Chapter 4
ENERGY

Energy was an important element in Beijing's pursuit of a 'Green Olympics'.

In 2001, when Beijing was awarded the Games, its skyline was dominated by coal-fired power plants and millions of households and businesses depended on coal-fired stoves.

Many activists called upon China to harness clean energy for the Games.

Reducing Beijing's dependence on coal and improving energy efficiency and air quality were a priority for the Games' organizers. Among the key Olympic commitments set by Beijing, the following were on energy:

- Construction of a second Shan-Jing gas pipeline with a transport capacity of 4-5 billion m3 per year by 2007;
- Conversion of coal burning boilers in urban areas, increased use of clean fuels and energy structure readjustment;
- Extending district heating supply to over 50 per cent of the urban residential area and increasing electricity and geothermal heating coverage to 16 million m^2;
- Clean fuels would be used by 90 per cent of Beijing's public buses and 70 per cent of all taxis;
- The reduction and control of industrial pollution, for example by closing down enterprises deemed to be heavy polluters or high energy consumers, and
- Relocation, closure or renovation of heavy polluting and energy consuming plants in the Beijing southeast area and Shijingshan district.

To fulfil its commitments, Beijing's Municipal Government conducted a city-wide overhaul of its energy infrastructure. It implemented several measures to reduce the city's dependency on coal and to improve air quality, and some of these are discussed in chapters two and three. Beijing also used the Games venues and sites to showcase and promote up-to-date renewable energy innovations and efficient uses of energy.

4.1 CHANGES IN ENERGY STRUCTURE

According to the Beijing Reform and Development Commission, during the Tenth Five Year Plan (2001-2005) Beijing's economy grew by 12 per cent every year. As such, the total energy consumption in the Chinese capital increased by 5 – 10 per cent each year during this period (Figure 4.1). Total emissions of air pollutants also increased.

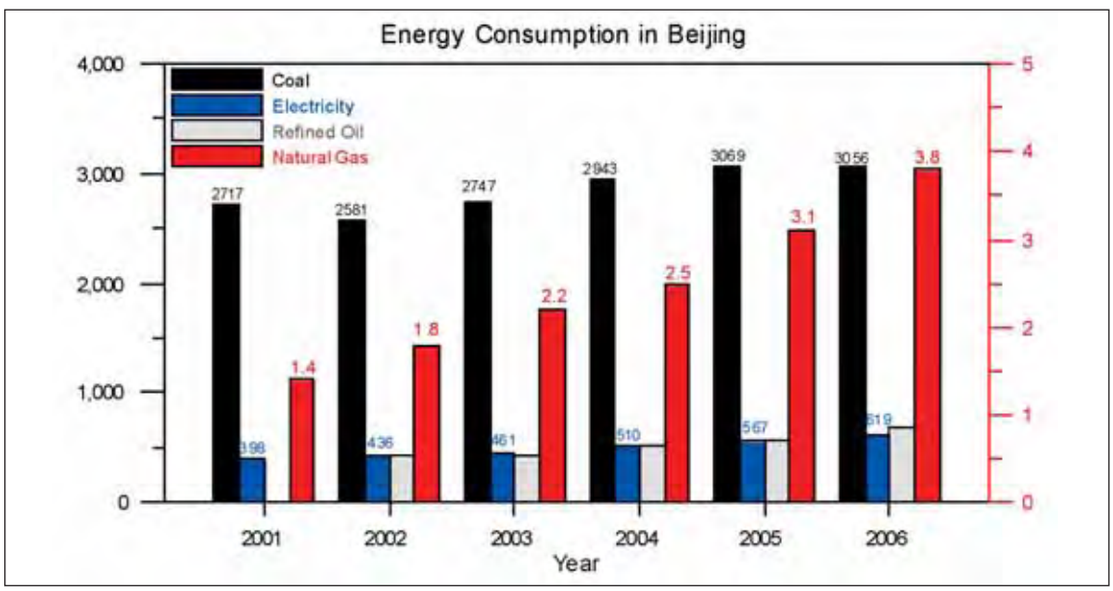
In order to develop sustainably and meet the city's Games commitments, Beijing's energy system needed to be diversified. The Beijing authorities stepped up an ambitious programme to reduce coal use and switch to cleaner energy such as natural gas, geothermal energy, district heating networks, wind energy and other renewable options.

Coal-burning boilers had long been a major source of air pollution in Beijing. The Beijing Environment Protection Bureau (EPB) identified two strategies to reduce emissions by coal-burning boilers: conversion to clean energy for small-scale plants and the complete technical renovation of larger-scale plants.

