China's Fuel Choice: A Comparative Analysis of Natural Gas and Coal

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China is one of the world's leading users of coal and is therefore faced with serious coal-smoke pollution in urban areas. But pressure is mounting for a solution and this can only intensify following Beijing's successful bid for the 2008 Olympic Games. To find just such a solution, a new study from the Institute of Environmental Sciences at Beijing University has investigated the potential for natural gas as a cleaner fuel for China's cities. →

A summary of EEPSEA Research Report 2001-RR14, Improving Air Quality in Chinese Cities by Substituting Natural Gas for Coal: Barriers and Incentive Policies, by Mao Xianqiang and Guo Xiurui (Institute of Environmental Sciences, Beijing Normal University, Beijing 100875, China; contact: maoxq@bnu.edu.cn *or* maoxq@263.net *and* gxrhuray@263.net).

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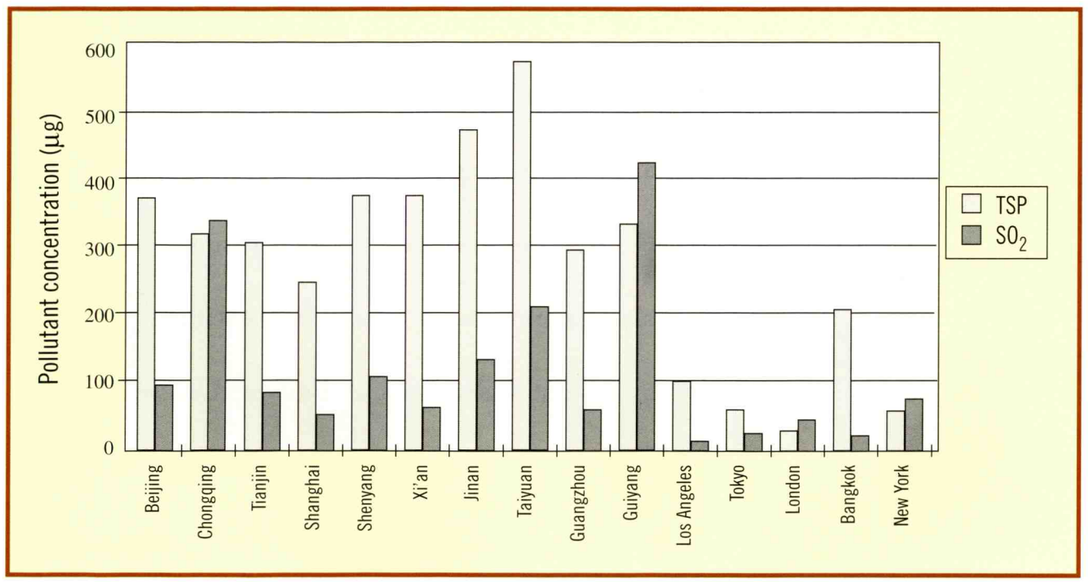
Natural gas has *clear environmental benefits*

The study shows that natural gas has clear environmental and economic benefits over coal. The study, by Mao Xianqiang and Guo Xiurui, found that the high cost of substituting natural gas for coal was the main factor hindering the adoption of the cleaner fuel. To overcome this hurdle, the researchers put forward a number of policy recommendations that would reduce the cost of natural gas and accelerate its take-up as the fuel of choice.

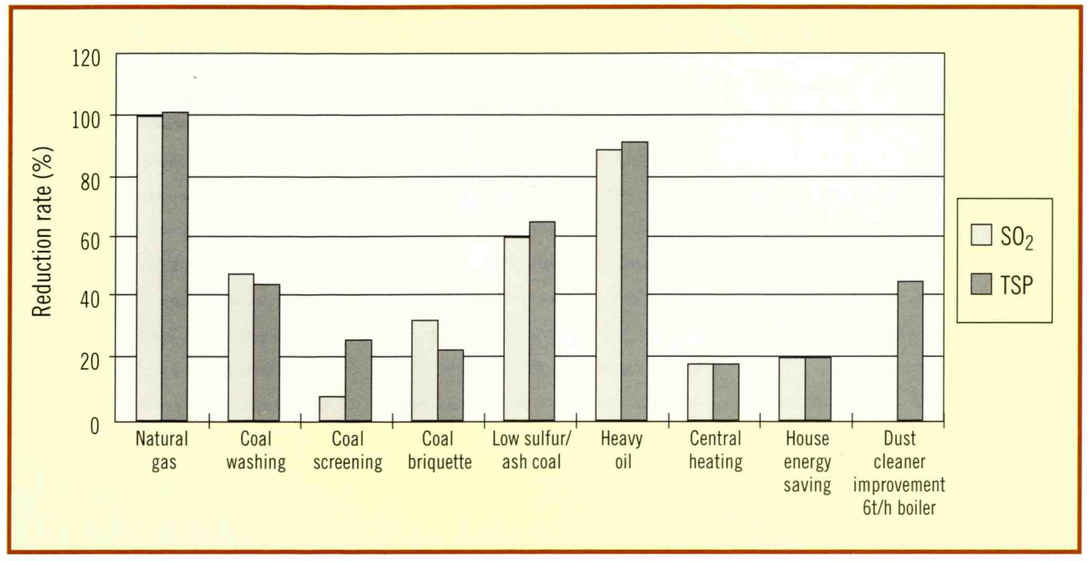
Xianqiang and Xiurui started their research by investigating the economic impact of air pollution in the major cities of Beijing and Chongqing. They drew on the findings of a 1997 World Bank Report and two previous Chinese studies, and applied a benefit transfer approach. The results showed that pollution damage represents a significant percentage of the individual cities' GDP. The researchers then reviewed past studies to determine why this situation exists. They found that China's energy structure is responsible for the country's serious air pollution problems; specifically its overwhelming reliance on coal. In most Chinese cities, coal is used for heating and cooking by residential and commercial consumers, causing a wide range of indoor and outdoor air pollution — 90% of SO_2 emissions come from coal combustion.

