VIU
Venice
International
University

TEN Center
Thematic
Environmental
Networks

VIUPapers
06.10

The Energy Challenge in China

Lisa Botter

The Energy Challenge in China
by Lisa Botter

Venice International University
Isola di San Servolo,
30100 Venezia
lisa.botter@univiu.org

Introduction

Energy is one of the major issues faced by all countries globally, whether they are developed or undeveloped, rural based or industrialized.

Everything in our life needs energy: human activities are highly energy demanding, and energy is essential in private and public buildings, in transportation, in industrial and agricultural activities, therefore, no development would be possible without it.

Fossil fuels, *e.g.* oil, coal and natural gas, are the most important energy sources in the world and in 1989, 85.5% of the energy demand came from these resources (Droege, 2008).

The most powerful countries worldwide are concerned with energy sources for two main reasons: on the one hand oil, the most widely used fossil fuel, is at risk of exhaustion and according to Droege, its production will peak in 2010. On the other hand, the combustion of fossil fuels is strongly pollutant and is one of the major causes of the high CO_2 concentrations in the atmosphere. It is also recognized that the, so called, greenhouse gases are the major cause behind the greenhouse effect and in consequence, global warming.

Moreover, fossil fuel combustion can contribute to other negative environmental impacts, such as:

- nearly all the acid rain;
- most of the airborne toxic heavy metals (including mercury from coal emissions—a neurotoxin that harms foetuses and can impair the intelligence of children);
- nearly all the urban smog;
- over half the nuclear waste;

• additional atmospheric loading of CO_2 which will impair the integrity of global ecosystems. (CSEP, http://www.efchina.org/FHome.do).

It is within this context, that China needs to find other solutions to assure the ongoing development of the global economy with respect to the environment and people's life.

The unique solutions to solve this urgent problem are essentially identified in energy efficiency and renewable energy use. The development of energy efficiency technologies and their application on buildings, transportation, industry and so on, would help to reduce the energy demand and fossil fuel consumption instantly. The development of renewable energy sources would contribute in achieving independence from fossil fuels whilst also offering positive effects on environmental preservation.

In the white paper (WP, 2007) China is defined "as an irreplaceable component of the world energy market which plays an increasingly important role in maintaining global energy security." The situation has changed completely over the last 30 years with a significant and steady increase in energy demand (EIA, 1999). This can be attributed to several different factors, *i.e.* population growth and the consequent acceleration of urbanization, the development of heavy industry and transportation.

Moreover, the country is the second largest producer and consumer in the world; the high production rate causes high energy consumption, mainly derived from coal, and results in strong environmental pollution.

China has always relied, with a rate of more than 90%, on its domestic energy sources, (WP, 2007) and it intends to continue respecting this target in the future, especially as it still has a huge quantity of energy resources which have so far not been exploited.

China ratified the Kyoto Protocol in 2005, but as it is considered as a developing country, it is not obliged to respect the limits stipulated in the Protocol. In fact, the *per-capita* of pollutant emissions is still very low due to the large population, but in 2006, the country as a whole, became the first largest polluter in the world (MNP, http://www.pbl.nl/en/index.html).

China, therefore, plays an important role in the energy sector; for this reason the challenges and goals which it has to face in order to guarantee world security are analyzed in this paper.

Energy Sources in China

Energy sources are distributed all over China, although distinctly uneven.

"Coal is found mainly in the north and the northwest, hydropower in the southwest, and oil and natural gas in the eastern, central and western regions and along the coast (WP, 2007)."

A detailed description of the energy sources in China is included here based on the White Paper on China's Energy Conditions and Policies, the World Nuclear Association, the Medium and Long-term Development Plan for Renewable Energy in China by National Development and Reform Commission (NDRC) and the China Renewable Energy and Sustainable Development Report.

Fossil Fuels

Coal:

China boasts rich fossil energy resources, dominated by coal. In fact, it is one of the world's largest coal producer and consumer: in 2005 the energy consumption deriving from coal was 1,087,624 ktoe (IEA, 2007), more than 70% of the total energy supply (Tu, 2007). In more detail, the coal reserves in China, in 2007, were about 44 billion tons of bituminous coal, 33.7 billion tons of subbituminous coal and 17.8 billion tons of lignite (EWG, 2007), ranking China third in the world (WP, 2007).

The largest reserves are concentrated in the north or northwest, in particular, Shanxi, Inner Mongolia, Xinjiang and Shaanxi provinces (Fig. 1).