Small coal-burning boilers (those with an annual consumption of 20 tonnes or less) were switched to cleaner fuels. In the year 2000, 6,829 boilers and 44,000 coal-fired furnaces and stoves were converted. As shown in Table 4.1, more than 15,000 boilers out of a total 16,000 in Beijing were renovated by the end of 2006.

Natural gas supply expanded from 1 billion m^3 in 2000 to 3.8 billion m^3 in 2006. The total length of city's gas pipeline reached 11,000 km and 3.5 million households were connected to natural gas in

FIGURE 4.1: ENERGY CONSUMPTION IN BEIJING, 2001-2006



Source: Beijing Municipal Bureau of Statistics and Beijing Energy Conservation and Environment Protection Centre

TABLE 4.1: COAL-BURING BOILERS RENOVATED AND THERMAL HEATING AREA AND NATURAL GAS SUPPLY, 2000-2006

Year	No. of coal-burning boilers renovated (less than 20 tonnes of coal per year)	Total thermal heating area (million m2)	Natural gas (billion m3)
2000	6,829	-	1.0
2001	2,041	5.36	1.4
2002	1,763	13.67	1.8
2003	1,914	76.52	2.2
2004	1,037	87.77	2.5
2005	-	-	3.1
2006	1,479	-	3.8

Source: Beijing Municipal Bureau of Statistics and Beijing Energy Conservation and Environment Protection Centre

TABLE 4.2: PRIMARY, SECONDARY, TERTIARY INDUSTRY RATIO, BEIJING

Year	Primary industry	Secondary industry	Tertiary industry
2000	2.5%	32.7%	64.8%
2006	1.0%	28.0%	71.0%

Source: Beijing Municipal Bureau of Statistics and Beijing Energy Conservation and Environment Protection Centre

TABLE 4.3: TOTAL ENERGY CONSUMPTION PER 10,000 YUAN OF GDP

Year	Total Energy Consumption (10,000 ton of SCE)		Terminal Consumption (10,000 ton of SCE)		Energy Consumption per 10,000 yuan GDP (ton of SCE)		Decrease Rate of Energy Consumption per 10,000 yuan GDP (%)	
	Amount	Equivalent	Amount	Equivalent	Amount	Equivalent	Amount	Equivalent
1996	3734.5	3416.8	3578.4	2966.0	2.09	1.91	2.75	2.99
1997	3719.2	3358.4	3568.3	2921.0	1.79	1.62	9.60	11.11
1998	3808.1	3437.9	3654.9	2990.1	1.60	1.45	6.88	6.25
1999	3906.6	3558.6	3749.0	3099.5	1.46	1.33	7.38	6.67
2000	4144.0	3713.5	3946.3	3171.7	1.31	1.17	5.07	7.14
2001	4229.2	3767.0	4036.6	3241.1	1.14	1.02	8.40	8.55
2002	4436.1	3922.1	4234.1	3384.4	1.02	0.91	5.83	6.54
2003	4648.2	4122.7	4475.9	3610.6	0.93	0.82	6.19	6.00
2004	5139.6	4521.9	4928.0	3928.5	0.85	0.75	2.83	3.19
2005	5521.9	4825.1	5323.1	4232.5	0.80	0.70	3.88	6.67

Note: Energy consumption per 10,000 yuan GDP is calculated at current prices, and decreasing rate is at comparable prices.
Source: Beijing Statistical Yearbook (2006)

2006 compared to 1.3 million in 2000.

In addition, the Beijing EPB launched a project to convert to electricity the many coal fired stoves operated by restaurants, businesses and households. As a result, more than 6,000 restaurants and 11,000 households switched from coal to electricity for heating between 2003 and 2006. In the Historic Old Beijing Protection Area, in Old Hutong, 90,000 households were converted to electric heating by 2008.

A total of 288 million yuan (US $38.37 million) was invested in the project. About 90,000 families benefited from the conversion process by the end of 2008.

Unlike the small scale burners which were converted or replaced, large coal burning facilities still exist. Beijing implemented measures to ensure that the large scale boilers adopted high efficiency dust removal technologies; controlled dust in coal storage facilities, and installed end-of-pipe desulfurization systems to reduce pollution.

Also, as a strategy to ensure better air quality for the Games, an aggressive programme was implemented in which heavy polluting factories were either shut down, renovated or relocated.

The overall energy structure in Beijing changed with shifts in the city's economic structure. As more of the economy moved from raw production (primary industries) to service industries (tertiary industries), pollution decreased in the city (see Table 4.2).

4.2 IMPROVED ENERGY EFFICIENCY

National standards for energy-saving buildings were implemented on a mandatory basis for new buildings. Accordingly, the following new techniques and products were adopted in new buildings:

- heat conservation and insulation techniques for outer walls;
- new types of energy saving windows and doors, and
- combining the supply of heat, power and cooling utilities.

