it can be seen that the installed capacity to tap this energy is much greater in the country than any other at present.



There are more than 300 enterprises dealing with solar water heaters in china at this moment. The industrial system has also been stimulating the development of related industries such as thermal insulation, glass, metal, etc.
Since the late 1990s, the total possessed quantity of water heaters have had a sharp increase from 15 million square meters to 62 million square meters in 2004, total sale amounts reached more than 20 billion RMB. It at an estimated 80 million square meters in end 2005.



There are mainly three kinds of solar water-heaters: *evacuated tube solar water-heaters*, *flat panel solar water-heaters* and *integral collector storage solar water heater*. In 2004, the total output reached 13,500,000 square meters. Among them, the output of evacuated tube solar water-heaters are 11,800,000 square meters, amounting to **87.5%** of the total output; output of flat panel water-heaters are 1,525,000 square meters, **11.3%** of total output; output of integral collector storage solar water-heaters are 162,000 square meters, making up **1.2%**.



Utilization of Solar water heaters:

- **Household solar water heaters**

Solar energy is the source of thermal energy to heat water in such equipment. Since both opertational cost and over all expenses of such water heaters is much less than other products (electric or gas heaters), its market share has been steadily increasing.

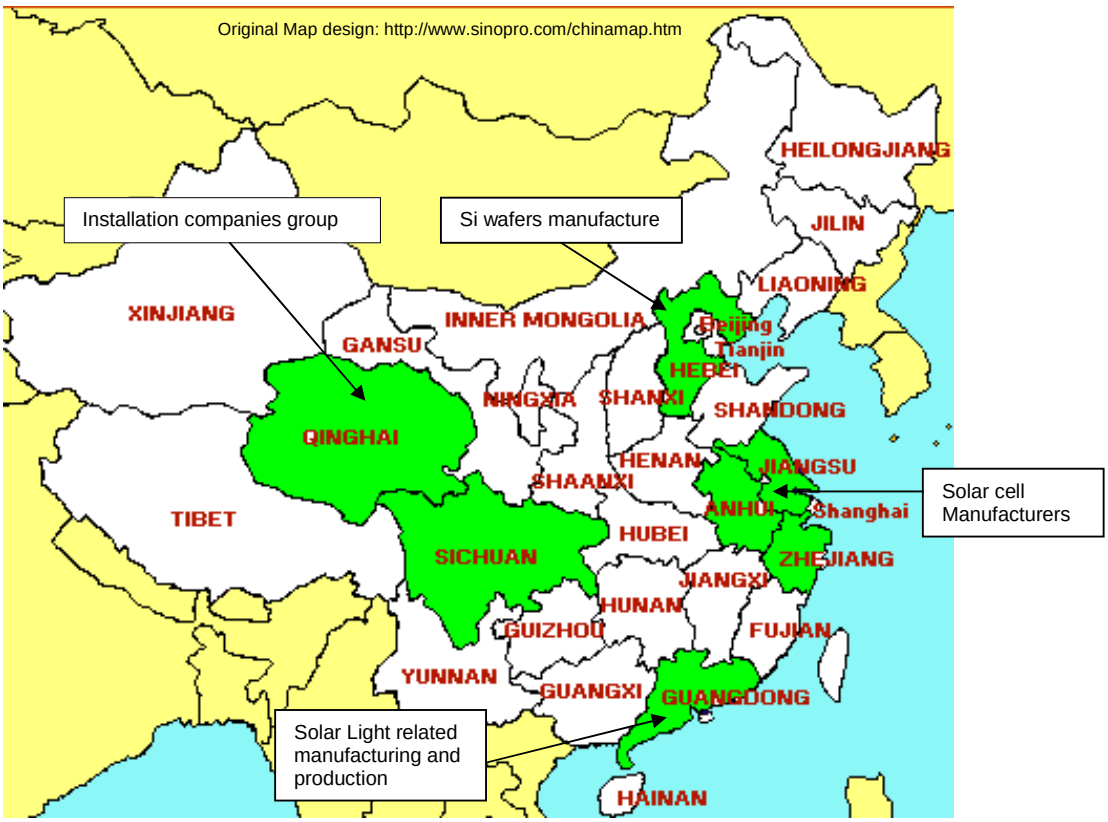
- **Energy saving by combination of water heaters with building construction**

Buildings such as office complexes, schools, hotels or residencial apartments all use a very large amount of energy to supply hot water. If solar energy water heaters anre to be integrated into buildings during construction, they can help save a lot of wasted energy. The national policies such as the energy conservation law also support this activity.

