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Activists protest a hike in gasoline and diesel prices in Jammu, India. Economic and political sensitivity to energy prices contribute to a policy dilemma in Asia and the Pacific.
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Energy security—defined as access to reliable, affordable, and environmentally sustainable energy supplies—is a top priority throughout Asia and the Pacific. Escalating demand for energy in the face of supply constraints, growing concern about the environment, economic and political sensitivity to energy prices, and over-dependence on oil from the Middle East—all of these developments have greatly increased the stakes for policymakers in recent years. Today, the Asia-Pacific region faces an energy-security dilemma of unprecedented dimensions (see Energy Insecurity Index). What can the region’s policymakers do to increase energy security in their countries?

Full energy security is an elusive goal. Very few countries in the world have sufficient energy supplies to meet all conceivable demand. In Asia and the Pacific, only tiny Brunei Darussalam is truly independent in terms of energy. Every other country in the region is dependent on international energy markets. This dependence is particularly troubling because many of the factors that might create an international energy crisis—such as a political upheaval in the Middle East—cannot be controlled or even significantly influenced by countries in the region.

Given this situation, business as usual is not an option. The global energy markets have changed in a spectacular fashion, and these changes are irreversible. The prices of oil and natural gas have moved to a new plateau, and it is now recognized that the global supply of oil will reach its maximum limit within a decade, given both policy and resource constraints.

The world’s number-one consumer, the United States, continues to consume more and more of the world’s oil and natural-gas resources. At the same time, emerging economies, such as China and India, are in a race to secure access to the energy they need for economic development. And the impact of alternative energy technologies will be limited, at least for the next decade or two. Policymakers must pursue innovative, or even sometimes radical, programs and policies to survive in the new global energy environment.

Asia-Pacific countries, and the region as a whole, must address the problem of energy security by taking forceful policy actions that in the short-to-medium term will hedge against supply interruptions and price volatility and in the medium-to-long term will improve the relationship between supply and demand, ultimately through exploiting and developing new energy sources. And this must be done in the context of improving environmental sustainability. We propose a series of steps in each of these three areas.

Policies that protect against price volatility and supply breakdowns

Price fluctuations have been, and will continue to be, an important characteristic of the world oil market. Sudden increases in oil prices, known as price shocks, can have a severe effect on national economies, especially in countries that are heavily dependent on imported oil. As their import needs rise, countries in Asia and the Pacific will be increasingly vulnerable to oil price volatility. The fact that oil is bought and sold in U.S. dollars exacerbates the risk when a country's currency is devalued vis-à-vis the dollar. Policies designed to avoid or lessen the effects of market disruptions include building strategic stockpiles, developing a regional futures market for oil and natural gas, improving regional cooperation, and mitigating the domestic impacts of short-term market instability.

1. Build up strategic oil stocks. One of the most obvious approaches to help ensure energy supplies in the Asia-Pacific region is to develop or augment strategic fuel stocks. As members of the Organization for Economic Cooperation and Development's International Energy Agency (OECD/IEA), Japan, the Republic of Korea (South Korea), Australia, and New Zealand maintain mandatory stocks of oil equivalent to at least 90 days of net oil imports. Japan currently holds national strategic oil stocks equivalent to about 92 days of consumption, managed by the state-owned Japan Oil, Gas, and Metals National Corporation (JOGMEC). In addition, the Japanese government requires private companies to hold stocks of crude oil and petroleum products equivalent to about 80 days of consumption.

Although not an OECD/IEA member, Taiwan is also relatively well prepared for potential supply disruptions. The Taiwanese government requires both the state-owned CPC Taiwan and the privately owned Formosa Petrochemical Corporation (FPC) to maintain stocks equivalent to at least 60 days of anticipated sales.

As a regional refining center and oil-trading hub, Singapore has large commercial stocks on hand at any given time. In addition, the Singapore government requires its three state-owned power companies to maintain oil stocks equivalent to 90 days of consumption.

Thailand requires domestic suppliers to keep an inventory equivalent to at least 5 percent of annual petroleum-product sales, equivalent to 18 days of consumption. In addition, the Thai government is planning to start maintaining strategic oil stocks.

Other countries are much more exposed to supply shortages. China just started a government stockpiling program. Until recently, India maintained commercial stocks equal to only 15 days of consumption, with no government stocks.

In 2004, China began constructing storage facilities for oil stocks at four sites. One has been completed, and the other three are scheduled for completion by

2007 or 2008. Under Phase I of the plan, China will hold 100 million barrels of strategic oil stocks by 2008, which is equivalent to more than 30 days of net oil imports at the 2005 level. India is also planning to establish strategic stocks. Initially, the Indian government's plan calls for holding at least 35 million barrels of strategic oil stocks before 2010, equivalent to about 20 days of India's net oil imports in 2005.

In planning the development of strategic oil stocks, policymakers need to make decisions in several important areas. For one thing, these facilities are expensive to build, and many countries simply cannot afford them on their own. The high costs involved suggest the value of international assistance or cooperation among neighboring countries.

Once financing has been obtained, policymakers must choose an appropriate site and ensure the safety of oil stocks, which may remain unused for many years. Other policy decisions include the timing of oil purchases to build up stocks, the organizational structure of the stockpiling system, the optimum size of stocks, and decision criteria and mechanisms for releasing stocks onto the market. Policymakers throughout the Asia-Pacific region need to tackle these issues and move toward the OECD/IEA standard of maintaining stocks equivalent to 90 days of net oil imports.

2. Establish a regional futures market for oil and natural gas. The United States and Europe have had futures markets for oil and natural gas for decades, but efforts to launch an international futures market in the Asia-Pacific region have failed up until now. A local futures market in Japan—the Tokyo Commodity Exchange (TOCOM)—has been modestly successful, but only for Japanese consumers and suppliers.

