



POLICY: ENERGY

Who Will Fuel China?

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Throughout this decade, China's real gross domestic product (GDP) has grown an average of over 11% each year. Although the recent economic troubles in Asia may dampen this trend, the likelihood for strong long-term growth raises serious questions about energy import requirements and the global environment. To help fuel her unprecedented growth, in 1993 China became a net importer of oil for the first time in history. In 1997, her average net imports were 800 thousand barrels per day, twice the 1995 levels (1). The impact of China's total fossil fuel consumption also dominates the politics of global environmental change. Any climate protection resulting from the greenhouse gas treaty negotiated in Kyoto, Japan, and opening for signature at the United Nations on 16 March, will depend on the future of Chinese emissions.

Chinese oil imports could reach 7 to 8 million barrels (mbl) per day by 2015, and 13 to 15 mbl per day by 2025 (2). In comparison, the United States currently imports 8.4 mbl per day. A large share of current Chinese imports come from the Persian Gulf. Together with projected global declines in oil production in 20 years (3), these demands on the global oil market pose a serious threat to future global energy security.

To limit dependence on oil imports, the Chinese government has embarked on two main supply-side strategies: development of domestic oil supplies and substitution of other fuels for oil. For the first, China hopes to attract foreign investment to develop remote sites in western China, most notably the Tarim oil basin. Initial exploration efforts, however, have been disappointing. As of July 1996, the Department of Energy reports that just 4 billion barrels of oil reserves have been verified at the Tarim basin (current global consumption is 25 billion barrels per year) (4). The second strategy has largely translated into aggressive domestic coal production. China's current Five-Year Plan projects domestic coal production of

1400 million tons by the year 2000 (5). Nevertheless, given the necessity of oil in many current industries, the current and projected large share of industrial sector GDP (42% in 1995), and a growing transportation sector, substitution of coal is projected to have a limited impact on the need to import oil.

On the demand-side, inefficiency has been the norm. In 1994, China reimposed central control over the domestic oil market through price fixing and channeling all sales through state agencies (6). This reversal of prior market reforms is partly responsible for excess demand in oil and the need for increased imports.

Other options to fuel China's development include hydroelectric and nuclear power. In 1995, hydroelectricity accounted for ~20% of China's electricity generation; China's three operating nuclear power plants accounted for less than 1%. China has launched an aggressive hydroelectric program that includes construction of what will be the world's largest dam, the Three Gorges Dam on the Yangtze River. Hydroelectric capacity is forecast to increase from 32 gigawatts in 1990 to 138 gigawatts in 2020. Official plans foresee installed nuclear capacity increasing from the current 2.1 gigawatts to 30 to 40 gigawatts by 2020 (7). Assuming foreign investment will rise to meet these optimistic scenarios, and considerable environmental challenges of hydro and nuclear development can be overcome, future hydro and nuclear development would account for less than 6% of primary energy needs by 2025. The share of relatively expensive non-hydro renewable energy is expected to be even less. Total energy supply from these technologies, such as solar thermal, photovoltaic, geothermal, and wind power currently account for less than 1% of China's commercial energy supply. Without significantly altering its energy structure, the bulk of China's 2025 primary energy supply will be coal (68%) and oil (25%).

With respect to future greenhouse gas emissions, assuming aggressive nuclear and hydro development and substantial declines in industrial energy intensity (energy per unit GDP), CO₂ emissions from energy use are projected to increase from 0.7 billion tons today to 2.1 billion tons by 2015 and to 3.2 billion tons carbon by 2025. This com-

pare to current global CO₂ emissions of 6.15 billion tons carbon. Complicating the negotiation process is China's inherent right to develop. A measure of development and fairness in past negotiations has been the distribution of emissions on a per capita basis (8). Under CO₂ and population projections, China would increase per capita emission from a current 0.6 tons to 2.2 tons by 2025. Despite this growth, the nearly three-decade projection is still only half the current per capita emissions of the United States.

Thus, for the foreseeable future, China has little incentive to participate in any agreement seen as limiting their right to economic growth. The Kyoto Protocol only sets greenhouse gas targets for current industrialized nations. However, continued growth in energy demand in China in particular, and developing countries in general, will more than offset emission reductions mandated by the Protocol.

As developed countries consider options for meeting the obligations of reducing emissions in accordance with the Kyoto Protocol, they must confront the implications of continued growth in energy demand in the rest of the world and particularly in China. Effectively limiting total global emissions will thus require a sustained international commitment to improving global energy efficiency and expanding research into and use of non-carbon emitting energy technologies. Reducing emissions in developed countries, coupled with less carbon-intensive economic growth in developing countries, comes closest to achieving meaningful climate policy goals. An ancillary benefit would come through reduced pressures on the global oil market. In the interim, committing to emissions targets reached by developed countries in Kyoto is a first step toward eliciting the essential cooperation of China and other developing countries and protecting our common future.

References

1. International Energy Agency, *Monthly Oil Market Report*, January 1998.
2. R. Thomas, D. Jeppeson, T. Drennen, D. Harris, D. Engi, *Modeling the Infrastructure Dynamics of China: Water, Agriculture, Energy, and Greenhouse Gases* (SAND Report, Sandia National Laboratories, Albuquerque, NM, in press).
3. C. B. Hatfield, *Nature* **387**, 121 (1997).
4. U.S. Department of Energy, *Country Analysis Reports: China*, May 1997.
5. C. P. Lin, Ed., *PRC Tomorrow: Development Under the Ninth Five-Year Plan* (Graduate Institute of Political Science, National Sun Yat-Sen University, Kaohsiung, Taiwan, 1996).
6. H. Wang, *Energy Policy* **23**, 627 (1995).
7. R. P. Suttmeier and P. C. Evans, *The Chin. Bus. Rev.* **23**, 16 (1996).
8. D. Chapman and T. Drennen, *Contemp. Policy Iss.* **8**, 16 (1990).

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