- **Utilization of air conditioning and heat supply**

The technology for heat supply and air-conditioning utilizing solar energy is not a distant dream in China. Highly efficient flat plate collectors have been used to satisfy air conditioning of as much as 500 square metres of area. Such technology is being actively researched, and many new test and demonstration projects are going on.

The Photovoltaic Industry



PV Development areas in China

Before 2000, the Chinese PV industry was seen to be relatively slow in its growth and there were four main manufacturers to produce crystalline Silicon solar cells and another four to produce amorphous Silicon solar modules. Annual production capacity of the PV manufacturers ranged from 0.5MWp to 2MWp. After the implementation of the 10th national 5-year plan (2001-2005), new companies emerged such as Baoding Yingli New Energy Co. and Suntech in Wuxi. The Market grew very quickly, owing to the fact that many domestic Government projects were developed and there was an increasing amount of demand in the international market, mainly Europe. By the end of 2004, total annual capacity of c-Si module in China reached to 100MWp (15MWp of a-Si capacity). However, 95% of pure silicon feedstock is still imported from foreign countries, as the domestic industry is still very weak in wafer and solar cell manufacturing.

Solar Grade Silicon Feedstock (2004)

No	Manufacturer	Capacity (Tons)
1	Luoyang Zhonggui, Henan	20 (300 under construction)
2	Ermei Semiconductor, Sichuan	20
3	Xinguang Silicon, Sichuan	(1260 Tons under construction)
Total	40 Tons that can produce only 3 MW of solar cells.	

1500 Tons Silicon feedstock can be expected by 2007, but only half of it can be used for PV to produce about 50MW solar cells and the other half is for semiconductor.

Wafer Production in China (2004)

Products	**Manufacturer**	**Capacity (MW)**
Poly-Si	ZhongYi, Ningbo	2 (2005-8)
	Baoding Yingli	6 (2005-70)
	Jinggong Solar, Zhejiang	10 (2005)
	Jiangxi Saiwei LDK Solar	150 (2005)
Single-Si	Beijing 605 Factory	2
	Xinri, Jinzhou	10 (mainly export)
	Yunnan Semiconductor Factory	0.5
	Ningjin, Hebei	50 (80% export)
	Ningbo Solar Cell Factory	1
	Trina Solar, Changzhou	25 (2005)
Total	**71.5 (20 available)**	

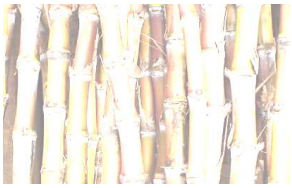
In 2005, capacity of solar grade mono-crystalline Silicon (mono-Si) has reached to 2000 Tons (135MW) and the real production is 1500 Tons (100MW); Capacity of poly-crystalline Silicon (poly-Si) reached to 1200 Tons (80MW).

Crystalline Silicon Solar Cell Manufacturing Capacity (2004)

Products	Manufacturer	Capacity (MW)	
		2004	2005
Single and Poly Crystalline Silicon Solar Cell	SunTech, Wuxi	50	120
	Yingli, Baoding	3	60
	Shanghai 811	10	10
	Gofly, Shanghai	2	2
	Ningbo Solar Cell Factory	4	20
	Yunnan Tianda	2	10
	Others		50
Total		**71**	**270**

Module Manufacturing Capacity (2004)

