Asian Energy Institute

AEI newsletter

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The AEI (Asian Energy Institute) is a network of 16 energy institutes from Asian countries. These include Bangladesh, China, India, Indonesia, Iran, Japan, Jordan, Korea, Kuwait, Malaysia, the Philippines, Pakistan, Sri Lanka, and Thailand. Besides, there are 14 associate members, both within and outside Asia. The AEI was formally established in August 1989. Its aims and objectives are to promote greater information exchange; facilitate sharing and dissemination of knowledge; undertake research and training activities that are of common interest to its members; and analyse global energy developments and their implications. TERI hosts the secretariat of the AEI at present. The secretariat publishes a bi-annual newsletter that informs the readers about the diverse research activities undertaken by the member institutes. Currently, AEI is hosting the regional secretariat for REEEP (Renewable Energy and Energy Efficiency Partnership) in South Asia.

Editor **Mitali Das Gupta**

Editorial

*R K Pachauri**

It was in 1987 that the Government of India hosted the Asian Relations Commemorative Conference in New Delhi. One of the major decisions taken in this conference was to establish an entity that would work across the Asian continent on issues of energy, not as an institution housed in a central location but as a network of centres located in different countries. This indeed was a visionary decision even though in 1987 oil prices were low and the worldwide energy situation was reasonably comfortable.

The AEI (Asian Energy Institute) has functioned all these years with spurts of activities that were determined as much by the perceptions of the specific problems that required collaborative research as the availability of funding to carry them out. Today Asia faces a major energy challenge, given high rates of economic growth in most parts of the continent, consequent upon which the demand for energy is growing rapidly. Also in evidence is the growing concern related to the environmental problems, both at the local and global levels. With negotiations for the second commitment period of the Kyoto Protocol gathering momentum, Asia is inevitably a continent on which attention is expected to be focused for the possible reduction in emissions of greenhouse gases. Asia also has large areas that would be susceptible to the impacts of climate change. All this provides another new rationale for collaborative research among institutions in the region.

Against this background, the AEI is now entering a new phase of its existence, which would serve the interests of not only the countries in areas but also the world as a whole, given the global implications of Asia's development. It is, therefore, a source of happiness and satisfaction that the AEI newsletter is being revived to herald a brighter future for the institution in the months and years ahead.

*Director-General, TERI, New Delhi, and Chairman, Intergovernmental Panel on Climate Change

India's quest for energy security: need to integrate with the Asian hydrocarbon economy

*Mani Shankar Aiyar**

The National Common Minimum Programme of the United Progressive Alliance Government, led by the Indian National Congress, which came to office in May 2004, is the first document of its kind to devote a separate section on 'energy security'. This reflects an increasing recognition that if the overarching national objective is eradication of poverty within the stipulated period of 20 years, it is essential that the economy attains and, more importantly, sustains a GDP (gross domestic product) growth rate of at least seven to eight per cent over the next two decades. This, in turn, is simply not feasible unless energy sources are found to fuel such a high rate of growth over such a long period of time. Thus, the key to poverty eradication lies in energy security.

The parameters of India's energy security paradigm are easily spelt out. At present levels of national income and GDP growth, hydrocarbons, that is, oil and gas together, account for about 45% of the national energy basket. Over the next two decades, in keeping with the fact that technology is making the 21st century the 'Century of Natural Gas' (as distinct from the 20th century, which was the 'Century of Petroleum'), the share of natural gas in our energy needs is expected to rise from the present level of about 6% to about 20%, while the contribution of oil and gas together is likely to remain at just under half of our total energy requirements. Therefore, whatever we do about coal or nuclear civil energy or non-conventional sources of energy or alternative fuels, energy security, in a substantial measure, will continue to be hydrocarbon security.

Already, our dependence on imported oil to meet our requirements has exceeded 75% and our expenditure

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on imported crude oil in 2004/05 amounted to 1 170 000 million rupees (about 26 billion dollars). The full import bill for the current year is likely to be even higher, considering the rise in oil prices. Notwithstanding the projected increase in domestic crude production from the existing level of a sliver below 35 MT (million tonnes) per annum to 50 MT per annum by 2025 (which means increasing our present domestic crude output by half), India's dependence on the imports of crude at the projected high and sustained levels of growth of GDP will only relentlessly rise to 85% or even more over the next two decades. Natural gas, which till the 1980s was regarded as a nuisance that stood between the explorer and the crude oil, is now becoming even more precious than crude.

Thus, by bringing down gas flaring to zero as quickly as possible, and exploring for gas, particularly in the Bay of Bengal, we have succeeded in pushing up the domestic gas output by a factor of 10 from about 9 MSCMD (million standard cubic metres a day) in the 1980s to 90 MSCMD at present. But, our gas explorers are now straining at the end of their tether. The more pessimistic among them do not think that domestic gas output can be doubled over the next 20 years; the more optimistic hope, and pray that output could reach 200 MSCMD by 2025. Even on the most optimistic projections, India's import dependence on gas is not likely to fall below 50%.

Therefore, India's only hope for poverty eradication would be to ensure energy security through integration with the Asian hydrocarbon economy. And since the Asian hydrocarbon economy is an integral part of the global energy economy, any Asian regional cooperation would have to seamlessly merge into global energy cooperation.

Once one has fixed the parameters of India's energy security firmly in mind, the quest for energy security is lit up with rays of hope. First and foremost, let us consider the domestic scene. It was estimated nearly a decade ago that India's prognosticated resources of oil and oil equivalent could be in the region of 30 billion tonnes. A joint study by the Director General Hydrocarbons and the Alberta Research Council has recently been commissioned to examine our prognosticated resources once again, and one can be fairly confident that advances in science and survey techniques will lead to a sensible augmentation of our prognosticated resources beyond even the decade-old estimate of some 30 billion tonnes. Were we to actually get it, India would pole vault into the Saudi Arabia League. Therefore, emphasis on prognosticated resources is really aimed at preventing us as a nation from falling into the mistaken depression of assuming that we are a hydrocarbon-poor country. On the contrary, we are well-endowed. The only question is of breaking geological and technological barriers that stand in the way of our reaching into the bowels of the earth and below the surface of the seas that surround us, to physically secure for our contemporary needs what nature has so bountifully endowed on us.