The two existing international markets in oil futures—the International Petroleum Exchange (IPE) in London and the New York Mercantile Exchange (NYMEX)—play a critical role in the global oil trade. In the United States and Europe, the volume of oil futures (“paper contracts”) amounts to about 300 million barrels per day (b/d). This volume of trade, which includes contracts for oil to be delivered up to five years in the future, is substantially larger than the trade in physical crude oil, which ranges from about 40 to 45 million b/d. The constant turnover of futures contracts leads to better price clarity for both buyers and sellers. In addition, the use of financial tools, such as options and derivatives, has brought a great deal of transparency to the market and has allowed both buyers and sellers to hedge their risks.

Buyers and sellers in Asia and the Pacific cannot easily use the oil futures markets in the United States or Europe because they are, in effect, trading a different commodity—Dubai crude—rather than West Texas Intermediate (WTI) or Brent crude. Although it is possible to use any futures market to mitigate risk, traders in Asia and the Pacific have been reluctant to use the American or European futures markets to hedge their positions because direct linkages are

difficult to establish. This disconnect between global oil markets at times allows sellers to charge higher prices to customers in the Asia-Pacific region.

Without an oil futures market, companies and governments in the Asia-Pacific region have been more dependent than their counterparts in other parts of the world on physical (as opposed to paper) trade and informal mechanisms such as over-the-counter swaps. The physical trade in Dubai crude is very small, at 120,000 b/d, which limits price transparency, while the over-the-counter swap market lacks the security features provided by a futures exchange.

A promising new development, the Dubai Mercantile Exchange (DME), opened in 2006. With 50-percent ownership by NYMEX, the DME is the first energy futures exchange in the Middle East. In addition, the Dubai Metals and Commodities Centre (DMCC) began trading fuel-oil futures toward the end of 2006. Starting with a regional futures market for Dubai/Oman crude and fuel oil, these exchanges may eventually provide a market for other energy commodities.

It is not yet certain whether these two new initiatives will succeed, but they merit strong support from consumers in the Asia-Pacific region. In addition to improving market transparency and reducing risk, a futures market in Dubai crude will allow traders to buy and sell differentials between the three benchmark crudes, providing a natural and permanent linkage between markets and integrating the Asia-Pacific region into the global system. Governments in the region need to encourage their state and private companies to use these new exchanges.

3. *Strengthen regional cooperation.* Cooperation among countries/economies in the region can play an important role in countering the potential for unproductive competition over scarce energy resources. Many proposals have been made in recent years to enhance regional cooperation, often involving joint investments outside the region or joint development of infrastructure such as pipelines, ports, and processing facilities.

Members of the Association of Southeast Asian Nations (ASEAN) signed the ASEAN Petroleum Security Agreement (APSA) in 1986, which calls for oil-producing members to increase their exports to member countries that face oil shortages. ASEAN members include four oil producers and exporters—Brunei, Indonesia, Malaysia, and Vietnam—and one major petroleum-product exporter—Singapore. The five other members are oil importers—Cambodia, Lao People's Democratic Republic (Laos), Myanmar, the Philippines, and Thailand. The 1986 agreement also calls on oil-importing countries to increase their imports from any exporting members that face a situation of oversupply.

In fact, the measures laid out under APSA have never been invoked. It will be even more difficult to invoke the agreement in the future than it has been in the past because, with production flat and domestic consumption rising, the oil-producing countries in ASEAN have less and less crude oil available for export.

A more practical alternative would be to coordinate the maintenance of

HOW DOES A FUTURES MARKET WORK?

Traders buy and sell oil futures at the New York Mercantile Exchange (NYMEX). Without a regional futures market for oil, companies and governments in Asia and the Pacific face higher prices and greater risks than their counterparts in Europe or the United States. © Daniel Acker/Bloomberg News/Landov



A futures contract represents a commitment by a buyer and a seller to the future exchange of a commodity—such as oil or natural gas—for cash. Each contract specifies the type and grade of commodity to be exchanged, the amount, the price, and the time and place at which it will be delivered.

Futures contracts may be bought and sold many times before the specified delivery date of the actual commodity. And the value of a futures contract goes up and down—above or below the price at which the trade was initiated—depending on market expectations. If the market is functioning well, short-term futures prices and spot prices (for immediate delivery) tend to converge, as they do on the New York and London exchanges.

Two important functions of a futures market are to assure that contracts are standardized and to provide “price discovery,” making prices known to buyers and sellers at any time. In providing price transparency, a futures market

improves energy security by helping buyers and sellers detect market signals instantaneously. Speculative signals will have short-term impacts, but futures markets are able to perform well in the longer term.

In a futures market, both the buyers and sellers of a commodity—as well as speculators, who have no intention of taking physical delivery—can buy and sell futures contracts to “hedge,” or transfer risk against adverse price fluctuations. By trading in futures, participants in the market will gain or lose smaller amounts of money than if they were simply buying commodities outright. They can also buy or sell at any time, taking advantage of favorable price fluctuations, and transaction costs are relatively low.

The exchange itself acts as a clearinghouse, functioning as a counterparty in every trade. When a futures contract changes hands, it is the clearinghouse that collects and disburses funds, protecting traders from the risk that a buyer or seller will default.

emergency stockpiles among countries in the region. The Asia-Pacific Economic Cooperation (APEC) group met at the East-West Center in August 2005 to discuss options for joint oil stockpiling and related cooperation. Members of APEC are Australia, Brunei, Canada, Chile, China, Hong Kong Special Administrative Region (SAR), Indonesia, Japan, South Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Philippines, Russia, Singapore, Taiwan, Thailand, the United States, and Vietnam.

The expansion and regional coordination of oil stocks is an important policy priority given the ever-increasing volume of oil imported into the region. National stocks could be held within a country's borders or offshore in jointly owned storage facilities. In either case, the initial financial requirements for constructing storage facilities and building up stocks could be substantial. The benefits of a coordinated effort may justify establishing a mechanism for more-affluent countries in the region to provide some initial financial assistance to their less-affluent neighbors.