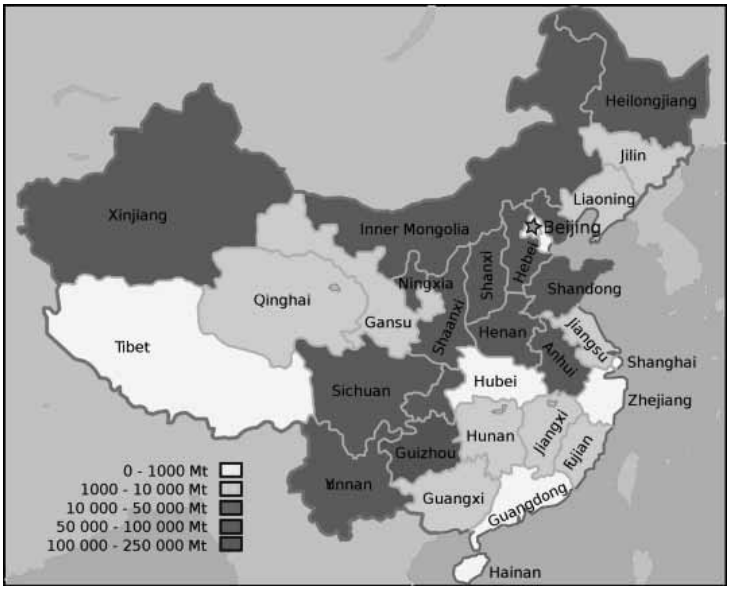

Fig. 1:
Distribution of coal reserves in China (source: coal.infomine.com/countries/)

Oil and Gas:

Verified oil reserves are 33% of the total oil deposits. Proven reserves of natural gas account for 14%. Oil and gas resources are located in areas with complex geological conditions and at great depths, so advanced and expensive prospecting and tapping techniques are required. Following the principle of unified planning and step-by-step implementation, China has built national oil reserve bases and expanded its oil reserve capacity. It has gradually established a system which can guarantee a secure supply of oil and natural gas in case of emergencies. China will continue to implement the policy of "simultaneous development of oil and gas", steadily increase crude oil output and make efforts to increase the output of natural gas. The country is increasing its efforts in exploiting oil and natural gas, in particular on the major oil and gas basins (Bohai Bay, Songliao, Tarim and Ordos), and is actively exploring new areas, fields and *strata* on the land and major sea areas to increase the amount of recoverable reserves. The country is promoting the construction of new oil and gas pipeline networks and gradually improves the existing national network of oil and gas pipelines (WP, 2007).

Nuclear Energy

China is also developing its nuclear capacity.

The Chinese mainland has 11 nuclear power reactors in commercial operation, 14 under construction, and at least 8 more with construction planned in 2009 (www.world-nuclear.org). A further 35 reactors are projected over the next decade (Pistilli, 2009), including some of the world's most advanced, to give a strong increase in nuclear capacity from the current 9 GWe to 86 GWe by 2020 (Pistilli, 2009).

China has fairly rich uranium resources concentrated in small and medium size deposits. These deposits are unevenly distributed over 23 provinces, in particular in Jiangxi, Guangdong, Hunan, Guangxi, Xinjiang, Liaoning, Yunnan, Hebei, Inner Mongolia, Zhejiang and Gansu.

The economic values of Chinese uranium are good or fairly good and can provide guarantees for the short- and medium-term development of nuclear power generation.

However, it does not have the amount of uranium that assures its independence from other countries for a long-term development of nuclear power generation (http://www.chinamining.org/Facts/2006-09-26/1159251956d1328.html).

It is for this reason that China has started to adopt an aggressive campaign to acquire uranium mines around the world which involves buying stakes in international uranium mining firms, but with particular focus on those in Australia (Pistilli, 2009).

In China, nuclear power has an important role, especially in the coastal areas which are remote from the coalfields and where the economy is undergoing rapid development. Generally, nuclear plants can be built close to the centres of demand, whereas suitable wind and hydro sites are situated some distance from demand (www.world-nuclear.org).

Renewable Energy

Hydropower:

In 2006, the theoretical reserves of hydropower resources were equal to 6,190 billion KWh, and the economically exploitable annual power output was 1,760 billion KWh, equivalent to 12% of global hydropower resources, ranking China as first in the world. However, untapped hydropower resources are mostly located in the high mountains and deep valleys of the southwest, far from the centres of consumption, entailing technical difficulties and high costs. Consequently, only 20% of the country's hydropower resources have been so far utilized (Schwartz, 2007).

The Chinese government is now strongly promoting hydropower energy as green energy in order to reduce the coal consumption and its related air pollution. Chinese leaders and their people are proud of the progress and modernity represented by the development of dams for producing this kind of energy. At the moment, the largest one is the Three Gorges dam which, during 2007, produced 8.6 billion KWh.

Upon its completion in 2009, it will be able to generate 84.7 billion KWh annually equivalent to the amount of the electric power produced by burning more than 40-50 million tons of coal with 100 million tons of CO_2 emissions (CTGPC, 2007).

China is now constructing its third largest hydroelectric power plant, the Xiang Jia Dam Hydroelectric Power Plant. The total planned installed capacity of this power plant is 6 KW, which will produce 30.7 billion KWh per year of electricity (Schwartz, 2007).

Solar Energy:

China is the first producer of solar photovoltaic panels in the world. In 2007, for instance, it produced 200 manufacturers equivalent to 1,700 MW which represents nearly the half of the world's total production, 3,800 MW (Biello, 2008).

"Almost none of that remained in the country, however 99% goes outside," says the CREIA (Chinese Renewable Energy Industries Association) general secretary Li Junfeng. According to Biello (2008) "The local market is very limited because solar photovoltaic panels are too expensive".