Manufacturer	Capacity (MW)	Manufacturer	Capacity (MW)
Yunnan Semiconductor	2	Gofly, Qinghai	1
Ningbo Solar	4	Gofly, Inner-M	1
SunTech, Wuxi	25	Huaguan, Tibet	2
Shanghai 811	10	Xian, Jiayang	10
Yingli, Baoding	16	Troni, Shenzhen	4
Nenglian, Shenzhen	2	Kyocera, Tianjin	10
Gofly, Shanghai	2	Zhonglian, Beijing	1
Rixin , Wuhan	1	Linuo, Shandong	2
Xianxing,Shenzhen	1	Quanxing, Guangdong	6
Jiawei, Shenzhen	2	Harbo, Beijing	4
Tuori, Shenzhen	5	Other	1
Sub-Total	**70**	**Sub-Total**	**42**
TOTAL			**112MWp**



Bio Energy in China

Bio-fuels

In 2004, China consumed 3.1 billion tons of oil, among which 1.2 billion was imported, making up 38.7% of the total. The IEA predicted that China would depend 61.0% of its oil supply from import by 2010, and 76.9% by 2020. China's sharp increase of oil import and its growing dependency on import pose potential threat to its oil security. Thus, in search for an alternative energy source, liquid bio-fuel, as a non-exhaustive, renewable energy has gained attention.

Apart from being a renewable energy source, which has the capacity to give China energy security, it also has immense environmental benefits, including afforestation of barren lands, reduction in soil erosion and other related benefits due to energy crop plantations. The plants grown themselves would absorb carbon dioxide, thus decreasing overall effect of green house gases. Rural and poverty stricken farmers will have great economic benefits as they start production of energy crops and sell them to Biofuel manufacturers.

China, since the 8th 5 year plan has been doing research on liquid biofuel transition technology. Currently, however, liquid biofuel is largely produced from deteriorative grain in China. This has however helped accumilate the expertise necessary for a liquid biofuel industry. Energy plants such as sorghum and sugarcane, which are very prevalent in China, will be planted in large scales, to be provided as raw material for the Bioethanol industry. China's bio-diesel industry is now in its preliminary stage, with an annul production capacity of less than 30 thousand tons, but it has a bright future. The resource potential is mainly determined by the acreage of suitable area for energy plants and the productivity of per acre. The soil resources available for energy agriculture is sufficient : 7596000 hectares area can be used in the energy agriculture in total. If one were to grow sweet sorghum bicolor on these lands (the output of its bio-fuel is similar to sugarcane), it can produce about 285000000 tons bio- alcohol and 14250000 tons of bio-diesel oil.

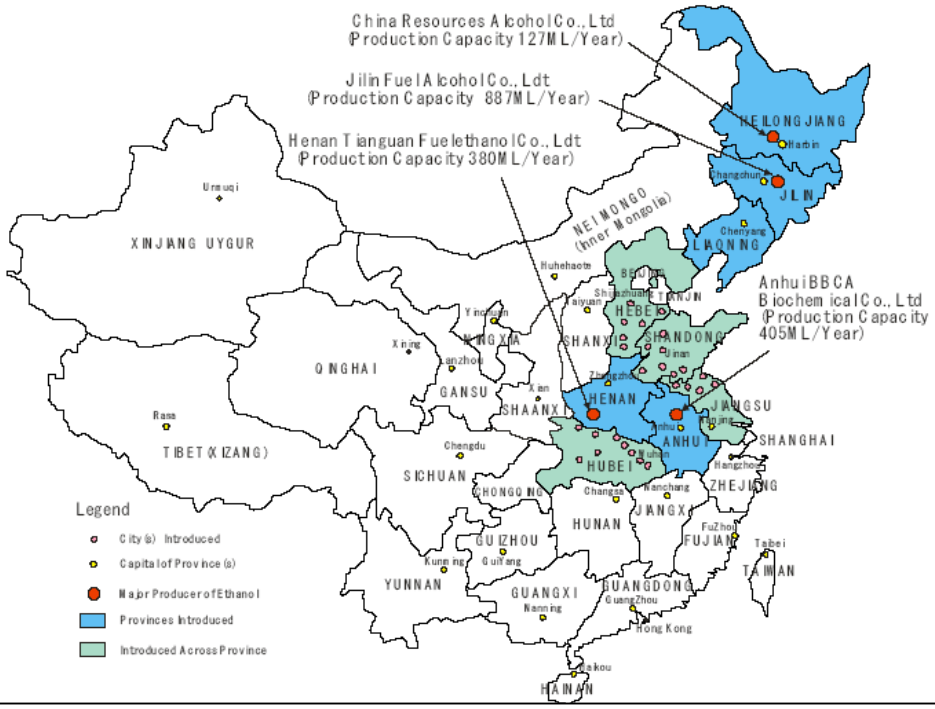
Sorghum Bicolor (S. bicolor) is the primary *Sorghum* species cultivated for grain for human consumption and for animal feed. The species originated in northern Africa and can grow in arid soils and withstand prolonged droughts. It is commonly known simply as **sorghum**. The species is source of ethanol fuel, and in some environments may be better than maize or sugarcane as it can grow under more harsh conditions.