On that, there are two geological issues that, although not peculiar to India, are specific to the origin of hydrocarbons in our subcontinent. One is that when many hundreds of millions of years ago the continent of Gondwana broke from the Antarctic and began slowly swimming up the Indian Ocean towards its rendezvous with Eurasia, it unfortunately passed over Madagascar: unfortunately because there were a series of volcanic blasts, which covered a vast proportion of our hydrocarbon resources under heavy volcanic cover; the so-called Deccan Trap, which extends from Kachchh through much of Gujarat, Maharashtra, Madhya Pradesh, and Andhra Pradesh. The problem of even conducting surveys, let alone drilling through the basalt cover, is not unique to India. But the scale at which heavy volcanic rock masks our hydrocarbon resources is peculiarly Indian. Finding an India-specific technological answer to this geological conundrum is perhaps the single-most important geological challenge confronting land exploration in India.

The second onland conundrum is that when Gondwana smashed into Eurasia with such force that it threw up the highest mountain ranges in the world, the Himalayas, it simultaneously buried the vast fossil wealth of the sea that had separated Gondwana from Eurasia. Therefore, in the expectation that oil was most likely to be found in the sub-Himalayan Terai region, the founder of India's indigenous exploration programme, Krishna Deo Malviya – whose centenary we have recently celebrated – decided to headquarter the ONGC (Oil and Natural Gas Commission) established in 1956 in his sub-Himalayan constituency of Dehra Dun. But half a century along, notwithstanding a very determined exploration programme, the sub-Himalayan region extending from Himachal Pradesh and Uttaranchal through to Uttar Pradesh and Bihar has not yet yielded a single drop of oil or a single cubic metre of gas. Cairn Energy, which has made massive discoveries in the Rajasthan desert (which had been earlier abandoned by both ONGC and Shell), has formulated the hypothesis that this failure to locate oil and gas in the sub-Himalayan tract is perhaps because the political boundary between Nepal and India has had the unintended effect of damaging the geological integrity

of the sub-Himalayan basin. Cairn has, therefore, acquired blocks in Nepal on the Nepalese side of the India–Nepal border and entered into a joint venture with the ONGC, which holds most blocks on the Indian side of the India–Nepal border, to try and see whether restoration of the geological integrity of the basin yields oil and gas both for India and Nepal.

Offshore, I discovered for myself the dimensions of India's particular technological problems when I visited Sleipner-A, a Norwegian platform anchored in the North Sea, and on enquiring about the water depth at which they were drilling, was astonished to learn that it was a mere 150 m (metres) compared to depths of 3000–3500 m at which we are drilling in the Arabian Sea. So, I asked the Norwegians as to why they called it the North Sea when we in India would call it the North Lake! While we are yet to strike hydrocarbons in the deep waters of the Arabian Sea, we have long had a measure of success in the Gulf of Cambay and so many successes in the Bay of Bengal that I have ventured to describe the Bay of Bengal to foreign audiences as the North Sea of South Asia! But there are still miles to go.

Therefore, the first and most important challenge to India's energy security is networking India's indigenous hydrocarbon knowledge base with the best that is available anywhere around the globe and wherever we can get it. In the course of the past few weeks of 2005, we have already established the network with Houston, Calgary, London, Stavanger/ Oslo, Ploesti/Bucharest, Moscow, Seoul, and Tokyo. We shortly hope to complete the circle with arrangements with Kuala Lumpur, Perth, Tehran, and King Fahd University of Petroleum in Dahran. The endeavour never stops. The more the merrier. Ultimately, it is only through new ideas that we will be able to find new oil. The Rajiv Gandhi Institute of Petroleum Technology, which we are planning as a kind of IIT (Indian Institute of Technology) in Uttar Pradesh for the petroleum sector, could over time, become the fulcrum of our hydrocarbon knowledge network.

The second major objective is to network the world's experience with the indigenous Indian experience. This means forging partnerships with oil majors and others to prospect for oil and gas onshore and offshore in an improved policy framework. The decade-old NELP (New Exploration Licensing Policy) rounds have not only stimulated with great success, a burgeoning Indian private sector in exploration and production, they have also brought in several international players. Indeed, NELP-V in 2005 has attracted as many foreign bids as the four NELP bids put together.

We are intending to offer a much larger number of blocks than hitherto in NELP-VI (2006). At the same time, we are moving towards an 'Open Acreage Policy' so that, in addition to offering ourselves blocks which others can bid for, exploration firms could suggest to us blocks, in which the petroleum community, domestic and international, might wish to commence exploration. The imperative need for this is that after more than half a century of exploration, less than 20% of the potential resources in our 26 sedimentary basins have even begun to be explored. We need to mount a massive operation of seismic surveys, with the most sophisticated tools available, including speculative surveys, to map our resources, place them in a National Data Repository, and put them up for exploration.

It is only after giving priority to these domestic concerns that the question of oil diplomacy abroad arises. The external dimension of oil diplomacy has, in my view, received disproportionate attention in the past 18 months: and the cause for this is myself, undertaking high-profile visits globally as the former Minister of Petroleum and Natural Gas (May 2004 to January 2006). But media attention to my travels should not distract attention from the more important domestic dimension of both our domestic endeavours and our oil diplomacy. This is not to underplay the external dimension for, realistically speaking and without putting excessive hope on unforeseen domestic breakthroughs, we will have to secure three-quarters of our crude from abroad and half of our gas requirements from external sources.

In addition to exponentially expanding domestic output beyond present targets, the key to crude oil security would be to both tie-up and diversify the sources of crude imports. Also, the oil prices should be brought to more reasonable levels, both at normal times and at times of irrationally spiralling international prices of the kind we have witnessed over the past two years.