APEC's Energy Working Group has considered joint projects to enhance energy security, but up until now action has been limited to conducting studies, and discussions have been on a project-by-project basis rather than aiming toward a comprehensive cooperative agreement. China, Japan, and South Korea have also discussed possible cooperative activities, and these three Northeast-Asian countries have held discussions with members of ASEAN. One potential area of cooperation is through collective bargaining to obtain lower prices and better terms on crude-oil imports from the Middle East. This concept has been discussed widely in Northeast Asia Petroleum Forums and meetings between ASEAN members and the three Northeast-Asian countries (ASEAN+3), but no collective-bargaining arrangement has yet been formulated because of concerns about a negative response from oil-exporting nations.

Although there are clear benefits to regional cooperation in the energy sector, there are also challenges. In recent years, there has been a gradual change in attitude, with countries in the region seeking closer ties not with each other, but with oil-producing nations in the Middle East and elsewhere. The rise of China as a growing oil importer has caused uneasiness among other oil importers in the region, particularly Japan.

Regional cooperation is also hampered by market restrictions. With countries in the region pursuing varying degrees of market deregulation, differences in domestic pricing policies and quality specifications for refined petroleum products have created a level of market segmentation that inhibits bilateral and multi-lateral trade. Despite the obvious benefits, there has not yet been any effort to coordinate product standards throughout the region.

Domestic politics and international tensions between countries pose additional barriers. Tensions between India and Pakistan, for example, have blocked development of a natural-gas pipeline from the Middle East through Pakistan to India. Similarly, internal politics in Bangladesh have made it difficult for India

and Bangladesh to take advantage of cost-effective and mutually beneficial trade in natural gas.

Two steps are recommended for immediate action to increase regional cooperation in the energy sector: (1) develop joint oil stocks with financial assistance from Western nations; and (2) harmonize quality standards for petroleum products to facilitate interregional trade.

4. Mitigate the domestic impacts of short-term market instability. It is not easy for any government to come up with policies that deal effectively with disruptions in energy markets. If a short-term disruption rises to the level of a supply emergency, a government may consider releasing strategic stocks or calling for international assistance.

If the disruption takes the form of a price spike, the best approach is generally to leave price determination to the market and to concentrate on ensuring that market mechanisms are fully functional and that physical supplies are not disrupted. In some cases, policymakers may consider a managed price linkage, in which domestic prices are managed administratively but changes in international prices are reflected, at least partially, in the domestic market. Alternatively, a government may choose to provide direct subsidies to domestic energy suppliers or consumers, rather than imposing price or production controls administratively. Any administrative measure taken by a government to reduce the impact of high international prices should be temporary and should be replaced as soon as possible by long-term policies that allow market forces to determine the price of energy.

Policies that improve the relationship between supply and demand

Recognizing the importance of energy for economic growth, most Asia-Pacific governments place a high priority on ensuring adequate energy supplies. Oil and utility companies in Japan, South Korea, China, and India are scouring the world looking for new sources of oil and natural gas. Exploration for new energy sources and investment in production, refining, and transportation facilities may increase available supplies, at least in the short term. Other efforts—such as competition for long-term contracts with existing suppliers—may help individual companies or countries secure supplies but have little impact on supply and demand in the region as a whole. Some actions even serve to bid up prices without necessarily having much impact on supply.

Our second set of recommendations, therefore, is directed toward the development of clear and effective policies to increase energy supplies and to improve energy efficiency in order to slow down the growth of demand. Policies are needed in six areas.

1. Initiate joint ventures with energy producers. Over the years, a number of governments and private companies in Asia and the Pacific have invested in oil

exploration and production enterprises outside the region. China, India, and Malaysia have made considerable effort to get a foothold in exploration projects in the Middle East. India's overseas push is led by the Oil and Natural Gas Corporation (ONGC). In China, the China National Petroleum Corporation (CNPC) is leading the effort, but other state oil companies are also involved.

Conversely, governments and companies from oil-producing regions have invested in refining and marketing enterprises in Asia and the Pacific. The Saudi Arabian state oil company Aramco, for example, has substantial investments in Asia-Pacific refining operations. Such joint investments have created equity partnerships that foster reliable flows of oil, enhancing energy security for Asian and Pacific consumers and revenue security for producers.

Joint projects could be expanded to include construction or expansion of oil-storage facilities. Middle-Eastern companies possess substantial oil-storage facilities in Europe and the Caribbean but none in Asia or the Pacific, despite the high volume of oil exported to the region. Atlantic-Basin oil producers might find regional storage facilities particularly beneficial to save on transport costs through economies of scale. The Norwegian company Statoil, for example, shares storage space for crude oil in South Korea under a cooperative arrangement with the state-run Korea National Oil Corporation (KNOC).

As a priority, joint ventures are recommended in four areas: (1) exploration and production projects; (2) refineries and retail operations in the Asia-Pacific region in cooperation with key oil producers; (3) shared storage facilities; and (4) joint infrastructure such as pipelines, ports, and terminals.

2. Reduce transportation bottlenecks. More than 90 percent of the crude oil imported into the Asia-Pacific region is shipped by sea tanker passing through the Malacca Strait (Figure 6.1). As this sea-lane—which is only 30 miles wide at its narrowest point—becomes more crowded, increased risks of accidents, piracy, or terrorist attack raise the possibility of a supply disruption. Indeed, the Malacca Strait is the Achilles heel of oil supply to East Asia and the Pacific. If the Strait had to be closed for any reason, ships would be diverted to a much longer route, dramatically increasing transport costs.

