

# The view from the world's biggest energy user

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China has become the world's second largest economy, but its biggest energy consumer. China's gross national product only surpassed that of Japan last year and was only 41 per cent of the US. But China's energy intensity – the ratio of energy input to economic output – is 3 times that of the US and 5 times that of Japan. Accordingly, there is a very high potential capacity to improve energy efficiency in the future. How far China succeeds in increasing the efficiency with which it uses energy will have an enormous influence on world energy markets.

## The economic and energy boom during the past five years

During the 11th Five Year Plan (2006-2010), China's economy developed at an extraordinary pace, as did its energy industry. The 11th Five Year Plan for China's Energy Development had limited growth in China's primary energy consumption to 2.7 Gigatons of coal equivalent (Gtce) a year by the end of the plan period. This would have amounted to roughly 4 per cent annual growth. However, by 2010 the actual energy consumption figure had reached 3.25Gtce, reflecting an annual growth rate of 7.66 per cent, or 6.7 per cent after a revision of the 2005 base data. So, from 1949, it took China 41 years to reach 1Gtce/year's consumption, another 14 years to reach 2Gtce/year by 2004, but only five years after that for China's energy appetite to exceed 3Gtce/year.

Moreover, coal dominated China's primary energy consumption mix. The 11th Five Year Plan was to reduce coal's share in total energy consumption to 66.1 per cent. However, in the past five years, the share of coal has stayed steady above 70 per cent, with coal consumption reaching 3.2Gt, or 0.65Gt higher than indicated in the Plan.

The unusually fast growth of energy consumption dramatically accelerated energy production in the 2006-2010 period. The actual annual growth rate of production was 7.75 per cent (after adjusting for the base data, still as high as 6.72 per cent), far higher than the planned 3.54 per cent yearly increase. By the end of 2010, total energy production peaked at 2.99Gtce, a 45.22 per cent increase over the year 2005 and 22.04 per cent higher than the plan. The unplanned production growth in crude oil, natural gas and nuclear power was not as significant as that of coal and hydropower. Given the relatively small volume of hydropower capacity, the excess in total energy production came mostly from coal, while the

excess in coal production was in turn driven by excess growth in domestic power consumption.

But the most eye-catching growth rates were in natural gas and hydropower. For the reason that the proportion of natural gas in China's energy structure had always been lower than the world average level, the growth of natural gas production was seen as a major element in the 11th Five Year Plan strategy to improve the country's energy structure. Natural gas production increased at record rates and at record volumes during the 11th Five Year Plan. The annual growth rate reached 14.45 per cent, and production nearly doubled over the five years. As the last phase of Yangtze Three Gorges Hydropower Project was completed and put into operation, China's hydropower capacity grew at an annual growth rate of 10.77 per cent.

## Explaining the excess

Why did actual energy consumption and production so over-shoot the planned targets? One reason was statistical – the national bureau of statistics had underestimated the level of energy consumption and production for the 11th Five Year plan's base year of 2005. But there were two more fundamental reasons.

First, the whole Chinese economy grew faster than the plan. The 11th Five Year Plan for National Economic and Social Development clearly laid down that China's target annual GDP growth rate would be 7.5 per cent. However, the actual annual average growth rate turned out to be 11.2 per cent, or 3.7 percentage points higher than expected. As the plan for energy consumption and production were made on the basis of National Economic and Social Development Plan, the greatly under-estimated level of economic growth had the effect of pulling up the growth rate of energy consumption. In fact, each percentage point of extra expansion in the general economy led to a disproportionately larger increase in energy consumption.

Second, less energy efficiency was achieved through industrial restructuring than was hoped. Aside from technological and management factors, China's economic development status and industry structure account for China's low energy efficiency compared with developed countries. Statistics show that a one percent increase in the share of the tertiary sector, or services, in the whole economy will reduce total energy consumption by around 0.1Gtce. From 2005 to 2010, the share of the tertiary sector in the economy went up by 2 per cent, at the expense of agriculture (but not of mining) which reduced the



relative size of the primary sector. The energy intensity of manufacturing and services is higher than that of agriculture. So the aim of reducing energy consumption through industry restructuring did not work out.

In addition to China being in the high energy consumption phase of urbanisation, the financial crisis also hindered China's steps toward industry restructuring. In order to offset the impact of the global financial crisis on China's economy, the Chinese government took countermeasures such as the Major Ten Industries' Rejuvenation Plan to stimulate economic growth as well as to create employment opportunities. However, those measures in fact encouraged the revival of high energy-consuming industries, making it harder to conserve energy and reduce emissions.