To diversify our sources of crude, we have already started looking towards West Africa and even as far as Venezuela in Latin America. But over a 20-year perspective, the brighter prospect lies in strengthening our strategic partnership with Russia so that we can access East Siberian (that is, North Asian) crude at Russia's Pacific coast ports such as Nakhodka near Vladivostok. Also, we should avail of the recently constructed BTC (Baku–Tblisi–Ceyhan) pipeline and the imminent Samsun–Ceyhan pipeline to initially access Caspian and Black Sea oil in the eastern Mediterranean. From there it could be transported through relatively smaller carriers through the Suez Canal to the Indian Ocean. More imaginatively, by extending the BTC and Samsun–Ceyhan pipelines

to the port of Ashkelon in Israel, it could be pumped further through the existing Ashkelon–Eilat pipeline to the head of the Gulf of Aqaba and hence brought by VLCC (very large crude carriers) through the Indian Ocean to our ports. If, at the same time, we could work with the Egyptians towards laying a pipeline from the Mediterranean to the Red Sea, perhaps parallel to the existing Red Sea–Mediterranean pipeline, then we could access large quantities of the North African and West African crude at the Red Sea terminal. This oil can be transported to India at a much lower cost than going all the way round the Cape of Good Hope. In practical terms, it is only by ensuring many diverse ingredients in the cocktail of crude available in the Indian Ocean area that we will be able to get rid of the pernicious 'Asian premium', which leads to our paying more per barrel than what West European and American buyers pay for West Asian crude. This is despite the fact that we are geographically much closer to the West Asian sources. Also the geopolitics of oil trading has changed so dramatically that the Asian consumers already account for more than two-thirds of the West Asian and South-east Asian crude oil exports.

Mention of geopolitics brings one to the interface between foreign policy and the quest for energy security. India would do well to adhere to its traditional fidelity to *Panchsheel*, the Five Principles of Coexistence, which have lain at the root of our foreign policy since the days of Jawaharlal Nehru. We must eschew any confrontation that would pit OPIC (Organization of Petroleum Importing Countries) against OPEC (Organization of Petroleum Exporting Countries). What we need is a dialogue between producers and consumers, recognizing that Asian energy security lies as much in security of supplies for Asian buyers as in security of demand for Asian sellers. Such mutual trade, if reinforced by mutual investment, will lead to mutual interdependence, which alone is the guarantor of true energy security.

Towards this end, India took the initiative in convening in New Delhi a round table in January 2005 of the principal West and South-east Asian suppliers – Saudi Arabia, United Arab Emirates, Kuwait, Iran, Qatar, and Oman – with the principal Asian buyers like India, China, Japan, and the Republic of Korea. A broad approach to the Asian energy security, as set out above, was resoundingly approved at the round table and a calendar of meeting all the way to 2013 was established at the first meeting itself.

This initiative was followed by a second round table in November 2005 with the same principal Asian consumers (plus Turkey) and the principal North and Central Asian suppliers, namely, Russia, Kazakhstan, Uzebekistan, Turkmenistan, and Azerbaijan. The outcome of the second round table was in conformity with the perception of the first. We thus have the tentative beginning of a cooperative relationship with the producers and consumers, which should make it possible, without a sense of rivalry, to establish among Asian importers an Asian equivalent of the International Energy Association (which provides a common forum for the OECD importers). This should also lay the tentative foundations of an Asian oil and gas community that might lead to the Asian Economic Community, which, as predicted by our Prime Minister Dr Manmohan Singh, will come into existence as an 'arc of prosperity' in the early part of the 21st century.

As for gas, although India itself may not be adequately endowed in terms of burgeoning demand in the 21st century, it is fortunate to be placed at the vortex of an extended neighbourhood that houses some of the largest gas resources in the world. To the west lies Iran, from where we are attempting to bring gas by pipeline through Pakistan to the India–Pakistan border. To our north lies Turkmenistan, which has projected ample gas resources in the uncommitted Daulatabad gas field near the Afghanistan border. If required, consideration could be given to augmenting the available supplies at Daulatabad from Uzbekistan, Kazakhstan, Azerbaijan, and even the Astrakhan littoral on the Russian shore of the Caspian Sea. The proposed North–South energy corridor, which would run from the Kazakhstan port of Akhtau to the Iranian port of Chah Bahar on the Arabian Sea, is another exciting prospect. India has attended, as an observer, for the first time at the ministerial level, the Asian Development Bank sponsored Steering Committee meeting on the TAP (Turkmenistan–Afghanistan–Pakistan) pipeline in Ashkabad in February 2006 to explore the prospects of extending TAP pipeline to India. To the east lies Bangladesh and Myanmar, both with high potential for natural gas. The central task of our oil diplomacy is to bring Myanmar gas through the north-east, and possibly also through Bangladesh, to India. Besides feeding east and north-east India from Myanmar, north India from Central Asia, and west India from Iran, we also need a whole series of LNG (liquefied natural gas) terminals along both the east and west coasts of peninsular India to access gas (as LNG) from points as disparate as Qatar, Australia, and Sakhalin.

The challenge is formidable but the prospects are exciting. It is a question of clear direction in policy planning, persistence in implementation, faith in our success, and unflinching commitment to the goal of poverty eradication through energy security.

Chinese energy security: emerging issues and global implications

Jeffrey Logan[1]

Tight oil markets have raised new concerns about the global energy security. They have also highlighted the link between energy security and climate change, and reminded us that no country can isolate itself from another.

Nowhere is energy insecurity more apparent than in China. Chinese oil demand increased by one-third between the beginning of 2003 and the end of 2005, driven almost exclusively by imports. Stories abound of Chinese companies and diplomats 'scouring' the earth to secure physical barrels of oil. In the natural gas sector, China's central government is threatening tougher approval for proposed liquefied natural gas import terminals as fears of future import dependency rise. But ironically, capacity shortages in China's electric power sector – largely insulated from the global market forces – had the largest impact on energy insecurity in China so far. A significant driver of recent oil demand growth in China, perhaps one-third of the rise in 2004, was the need for oil-fired back-up power generation to overcome these shortages.[2]

While China has contributed to the global sense of energy insecurity, it is unfairly singled out for its role in driving oil prices higher. Chinese oil demand grew phenomenally in 2004 at over 15%, but its share of incremental global demand has been moving opposite to the price since 2002 (Figure 1). The US had roughly the same marginal call on the world crude markets in 2004 as China.

This paper summarizes China's energy insecurity and calls for stronger US leadership in addressing the linked issues of energy security and climate change. To engage China in a new thinking on energy security and climate, the US will first need to demonstrate by way of example. Greater cooperation with China and other large developing countries is vital to US security, trade, and environmental interests. Valid concerns exist about how China will evolve in the coming decades—a democratizing, increasingly transparent, and responsible member of the global community, or otherwise? We need to strive for the former vision through active, positive engagement rather than ensuring the latter through a self-fulfilling prophecy.