Because the Asia-Pacific region is so fragmented geographically and because oil resources are distributed so unevenly across the region, the potential for transporting oil by pipeline is extremely limited. At present, there are no pipelines bringing oil into the region. The only current alternative to oil shipped by sea tanker is a limited supply transported by railway from Russia and Kazakhstan to China. The one international oil pipeline currently under construction—from Kazakhstan to western China—will, at its maximum capacity, supply less than 10 percent of China's projected oil imports. Plans to supply oil by pipeline from Russia to Northeast Asia have been delayed by high costs and geopolitical barriers.

The dominance of Middle-Eastern oil and of sea-lane transportation is unlikely to change in the foreseeable future. Nevertheless, future development of

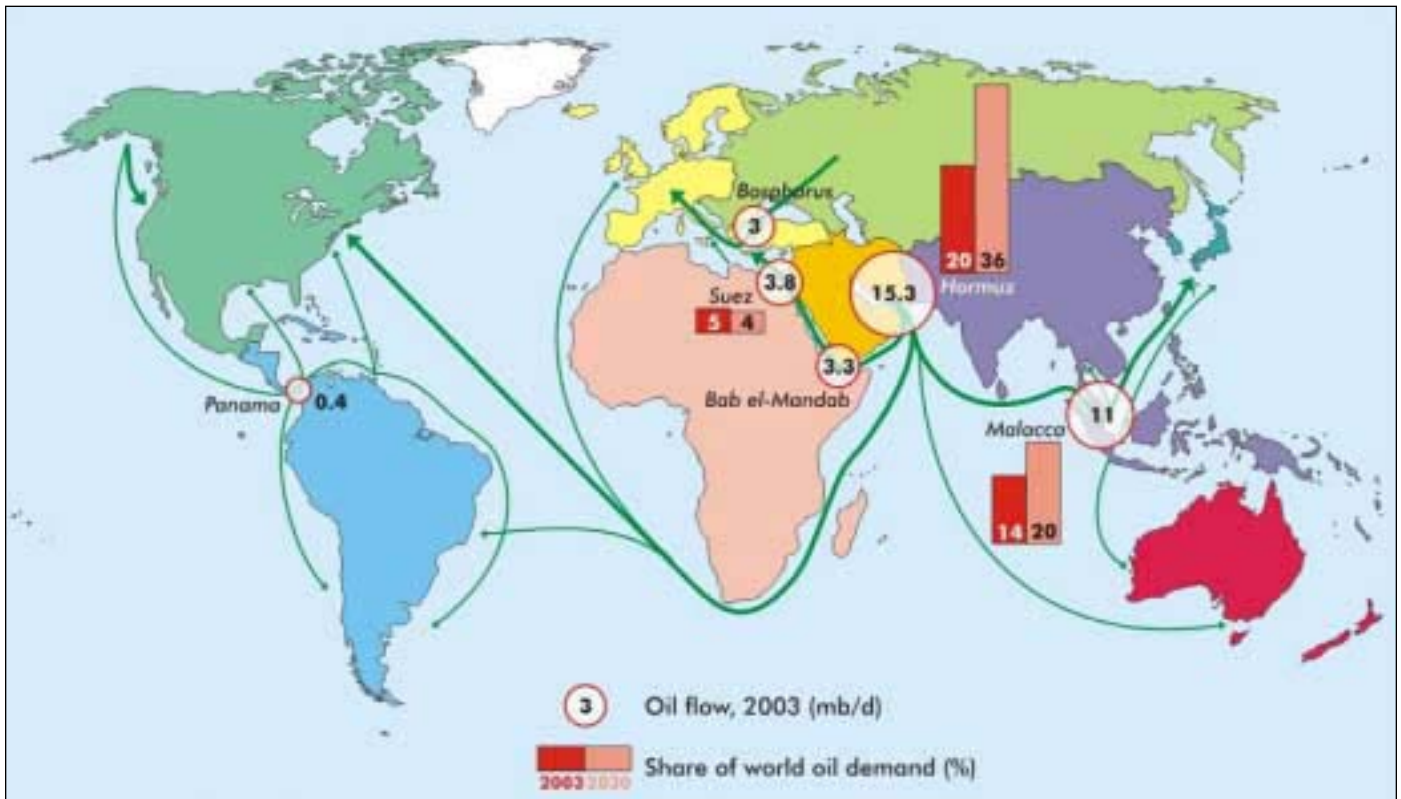


Figure 6.1. Maritime oil flows and major chokepoints, 2003 (million barrels per day: b/d), and share of world oil demand, 2003 and 2030 (percent)

Source: OECD/IEA (2004). [World energy outlook © OECD/IEA, 2004, Figure 3.25, p. 120].

oil pipelines will help China, Japan, and other Asia-Pacific nations diversify their sources of supply to some extent.

Pipelines and ports must be built based on economic considerations and not just political or security concerns. In our view, the most effective channel for exploring and assessing the possibilities would be through the creation of a multinational taskforce in the region to: (1) study alternative sea routes and improve security in the Malacca Strait through joint patrols; and (2) study potential pipeline routes, involving the private sector to assure that economic considerations receive priority.

3. Limit energy consumption through conservation measures. Energy conservation—through more efficient energy use—offers one of the most effective means to slow down the growth in energy demand and thus improve the balance between demand and supply. Current levels of energy efficiency vary widely throughout the region, but every country/economy in Asia and the Pacific could benefit from improved energy efficiency through new policies and technologies.

Indeed, energy conservation is a top priority in the region, particularly for China, India, and other rapidly developing economies. Today, the Chinese and

Indian economies are among the least energy efficient in the region—measured in terms of the amount of energy consumed per unit of Gross Domestic Product (GDP) (Figure 6.2).

The Chinese government introduced an energy-conservation law in 1998 and initiated a Special Program on Mid- to Long-Term Energy Conservation in November 2004. The program identified 10 areas in which energy-conservation projects would be implemented (Hai 2005). The target is to save 1.43 billion barrels of oil equivalent (boe) of energy over a five-year period from 2006 to 2010, equivalent to nearly 800,000 barrels of oil equivalent per day (boe/d). Recent conservation policies have included a modest increase in gasoline and diesel prices.