Professor Can Li (2009), head of the recently established National Laboratory for Clean Energy, states that "solar is a very important energy source for the future of China," according to him there is a lot of land that is not suitable for farming, *e.g.* the provinces of Gansu and Xinjiang which are mainly composed of desert conditions. It is estimated that by covering a third-to-half of this area with solar cells and catching only a tenth of the energy, the current energy requirements of the whole country would be met (http://rightsite.asia/en/article/incentives-create-opportunities-investment-chinas-solar-energy-sector).

In Wuwei city (Gansu province) a solar plant generating 500 KWh of electricity already exists. This plant is the first one on such a scale tested in desert conditions and linked to the grid. Gansu province has also accepted to build one of the biggest solar photovoltaic plants in the world, with a 10 MW capacity in Dunhuang. However, this will be one of the biggest plants in the world for a short period of time only, given that the creation of new and bigger solar plants in China is announced with increasing frequency.

Gansu, Qinghai and Inner Mongolia have all declared their intention to build solar power stations of 20 MW or more. Their intentions have to be supported by government funding since solar electricity generation costs are about 10 times higher than coal. It is also true that by increasing the production of solar photovoltaic cells, the cost of electricity generation will fall fast.

When the Dunhuang plant is completed, the price per KW will be less than 1 yuan, three times cheaper than the current price, 3 yuan.

The solar energy prices are expected to reach the coal-fired power prices between 2015 and 2020 (Li, 2009).

China is also the leader in selling solar heating technology which provides hot water all over the country, for instance at the Beijing airport and at Kunming in Yuannan Province where one half of its 4.7 million residents use solar hot water heaters (Biello, 2008).

It is estimated that by 2020 the coverage area of installed solar hot water heaters in China will be approximately 100 million sqm equivalent to a market of 60 billion yuan (Schwartz, 2007).

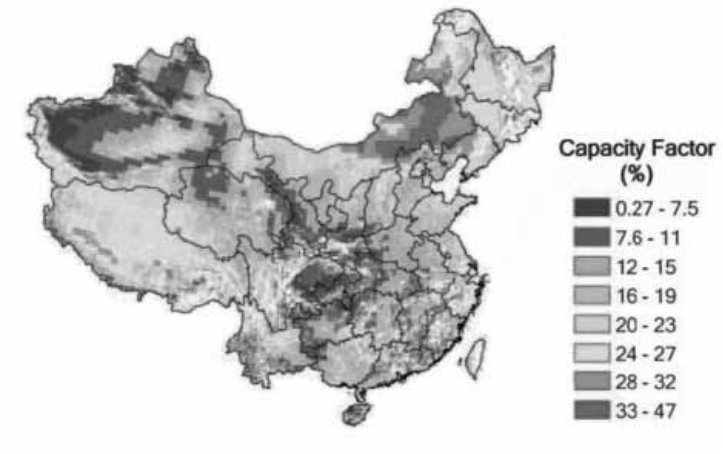

Fig. 2:
Distribution of wind resources in China (source: McElroy, 2009)

Wind Energy:

In 2008, China produced 6 GW of wind energy ranking it fifth in the world.

However, in 2009 it is placed as the fourth largest producer of wind energy after the United States, Germany and Spain. Energy experts affirm that China has a huge wind energy potential and with the massive push that the country is giving to the renewable technology development, it could achieve 100 GW by 2020, more than tripling its target for wind power capacity. According to this estimation, wind energy in China could grow to 1667% by 2020 (Schwartz & Hodum, 2008).

At this rate, China could overtake Germany and Spain reaching second place in terms of total wind power capacity in 2010 (EWG, 2007).

China will represent the fastest growing market of the world if these forecasts are respected.

According to the China Climate Science Research Institute "China has 3.22 million MW of wind resources, the biggest amount in the world and the amount which can be developed is 1 million MW or more, including 253,000 MW of land-based wind power capacity and 750,000 MW of off-shore wind power generating capacity".

Fig. 2 shows a map representing wind resources in China.

Biomass and Biofuel:

China has a huge amount of biomass resources estimated at around 480 million toe in total, 76% of which could be utilized for electricity or heat production.

Biomass is constituted mainly by crop residues (51.3%), animal dung (22.6%), firewood (13.8%), industrial waste (9.9%) and municipal solid waste (2.4%) (http://www.biomass-asia-workshop.jp/biomassws/03workshop/material/day1china.pdf.).

Biomass is one of the most important types of renewable energy in China as it can act as a replacement for petroleum oil, it

can meet demands for power in rural areas, it can replace coal for small boilers and living stoves (http://www.biomass-asia-workshop.jp/biomassws/03workshop/material/day1china.pdf.).

In the 11th 5-Year Plan Period, 2006-2010, the central government increased its investment in research and development of biofuels, and the Ministry of Science and Technology (MOST), the NDRC, the Chinese Academy of Sciences (CAS), and the Ministry of Agriculture (MOA) have established special projects with more than 800 million yuan invested for research and development in bioenergy. In September 2007, the Chinese government issued the "Mid to Long-term Development Plan for Renewable Energy", which established bioenergy as "an important constituent part of renewable energy, set concrete development objectives for bioenergy through 2020 and made bioenergy development as a focus of economic development for localities which are rich in biomass resources" (Schwartz, 2007).