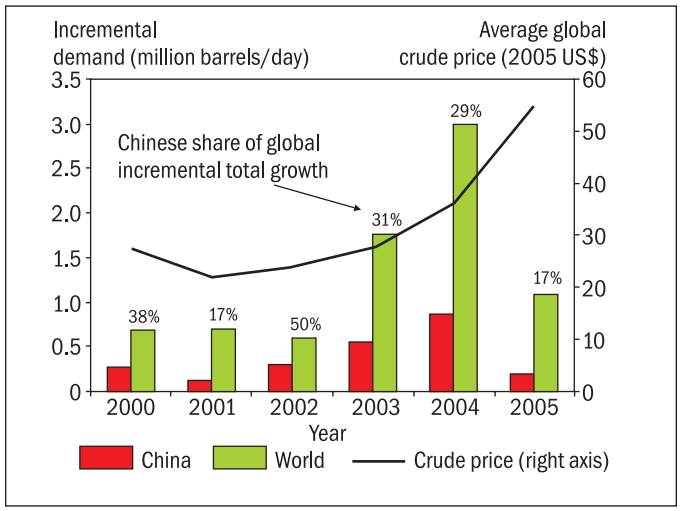

Figure 1 China's share of incremental global crude oil demand
Source IEA (2006)

Searching for oil security

Without a dramatic change, Chinese oil consumption appears set to grow rapidly in the foreseeable future. The IEA (International Energy Agency) forecasts that Chinese petroleum demand will reach 14 MBD (million barrels per day) in 2030. Chinese import dependency will continue to grow, with three out of four barrels coming from abroad (IEA 2004). If the forecasts prove accurate, China would be importing as much oil in 2030 as the US did in 2004.

To put the Chinese oil demand in perspective, although it has grown more quickly than any other region in the past five years, the relatively low starting point means that China still consumes only one-third as much as the US, or one-fourteenth as much on a per capita basis (Figure 2).

Rising Chinese demand has stoked the debate about whether worldwide petroleum supply is sufficient and stable enough to meet demand in the coming decades. Important uncertainty relates to

- identifying upstream investment opportunities;
- maintaining stable output in producer countries;
- building dependable mid- and downstream infrastructure; and
- creating policies and deploying technologies that affect oil demand.

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[2]China does not publish statistics on oil demand used in back-up power generation but the IEA (International Energy Agency) estimated that about 250 000–350 000 barrels per day of the 860 000 barrels per day increase in 2004 was due to back-up generation. See the IEA's March 2005 *Oil Market Report*.

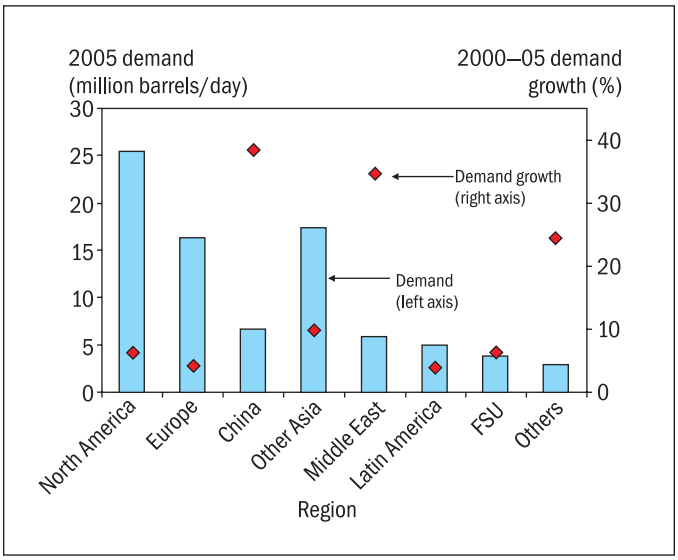

Figure 2 Crude oil demand and recent growth rates in various locations
Source IEA (various years)

It appears that competition among countries to secure the oil assets will increase unless a new approach is taken. China and India are often singled out as drivers of the competition for a limited oil supply. But they seem guilty of little more than economic success when measured on the scale of geopolitical oil machinations. It is also too early to discredit the chance for successful home-grown regional cooperation initiatives emerging from Asia.

Chinese policy-makers have embarked on a multi-pronged approach to improve oil security by diversifying suppliers, switching over from oil, building strategic oil reserves, and enacting new policies to lower demand. But the most attractive measure has been the surging activity of Chinese NOCs (national oil companies) abroad and their attempt to purchase equity oil stakes.

Overseas equity oil

The Chinese NOCs have accelerated their hunt for overseas oil assets in the past few years. Chinese diplomatic efforts have often preceded investment. Drivers behind the 'go abroad' strategy in the oil sector include

- limited opportunities to develop significant new oil resources domestically;
- realization that 'cheap' investment opportunities abroad will become ever more limited;
- geopolitical factors related to China's fear of containment; and
- aspirations by the Chinese NOCs to become major international corporations.

The general perception among Chinese policy-makers, although not many energy economists, is that the NOCs can help achieve price and supply security by owning overseas petroleum assets.

Until recently, Chinese companies operated mainly in locations not dominated by the international oil majors like Angola, Egypt, Iran, and Sudan. To illustrate this fact, about half the Chinese overseas equity oil production currently comes from Sudan. However, activities have picked up in other areas recently, including Australia, Brazil, Equatorial Guinea, Indonesia, Kazakhstan, and Saudi Arabia to name a few. What the Chinese NOCs lack in overseas technology and managerial expertise, they can often make up in deal 'packaging' and risk tolerance. Chinese NOCs have a reputation of overbidding on assets, although they are gaining experience in conducting business abroad.

The concern that the Chinese companies will destabilize or otherwise control the global oil markets seems misplaced. In 2003, the Chinese state-owned oil companies pumped about 400 000 barrels of overseas equity oil per day.[3] If this output increases by 10% annually as some have predicted, the volume would hit 2 million barrels per day in 2020. This would equal about two per cent of the global petroleum output then, indicating the still-modest influence that Chinese NOCs would exercise. Still, there are genuine concerns about stable and sufficient future supplies.