Olympic venues showcased these techniques. According to BOCOG, all the venues had energy saving fencing structures with insulation and thermal storage. The National Indoor Stadium, Olympic Village, Media Village, Wukeson Indoor Stadium and Tennis Centre adopted "LOW-E" double glazing, which lowered energy consumed by air-conditioning and improved thermal comfort for athletes, officials and spectators. Reclaimed water from the Qinghe Sewage Treatment Plant was used to provide cooling and heating for the Olympic Village.

Government offices took the lead in energy conservation. In 2005, 54 government departments reduced their consumption by 11 per cent through renovations to existing office buildings and improved energy-saving behaviour by staff. In 2006, 10 government departments were selected for energy saving and technical renovation pilot projects.

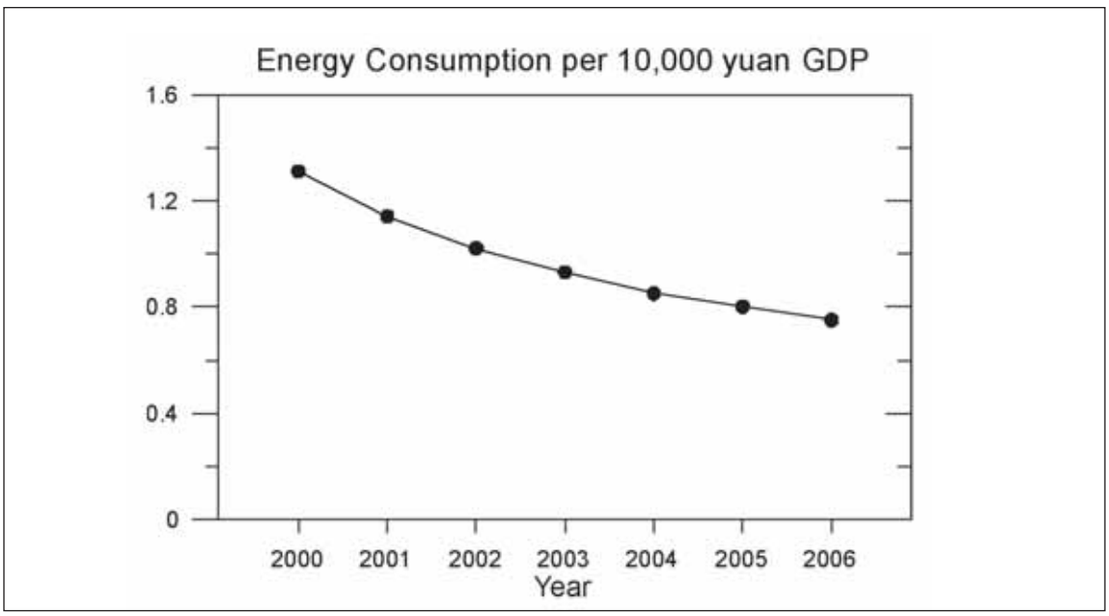
Switching to clean energy and improving energy efficiency had a positive effect. Energy consumption per 10,000 yuan of GDP in Beijing decreased gradually to 0.75 TCE (tonnes of coal equivalent) in 2006; 43 per cent less in 2006 than in 2001, an annual decrease of 7 per cent (see Table 4.3 and Figure 4.2).

4.3 RENEWABLE ENERGY

To improve air quality and achieve its energy saving goals for the Games, the Beijing Municipal Government accelerated the development of renewable energy.

By 2006, solar power was the city's main source of renewable energy (Figure 4.3). The use of solar heaters

FIGURE 4.2: ENERGY CONS UMPTION PER 10,000 YUAN GDP, 2000-2006



Source: Beijing Statistical Yearbook (2006) and 2007 Beijing Energy Development Report

in Beijing reached 3.4 million m^2 in 2006, an increase of 17.6 per cent from the previous year.

The size of solar photovoltaic projects reached 775 kilowatts, generating 1.13 million kilowatt-hours of electricity.

Over 120,000 solar powered street lamps (among the highest number in the world) were installed in Beijing, particularly around the Olympic venues. Solar panels were a standard feature in Olympic venues and generated power for lighting and heating.

The Beijing authorities also invested in geothermal heating demonstration projects. Between 1999 and 2006, 174 new geothermal wells were constructed, of which 141 provided heating to the city. By the end of 2006, a surface area of 6.6 million m^2 had been connected to the municipal geothermal well system. This removed the need to burn an estimated 180,000 tonnes of coal each year, thus reducing annual sulfur dioxide emissions by more than 5,000 tonnes.

A 50,000 kilowatt-capacity wind farm at Beijing Guanting, completed in 2007, supplies almost 100 million kilowatt-hours of electricity to Beijing. According to Greenpeace, clean wind energy accounted for 20 per cent of electricity used in the venues during the Games. Construction of a second wind farm at Guanting is due to be completed by 2010.