Geothermal Energy:

China has a wealth of geothermal resources spread throughout the country although the richest area is the southwest with the presence of 51% of the total amount (Zhang, 2005). At the moment, China's largest geothermal installation is Tibet's Yangbajing geothermal plant, which uses equipment imported from Italy and has total capacity of 25.18 MW (Schwartz, 2007).

China is one of the major users of the direct-use of geothermal energy, however, geothermal energy accounts for less than 0.5% of the total energy resources. According to Chinese experts, the main reason why geothermal development has been relatively slow is due to the fact that where high temperature geothermal resources are most abundant, hydropower resources are also in abundance. Presumably the development of hydropower projects has taken precedence over geothermal projects. Although it appears that along with the restructuring of the economy, national investment in geothermal has decreased, given that standards of living have risen the geothermal source is gaining more popularity as the geothermal waters are being used for health, tourism, and balneology in various hot springs (Zheng *et al.*, 2005).

Even if China is trying to develop geothermal energy and is now drilling 3,000 exploratory wells in different locations, the forecast of geothermal energy production is still very small: 75 MW in 2020, 200 MW in 2030 and 500 MW in 2050.

Energy Consumption and Energy Conservation in China

The goals of the 10th Five Year Plan (2001-2005) have not been respected due to the uncontrollable economic growth in the country. The energy consumption levels are continuously increasing and the Chinese government is trying to solve these problems in order to reduce the environmental impact.

Nowadays, 70% of China's energy demand is covered by coal. Oil is the second largest energy resource accounting for 20% of the total energy consumption. Hydroelectric energy covers 6%, natural gas 3% and nuclear power 1% (EIA, 2006; see Fig. 3).

Although China's economical growth has recently slowed down, a direct result of the global financial crisis (GDP was 13% in 2007, and is 6.1% in 2009, EIA 2006), the energy demand is still very high.

Actually, China has increased imports of oil and natural gas year after year, and has become the largest producer and consumer of coal (Fig. 4, Fig. 5 and Fig. 6). Coal consumption will probably double over the next twenty years and the percentage of energy represented by coal is going to increase (EIA, 2006).

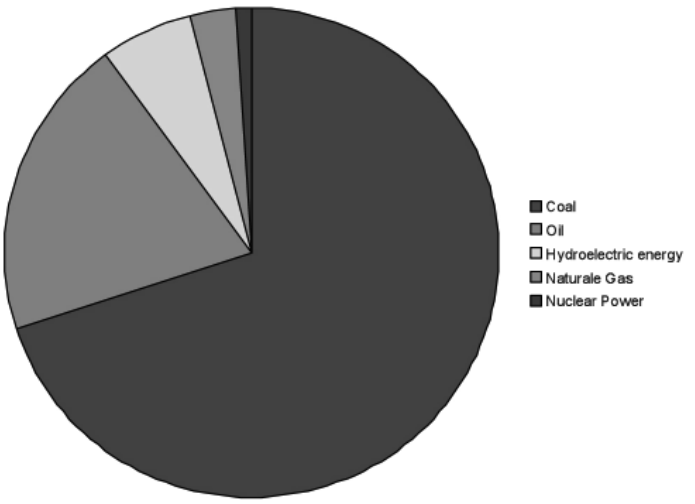

Fig. 3:
Energy demand in China (source: EIA, 2006).

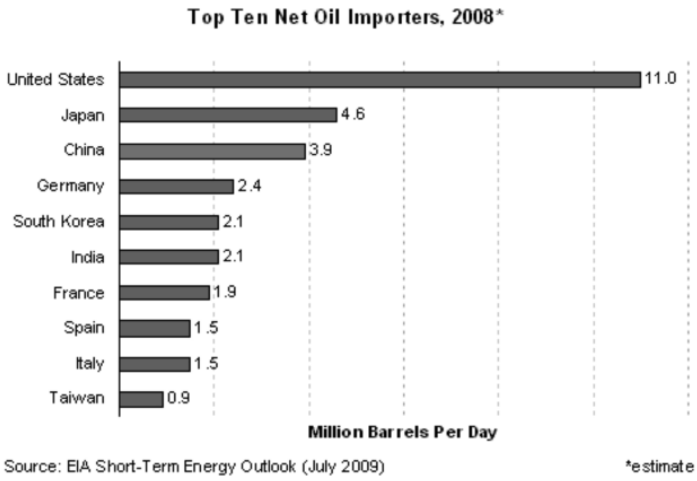

Fig. 4:
Top ten net oil importers of 2008 (source: EIA, 2006).

China's energy consumption is a challenge for all countries considering its strong reliance on fossil fuels and the effects that this can have on global warming and climate change. It is probable that China will depend on fossil fuels for some time in the future and for this reason it is extremely urgent that energy consumption is reduced. It is also important to promote renewable energy use, this however, is a process that needs more time to be developed in order to have a short term positive impact. On the contrary, it is more effective to reduce consumption and improve energy efficiency in order to have an immediate positive impact.