Recent disappointments for the Chinese NOCs include the apparent Russian decision to build an oil pipeline to Nakhodka with Japanese contributions, rather than to Daqing in north-east China with CNPC (China National Petroleum Corporation) participation. CNPC apparently succeeded in purchasing PetroKazakhstan for 4.2 billion dollars in 2005 but the benefits of this project will hinge largely on the future price of oil. The highly publicized but ultimately failed bid by China National Offshore Oil Company for Unocal in 2005 was also a setback, and one whose repercussions may still appear in future. Zero-sum thinking was at the core of the US opposition to sale.

Strong lobbying and the US Congressional opposition to the sale resulted in CNOOC (China National Offshore Oil Corporation) dropping its 18.5-billion-dollar offer. While the advertised US concerns focused on Chinese subsidies to CNOOC and transfer of 'sensitive' technology, many observers believe a simpler perceived arithmetic drove opposition to the

[3] As a point of comparison, Unocal reported pumping the equivalent of 411 000 barrels of oil per day in its annual report.

deal: China gains, America loses. But the potential merger was more nuanced and could have served global interests constructively if specific US concerns were negotiated. Deprived of Unocal's gas assets in Asia, Chinese NOCs will likely seek to accelerate their energy deals with the so-called rogue nations and develop fuels dirtier and more dangerous than natural gas. Perhaps more importantly, China follows the US example that arguably narrow political interests trump the market.

Future directions for the Chinese NOCs abroad are hard to anticipate. Domestic Chinese reform, global oil prices, and international relations will all influence the overall strategy. Many international analysts question whether the Chinese NOCs can actually improve oil security just by owning overseas barrels, and some Chinese policy-makers are also beginning to at least quietly question the logic of the policy. Less controversially, China has clearly strengthened its oil security over the past decade by diversifying sources of oil imports.

Diversifying global oil purchases

Over the past decade, Chinese crude imports have come from a more diverse set of suppliers. In 1996, about three-quarters of China's crude imports came from just three countries: Indonesia, Oman, and Yemen. By 2004, Saudi Arabia was the largest supplier of oil to China, accounting for 14% of imports, with Angola, Iran, Oman, Russia, Viet Nam, and Yemen together supplying another 60%. The remainder came from a long list of other suppliers (Figure 3). By diversifying crude suppliers, China has lowered the risk of a damaging supply disruption. Supply diversification requires careful planning to ensure that the refining capacity can process unique crude properties from different locations.

Establishing strategic oil reserves

China's Tenth Five-year Plan (2001–05) called for construction and use of SPRs (strategic petroleum reserves) by 2005. One of the four sites is reportedly complete and ready to begin storing government-owned supplies. Chinese officials plan to gradually fill up to 100 million barrels of storage by 2008 (equivalent to 35 days of imports then), but the stockpiling has been delayed due to the current high price of crude oil. Used in coordination with other countries, China's SPR can contribute constructively to the global price and supply security. There is at least some concern that China will use its SPR to influence domestic prices, rather than in coordination with other countries in the event of potential supply disruptions.

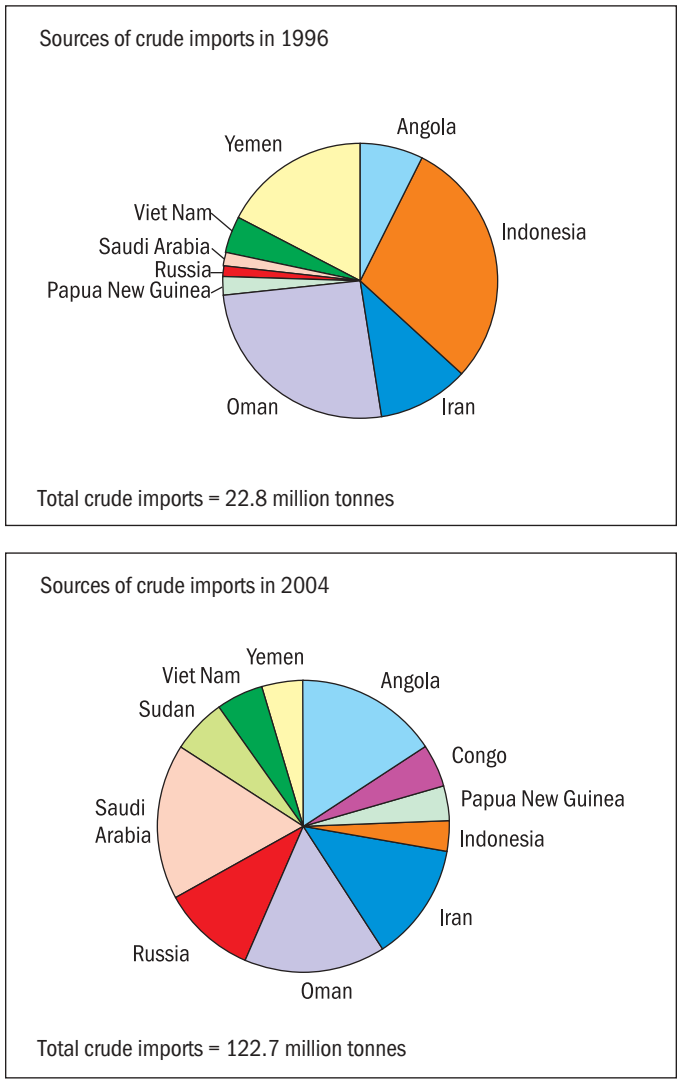

Figure 3 Diversification of crude oil supply sources for China (1996 and 2004)
Source IEA (2005)

Demand-side measures

Oil demand in China's transport sector will most likely grow strongly and steadily over the mid- to long-term. Currently, there are 25 million vehicles in China, with projections of 90–140 million by 2020. This would push transport sector's share of the total oil demand from one-third at present to nearly 60% over the 15-year period.[4]

To partially address this problem, China enacted new automobile efficiency standards during the late 2004. In Phase I, running from mid-2005 until January 2008, no increase in average fleet fuel

[4] China's transport sector accounted for 1.6 MBD (million barrels per day) of demand in 2004. It is likely to grow to 5.0 MBD in 2020, even with vehicle use at the high end of forecasts.

consumption will be allowed without penalties. Phase II would then begin and require a 10% improvement in the fleet fuel efficiency. Enforcing the requirements of the law will be instrumental to the effort's success.