Why Coal is King

One obvious solution is natural gas. Compared to coal, natural gas is a high-quality energy source: it is very efficient and has low pollution emissions. However, the researchers found that the low share of natural gas in China's energy reserves has made the use of natural gas a controversial topic. Two arguments have been made against the adoption of natural gas as a fuel. One is that its use as a raw material for the chemical industry should take precedence. The other is that clean-coal technology, not fuel substitution, is the most cost-effective method of improving air quality.



Air Pollutant Concentrations in Selected Major Cities in China and the World (1995)



Reduction Rate of Some Pollution Reduction Technologies

To find out whether natural gas could represent a practical energy source for China's cities, Xianqiang and Xiurui investigated these two claims. They found that alternative raw material sources exist to natural gas: residual oil and water coal slurry can be used in place of natural gas in the production of important chemicals such as synthetic ammonia and urea.

They also found that natural gas is not necessarily a cost-effective raw material choice — government subsidies over the past few decades have given it an artificial price advantage over other raw materials. When they investigated clean-coal technology, the researchers found that many of the available systems — such as flue gas desulfurization — are limited to large-scale users and have high administrative and monitoring costs. They found that small and scattered coal users can only use a few clean-coal technologies such as coal briquettes and low-sulfur coal substitution. Xianqiang and Xiurui also found that the pollution reduction rates for most clean-coal technologies are relatively low, compared to natural gas. Natural gas has very low emissions and is well suited for households and small-scale boilers.

Calculating the Benefits of Gas

Deepening their investigation, Xianqiang and Xiurui undertook a cost-benefit analysis of the substitution of natural gas for coal. They investigated two natural gas substitution projects in Beijing and Chongqing. The Chongqing project consists of substituting natural gas for coal in over 1,000 boilers, 18,500 catering cooking ranges and 1,500 drinking-water boilers. This is expected to reduce SO_2 pollution in the Chongqing urban area by over 80% and TSP and PM10 pollution levels by 35%. Using a dose-response function and benefit transfer, the researchers estimated that this would produce benefits of between CNY 1.2 and 19 billion. After incorporating the costs of the pipeline system for the Chongqing project, they found that the project

would have an internal rate of return (IRR) of at least 26%.

Xianqiang and Xiurui undertook a similar analysis of a 1 billion m^3 natural gas substitution project in Beijing. They found that this would give total benefits of between CNY 544,000 and 7.63 billion and an IRR of at least 3%. A 3 billion m^3 project would have an IRR of 11%, showing the importance of economies of scale. These two cost-benefit analyses show that in cities with a high concentration of population and economic activity, natural gas as the municipal energy source has clear environmental and economic benefits in reducing non-point air pollution.

Market Barriers to Gas

In light of these findings, Xianqiang and Xiurui investigated the factors affecting supply and demand of natural gas in China to find out why it is not used more extensively. They began by examining the cost to consumers of substituting natural gas for coal. They found that natural gas substitution meant higher fuel costs, as it is considerably more expensive than coal in terms of price per unit of thermal energy. Consumers would also need to spend money to convert or replace their old coal boilers. Other obstacles are the initial installation fee and gas source fee that consumers in Chongqing and Beijing must pay to local distribution companies and the high cost of constructing urban natural gas distribution systems.

The researchers also highlighted the barriers present in China's system of central planning. This often leads to situations in which consumers with large natural gas quotas are unable to use up their allocations, while other consumers faced with a shortage of natural gas are unable to buy more on the market. Producers are required to continue to supply gas to consumers who cannot pay, resulting in huge arrears.

Towards a Cleaner Future

In light of their analysis, Xianqiang and Xiurui argue that China should focus on creating a market-oriented system for natural gas production and retailing. They advise that surcharges levied against municipal consumers should be cancelled and that foreign and private capital should be attracted to fund the development of natural gas production, transportation and distribution infrastructure. In addition, pollution charges should be levied on coal to create a "level playing field" for clean fuels. With the economic and environmental arguments for natural gas well proven, China would do well to aim for a gold in natural gas use in time for its debut as an Olympic host.

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