Dilemmas of Energy Choice in Northeast Asia

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Northeast Asia faces a dilemma in its choice of energy strategies. In the coming decade, rapid economic growth will drive a huge increase in energy demand. Although demand will be greatest in China, Japan and South Korea will also increase energy capacity and North Korea and the Russian Far East hope to attract foreign investment to do the same. The dilemma is that the primary projected strategies to meet the demand--expansion of (dirty) coal, maritime oil transport, and nuclear power--are problematic on both environmental and security grounds.

An increased reliance on coal forebodes two major negative ecological impacts: a dramatic increase in acid rain-causing sulfur emissions; and a large increase in carbon dioxide and other greenhouse gas emissions. Under current projections, China will emerge as the world's leading source of carbon emissions within twenty five years.

Acid rain is a problem of both domestic and crossborder proportions, with dirty coal-burning power plants in northeastern and southeastern China as the primary source. According to the most recent and comprehensive estimates, some 37% of Japan's acid rain problem is sourced from China. In North Korea, 34% is sourced from China and another 30% from South Korea. The region's oceans are especially vulnerable: 15% of China's sulfur emissions are deposited in the ocean, while for South Korea and Japan the figures are 51% and 48%, respectively. On both land and sea, acid rain undermines biological productivity, with implications for major crop and fish food sources, and threatens to degrade the region's forests.

Worries over widespread regional environmental damage have prompted some policy analysts, including in Japan and Korea, to promote nuclear power as an alternative to coal-fired power. However, there are also large environmental externalities associated with nuclear power, including the risk of Chernobyl-style accidents; the production of radioactive waste, equipment and buildings; and routine radioactive emissions.

Currently, nuclear power accounts for between 25% and 50% of electricity generating capacity in Japan, Taiwan and South Korea. This fraction is projected to increase to 35-55% by 2010. Japan is committed to breeder reactors as is South Korea's nuclear establishment, along with mixed-oxide fuel plutonium recycling (although South Korea has forsworn plutonium reprocessing).

The construction of nuclear power plants continues to pose risks, due to siting and seismicity problems (in Japan), shoddy and corrupt construction (South Korea), lack of operating and maintenance funds (Russian Far East), and lack of safety, regulatory, and trained operating staff (North Korea). Emergency evacuation poses intractable, likely impossible problems in all the densely populated states of the region. None of the states has adopted a nuclear waste disposal strategy. Public accountability for nuclear power decisions is low or nonexistent in the region.

Another option is to switch to natural gas, imported either by sea, or, more hypothetically, by massive pipeline construction from Siberia through China to North and South Korea, and on to Japan. These two strategies both entail very large capital investments in the supply and transport side, as well as in retrofitting cities to distribute natural gas. As a relatively clean fuel, however, natural gas has some strong advantages over coal, oil, and nuclear power.

The large environmental and security externalities associated with dirty coal and nuclear power make both unattractive. There is a third alternative, however, based on a combination of clean coal, fuel switching, and energy efficiency. The "Third Path" strategy is focused on minimizing waste on both the demand and supply sides of the energy equation. It requires investment in widespread improvement in the efficiency of end use in all sectors, as well as expansion of coal-based electricity supply which controls sulfur emissions.

In China, for example, studies at Lawrence Berkeley Laboratory have shown that China's energy services have grown more (since the early 1980s) from increased end-use efficiency than from investment in new energy supplies. The Nautilus Institute has identified substantial and relatively cheap, fast, and incremental (therefore, low-risk) efficiency options for North Korea. Similar potential exists in South Korea and in the most advanced and technologically innovative economy in this region, Japan.

The "political economy" of the Third Path revolves around the prospective cost to Japan of unrestrained growth in coal use in China (and to a lesser extent, in the two Koreas), on the one hand, and the cost to China of reducing its sulfur emissions, on the other. Technological controls include:

- desulfurization of fuel oil, coal, and diesel fuel before combustion [1]
- desulfurization of fuels during combustion by additive processes and flautist bed combustion [2]
- capture of sulfur after combustion by flue gas treatments such as wet limestone scrubbers [3]

Relatedly, these and end-use efficiency measures overlap with those required to reduce China's prospective energy-related greenhouse emissions to acceptable levels. Thus, the OECD countries as a whole, and Japan and South Korea in particular, have a strong common interest in financing the requisite technological advances in China's energy sector.

Electricity generation in APEC Asian states is projected to increase from its 1991 level of 235 GWe to 1,100 GWe in 2010--an annual 8 percent increase. This projected increase will require some $297 billion over the 1991-2000 period, and an additional $557 billion from 2000 to 2010. About 62 percent is projected to be in China. It is highly improbable that China can sustain this rate of capital investment in electric power plants, which amounts to an average of $26 billion per year. Moreover, the investment required to control China's sulfur emissions with best available technology would amount to $34 billion per year.