Chinese policy-makers also continue to consider a national vehicle fuel tax that would replace the existing road-use fees at the local level, although the current high oil prices have stymied adoption.

Fuel switching

Many large oil-importing nations have begun considering seriously substitutes for vulnerable oil supply. China and the US are considering massive investment in coal liquefaction plants, for example, that might offset the need to import a portion of its oil. The controversial economics of this technology have created at least some opposition among the Chinese policy-makers. The GHG (greenhouse gas) implications of such a move would also be significant: coal-to-liquid petroleum products create up to 80% more carbon dioxide emissions per unit of useable energy than petroleum-derived products. China also has the opportunity to offset some petroleum use by switching to natural gas and biofuels. While these would have generally positive impacts on climate, there are limits based on natural gas availability and agricultural objectives.

Advancing the global good

The Chinese response to surging crude imports has had mixed results. Several measures, including stronger fuel economy standards, greater supply, import diversity, and construction of strategic oil stockpiles are likely to contribute positively to both the Chinese as well as global energy security. Others, like directing state-owned oil companies to purchase overseas oil assets or a massive shift to coal liquefaction, could become expensive failures with uncertain global consequences.

Global energy security is often hampered by zero-sum thinking at the policy-making level. Cooperation between countries, rather than competition, can both increase the size of the pie and minimize risk of the global economic, environmental, and social dislocations. To overcome the rising concern about energy security, global climate change, and sustainable economic development, policy-makers need to think outside the zero-sum box. Cooperation can be difficult at the level of implementation, but high-level political leadership can lead to surprising results.

Bilateral and regional engagement on energy policy can help clarify concerns and expectations, highlight what works and what does not, and prevent, perhaps, other electricity crises from occurring. High-level discussions could focus on at least four promising areas.

First, energy efficiency holds tremendous immediate potential to solve development needs in an economic and environmentally acceptable way. Huge opportunities exist right now in India, China, and the US. Greater efficiency in the US auto fleet, for example, has been opposed by narrow political interests. Direct benefits created from increasing vehicle fuel efficiency would lower the US trade deficit by requiring less imported oil, cut emissions of local and global concern, position the US manufacturers to compete more effectively, and improve market sentiment about the future supply–demand balance. A positive externality from such a measure would also lower the global oil supply tension, and weaken the US critics in Iran and Venezuela.

Second, natural gas used in place of coal and oil is another option that can dramatically reduce the environmental impact of energy use. Global trade in this relatively clean energy source is projected to expand dramatically, especially in Asia. There are genuine concerns, however, about substituting one type of insecurity with another, and Russia's recent actions with the Ukraine and other FSU (Former Soviet Union) countries clearly highlight this point. The US and the EU need to engage Russia more directly on its reliability and sincerity as a global energy supplier.

Third, SPRs are a proven method to lower the risks associated with supply disruptions and help keep prices stable. The IEA has shared experiences with China over how member countries create and operate the SPRs. Greater transparency and cooperation between China's emerging SPR and the IEA, for example, could bring greater global benefits.

Finally, we will need to deploy a full arsenal of measures, including CCS (carbon capture and storage), to stabilize atmospheric concentrations of GHGs at a safe level. The CCS could help large coal producers like China, India, and the US to meet their energy and development needs without further destabilizing the global climate system. The US, in particular, needs to demonstrate the viability of this technology before it can expect the developing countries to embrace it.

There is a new urgency to address the linked energy security, economic development, and climate protection issues, especially in Asia. Recent efforts by the G-8 are a start, although much more is needed. US participation in the Kyoto Protocol (or leadership on an improvement) and a strong domestic policy to

reduce GHG emissions seem like good starting points to restore international cooperation.

While the US leadership is essential, the current administration has shown almost no interest or ability to engage in dialogues. The Asia-Pacific Partnership for Clean Development and Climate could help to create better dialogue among the most important global energy consumers but current activities appear more of a diversion than a serious attempt to solve real problems.

The US isolationism on climate and energy security issues is almost certain to change with the new administration in 2008. With current dynamics in the US Congress and interest among state and regional stakeholders, it could happen even sooner. Given the magnitude of problems, however, there is now no time left to lose.

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Some energy security issues in Bangladesh

Ijaz Hossain[1]

In the face of rising oil prices, energy security has become a critical issue for energy supply in the developing countries. This concern is especially compelling for countries that need to import large quantities of fossil fuels. Even though Bangladesh's energy imports are less than one quarter of the total, they are still significant for the following reasons.

- The entire transport sector is dependent on the imported oil.
- Oil imports form a significant portion of total imports.

The fact that Bangladesh has no oil resources makes it extremely vulnerable to an oil-supply disruption. The high price of oil exacerbates the situation. Instability in the Middle East, Nigeria, and Venezuela – the three regions which together account for more than 90% of the traded oil – makes supply disruption a distinct reality. Despite increasing globalization and openness in the developing countries to foreign direct investments in energy resources, the supply situation of fossil fuels is not improving. Large demand for oil in rapidly expanding economies of the world invariably means that in a not-too-distant future, all countries will be competing to secure oil supplies. This is already clearly evident with India and China vigorously pursuing this goal. It is obvious that smaller and poorer developing countries, such as Bangladesh, will be severely disadvantaged in this competition. Bangladesh is already severely handicapped by a huge gap between its imports and exports, and in fact, on paper it remains a puzzle how the country is managing to keep its dollar exchange rate relatively stable, and hold on to its foreign currency reserves in the face of this large deficit. Part of the answer probably lies in the fact that large quantities of foreign currency are remitted to the country through informal channels.

