Environmental Impacts of Rising Energy Use in China: Solutions for a Sustainable Development

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Today, China is the world's second largest energy consumer and by 2015 is expected to overtake the U.S. as number one. Nevertheless, on a per capita basis, its consumption level is low compared with industrialised countries. According to Brown (2005), if the Chinese were to use oil with the same intensity as Americans, by 2031 they would need 99 million barrels per day. 2030 production is projected at 116.3 mbd (IEA, 2007). Sinton (2008) says that if China were to equal U.S. per capita coal use, it would use twice as much as it now does. Sinton also says if China were to equal US per capita total primary energy consumption, the result would be consumption amounting to 87 percent of 2006 world consumption. Thus, Chinese development may put pressure on the global security of supply. However, this article will focus on the environmental issue that is related to energy.

The Chinese Energy Mix[1]

Before studying the state of the Chinese environment, one first needs to analyse its energy consumption as it is one of the drivers of its degradation. China currently consumes 1,900 million tons of oil equivalent (Mtoe, hereafter) and mainly relies on coal that represents 64 percent of its energy consumption. Oil (19 percent) and biomass (11 percent) are the two other main sources of energy. On a global scale, the world's consumption is more balanced even though it is still dominated by fossil fuels. Oil and coal represent respectively 34 and 26 percent of global consumption while natural gas accounts for 21 percent.

Comparing these two mixes shows China's heavy reliance on coal. This can be explained by the fact that China consumes very little natural gas and is endowed with huge reserves of coal. The use of coal has been increasing in recent years due to the surge in electricity needs which is coal-based at 80 percent. Regarding oil consumption, it has been rising recently but is still less intensively used as the Chinese government has for long lauded self-sufficiency. The use of hydropower and nuclear power is lower in China than worldwide even though it has many projects involving the expansion of these two types of energy as well as other renewables. Lastly, biomass remains an important source of energy although its use has been considerably reduced in the last two decades. It is noteworthy that in China, unlike in most other developed countries, biomass refers to non-commercial traditional biomass.

In terms of forecasts, the increase in Chinese energy demand over the period 2006-2030 will dwarf that of other countries. This increase is projected to represent nearly 2,000 Mtoe which corresponds to four-times the rise in energy demand of both Latin America and Africa or three-times that of the OECD over the same period. Coal will remain the dominant fuel in 2030, with a share of 63 percent while nuclear power, as well as natural gas, hydro and other renewables will increase their shares at the expense of biomass.

Environmental Consequences

All energy sources have drawbacks from an environmental point of view. Exploiting an energy source can create unwanted and damaging by-products or drive other products' supply down. More simply, hazards exist and accidents may happen. However, the two worst forms of energy sources are the traditional (also known as non-commercial) biomass and coal. Burning coal[2], as well as wood or waste for the biomass, releases sulphur oxides, carbon oxides, nitrous oxides, and other impurities into the air. For instance, 70 percent of smoke dust emission, 90 percent of sulphur dioxide emission, 67 percent of nitrogen oxide and 70 percent of carbon dioxide in China are due to coal combustion (Zhang, 2007). Burning coal also releases mercury. Mercury enters the environment as industrial air pollution from factories, notably when coal is burned. It is then deposited into oceans and waters and contaminates the food chain (NRDC, 2007). Since it is a global pollutant, it disperses around the globe and affects the five continents. For example, the U.S. EPA reported that a third of the U.S.'s lakes and a quarter of its rivers are polluted with mercury. Therefore, it has recommended not to eat fish caught there (Pottinger et al., 2004). According to Pottinger et al. (2004), 30 percent or more of mercury in the American waters or soils come from other countries, in particular China, which is reported to be the world's largest (non-natural) emitter of mercury. All theses emissions affect the environment on three levels. The global environment is affected through global warming by emissions of carbon

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dioxide. The environment is regionally altered by emissions of nitrous and sulphur dioxides that cause acid rain. On a local level, particulate emissions, among others, can pose a direct threat to human health. These three types of pollution will be successively analysed.

Global Consequences

Global environmental degradation is due to the significant increase of greenhouse gases and more particularly CO_2, which makes the largest contribution to global warming. CO_2 is mostly released into the environment when a fossil fuel is combusted for energy use. Among all the types of fossil fuel, coal is the one that discharges the most CO_2 when burned. As China uses a lot of coal in its energy mix, it is today the leading global CO_2 emitter. The effects of such an increase are numerous and well-known and will impact health, agriculture, forest, water resources, coastal areas, species and natural areas. In 2030, Chinese emissions are forecast to be 66 percent higher than those of the U.S., which is ranked second (IEA, 2007).

Regional Consequences

Regional pollution is embodied by acid rain which occurs when SO_2 and NO_X are mixed together in the air and create acidic compounds that are absorbed by clouds (IEA, 2007). Acid deposition has been recognised as a potential environmental problem in China in the late 70s, early 80s (Larssen et al., 1999). Nowadays, about 40 percent of China suffers from acid rain, mainly south of the Yangtze River and in coastal areas (He et al., 2002). Acid rain has repercussions on vegetation, soils, crop yields, buildings, and public health. In terms of costs, a study undertaken by Zhang, Wen (2000, cited in Day, 2005) showed that Chinese agricultural production has already been lowered by 5 to 10 percent due to acid deposition.