India has not yet introduced far-reaching energy-conservation measures, but Indian policymakers are coming to recognize the cost of inefficient energy use (EIA 2004). As in China, savings from improved energy efficiency could be substantial. Indonesia, Malaysia, Pakistan, Thailand, and Vietnam also have a long way to go toward improving energy efficiency.

By contrast, Japan is one of the world's most efficient energy users, thanks to strict energy-conservation policies. In addition, two Japanese companies, Honda and Toyota, are world leaders in the development of fuel-saving technologies for the transportation sector. Today, hybrid automobiles developed in Japan are contributing to better energy efficiency everywhere in the world—including the United States.

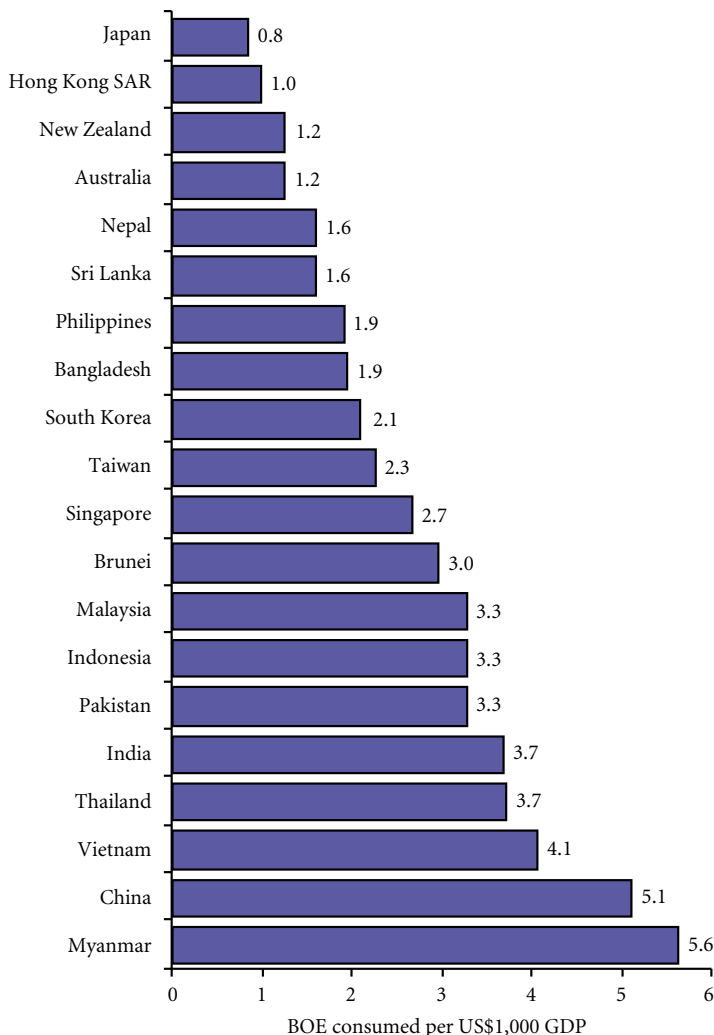
Australia and New Zealand also have comprehensive energy-conservation laws and government agencies responsible for implementation. Taiwan and South Korea are in an intermediate position, using energy somewhat more efficiently than the developing and newly industrialized economies in the region.

Asian and Pacific governments can take several steps to conserve energy by limiting consumption. Indeed, policies to manage energy demand should be given equal—or even higher—priority, compared with policies to ensure supplies and diversify sources of energy.

Excessive energy consumption can be curbed by reducing inappropriate government intervention, removing price distortions, and allowing market prices to reflect the true cost of energy. Policymakers need to continue the current trend toward market reform until energy prices are determined entirely by free-market forces. Tax benefits and incentives should be designed to encourage the use of energy-saving goods and services, such as hybrid automobiles, and to support increased use of renewable energy. In addition to these “carrots,” policymakers will need to introduce “sticks” such as higher taxes on excessive energy consumption and higher mandatory standards for automobile fuel efficiency.

4. *Improve the efficiency of energy markets.* Many governments in Asia and the Pacific have intervened in energy markets to achieve specific policy goals. Some of these interventions have tended to reduce market efficiency, however. After decades of experience with different types of market interventions and regula-

Figure 6.2. Energy intensity of economic activity in selected Asia-Pacific countries/economies, 2005: Barrels of oil equivalent (boe) used per US\$1,000 of Gross Domestic Product (GDP), based on exchange rates



Source: Compiled by authors.

tions, policymakers in the region are coming to realize that energy security—defined as an uninterrupted supply of energy at the lowest possible cost—can be achieved through the efficient operation of market forces. Since the mid-1990s, Asian and Pacific policymakers have witnessed the negative consequences of excessive market regulation and are adopting measures to liberalize energy markets.

In the past, many countries enacted policies to favor and protect domestic energy suppliers. This does not create a problem if local suppliers can provide energy at the lowest available cost. A problem arises, however, if domestic energy is more expensive than energy from sources available on the international market. In such a situation, a country may decide to subsidize the domestic source, which imposes a cost on taxpayers (who are also typically consumers), or to restrict or tax imports, which imposes higher prices on consumers directly.

In addition to supporting local energy suppliers, subsidies may be created to help a local industry (such as agriculture) or population group (such as the

urban poor). The Indian government, for example, taxes gasoline and diesel in order to subsidize the price of kerosene and liquefied petroleum gas (LPG), which are widely used for cooking by the urban poor and middle classes.

In such situations, deregulating energy markets is likely to be disruptive to specific industries or segments of society. Largely for this reason, energy deregulation in countries around the region has moved in stops and starts. As a result, there is wide variation in national policies and regulations that affect the energy industry.