(From Wikipedia)

Other energy plats such as the Barbadosnut and Pistacia lentiscus are used to make biodiesel oil from seeds. The amount of bio-diesel oil which made per acre of barbadosnut plantation can reach 200kg. The oil percentage of Pistacia lentiscus is about 30%. If it is assumed that around 40 Pistacia lentiscus grow per acre of area and every Pistacia lentiscus plant produces 20 kg seeds, the amount of bio-diesel oil which was made from per acre of area of Pistacia lentiscus is also 200kg. Both barbadosnut and Pistacia lentiscus grow in vast areas in China.

However, the main limitation in this field of technology is the price of the raw materian. Effictively, the price of bio-diesel produced also increases (one ton of bio-diesel produced will cost more than 4000 yuan). With the development of relevant research, it is absolutely possible that similar or more productive adoptable species can be discovered or cultivated. (Including the ameliorative species of barbadosnut and Pistacia lentiscus).

Areas where E10 is used and its manufacturers in China (2005)



Source: Current Status of New and Renewable Energies in China: Introduction of Fuel Ethanol by Chew Chong Siang, Institute of Energy Economics, Japan

Major Chinese ethanol manufacturers and their shipment destinations

Location	Company Name	Major Raw Material	Ethanol Production Capacity (10,000 k/year)	Supply Location	Supply Volume (10,000 k/year)
Heilongjiang - Zhaodong City	China Resources Alcohol Co., Ltd	Corn	12.7	Heilongjiang	12.7
Jilin -Jilin City	Jilin Fuel Ethanol Co., Ltd.	Corn	38.0	Jilin Liaoning	12.7 25.3
Henan -Nanyang City	Henan Tianguan Fuelethanol Co., Ltd.	Wheat	38.0	Henan	16.5
				Hubei (9 cities) *1 Hebei (4 cities) *2	21.5
				Anhui	12.7
Anhui -Bengbu City	Anhui BBCA Biochemical Co., Ltd.	Corn	40.5	Shandong (7 cities) *3	27.9
				Jiangsu (5 cities) *4	
				Hebei (2 cities) *5	
				Total	**129.3**

Note:

1. The nine cities in Hubei Province refer to Xiangfan, Jingmen, Suizhou, Xiaogan, Shiyan, Wuhan, Yichang, Huangshi and Ezhou.
2. The four cities in Hebei Province refer to Shijiazhuang, Baoding, Xingtai and Handan.
3. The seven cities in Shandong Province refer to Jinan, Heze, Zaozhuang, Linyi, Liaocheng, Jining and Tai'an.
4. The five cities in Jiangsu Province refer to Xuzhou, Lianyugang, Huai'an, Yancheng and Suqian.
5. The two cities in Hebei Province refer to Cangzhou and Hengshui.