The critical missing link in this political economic equation is how much it would cost to achieve BAT sulfur reduction in China using energy efficiency rather than emission-control technology. If acid rain in China can be reduced by energy efficiency, cleaner coal and control technologies, and a combination of fuel switching (natural gas supplemented by renewables), a substantial fraction of the annual costs referred to above could be avoided. The potential gains may persuade China to accept substantial "green" and efficiency investment by Japan and other donor states. On the other hand, the threat of China's acid rain may induce Japan and South Korea to lead in innovative financing of China's energy sector in ways that provide more energy in China at lesser cost.

At this stage, however, no one has compiled the basic elements of the overall regional picture that would allow a strong argument to be put forward to this end. Similarly, until these elements are assembled, no one can evaluate properly the claim of nuclear power to be the only technological and economic solution to acid rain in the region.

Towards Least-Cost Energy Investment

The central constraining factor in energy development choice in Northeast Asia will be capital. Under any policy and technology scenario, the capital requirements of meeting expected energy demand will be very high. No matter what other strategic and political objectives policymakers pursue in making energy investment choices, incentives will be strong to optimize financially.

Optimizing scarce capital requires choosing energy development projects which are least-cost. There are four components of a least-cost calculus:

1. up-front investment and operating capital requirements;
2. total fuel-cycle costs;
3. total costs, including environmental and security externalities; and
4. dynamic opportunity costs, which compare likely future prices stemming from technological trajectories.

Most estimates of the "cost" of energy expansion in Northeast Asia are partial: They consider only up-front capital requirements, or up-front capital requirements plus some additional investment to reduce environmental externalities such as scrubbers. On this basis, conclusions are drawn about the relative costs of nuclear, dirty coal, fuel switching, and energy efficiency/clean coal. A more complete estimate which includes total fuel-cycle costs could find that, even without adding in environmental and security externalities, nuclear power and dirty coal are relatively more costly.

The opportunity costs of one versus another strategy have not yet been analyzed, let alone estimated. The large-scale capital requirements of energy investment commit companies, sectors, and even national economies to particular technological trajectories. What is cheap today may be expensive tomorrow if opportunities to innovate and learn are foregone. Energy investment, in other words, is not only about meeting energy demand but about developing an industry policy. Moreover, commitments to particular energy technologies may have policy and institutional opportunity costs. Around the world, the trend among utilities, for example, is toward privatization. The large risks attached to nuclear power, however, make it unfeasible for private sector ownership without substantial public subsidies, which are increasingly incompatible with trends to fully privatizing utilities.

Determining the least-cost energy choice is the first of two crucial steps in optimizing energy investment. The second step is securing the capital. The current structure of capital markets, as well as bilateral and multilateral aid programs, may skew the availability of capital for particular energy choices. Government support in the form of Eximbank subsidies, for example, may be available only for coal or nuclear power, no matter what the relative costs of alternatives.

Moreover, the distribution of the cost of reducing externalities may affect the availability of capital. Who would pay for what, in other words, will influence whether or not capital is available at all, regardless of overall least cost. In China, for example, provincial governments and other buyers of coal-fired plants are typically unwilling to invest in coal-scrubbing technologies. Suppliers, on the other hand, will not absorb the costs if it entails curbing profit margins or risking the sale. As a result, investments are made that are relatively more costly than alternatives.

To channel investment toward least-cost projects requires innovative financing mechanisms in both the private and public sectors. Innovative mechanisms might include public-private partnerships, joint implementation strategies, environmental guidelines or codes of conduct, and new ways of packaging deals. For example, the U.S. company AES recently found the Indian government reluctant to install scrubbers in a new coal-fired plant. AES offered to absorb the cost of the scrubbers--if the Indian government would buy another plant. The gain stemming from economies of scale meant that the company still came out ahead. In contrast, China--perhaps for political reasons--has resisted such overtures by Japan.

Notes

1. The RAINS-ASIA study coordinated by the World Bank supplemented by Japanese, Korean and Chinese national studies are the best current sources on acid rain. See G. Carmichael and R. Arndt, "Long Range Transport and Deposition of Sulfur in Asia," Chapter 5 in RAINS-ASIA: An Assessment Model for Acid Rain in Asia, March 1995.

2. See: D. Beg, "Privatization Initiatives in Developing Countries with Particular Reference to the Power Sector," and P. Saint-Andrew, "Cooperation as a Vehicle for Technology Transfer," in J. Gray et al edited, Energy Technology Cooperation for Sustainable Economic Development, University Press of America, Maryland, 1993; M. Hoskote, "Independent Power Projects (IPPs)," Energy Themes, World Bank, May 1995; A. Churchill and R. Saunders, Financing of the Energy Sector in Developing Countries, World Bank Industry and Energy Department, April, 1989; Tadashi Aoyagi, Financing a Sustainable Energy Future for Developing Countries, Mitsubishi Research Institute, paper to US-Japan Perspectives on Sustainable Energy Future, Presidio Energy Workshop, January 19, 1995.

3. See M. Bell, Continuing Industrialisation, Climate Change and International Technology Transfer, Science Policy Research Unit, Sussex University, December 1990, pp. 75-80.

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