The Beijing Environment and Sanitation Group and French company, Veolia, cooperated in the construction of Asuwei landfill marsh gas electricity generation project in 2006. The project supplies now electricity to 17,000 households each year.

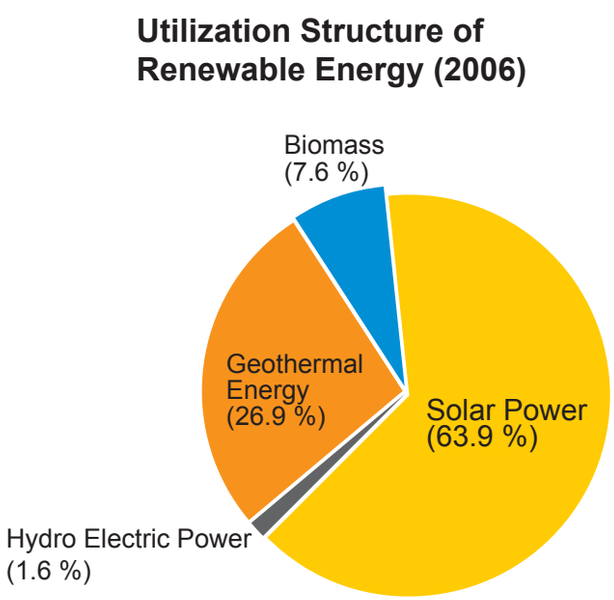
By the end of 2006, the use of renewable energy amounted to an equivalent of 892,000 tonnes of standard coal. This was a 35.6 per cent increase from 2004. Asuwei can manage 13 million m^3 of methane each year to generate 20 million kilowatt-hours of electricity, which has an effect of reducing 100,000 tonnes of carbon dioxide emissions annually. The use of solar power equates to 570,000 tonnes of standard coal, accounting for 63.9 per cent of the total renewable energy consumed. Use of geothermal energy equates to 240,000 tonnes of coal, and small hydroelectric power equates to 14,000 tonnes of standard coal (See Figure 4.3).

Green Lighting Project

To achieve further energy savings, a green lighting project was launched in Beijing in 2004. According to the Beijing Development and Reform Commission, through the program 1.8 million energy-efficient lights were in use in Beijing by 2006. Greenpeace cooperated with BOCOG to promote the switch to energy-efficient lights in schools. Over 1.5 million lights were installed in 2,000 primary and secondary schools, and 300,000 lights in government buildings, hotels, restaurants and universities.

The Development and Reform Commission estimates that the project now saves 39 million kilowatt-hours of electricity annually, which in turn has the

FIGURE 4.3: RENEWABLE ENERGY STRUCTURE IN BEIJING, 2006



Source: 2007 Beijing Energy Development Report

effect of reducing 1,164 tonnes of SO_2, 1,700 tonnes of NOx (Nitrogen Oxides), and 38,700 tonnes of CO emissions every year.

4.4 COMMENTS AND RECOMMENDATIONS

Since 2001, the Beijing Municipal Government has pursued a range of energy-saving policies and measures. Achievements include converting more than 15,000 coal-burning boilers to cleaner energy and developing the renewable sector. An area of over 100 million m^2 benefited from a thermal heating network and high energy-consuming enterprises were relocated.

It is clear the Olympic Games accelerated the introduction of efficient energy infrastructure in Beijing. The Games venues were used to showcase best practices in renewable energy and energy efficiency, and provided a basis for organizers of other mass events to learn from. More than 20 per cent of the total electricity consumed in all the venues was supplied by renewable energy.

Beijing's energy infrastructure has undergone massive restructuring, with a gradual transition from heavy dependence on coal to cleaner energy sources. Although not all measures were specific to the Olympics, they contributed to creating a greener backdrop for the 2008 Olympic Games.

In the meantime though, the city remains heavily reliant on coal and total consumption has increased, apart from during 2006. Its portion, 40 per cent, of total energy consumption, is still high and this has major environmental consequences, ranging from local air pollution to the long range transport of toxic elements such as mercury.

A more deliberate effort should be made to reduce coal consumption in Beijing, in tandem with increasing the supply of clean and renewable energy, and promoting greater energy efficiency of industries and buildings.

Future energy-saving policies in Beijing must stress low-carbon sustainable strategies to reduce CO emissions and air pollution. Low-carbon emitting industries could lead China's future economic growth. The Chinese Central Government could consider offering incentives to such industries.

Greater public awareness of the need to reduce household carbon emissions is also recommended for Beijing and other parts of China.

Many Games venues harnessed solar power.