Energy efficiency must be improved mainly in buildings, industry and transportation.

One of the major causes of energy inefficiencies in China are buildings. Considering the growth rate of the Chinese population and the consequent construction boom, the need to focus attention on energy efficiency in buildings is comprehensible. It

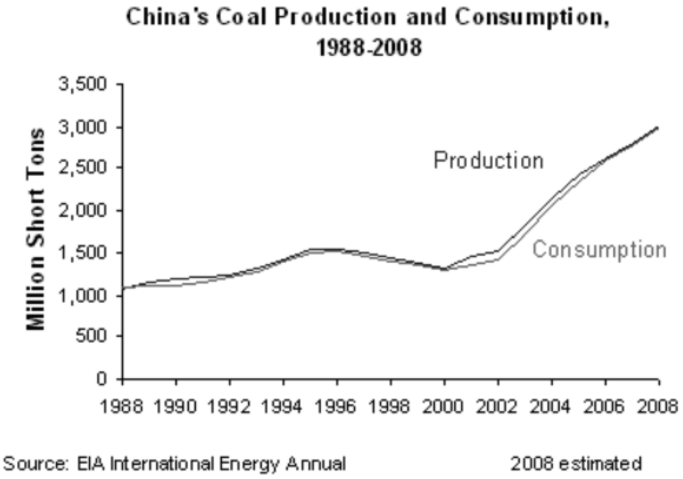

Fig. 5:
China's coal production and consumption (source: EIA, 2006).

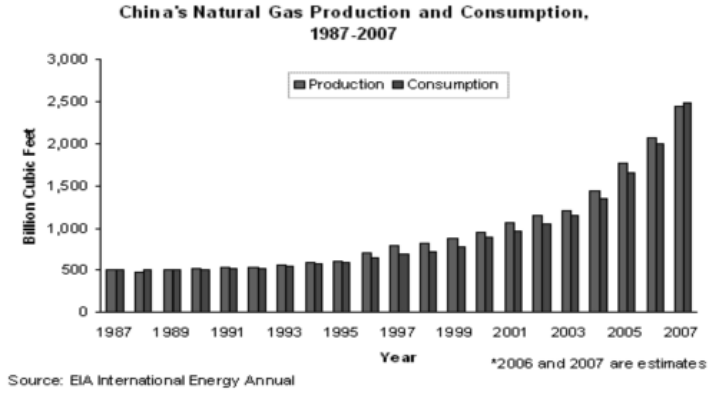

Fig. 6:
China's natural gas production and consumption (source: EIA, 2006)

is estimated that the lifecycle of a building (material manufacturing, construction and final demolition) represents 45% of the total energy use in China and that the final building energy use accounts for 25% (Campana, 2009). Moreover, the strong demand for new buildings has led to cheap and quick construction thus, causing a decline in quality (Campana, 2009).

The industrial sector, in particular steel, cement and petrochemical industries, present inefficiencies and a strong energy consumption. This sector is responsible for about 70% of national energy consumption and about 61% of the total CO_2 emissions (Wang, 2006).

Unfortunately, technologies applied to the industrial sector did not keep up with the energy demand and now China needs to quickly develop alternative solutions to coal. While there has been improvement in the past, technology used by China's major industries still lags behind with regards to efficiency standards

compared to the more advanced technologies adopted in other countries (Wang, 2006). In this sector, the Chinese government is concentrating its efforts to develop renewable energy from the current 7% to 15% by 2020 (http://www.chinaorbit.com/china-economy/china-environment-challenge.html).

The inefficiencies in the transportation sector are responsible for more than 30% of the national oil consumption. Vehicle energy efficiency is far below world standards and vehicle usage and ownership is on an upward increase. As a result, unregulated vehicle emissions will also continue to increase and will be released into the atmosphere (http://www.chinaorbit.com/china-economy/china-environment-challenge.html).

Energy conservation seems to be the right way to preserve energy sources even though it is an arduous task in a period of social and economic development of the country. In the 11th Five Year Economic Program (2006-2010) an index for energy conservation and the responsibilities of all stakeholders (autonomous regions, provinces, municipalities, and enterprises) are defined. The country aims to establish an energy- and resource-saving industrial structure, improve energy efficiency, promote research and development in energy-saving technologies and reform the economic policies promoting energy conservation. At the beginning of 2006, the Chinese government aimed to reduce energy intensity by 20% in unit GDP production by 2010, this goal, however, was not reached in the first year of the 11th Five Year Economic Program (2006). China must reduce energy intensity by 5.4%, per year, for the period 2006-2010 in order to meet the overall national energy conservation target for 2010.

China's Challenges

From the overview on the first part of this paper China clearly has many challenges to face.

First of all the country should lower its dependence from fossil fuels as it is clear that the major cause of global warming are greenhouse gases, in particular CO_2. It is also recognised that fossil fuels are the main cause of CO_2 emissions. The increase in oil-fired vehicles and heavy coal consumption have poisoned and transformed the air in a mixture of coal smoke and exhaust gas.

