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Energy use in Asia-Pacific will grow dramatically over the next decade and indeed, for the next hundred years. As a whole, the Asia-Pacific region (South and East Asia) is expected to use 133 percent more commercial energy in 2010 than it did in 1995. In China alone, electricity-generating capacity is expected to nearly quadruple.

The explosive hunger for energy is prompting structural changes in Asian economies, primarily a move toward greater reliance on domestic, regional and global energy and financial markets to meet energy demand. The transition towards markets will present governments with new policy imperatives--and options. Given the increasing level of globalization, the most powerful policy instruments- -those which shape market incentives--will be those undertaken collectively. Regional cooperation could be crucial in nudging markets toward an energy path which enhances both environmental and supply security.

Moving Towards Markets

Energy demand in Asia is driven primarily by rapid economic growth., as well as demographic factors. By 2025, over 4 billion people will be living in Asia, over half of them living in cities. The recent financial crisis in Asia will slash the projected rate of economic growth by as much as half and with it, energy demand and power sector investment. Nonetheless, the long term economic "fundamentals" point towards sustained industrialization and increased energy use, including within the region's two giants, China and India.

One of the central elements in the energy picture is financing. Annual investments required to meet Asia's power demand over the next decade are projected to be some $600 billion. In Northeast Asia alone (China, Japan, Taiwan, North and South Korea), the investment requirements of the power sector are projected to average $72 billion per year for the next 15 years--a total of $1.8 trillion. The key question is where will the capital come from.

In nearly all of the developing countries of Asia, the power sector is dominated by the central government. Moreover, domestic capital markets are still largely undeveloped. Given the scale of the required capital, multilateral banks such as the World Bank can at best play a brokering role. As a result, Asian governments are making policy changes to allow private Independent Power Producers, both domestic and foreign, to invest in power generation. In China, foreign investment accounted for 18 percent of power sector investment in 1995, up from only 6.4 percent in 1985.

Governments are also turning towards external markets to meet energy supplies. While there are large reserves of coal in China, India, and Southeast Asia (and Australia), a growing demand for oil has created a new and growing dependence on oil imports. Imports accounted for 59 percent of Asia Pacific oil supplies in 1995 and oil import dependence, primarily on the Middle East, will increase to 77 percent by 2010.

Apart from oil, energy supplies in East Asia are met largely via intra- regional markets, including Australia. There is a substantial intra- regional trade in coal and LNG, as well as oil. The primary exporters are Indonesia and Australia and the primary importers are Japan, South Korea and Taiwan. The demand for natural gas is met almost entirely within the region. Excluding China, about two-thirds of coal demand is met by imports and three quarters of imports are supplied within the region.

One Hundred Years of Smoke and Smog?

The expected surge in energy demand in Asia will bring welfare benefits to millions of Asians, as well as to economies throughout the world which will gain export markets. On the other hand, the region's growing hunger for energy resources will create new forms of insecurity. Moreover, given Asia-Pacific's current dependence on fossil fuels, its highly inefficient and technologically backward power sector, and its weak environmental management capacities, a future which resembles the past will rain massive ecological damage on Asia, primarily through acid deposition, and globally, through climate change.

Current energy demand in Asia-Pacific is met overwhelmingly by coal and oil. Natural gas accounts for 9 percent of primary commercial energy consumption, and nuclear and hydro account for 5 and 2 percent respectively. In India, domestic coal accounts for over 55 percent of energy consumption. In China, the world's leading coal producer, coal accounts for a whopping 77 percent of energy consumption. Emissions from coal-fired power plants, especially in China and India, have resulted in widespread acid deposition both within and beyond national borders.

Acid deposition is an especially pressing problem in India and Northeast Asia. In Northeast Asia, under a "business-as-usual" scenario, sulfur dioxide emissions will more than double by 2010 and nearly triple by 2020; emissions of nitrogen oxide will more than triple between 1990 and 2020. Even under a "higher efficiency forecast" scenario, sulfur dioxide emissions would double in the next 30 years.

The impacts of acid deposition are widespread, from modifying the rate of nutrient leaching from soils and biomass; diminish or destroy fish populations; affect soil bacteria and fungi; increase uptake of heavy metals such as cadmium; and exacerbate pre-existing stresses such as pesticide contamination. Initial studies have suggested that the increase in Nox emissions and fertilizer use in Northeast Asia may threaten rice, wheat and corn production.

Northeast Asia is especially vulnerable due to the combination of high deposition and sensitive soils and vegetation. Coal-related emissions also jeopardize human health by causing respiratory problems. By the end of the 1980's, the annual cost of direct acid-rain damage in the worst affected areas of China was estimated to be 16 billion yuan (US $2 billion).

Acid rain is a problem both within and between countries in Asia. In Northeast Asia, sulfur emissions emanating from China deposit acid in Japan, North Korea, South Korea and the Sea of Japan. According to RAINS-Asia, China accounted for some 37 percent of Japan's sulfur deposition and 34 percent of North Korea's in 1990.

In addition to acid rain, Asia's future heavy reliance on coal and oil to fuel energy will produce a large volume of greenhouse gas emissions, especially carbon. In 1992, China was second only to the United States in total carbon dioxide emissions; India was the world's sixth largest emitter. Cumulatively, the U.S. and the European Union are responsible for the lion's share of the stock of carbon dioxide emissions in the atmosphere. The U.S., for example, has generated 4 times more emissions than China and nearly 14 times more than India. In terms of the flow of emissions, however, China will soon emerge as the world's single largest emitter. As whole, Asia's emissions of carbon dioxide will surpass those of OECD countries by 2015.