Local Consequences

The reasons for the local pollution are also a heavy reliance on coal and non-conventional biomass that both emit a lot of noxious gases (carbon oxides, sulphur oxides, nitrous oxides, particulate matter…). For instance, nitrogen dioxide is a lung irritant which increases the lung sensitivity to other pollutants. Sulphur dioxide is an acidic gas that can lead to short-term lung irritation or long-term lung tissue changes and has negative impact on agricultural crops. According to WHO[3], 17 percent of all deaths in the Asia-Pacific Region (in which the bulk of the population is represented by China) are related to environmental problems. This pollution can either be referred to as indoor air pollution (through the use of biomass in most of the cases) or outdoor air pollution[4]. Indoor air pollution occurs mainly in poor areas where traditional biomass is highly used. In developing countries, people tend to rely on wood, dung or crop residues for domestic energy. For example, in China, it has been shown that two-thirds of women with lung cancer were non-smokers (Bruce et al., 2000). According to Zhang, Smith (2007), indoor air pollution is responsible for more than 400,000 premature deaths annually in China. As for outdoor air pollution, in the last ranking of the world's most polluted cities, China accounted for 20 of them[5] and according to a World Health Organization report (2004), only 31 percent of Chinese cities met the WHO standards in terms of air quality. Recently Wen, Chen (2008) assessed the economic losses of air pollution at 4.1 percent of GDP in 2002. And in its last report on this topic, the World Bank (2007a) assessed the economic cost of Chinese pollution (both water and air) at 3 or 6 percent of the GDP in 2003, depending on the methodology used (Adjusted human capital approach or Value of statistical life).

To conclude, China is severely hit by pollution which puts a heavy burden on populations. Pollution causes many diseases and deaths and hampers agricultural productivity and buildings' longevity. Therefore, it represents a public issue that needs to be urgently tackled.

Solutions to Implement an Environmentally Sustainable Development

In economic theory and in absence of externalities, efficient pricing exists when the incremental cost of producing, transporting and distributing a commodity equals its market price (The World Bank, 2007b). It is the reason why many scholars have advocated for a subsidy removal in China. As subsidies affect either the prices paid by producers or consumers, or the prices received by producers, they create market distortions. Assuming that polluting fuels are most of the time subsidised, this leads to an over-optimal level of pollution. Reducing (or removing) subsidies enables a reduction in the incentive to consume or to over-consume polluting sources of energy. The IEA (1999) showed that a subsidy removal in China would reduce CO2 emissions by 13.44 percent while increasing GDP by approximately 0.37 percent. Larsen, Shah (1992) advocated that economic policies should first and foremost remove fossil

fuel subsidies in order to protect both local and global environment. The same rationale can be applied to externalities. Internalising them (and thus, putting a price on noxious emissions) is one of the common ways to tackle pollution. This idea dates back to the works of Pigou and has been used with emissions trading in the Kyoto Protocol, in the U.S. with the EPA's Emissions Trading Program, and in Finland or Sweden with carbon taxes (Blackman, Harrington, 1999).

The notion of energy prices and a possible increase of these prices in China has already been considered. Hang, Tu (2007) calculated coal, oil and electricity price elasticity in China to underline the positive impacts of higher energy prices on energy efficiency and security of supply. Shi, Polenske (2005) also confirmed that China's energy intensity was negatively correlated with energy prices. The abovementioned study from the IEA (1999) also emphasised the positive effects of a subsidy removal on CO2 emissions in China. Rouhier (2009) recently showed that a price instrument could work in China thanks to a negative price elasticity of both SO2 and CO2 emissions. First of all, through a subsidy removal, the government would enable energy prices to give correct signals to consumers that would thus reduce the quantity of fossil fuels consumed and to producers that would go for better technologies or less polluting fuels. Then, by making the producers pay for the externalities they create through, for example, carbon emissions fees or a sulphur tax, the government would also reduce pollution. Such a price increase would affect energy efficiency as well as diversification. Indeed, pricing has a big role to play, either by making energy more expensive and thus, more valuable (energy efficiency), or by increasing polluting fuels' prices (fuel switching), or by making new and less polluting technologies financially interesting (emissions control). Overall, more expensive energy prices would increase energy intensity, help reduce the consumption of polluting fuels and thus carbon (as well as sulphur) emissions, and also improve public finance.

Even though this solution will be hard to implement and might face social dissent, we do believe in its legitimacy. Yushi *et al*. (2008) assessed the direct external cost of coal at RMB 1,745 billion. They performed a cost-benefit analysis of the full internalisation of coal external costs and found that the total added social wealth of such a solution was about RMB 942.3 billion. Besides, most of these changes could occur at reasonable costs thanks to international co-operation through the global climate policy and the Clean Development Mechanisms. On this point, one must point out that international negotiations, notably in Copenhagen, will have an impact on what can be financed through those mechanisms. Developed countries might be reluctant to finance the internalisation of Chinese externalities. However, with the money that would be saved by the government (subsidy removal) plus the money that will be collected through a price on pollution, government would be able to finance new infrastructure as well as implement policies to improve the fate of the poor.

Footnotes

[1] Figures based upon IEA (2008).

[2] It is noteworthy that the extraction of coal also emits coal-bed gas that is most of the time methane. Methane belongs to the category of greenhouse gases and is 21 times more damaging than carbon dioxide. Hence not only burning coal is environmentally damaging, but also extracting it and transporting it.

[3] http://www.wpro.who.int/china/sites/ehe/overview.htm

[4] It should also be noted that there is a growing gap between water resources, water quality and the ever-increasing needs of people or industries.

[5] World Bank – China quick facts available at http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/CHINAEXTN/0,,contentMDK:20680895~pagePK:1497618~piPK:217854~theSitePK:318950,00.html

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