Hydro Energy In China

The surface flow and the water drop mainly determine the amount of available hydro energy resource. China has superior natural conditions with plentiful surface flow and great water drop. In China, there are more than 5000 rivers with watershed above 1000 km2. 20 of them are more than 1000 km long, more than 1600 of them have watershed above 1000 km2, and 3019 of them have hydro energy over 10MW.

China has been leading in hydroelectric power generation, with over 20% of its total conventional energy coming this source. In 2006 there was 10,000 MW of installed hydropower capacity that went into operation in China. The National Development and Reform Commission also approved 13 additional hydropower projects in 2006, which cumulatively will have 19,511 MW of power generating capacity.

The area of China is roughly equal to Brazil, Russia, Canada and U.S.A., but the total amount of the annual surface flow of water is smaller than these countries. And yet, the hydro energy resources in China rank the first in the World. This is due to the strategic stepped geographical feature of the terrain - from higher western grounds to a very low-lying eastern side of China. For a comparison, the height above sea level in the eastern coastal area is only 50m, while that of the Qinghai-Tibet Plateau is over 4000m.

There are many benefits of Small-scale hydro –

1. To Meet Rural Electric Demand And To Reduce The Population Which Cannot Enjoy The Convenience Of Electricity
   The local government, with the help of social fund-raising and people's hard working, exploits hydropower resources according to the local conditions, supplies electric power for the economic development of remote areas.

2. To raise the income of the poor population in the rural area
   Exploiting small-scale hydro can promote the development of township enterprise andfamily workshop, increase the rural employment opportunity and raise income.

3. To protect the environment
   The small-scale hydro is a type of clean and renewable energy, and it can manage and protect the ecology environment. The small-scale hydro projects combine river harnessing and power generation, by constructing a lot of water conservancy and power generation projects at the source of rivers, using biological, project managing and many other methods, increase the coverage rate of the vegetations, conserve the source of water, prevent soil erosion, and manage the small basins comprehensively.

4. To Replace the Non-renewable Energy
   Environmental pollution by industrialization becomes more and more serious, and restricts the economy development.

Statistics show that from the end of the last 90s till the beginning of this century, China's capacity of small-scale hydro increased by 6.46% per year on average. In 2010 the capacity will reach 46990MW, i.e. 37% of the exploitable resources. In 2020 the capacity will reach 87710MW, i.e. 68.5% of the exploitable resources. In order to maintain the increasing speed, every year 3320 MW of small-scale hydro should be constructed. If supported by the National Renewable Energy Law and modernized before 2015, the small-scale hydro will have the capacity of 70% exploitable resource or more with 448000TWh annual output, which is about 76% of rural electric consumption in 2020.

The Hydro Energy Resource in China

River System	Hydro Energy Potential			Hydro Energy Exploitable		
	MW	GW.h/a	Proportion (%)	Capacity (MW)	Annual Generation (GW·h/a)	Proportion (%)
All Rivers	676047.1	5922180	100	378532.4	1923304	100
Yangzi	268017.7	2347840	39.6	197243.3	1027498	53.4
Huanghe	40548	355200	6	28003.9	116991	6.1
Zhujiang	33483.7	293320	5	24850.2	112478	5.8
Hailuan	2944	25790	0.4	2134.8	5168	0.3
Huai	1446	12700	0.2	660.1	1894	0.1
Northeast	15306	134080	2.3	13707.5	43942	2.3
Southeast	20667.8	181050	3.1	13896.8	54741	2.9
Southwest	96901.5	848860	14.3	37684.1	209868	10.9
Brahmaputra & Other Tibet Rivers	159743.3	1399350	23.6	50382.3	296858	15.4
North Inland & Sinkiang	36985.5	323990	5.5	9969.4	53866	2.8

Exploitable Medium and Small-scale hydro Resource in China (MW)