Besides contributing to greenhouse gases and local pollution, the use and transshipment of oil poses the risk of severe marine pollution arising from supertanker and offshore oil exploration and drilling platform spills. The rate of marine oil spills seems to be increasing and several large spills--the most recent in the Singapore Straits in October--have occurred this year.

Energy and Security

While a large increase in the use of fossil fuels, especially coal, will undermine environmental security, an increased thirst for oil presents another kind of security problem, viz, vulnerability to supply disruption and price volatility. The primary source for crude oil imports is the Middle East. In 1997, 76 percent of total Asia-Pacific crude imports came from the Middle East. By 2005, the Midd-east share is projected to rise to 90 percent.

The growing dependence on Middle East oil may make Asian importers vulnerable to supply disruption and monopolistic pricing. The problem of oil dependence, writes one analyst, "is not that we are about to 'run out' of oil. The problem is that the world's conventional oil resources are concentrated in relatively few countries who are able to manipulate the economic scarcity of oil to their advantage." Moreover, dependence on Mid-east oil may have broad geo-political repercussions, since it will generate a level of interdependence much higher than that prevailing between the Middle East and the West.

Concerns about environmental impacts and supply/price security have prompted interest in other cleaner fuels, especially natural gas, nuclear power and hydro. While growing in absolute terms, the share of oil in electricity generation in Asia Pacific will slip from about 15 percent in 1993 to only about 5 per cent in 2010. The share of nuclear, on the other hand, is projected to increase from 12 to nearly 14 percent, hydro from 15.5 to nearly 17 per cent, and natural gas from about 12 to about 14 percent.

While they would help to reduce air pollution, both nuclear power and hydro generate their own security and environmental problems. For nuclear power, the overriding problems are safety and the potential proliferation of nuclear weapons, especially given the region's undeveloped capacities for spent fuel management and the tack of a regional spent fuel management regime. Japan's proposal to develop closed-cycle plutonium reactors is especially worrying. Large-scale hydropower, on the other hand, often has large social and ecological costs, include large-scale displacement of communities, loss of agricultural, fishing, tourism and other resources, and biodiversity loss.

Given the nexus of source-related environment and security issues, the most attractive energy sources to fuel Asia's energy growth are to increase energy efficiency and switch to natural gas--of which there are substantial reserves in the region--and renewables. The widespread use of natural gas, however, will require a huge investment in infrastructure to transport and distribute--either via pipeline or transmission lines--gas (or gas-fired electricity) from fields in the northern regions of China, Central Asia and the Russian Far East, and Southeast Asia. Given the transboundary nature of the gas fields and especially the pipelines, it will also require a high level of regional cooperation.

The role of renewables is still very small. However, four Asia-Pacific nations--India, Japan, China and Australia--are pursuing renewable resources for electricity generation on a large scale. Moreover, small- scale renewable energy technologies can offer proven and environmentally benign alternatives to grid-based power. In India, less than 40 percent of households are connected to the grid.

Nonetheless, like a shift to natural gas, a major shift towards renewable energy sources is some ways off into the future. In the short to medium term; that is, the next 10-20 years, coal will continue to dominate the Asian region and the short term policy imperatives will revolve around ways to make the use of coal cleaner and more efficient and to substitute cleaner fuels for coal and oil as much as possible. The deeper dilemma entailed in finding environmentally sustainable, secure and politically sound alternatives to coal and oil energy can be solved only in the medium to long term..

A Regional Energy Vision?

The anticipated explosion in energy demand in Asia poses dilemmas for policy makers. It will be a challenge simply to meet the demand at all--to mobilize the required to finance and channel it into well- managed and efficient power projects. The deeper challenge is to meet the demand in ways which at once promote environmental health and security, enhance supply security, and encourage (or at least do not undermine) prospects for peace. In other words, if it is not to create new sets of intractable problems, energy planning must be based on integrating security and

environmental, as well as economic objectives. Given the past large societal investment in (dirty) coal and imported oil (and nuclear power, especially in Japan), and the long lead times required to develop and disseminate alternatives, this challenge can fully be met only over the long term--perhaps 50-100 years.

The crucial and central policy imperative is to define overarching, integrated objectives for the development path of the energy sector. In other words, the bedrock for energy policy and planning should be the embrace of a long term vision. The heart of such a scenario should be to end dependence on fossil fuels by shifting to renewable forms of energy.

Guided by a long term "Fossil Free Future scenario, an ensemble of policy initiatives can. be designed which fulfill short and medium term energy sector objectives while at the same time promoting a transition to renewables. Given the shift towards market forces throughout the region, policy instruments and initiatives must be designed which appropriately and effectively enhance the role of market forces themselves.

Regionally coordinated policy initiatives could include: 1) better energy pricing, especially by removing energy subsidies; 2) raising and harmonizing energy efficiency standards; 3) developing innovative financing instruments to cover technological risk associated with new cleaner technologies; 4) improving ecological information systems and monitoring, including the development of standardized data bases and performance indicators. In addition, countries could cooperate in creating or expanding the voices of scientists, the private sector and citizen groups in regional fora, such as the APEC's Regional Energy Cooperation Working Group.

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