Problems related to fossil fuels are not only about pollution, but also about the shortage of these resources. In particular, oil will reach its peak production in 2010 and since oil is the world's main fuel, it is evident how important and urgent it is to find other energy sources whilst privileging those which are environmentally-friendly.

However, since fossil fuels will be important for the Chinese economy over the long term, the country has to face other kind of problems, such as the already mentioned energy resource distribution and the mismatch between it and where consumption mainly occurs.

Coal is found mainly in the north and the northwest, whilst oil and natural gas in the eastern, central and western regions, and also along the coast. The consumers of energy resources, however, are mainly in the southeast coastal areas, where the economy is most developed. Such wide differences in location between the producers and the consumers cause enormous logistic problems: large-scale transportation of coal and oil over long distances from the north to the south, and transmission of natural gas and electricity from the west to the east (WP, 2007).

The largest coal reserves are concentrated in the north or northwest, in particular Shanxi, Inner Mongolia and Shaanxi Provinces; distribution of this type triggers enormous logistic problems which result in an extremely intense use of the rail system for transporting coal.

Compared with other parts of the world, China faces severe geological difficulties in tapping its coal resources, and obtains most of its coal *via* underground mining, as only a small amount can be mined using opencast methods.

Difficulties in mining are also underlined by the many accidents involving miners which have occurred in the past. Official statistics affirm that 250,000 miners have been killed since 1949 (Tu, 2007). Figures also state that accidents are decreasing: from 70,000 deaths in 1950 to 10,000 in 1990; but it is also true that in 2006, 80% of the global deaths in China were connected to mining activities (Tu, 2007).

The EIA highlighted the inefficiencies of the smaller coal mines in particular. They hold a sizeable portion of the market, but inefficient management, insufficient investment, outdated equipment, and poor safety records prevent the full utilization of coal resources (EIA, 2006).

China must face further challenges concerning renewable resources, as these are also imbalanced in their distribution.

With regards to biomass, the distribution of crop residues (the most important biomass resource) is dispersive and greatly influenced by seasonal activities. Transportation and the storage of crops will influence and determine biomass power generation capacity and its applications. (http://www.biomass-asia-workshop.jp/biomassws/03workshop/material/day1china.pdf).

Solar energy is thinly distributed due to the high costs which are 10 times higher than coal, despite China being the primary seller of photovoltaic panels in the world.

Concerning geothermal energy, the main weakness is that many reservoirs have very limited recharge; moreover, the lack of monitoring and management of some reservoirs under exploitation determines an accelerated drop in pressure and thus land subsidence in the producing area. Injection of water into the reservoir has become a necessary activity for sustainable use of geothermal resource (Zhang, 2005).

Challenges related to hydropower energy are both environmental and social as this energy source is largely produced by dams. In fact, dams are both useful and damaging to the population and the environment. Yu Xiaogang, an important Chinese environmentalist, warns people against dams affirming that: "It is widely recognized that dams, particularly large-scale projects, can flood important habitat, damage river ecosystems and surrounding *flora and fauna*, and destroy the livelihoods and cultural heritage of river people" (Buckley, 2007).

Special attention should also be paid to rural areas. The rural economy and living standards are restricted by the shortage of the energy supply (Zheng *et al.*, 2005). Even though rural population has decreased due to urbanization it is, nevertheless, still vast (from 80% in 1980 to 62% in 2001); around one fifth of China's rural population still lacks access to electricity and the rural energy demand is growing fast. Total energy consumption in rural areas increased to 670 Mtce in 2000, almost half of the total energy consumption in the whole of China for that year (Zheng *et al.*, 2005).

An insufficient infrastructure has forced the province's 8.7 million agricultural-based households to depend largely on wood and straw burned in conventional ovens for heating and cooking. These resources, while inexpensive and locally available, release harmful pollutants, provide a low level of thermal efficiency and are the known cause behind serious long-term health problems.

China's Energy Strategy

This section analyzes the strategies which must be implemented by China in order to face the energy challenges, and with the aim to promote sustainable development without negatively affecting the economic growth.

The Chinese government is aware of the importance of coal for the energy supply and in the white paper (2007) highlights the urgent need to redevelop the structure of the coal industry and push forward the development and integration of coal resources by renovating medium- and small-sized coal mines. The Chinese government is also determined to close down, in accordance with the law, small mines which do not conform to industrial policies, which have poor safety conditions, that waste resources and harm the environment. The country aims to support large coal mining bases in conducting resource surveys and detailed geological surveys and will set standards for commercial prospecting and improve the level of guarantee for coal resources.

Finally, China is promoting the coordinated development of related industries, and encourages coal-electricity joint operation or coal-electricity-transport integrated management, so as to extend the coal industry chain. It aims at mechanizing coal mines and enhancing overall mechanization in coal mining, promoting clean production, encouraging research and development, and spreading of clean coal technologies.