Province	Small Hydro	Medium Hydro	Total	Province	Small Hydro	Medium Hydro	Total
Beijing	90	448.5	538.5	Hubei	4036	1592.2	5627.1
Hebei	939.3	346	1554.7	Hunan	4146	2798.2	6944.2
Shanxi	581	346	927	Guangdong	4166	2313.2	6479.2
Neimeng	387	1196	1583	Guangxi	2322	2589	4911
Liaoning	429.1	1028.9	1453	Hainan	397	286.3	683.7
Jilin	1887.9	1423.1	3311	Xichuan	5878	12786.3	18664.3
Heilongjiang	728	777.8	1505.8	Guizhou	2554	3640.5	6194.5
Jiangsu	112		112	Yunnan	10250	7175.8	17425.8
Zhejiang	3226.5	1172.5	4399	Xizang	16000	2348	18348
Anhui	684.5	450.5	1135	Shanxi	1569	1553.5	3102
Fujian	3594	2724.9	6318.9	Gansu	1089	2547.6	3636.6
Jiangxi	3083.3	2308.9	5332.2	Qinghai	2000	3214.6	5214.6
Shandong	215		215	Ningxia	23	55	78
Henan	1031	522.5	1553.5	Xinjiang	3979	7287.7	11226.7
				Total	**71870**	**63181.3**	**150513**

The top 6 provinces where small-scale hydro resource has been exploited most are
Guangdong,
Sichuan,
Fujian,
Yunnan,
Hunan, and
Zhejiang,
the exploited resource
amount is 4,080,000kW, 3,670,000kW, 3,620,000kW, 2,330,000kW, 2,170,000kW
and 2,060,000kW respectively.

In 2002 the top 4 provinces where the proportion of exploited small-scale hydro was highest are Guangdong (64%), Fujian (52%), Zhejiang (47%) and
Hainan (47%)

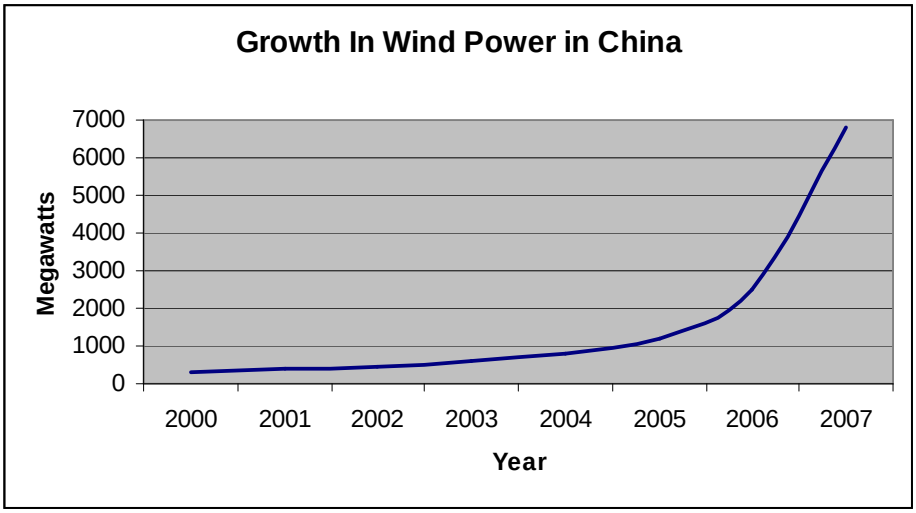
Top 6 Provinces where small scale hydro has been exploited most

Wind Energy in China

China is rich in wind resources. The technically exploitable resource is 1,000GW, distributed across the southeast coastal
areas, adjacent islands, Inner Mongolia, Xinjiang, the Gansu Hexi Corridor, Huabei and the Qinghai-Tibetan Plateau.

1. The most abundant wind resources along the coast and islands include the provinces of Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi and Hainan. Areas within 10 km of the coast have an annual wind power density above 200W/m2.
2. The most abundant wind resources in the north include Heilongjiang,Jilin,Liaoning, Hebei, Inner Mongolia, Gansu, Ningxia and Xinjiang; this area is about 200km wide. The wind power density ranges from 200W/m2 up to 300 W/m2 and sometimes even reaches above 500W/m2, for example in the Ala mountains, Dabancheng, Huitengxile, Huitengliang of Xilinhaote and the Chengde hunting grounds.