In the oil industry, differences in the regulatory environment have led to increasing refining capacity in some countries/economies and refinery closures in others. Some governments protect refiners by imposing high import tariffs on petroleum products compared with low tariffs on crude oil. In such a situation, refiners can charge high prices in the domestic market, thus artificially increasing their profit margins. Refiners operating in such an environment will tend to increase their capacity even though the domestic market has been adequately supplied. They will direct their surplus production toward the export market, depressing international market prices and lowering profit margins for refiners in other countries.

India, China, Japan, South Korea, and Taiwan all provide substantial tariff protection to their refiners. Tariff protection in India, in particular, has led to excess refining capacity, resulting in large exports of petroleum products. These exports have tended to depress the profitability of refinery operations in other countries of the region. Because the price of petroleum products is largely based on the international price of crude oil, consumers have not seen a drop in prices, however.

In recent years, domestic energy markets—the power sector in particular—have undergone some degree of deregulation in most countries of the region. Deregulation generally entails promoting competition by allowing more private-sector involvement, aligning domestic prices with international market prices, and phasing out government-owned monopolies. Among other advantages, deregulation promotes more efficient energy use and helps send clear market signals regarding the relative scarcity of competing fuels. Steps to improve market efficiency also include better exchange of information and coordination of product standards to facilitate trade (Fesharaki and Brown 2003).

Oil markets in Australia, New Zealand, Singapore, and Thailand have been fully deregulated for some time (Table 6.1). Markets in South Korea and the Philippines were fully deregulated relatively recently. In other countries/economies, some kind of effective protection remains, such as high import tariffs, restrictions on imports and/or exports, regulations that hinder new entrants into the market, or government interventions to set domestic prices.

Since joining the World Trade Organization (WTO) in 2001, the Chinese have begun opening their oil and other energy markets to foreign investors, while still attempting to assure the central role of their state oil companies. In

**Table 6.1. Qualitative assessment of oil-sector deregulation:
Selected Asia-Pacific countries/economies and the United States**

Country/ economy	Tariff differential: Petroleum products vs. crude oil	Level of government involvement	Refining capacity management criteria	Entry of new players into the market	Years to complete deregulation
Australia	~0%	Low	Economic	Easy	1 (1988–1989)
China	6–9%	High	Government administered	Very difficult	2002–?
India	7–8%	High	Maximum utility	Very difficult	2001–?
Indonesia	5%	High	Government administered ^a	Very difficult	2001–? ^b
Japan	0–10%	Medium	Economic/ market share	Difficult	10 (1987–1997)
Malaysia	US\$1/barrel tax break on domestic crude	Medium	Economic	Somewhat difficult	1985–?
Philippines	0%	Low in theory	Economic	Very easy	1 (1996–1997)
Republic of Korea	2%	Low	Economic/ market share	Possible but difficult	8 (1991–1999)
Taiwan	7–8%	Medium	Economic/ maximum utility	Difficult	7 (1995–2002)
Thailand	~0%	Low	Economic	Easy	3 (1991–1994)
United States	US\$0.0000– 0.0053/liter	Low	Purely economic	Easy	<1 (1980)

Source: Compiled by authors.

^a Market reform in progress.

^b Reform has been delayed.

Japan and Taiwan, oil imports are fully deregulated in principle, but restrictions are still in place that hinder participation by companies that are not refiners. Indonesia has recently passed legislation opening the domestic market, but the government faces a political dilemma: how to phase out price subsidies that are popular with consumers. Despite fairly large price increases in March 2005, the domestic market is still heavily subsidized. In Malaysia, the wholesale market for petroleum products is open and competitive, but the government regulates retail prices and limits the number of companies that can participate in the retail market. In 2006, the Malaysian government reduced subsidies and allowed retail prices to rise sharply.

Several countries have expressed an interest in moving toward a more open oil market—sometimes in response to outside pressure—but are still heavily regulated. In China and India, barriers to entry into the market are in place, domestic refiners are protected, and both governments intervene in pricing.

There is no consistent pattern in the relationship between a country's level of economic development and deregulation of oil, natural-gas, and other energy markets. For instance, among the high-income nations of the region, Australia is fully deregulated, but Japan is still in transition. In Thailand, a country at a much lower level of economic development, the oil industry has been fully deregulated for some time.

In fact, there is often a conflict of interest between state energy companies that enjoy a monopoly and economists who favor a quick move toward an open market. This is one area where policymakers in Asia and the Pacific need to move decisively and accept the political consequences of reform. Current half-hearted attempts need to expand to a full-fledged move toward free energy markets throughout the region.

5. Increase domestic energy supplies. Increasing domestic energy production is a top priority for virtually every country in the Asia-Pacific region. This includes countries that already produce substantial amounts of energy—Australia, Brunei, China, India, Indonesia, Malaysia, and Vietnam—as well as countries/economies that produce relatively little—Japan, the Philippines, South Korea, Taiwan, and Thailand.

High international prices since 2004 have provided particularly strong incentives for countries in the region to produce more oil and natural gas. As a result, oil production in Asia and the Pacific actually increased in 2004 and again in 2005, defying earlier predictions that production would decline. Given the region's limited reserves, however, oil production cannot continue increasing over the long term.

Even countries with few resources have managed to boost domestic energy production to some extent. Thailand, for example, only began producing oil in 1980, and up to 1990 Thai oil production was less than 60,000 b/d. Since then, production has more than doubled—to about 150,000 b/d in 2005. This level of production was achieved as a result of offshore exploration in the Gulf of Thailand, partly in cooperation with Malaysia. Similarly, the Philippines will start producing natural gas once the sizable offshore Malampaya field is developed. Even Japan and Taiwan maintain small levels of domestic oil production.