Chinese investments in energy efficiency are very low in comparison to the total amount of investments in the country's economy. In fact, energy efficiency was one–third of historic maximum levels in 1983, whereas supply-side investments have the

priority over the energy efficiency investments which account for just 5% (CSEP, http://www.efchina.org/FPubInfo.do?act=list&abb=AboutUs&sabb=2&pageno=3).

However, things are changing and leaders are becoming more aware about the necessity to invest in energy efficiency. “Energy efficiency is not just one of our core strategies; it has to be *the* core of energy strategy”, the Chinese vice Premier said at an energy conference in Beijing (2007). With unprecedented speed senior leaders have adopted a number of laws, regulations, and incentives to temper demand and drive investment into energy efficient technologies.

“The China Medium and Long Term Energy Conservation Plan” by NDRC (2004) also promotes the energy conservation as a sound choice for alleviating not only the resources shortage, but also to improve the environmental quality and enhancing enterprises’ competitiveness. NDRC (2004) strongly affirms in this report that China “must vigorously conserve energy, reduce energy intensity, improve the energy utilization efficiency, and accelerate building an energy conserving society.”

The importance that China gives to the energy conservation is also well described in the White Paper (2007). Energy conservation is a basic state policy and China must emphasize both developing and saving, but place priority on saving.

Practically speaking, China must adopt measures such as promoting research and development of energy-saving technologies, producing and popularizing energy-saving products, improving energy management expertise, improving energy-saving legislation and standards, and enhancing energy efficiency.

The Chinese Government must adopt different strategies in each sector in order to reach the energy conservation goal (11th Five-Year Plan (2006-2010)):

Industrial sector: to develop an industrialization characterized by high scientific and technological content, good economic returns, low resource consumption, minimum of environmental pollution, and full use of human resources; to speed up technological reform, improve management and economize on energy; to raise the standards for energy efficiency of industry; to eliminate backward and high energy-consuming products, and perfect the market access system.

Transport sector: to speed up the elimination of old cars and ships; to actively develop public transport; to set limits on high oil-consuming cars, and develop energy-saving and environmentally-friendly transport.

Building sector: to accelerate the innovation of coal-fueled industrial boilers (kilns), and regional simultaneous generation of heat and power and surplus heat and pressure utilization; to improve the efficiency of energy utilization; to save more energy in the sphere of electrical machinery and optimize energy systems; to promote the energy-saving renovation of existing buildings, and extensively use new walling materials; to carry out the Green

Lighting Project, and spread more rapidly high-performance electrical appliances; to spread technologies for firewood- and coal-saving stoves and energy-saving houses in rural areas, and eliminate old, high energy-consuming farm machinery and fishing boats, so as to promote energy conservation in agriculture and the rural areas.

In order to make people aware of the energy issue and to create a healthy and civilized society, the Chinese government encourages the culture of energy conservation incorporating it into the system of elementary education, vocational education, higher education and technical training.

China is endorsing the energy-conservation week campaign and is publicizing and popularizing relevant knowledge by using mass media.

These strategies will be accompanied by an in-depth reformulation of fiscal and taxation policies, the reform of energy prices and the promotion of an energy labelling mechanism.

Another important strategy to deal with energy issue is the promotion of the renewable energy use. In 2005, the China's National People's Congress (NPC) promulgated a law on renewable energy that became effective from the 1st January 2006.

The NCP delegated the NDRC (National Development and Reform Commission) to develop a renewable energy plan and to implement regulations.

"Energy authorities of the State Council implement management for the development and utilization of renewable energy at the national level. Relevant departments of the State Council are responsible for the management of relevant development and utilization of renewable energy within their authorities. Energy authorities of local people's governments above the county level are responsible for the management of the development and utilization of renewable energy within their own jurisdiction. Relevant departments of local people's governments above the county level are responsible for the management of relevant development and utilization of renewable energy within their authorities (art. 5)."

The law was prepared in order to promote the development and utilization of renewable energy, to improve the energy structure, to diversify energy supplies, to safeguard energy security, to protect the environment, and to realize the sustainable development of the economy and society (art. 1).

Moreover, the Renewable Energy Law established renewable energy requirements to boost the use of renewable energy capacity up to 10% by the year 2010.

The law established a national fund to foster renewable energy development, and discounted lending and tax preferences for renewable energy projects. The Chinese Government encourages economic entities to participate in the development and utilization of renewable energy and protects legal rights and interests of the developers and users of renewable energy on the basis of law (art. 4).

Using special funds China is promoting resource surveys, research and development of relevant technologies, pilot and demonstration projects, as well as exploration and utilization of renewable energy in rural areas.

China has released the Medium- and Long-term Program for Renewable Energy Development, putting forward the goal of increasing renewable energy consumption to 10% of the total energy consumption by 2010 and 15% by 2020, (WP, 2007; Fig. 7).

China is also improving rural conditions by carrying out the Lighting Project which focuses on solving the power problems in areas with no access to electricity and connection to the grid. It is also promoting the full use of small sized hydropower stations, wind energy and solar energy for power generation. Moreover, China is actively further developing rural household methane and intends to make better use of biomass to provide clean energy for the rural people, it continues to endorse firewood- and energy-saving stoves and is increasing the supply of high-quality fossil energy and the proportion of commercial energy consumption in rural areas. Moreover, China is continuing its efforts to strengthen the construction of the rural grids and expand their coverage (WP, 2007).