The onerous burden of importing oil was felt rather strongly last year with the price of crude oil rising above 50 dollars per barrel. Oil imports constitute nearly two per cent of the gross domestic product in Bangladesh. As can be seen from Table 1, oil import bill is a significant portion of the total value of exports. Oil imports have jumped from being five to six per cent of the total imports just a few years back to over 12% last year, and are expected to reach 15% this year. Even though in the medium term (10–20 years), the price of oil is not likely to be this high, in the short term (5–10 years), oil price as high as 100 dollars per barrel has been predicted by some experts. If an oil shock coincides with one or more of the natural disasters (massive flood or large-scale crop failure) or even political instability (some of which can paralyse the country for weeks) that Bangladesh is periodically afflicted with, then the consequences

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Table 1 Few facts on Bangladesh's external sector

Item	*Value in 2003/04*
Exports	7.48 billion dollars
Imports	10.03 billion dollars
Oil imports (est.)	1.35 billion dollars
Foreign exchange reserves	2.5-3.0 billion dollars
Taka devaluation against US dollar	Average five per cent per year
Commercial energy	17.1 million tonnes of oil equivalent
Crude oil imports	1.3 million tonnes
Petroleum product imports	2.4 million tonnes

could indeed be disastrous. The country's economic performance based purely on the per capita income, when compared to that of India, may not appear that bad. However, a closer look at some of the other indicators, such as foreign currency reserves, export earnings, or stability of the exchange rate of the local currency to one of the major convertible currencies, reveal the inherent weaknesses of the economy. It should, therefore, be obvious that an oil shock will affect Bangladesh far more than India or China.

It is now a regular news item how large developing countries to protect themselves from oil shocks, are trying to acquire oil assets around the world. It is important to note that these countries by virtue of their economic, political, and military powers would be able to secure and protect these far away energy assets. Moreover, most large countries have some domestic supply that can cushion shocks. Bangladesh and many other small developing countries with no oil resources have become extremely vulnerable in the new emerging global energy scenario, and in case of serious supply disruption, may have to purchase oil at exorbitant prices, and in the worst-case scenario altogether fail to procure oil.

Strategic oil reserves and fuel diversification in the transport sector are important measures for Bangladesh to consider. Of course, energy efficiency, conservation, and modal shift are worthy options, but such adjustments are extremely difficult when a country is on a critical development path as Bangladesh is on now. Since Bangladesh is fortunate to have a large quantity of natural gas (compared to the present demand), diversification into even uncharted territory at least for a portion of the transport fleet should seriously be considered. Some of these options are as follows.

- CNG (compressed natural gas)
- Electric and fuel-cell vehicles
- GTL (gas-to-liquid) technology

The CNG option is being pursued in the country but greater and diversified efforts are required to achieve energy security. Other options may appear too expensive, but it must be borne in mind that at 60 dollars per barrel, these options become competitive. From a purely commercial consideration, currently, there is very little justification for going for these options except CNG because high oil prices may not be sustained. But when these options are considered from an energy security point of view, it makes sense. Shifting between 20% and 30% of the oil-based transport to these alternative fuel options could make Bangladesh more resilient to the oil supply disruption shocks. Further, in the event of sustained high oil prices, the bonus is that this energy security measure becomes the cost-effective option for the country.

The other more difficult transport sector strategies that Bangladesh can adopt to make itself more energy secure are as follows.

- Electrification of railways
- Shifting both freight and passenger transport to railways
- Converting river transport to CNG
- Shifting road transport to river transport

Despite inheriting an excellent railway system, Bangladesh has failed to reap its benefits. Today, the railway system survives as a mode of transport greatly stunted by the rapid and extensive growth of the road system. In addition, whereas, nearly all major railway systems around the world have undergone the logical progression from coal to oil to electricity, Bangladesh is still continuing with diesel locomotives. This conversion would not only reduce the present level of oil consumption, but also through its expansion, allow future modal shift. Similar fate has befallen the river transport system. The country was known for its riverine transport system during the British times. The reasons behind its greatly reduced importance, apart from the competition from the road transport system, is the lowering of the navigability of rivers and the general neglect of this mode. CNG is well-suited for this application because the extra weight of cylinders is of little concern here.

From the foregoing discussion, it is clear that Bangladesh can adopt measures that will make it more energy secure, and at the same time help develop a more sustainable transport system because significant global and local environmental co-benefits accompany some of the measures discussed. For example, the use of CNG will lead to greatly reduced local pollution while expansion of the railway and river transport systems will significantly lower the energy requirement per passenger kilometre and per tonne kilometre.

Asia's energy security challenges: need for collaboration

Mitali Das Gupta and Pragya Jaswal[1]

Introduction

Asia's energy demand is growing rapidly, fuelling its dynamic economic growth. At the same time, Asia's limited energy resource base and slow energy industry reforms have hobbled the region's ability to mobilize supplies needed to meet the booming demand. As a result, dependence on energy imports – particularly for oil – is rising rapidly, with a consequent rise in oil prices.

The World Bank (2006) estimates that in the developing countries, while the GDP (gross domestic product) growth has remained robust, higher oil prices have sharply slowed down the real income growth among oil importers from 6.4% to 3.7% between 2004 and today. Looking forward, continued high oil prices, coupled with inflationary pressures, are expected to restrain growth in most developing countries over the next two years. Ito, Zhidong, and Komiyama (2005) estimate that about 70% of the increase in the world primary energy consumption would be accounted for by the non-OECD (Organization of Economic Cooperation and Development) countries, two-thirds of which will be from the Asian region. Also, though the Asian region is richly endowed with energy resources, there are marked geographical concentrations and disparities. Certain parts of Asia, especially East and South Asia, are facing energy shortages. Thus, increasing demand and rising demand/supply imbalance of energy resources result in a profound and deepening sense of energy insecurity in Asia, with long-term implications.

Energy security is a widely used term coined during the 1950s to mean safeguarding adequate supplies in the event of war. However, presently, it has moved beyond the military aspect to include long-term economic safeguards against the effects of oil price rise. Also, energy security does not only mean limited vulnerability to price fluctuations, but also means continuous availability of energy services to meet the needs of people and minimize the risks associated with the supply and use of energy.[2]

For Asia, energy is becoming a matter of national security. As its economic prosperity is increasingly being exposed to the global supply disruptions and instability in the energy-exporting regions, governments across the region are deciding that energy security is becoming too important to be left entirely to the markets. Also, it is slowly being recognized that the issue of energy security can no longer be viewed as a task to be addressed by each country individually, but instead, to be addressed through a region-wide cooperation and networking approach, thereby institutionalizing an energy policy cooperation framework.