In several countries/economies of the region, there are good prospects for supplementing domestic energy supplies with nuclear power. Japan, South Korea, and Taiwan already produce nuclear energy to meet a significant proportion of their electricity needs. The Japanese government plans to increase the use of nuclear power to help reduce carbon-dioxide emissions as called for under the Kyoto Protocol. South Korea has plans to construct additional nuclear

plants, and even in Taiwan—where the ruling Democratic Progressive Party has used opposition to nuclear power as a plank in its political platform—a new nuclear plant is being built, albeit with significant delays. China and, to a lesser extent, India also have ambitious programs to build additional nuclear-power capacity over the next 10 to 15 years.

To increase domestic energy production, it is recommended that governments in the region: (1) provide better terms and conditions for exploration and development of energy sources, including tax holidays, lower government royalties, a streamlined permitting process, and less red tape; and (2) increase financial assistance for the development of infrastructure.

6. Develop innovative energy sources. Although the potential for increasing oil and natural-gas production is limited, several innovative energy sources may contribute to future energy security in Asia and the Pacific. Many countries in the region have large biomass resources, including fuelwood and agricultural and animal wastes. Small-scale projects in several countries focus on improving the efficiency and environmental impact of biomass fuels used in households or to generate electricity on a small scale. Projects in China, for example, focus on power generation from biomass, marsh gas, and other sources (Li, Shi, and Ma 2006). Biomass projects are also ongoing in India and Vietnam. In New Zealand, tree plantations are being used for power generation.

China, India, Japan, and New Zealand are also interested in developing ethanol and other biofuels, produced from waste products or agricultural crops. These can partially substitute for oil in the transportation sector. Japan has recently introduced biofuels into the market, and use is expected to increase as supplies become available. The Chinese are currently building two large plants to produce ethanol. Current biofuel production in China is only a little more than 1,000 boe/d, but the goal is to increase production capacity to more than 20,000 boe/d.

Natural gas can be produced from methane that is present in most coal deposits, including those in several Asia-Pacific countries. Coal-bed methane accounts for 10 percent of total natural-gas production in the United States, but it has never been produced commercially in the Asia-Pacific region. Extracting coal-bed methane is expensive, and methane cannot be extracted from coal in every situation. The Chinese are currently exploring their coal-bed methane resources and developing production capacity. They should be producing coal-bed methane commercially by the end of this decade.

India has taken the lead in the development of wind power, supported by substantial government tax incentives. As of September 2005, India had the largest wind-power capacity of any developing country in the world, with installed capacity of 4,228 megawatts (MW). This represented 3 percent of India's total capacity to generate electricity. China had only 1,268 MW of installed capacity, but the Chinese are currently constructing a 1,000-MW wind-power

facility in Inner Mongolia at a cost of US\$1.2 billion. The Chinese government has ambitious plans to increase installed wind-power capacity to 5,000 MW by 2010. This would represent 0.2 percent of China's capacity for electricity generation. Australia, Japan, New Zealand, and South Korea also generate electricity from wind power, but the share in overall power generation is very small.

Australia, China, Japan, New Zealand, and South Korea all make limited use of solar energy. In addition, Australia, China, Indonesia, Japan, and New Zealand use geothermal energy, most frequently associated with volcanic or natural steam outlets.

Other innovative energy sources are being developed outside the region that may eventually be of benefit in Asia and the Pacific. These include non-conventional sources of oil—bitumen and oil sands—which can be mined and converted to heavy or synthetic oil. In Asia and the Pacific, Australia, India, and Indonesia have some potential heavy-oil resources (OECD/IEA 2005). China and Australia also possess oil shale that could potentially be mined and processed to produce oil. It is too soon to tell whether these resources will ever be commercially viable, however, given the high cost of extraction and processing.

In addition, there is speculation that the sea beds around Australia, Japan, and New Zealand contain rich resources of methane hydrates, formed when methane mixes with water under specific conditions. Commercial use is a prospect for the distant future, however (OECD/IEA 2005).

Finally, ongoing research to develop hydrogen fuel cells could be of great benefit to countries in Asia and the Pacific. In the long run, hydrogen and nuclear power offer the potential of a virtually infinite supply of energy. Hydrogen power offers a great deal more flexibility than nuclear power and has little or no effect on the environment, but considerable technological advance will be necessary before hydrogen power becomes commercially viable (Salameh 2004).

*Policies that improve environmental sustainability*_____

Early thinking about energy security was so heavily influenced by fears of supply interruption that environmental concerns received little attention. By the late 1980s, however, a rising dependence on fossil fuels and a new awareness of their role in air pollution and global warming made environmental protection and sustainable development key concepts in the debate on energy security.

Since the late 1990s, every major country in Asia and the Pacific has moved to some extent to tighten emission standards for fuels used in transportation, industry, and power generation. One example is the trend toward stricter limits on the sulfur content of high-speed and automotive diesel (Table 6.2). This policy trend is particularly important because the number of motor vehicles in most Asian countries is projected to more than double between 2005 and 2015.

As the process is ongoing, current regulations on emission standards vary

Table 6.2. Maximum allowable sulfur content in high-speed and automotive diesel, selected countries/economies in the Asia-Pacific region (parts per million: ppm)

Country/ economy	1998	2001	2002	2003	2004	2005
Australia	5,000	500–5,000	500–5,000	500	500	500
China ^a	2,000–5,000	500–2,000	500–2,000	500–2,000	500–2,000	350–500
India ^b	5,000	2,500	2,500	2,500	2,500	350–500
Indonesia ^c	5,000	5,000	5,000	5,000	5,000	5,000
Japan ^d	500	500	500	50	50	50
Malaysia	3,000	1,000	1,000	500	500	500
New Zealand	3,000	1,000	1,000	1,000	1,000	500
Pakistan	10,000	5,000	5,000	5,000	5,000	5,000
Philippines	5,000	2,000	2,000	2,000	500	500
Singapore	3,000	500	2,000	500	500	500
South Korea	500	500	500	430	430	430
Taiwan	500	500	350	350	350	50
Thailand	3,000	500	500	500	350	350

Source: Compiled by authors.