Fig. 7: Renewable energy consumption in China (sources: NDRC, Medium and Long-term Development Plan for Renewable Energy in China (2007)).

	2006	2010	2020
Hydropower	130 GW	190 GW	300 GW
Wind power	2.6 GW	5 GW	30 GW
Biomass power	2 GW	5 GW	30 GW
Solar PV	0.08 GW	0.3 GW	1.8 GW
Solar hot water	100 million m2	150 million m2	300 million m2
Ethanol	1 million tons	2 million tons	10 million tons
Biodiesel	0.05 million tons	0.2 million tons	2 million tons
Biomass pellets	0	1 million tons	50 million tons
Biogas and biomass gasification	8 billion m3/year	19 billion m3/year	44 billion m3/year
Share of total primary energy (including large hydropower)	8%	10%	15%

Conclusions

China has placed the promotion of energy conservation, energy efficiency and renewable energy as its top priority, but it is also aware that fossil fuels are still very important for the country's economy.

In fact, China is looking to fully rely on a more diversified and sustainable energy supply mix; it has accelerated investment in nuclear and alternative energy, and continues to finance numerous fossil fuel projects.

The country is willing to set goals regarding the creation of a resource-conserving and environmentally-friendly society, and of coordinating the energy development and environmental protection assuring the economic growth (WP, 2007).

China has demonstrated that it has recognized its role in preserving the global energy security and stability by opening itself towards international cooperation with energy organizations, universities and research centres, and foreign governments; the cooperation is based on the principle of equity, mutual benefit and win-win solutions (WP, 2007).

China represents a key player in the energy sector and has demonstrated to be fully aware of its role.

Bibliography

Droege P., 2008. *La città rinnovabile - Guida completa ad una rivoluzione urbana*. Edizioni Ambiente.

http://www.efchina.org/FHome.do (China Sustainable Energy Programme, CSEP)

Information Office of the State Council of the PR of China, 2007. *White Paper. China's energy* conditions and Policies.

http://www.pbl.nl/en/index.html (Netherlands Environmental Assessment Agency, MNP)

http://www.iea.org/index.asp

Energy Information Administration, 1999. *International Energy Outlook*.

Tu J., 2007. *Coal Mining Safety: China's Achilles 'Heel. China Security*, Vol. 3 No 2 pp. 36 – 53, World Security Institute.

EWG, 2007. Energy Work Group. *Coal: Resources and Future Production*. EWG-Series No 1/2007.

coal.infomine.com/countries/

http://www.world-nuclear.org

Pistilli M., 2009. *Uranium Resource Competition Heats Up. http://www.uraniuminvestingnews.com/*

http://www.chinamining.org/Facts/2006-09-26/1159251956d1328.html

Schwartz L., 2007. *China Renewable Energy and Sustainable Development Report. China Strategies*, LLC, September 2007, Vol. IX.

CTGPC 2007. *China Three Gorges Project Coorpopration Annual Report*.

Biello D., 2008. *China's Big Push for Renewable Energy*. http://www.scientificamerican.com

http://rightsite.asia/en/article/incentives-create-opportunities-investment-chinas-solar-energy-sector

Schwartz L., Hodum R., 2008. *China's Wind Power Industry: Blowing Past Expectations*.

China Strategies, LLC. http://www.renewableenergyworld.com

McElroy M., 2009. http://www.impactlab.com/2009/09/17/china-on-pace-to-become-worlds-largest-wind-power-market/

Wu G., *Research and Development on Biomass Energy in China*. http://www.biomass-asia-workshop.jp/biomassws/03workshop/material/day1china.pdf.

Zhang B., 2005. *Geothermal Resources in China*. Proceedings World Geothermal Congress 2005, Antalya, Turkey, 24-29 April 2005.

Zheng Y., Yang M. and Shao Z., 2005. *Rural Energy Policy in China*. http://www.frankhaugwitz.info/seiten/policy.html

EIA, Energy Information Administration. http://www.eia.doe.gov/

Campana A., 2009. *Boomtown Energy Drain: Promoting Energy Efficiency in China's Buildings*.

A China Environmental Health Project Research Brief.

Wang Y., 2006. *Energy Efficiency Policy and CO2 in China's Industry: Tapping the Potential*. "Working Together to Respond to Climate Change". Annex I Expert Group Seminar in Conjunction with the OECD. Global Forum on Sustainable Development.

Medium and Long Term Program for Renewable Energy Development.

http://www.chinaorbit.com/china-economy/china-environment-challenge.html

Buckley, 2007. *Hydropower in China: Public Participation & Energy Diversity Key*. http://www.renewableenergyworld.com/rea/home

http://www.efchina.org/FPubInfo.do?act=list&abb=AboutUs&sabb=2&pageno=3 (China Sustainable Energy Programme, CSEP)

11th Five-Year Plan (2006-2010). http://www.gov.cn/english/special/115y_index.htm