Installed capacity of wind power in China increased 1040 MW or 82.5% from the end of 2005 to the end of 2006. At the end of 2007, wind power in China accounted for less than one per cent of electricity production in the country, with an installed capacity of just over 6 gigawatts (GW). Yet, China is the fifth largest producer of wind power, after Germany, the United States, Spain, and India. Wind power industry statistics show that by the end of 2008 China's total installed base of wind power production will reach 10 GW, and estimates suggest that by 2010 the total installed capacity for wind power generation in China may reach 20 GW.



Installed Wind Capacity By Province

No.	Province	Units	Installed capacity /kW	No.	Province	Units	Installed Capacity /kW
1	Hebei	343	325,750	9	Fujian	90	88,750
2	Inner Mongolia	668	508,890	10	Shandong	161	144,600
3	Liaoning	334	232,260	11	Guangdong	377	211,140
4	Jilin	303	252,710	12	Hainan	18	8,700
5	Heilongjiang	186	165,750	13	Gansu	163	127,750
6	Shanghai	18	24,400	14	Ningxia	195	159,450
7	Jiangsu	68	108,000	15	Xinjiang	329	206,610
8	Zhejiang	57	33,250	16	Hongkong	1	800
					China (without Taiwan)	**3,311**	**2,598,810**

Prominent areas (marked as provinces) rich in wind resources and those, which have been exploited to construct wind farms for power generation, are given below in the map.

Conclusion

China has already taken a strong stand in the area of Renewable Energy. It has taken many measures to develop without harm to the environment as far as possible. The various policies and laws that have been passed will only ensure that the Chinese economy grows using renewable energy with a major role to play. Very soon, the Peoples' Republic of China will be a leading country in terms of production and potential in wind, hydro solar, and bio energy.

China is a vast country, and its decision to incorporate clean energy and energy efficient technology into their developmental process will thus impact the planet as a whole. The use of alternate fuel and less polluting energy sources will automatically mitigate the imminent issues of climate change and global warming, as well as help in decreasing the pressure on fossil fuels like coal and petroleum. As we know, the price of petroleum has been steadily increasing to very high levels, and any economy of a massive size, as China's cannot afford to allocate its resources only to fuel. Renewable energy also facilitates the decentralized power generation, which avoids the concern of laying down power lines to reach remote or obscure areas. Decentralized power generation - such as small hydro, biogas plants or cogeneration plants - is effective to facilitate rural electrification in villages that are still off the power grid. It also provides employment opportunity for the village folk in the area.

However, China has numerous problems that it faces in the wake of this new era or renewable energy development. As any developing country, it faces financial and technical difficulties, and yet its pace of development is extremely fast.There are many inadequacies of renewable energy technology, such as photovoltaic cells, which have a very low efficiency for energy conversion and are also very expensive for production. Technology must advance in order for these to be viable for common use.

The excellent Renewable Energy law puts a lot of importance for the growth of renewable energy in the power sector and has set many deadlines. However, it is important that these are implemented just as well. It is important to know, that China is confident that it shall be able to surpass the many hurdles it might face on its path.

References:

10. Proceedings from China Renewable Energy Strategy Workshop

11. The Renewable Energy Development in China by Zhuang Xing, Energy Research Institute

12. Current Status of New and Renewable Energies in China: Introduction of Fuel Ethanol by Chew Chong Siang, Institute of Energy Economics, Japan

13. China's medium to Long term Renewable Energy Development - Promotion of Bio ethanol Introduction and Future Strategic Developments by CHEW CHONG SIANG, Institute of Energy Economics, Japan

14. http://www.wikipedia.com

15. Current Status and Future Expectation of PV in China - China EU Energy Collaboration Forum

16. China Wind Power Report 2007 - China environmental Science Press

17. Article ‘’The development of hydroelectricity in China is in a dilemma’’ - By Kui Jiang

18. Article ‘’China pledges to double reliance on renewable energy by 2020’’ - Jonathan Watts, The Guardian