^a For Beijing, 350 ppm required as of 1 July 2005.

^b For entire country, 500 ppm required as of August 2005.

^c Domestic refiners can make 1,000 ppm, although imports in general are at about 5,000 ppm.

^d Industry met stricter standards in 2005 before government regulations came into effect.

widely among countries/economies in the region. Australia, Hong Kong, Japan, New Zealand, South Korea, and Taiwan have adopted environmental standards for petroleum products that are at or near levels required in the United States and Europe. China, India, and other South-Asian nations have the least-stringent emission standards in the region, while Brunei, Malaysia, the Philippines, Singapore, and Thailand in Southeast Asia are in an intermediate position.

Another approach to controlling urban air pollution is to require public-transport vehicles to switch from petroleum fuels to compressed natural gas (CNG). The government of India now requires buses and taxis in Delhi to use CNG, and in Seoul, South Korea, the government is promoting the use of CNG in buses.

In several developing countries of Asia and the Pacific, heavy reliance on coal has polluted the environment, caused widespread health problems, and created international tension as acid rain and industrial dust extend across national borders. These problems are particularly acute in China where power generation is increasing very rapidly, almost entirely based on coal. In 1987, China's total installed capacity to generate electricity was 100,000 MW. At the beginning of 2006, it was 500,000 MW. This growth in capacity represents a huge increase in the use of coal. In fact, in only five years—between 2000 and

2005—coal consumption in China nearly doubled. Even in the region’s developed economies—Japan, South Korea, and Taiwan—coal plays an important role in power generation, producing high carbon-dioxide emissions.

Our third set of recommendations is directed toward improving the environmental sustainability of energy use. In addition to tighter emission controls, policies are needed in three areas to achieve meaningful levels of environmental protection that are politically acceptable and economically viable.

1. Expand the use of natural gas for power generation. Countries around the region are already moving to make greater use of natural gas for power generation. The main barrier is cost, especially now with global markets tight and prices at an all-time high. In addition to the cost of gas itself, switching to the use of natural gas requires massive initial investments in the construction of regasification facilities and pipelines. It also takes several years of development before such facilities become fully operational.

2. Accelerate the development and expansion of clean coal technologies. Given today’s high cost of oil and natural gas, China and other countries in the region are not likely to reduce their dependence on coal in the foreseeable future. The Chinese and other coal users need to introduce improved technologies for coal combustion and post-combustion cleanup to reduce the environmental consequences of coal use. For example, power plants can reduce emissions of sulfur dioxide (SO₂) by adding flue gas desulfurizers. Effective technologies are available, although substantial capital investments are required to put them in place.

3. Expand the use of nuclear power. The case for the accelerated development of nuclear power as a source of energy is strengthened by environmental considerations. This is true even though the use of nuclear power entails its own environmental concerns, principally waste disposal and prevention of accidents. These concerns have stymied nuclear-power development in some countries, especially the United States. Yet the environmental problems related to nuclear power need to be balanced against the problems related to the use of fossil fuels.

A call for political will _____

In his January 2006 State of the Union message, U.S. President George Bush called for alternative technologies to help reduce America’s addiction to oil, “which is often imported from unstable parts of the world.” If this is a problem for the United States, it is an even greater problem for Asia and the Pacific. Both the United States and the Asia-Pacific region import more than 60 percent of their oil supply, but the Asia-Pacific region is much more dependent than the United States on oil from the turbulent Middle East.

Indeed, energy security has been an important issue for countries in the

Asia-Pacific region for many years. Efforts to enhance energy security have included policies to promote energy conservation, to diversify energy types and sources, and to maintain strategic stocks, as well as various forms of government intervention in energy markets. Over the years, governments in the region have learned from past mistakes that overregulation of energy markets does not necessarily ensure security, and many are moving to improve market transparency and the efficient operation of market forces.

Today, the challenge of energy security is greater than ever. The days of cheap and plentiful oil are over. World oil production is likely to reach a peak some time in the next 10 to 15 years and will not go up higher. Although production levels may stay at that peak for many years before they eventually start to fall, the world is probably entering an era of permanently high oil prices.

Given this prospect, government and business leaders will have to explore a variety of energy policies for the future. High oil prices, although painful for consumers, may provide a needed incentive.

With oil consumption still growing much faster than production, international cooperation could play an important role in the Asia-Pacific region in securing supplies from the Middle East and other oil-producing regions, bargaining for the best prices and contractual terms, and exploring and developing alternative sources of energy. In practice, however, heightened competition in international oil markets may work against cooperative efforts.

As a minimum, countries can enhance trade in oil and petroleum products by harmonizing quality standards and allowing the markets to determine price. Countries in the region are also on a path toward increased use of natural gas and, in some cases, hydropower and nuclear energy.

In addition to regional concerns, energy policies in Asia and the Pacific will have an important effect on the global energy balance. As the world's largest energy consumer, the United States bears an even greater global responsibility than countries in the region. Policymakers in the Asia-Pacific region and the United States must be willing to make bold and profound changes.

A number of specific measures have been described here to help boost energy security. These measures must be undertaken with full commitment: Half measures are not enough, and they may even make the situation worse.

Both innovative and long-standing approaches to ensure energy security—from projects that expand the use of alternative fuels to policies that improve market functioning and international cooperation—can only work if there is political will among countries in the region. As of today, the political will and commitment are only half-hearted. Higher oil prices and other changes in energy markets may act as catalysts to encourage more decisive action. The bottom line is that policymakers in the region are entering a new era in which the supply of traditional energy sources will be inadequate to meet the needs of their growing economies and the aspirations of their citizens. They need to act boldly and decisively, and they need to act now.