### The outlook for the next five years

In the 12th Five Year Plan (2011-2015) for National Economic and Social Development, there are three constraint indicators which are closely related to energy consumption. These are that non-fossil energy consumption should rise to 11.4 per cent of total primary energy consumption; that energy consumption per unit of GDP should fall by 16 per cent; and that carbon dioxide emission per unit of GDP should decrease by 17 per cent. Among the three, non-fossil energy consumption indicator is the most important.

Assuming that the 16 per cent decrease in energy intensity from 2010 to 2015, the economy will still be able to grow at the expected growth rate of 7 per cent, provided the annual growth rate of primary energy consumption will be 3.95 per cent. This would allow China's total primary energy consumption to grow to at least 3.945Gtce by 2015, from 3.25Gtce in 2010.

Assuming that non-fossil energy consumption per GDP will increase to 11.4 per cent of total primary energy consumption, the proportion of natural gas in energy consumption structure will have to rise so as to realise the goal of reducing energy consumption and carbon dioxide emission per GDP.

China's natural gas production is on the rising

track. Assuming that future growth rate of production equals the average annual growth rate in the 11th Five Year Plan period, China's natural gas production will be 190Bcm. Add 70bcm of net imports, and China's natural gas demand should reach 260bcm (0.31565Gtce) by 2015, accounting for 8 per cent in the 3.945gtce of total primary energy consumption. In the next five years, demand for crude oil will rise steadily, rising to 0.51 Gt or 10.2 million barrels a day, accounting for 18.4 per cent in the total.

Domestic oil production is impossible to increase much. So demand growth will mostly have to rely on the international market. By 2015 China will probably depend on imports for nearly 60 per cent of oil, but at the same time it is filling up its Strategic Petroleum Reserve which should contain 270m barrels by the end of 2012. The Middle East and Africa will remain China's dominant sources of imported oil. But, with the Russia-China crude pipeline in commercial operation since 2010, the second phase of the Kazakh-Chinese crude pipeline finished, and several 'loans-for-oil' deals signed with South American suppliers in the last couple of years, Beijing is diversifying its sources of supply. The rapid pace of upstream investment by China's three oil majors will also consolidate these companies' trading power.

The huge residual of this equation is the demand for coal, whose consumption is virtually guaranteed to increase to 3.44Gt by 2015. But the share of coal in total energy consumption will have to shrink a little if non-fossil energy is to increase its share to 11.4 per cent in total energy consumption. Among low carbon sources, hydropower will continue to dominate, with nuclear power second and a fast-growing contribution from wind. →

*Planned Energy Consumption in 2015*

	2010 Actual	2015 Estimated	2015 Proportion (%)
Total energy consumption - Gtce	3.25	3.945	100
Coal - Gt	3.20	3.44	62.2
Crude oil - Gt	0.43	0.51	18.4
Natural gas - Bcm	104.80	260	8
Non-fossil energy - Gtce	0.21	0.45	11.4



## Future uncertainties

Many uncertainties surround forecasts about China and energy. The biggest uncertainty, given what happened during the 11th Five Year plan period, is the country's overall growth rate. My analysis, and the government's, is based on the assumption of 7 per cent average growth in the coming five years. But if the growth rate were to average 10 per cent, the total primary energy consumption would rise to 4.3Gtce, even if efforts to reduce energy intensity were to do well.

In the next five years natural gas will play an important part in energy consumption optimisation. But a crucial factor here is pricing reform. If the natural gas price is still relatively low, motivation to develop unconventional gas would be reduced. Thus, any delay in the price reform may directly influence the realisation of the goal of natural gas taking 8 per cent in the total primary energy consumption structure.

Development of the gas market and the expansion of wind power are both related to energy infrastructure. Future growth of China's natural gas consumption is closely tied to the construction of three major cross-border gas pipelines – the Central Asia-China gas pipeline coming from Kazakhstan and connected to the domestic West-East gas pipeline, the China-Myanmar gas pipeline and the Russia-China gas pipeline – as well as the construction of LNG import facilities. Improvements in the domestic gas network and strategic gas storage are also vital to meet the rapid growth of demand. In 2010, China's wind power capacity was an astonishing 33 times bigger than in 2005, rising from 1.26m kw to 41.82m kw over that period. This amounts to a quarter of world wind power capacity. However, to maintain this rate of growth requires constant improvement in grid connection.

The Fukushima nuclear accidents in Japan may affect China's medium and long term plan for nuclear power development, especially if new safety measures raise the cost of nuclear construction and operation, affecting the competitiveness of nuclear power. But the influence on the 12th Five Year Plan period will be relatively limited, because of the long lead time in building nuclear power plants. Plants now under construction will be completed and put into use in the 12th Five Year Plan period. Even if future projects are postponed, the impact will only show in the more distant future. ■