The present paper discusses the energy overview of Asia, analyses various energy security challenges in the region, and highlights the need for networking and efforts towards greater regional cooperation and coordination to secure energy supply.

Asia's energy fundamentals

The rapid growth in economies, population, urbanization, and industrialization has led to a 63% growth in commercial energy consumption between 1985 and 2004 in the Asian region (Figure 1a). Its share in the total world energy consumption has grown from 38% in 1985 to 44% in 2004 (BP Statistics 2005). About 70% of the total energy consumption in Asia is contributed by China, the Russian Federation,[3] India, and Japan. However, a large percentage of the total energy consumption in Asia is met through non-commercial energy sources such as fuelwood and animal waste. This is particularly the case in South Asia and parts of East Asia (developing countries). Dependence on traditional fuels in South Asia, on an average, is 24.5%. The corresponding figure for East Asia is 11% (UNDP 2005). In the case of countries in West Asia, Central Asia, and the more developed countries of East Asia, reliance on traditional fuels is quite low (Figure 1b).

The fuel mix of the region to a large extent is driven by the resource base of the region. Hence, oil dominates the fuel mix (52%) in West Asia followed by natural gas (45%). In Central Asia, natural gas is the main fuel (54%). In East and

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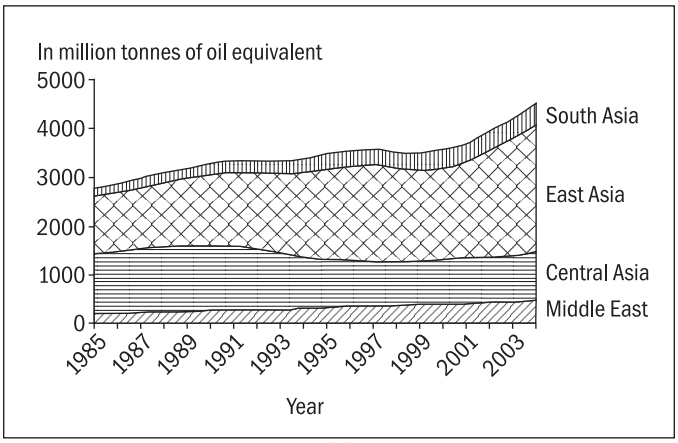
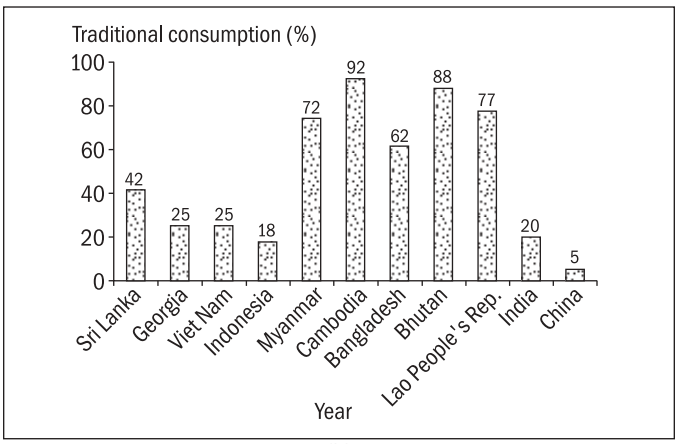
[2]This is based on the definition provided by the Asia Pacific Centre for Energy Security, Hawaii.

[3]Although Russia is considered as part of Europe, for the purpose of this paper, Russia is taken as a part of Asia as a large proportion of the oil and gas reserves of Russia geographically fall in Asia.



(a)



(b)

Figure 1 (a) Energy consumption trends in Asia, and (b) traditional fuel consumption (2002)
Sources BP (2005) and UNDP (2005)

South Asia,[4] coal dominates the fuel mix (about 47%) followed by oil (about 34%). Over the years, there has been an increase in the share of cleaner fuels like natural gas (in other regions of Asia apart from Central Asia) and hydroelectricity, prompted by environmental considerations. Table 1 shows the fuel mix of each of these regions.

In terms of energy intensities (that is, energy consumed per unit of GDP), although India has the highest intensity in South Asia, followed by Pakistan, these two countries have been able to achieve moderate reductions in the past few years. On the other hand, other South Asian countries like Bangladesh, Nepal, and Sri Lanka have comparatively much lower energy intensity values but have recorded a positive growth in their energy intensities. The reason for this is primarily the inefficient use of energy

[4]In Figure 1 and Table 1, South Asia includes just India, Pakistan, and Bangladesh due to limitations in data availability.

Table 1 Fuel mix in Asia in 2004

Million tonnes of oil equivalent	*Oil*	*Natural gas*	*Coal*	*Nuclear energy*	*Hydro-electricity*	*Total*
Central Asia	178	522	174	52	47	973
	18	*54*	*18*	*5*	*5*	
West Asia	251	218	9	–	4	482
	52	*45*	*2*	–	*1*	
East Asia	907	242	1242	115	117	2622
	35	*9*	*47*	*4*	*4*	
South Asia	138	64	208	4	25	440
	31	*15*	*47*	*1*	*6*	
Total Asia	1474	1045	1634	171	193	4517

Source BP (2005)
Note Figures in italics are percentage shares in total fuel mix.

in these countries. Among East Asian countries, Korea's (south) energy intensity values are quite high and it has registered a positive growth at a rate of 0.5%. China, despite being the most energy-intensive country in East Asia, has witnessed a significant decline in its energy intensity (falling at a rate of 5.5% per annum between 1980 and 2003). This has been due to China's multifaceted efforts towards energy conservation. The Central and West Asian countries, on an average, have much higher energy intensity levels. This is due to widespread distortions in energy prices in the region, low cost recovery in case of the electricity sector, and weak energy-efficiency policy, leading to inefficient use of supply. The central command planning in case of the former Soviet Union also contributed to the inefficient use of energy. With transition to market economies, there have been some improvements in energy intensities in the Central Asian region (Figure 2).

Except for the South Asian countries and the developing countries of East Asia, rest of the Asian countries enjoy a much higher per capita energy consumption. Table 2 gives the per capita energy consumption figures for these countries for 2003 and their comparison with the world average of 66.7 mBtu (million British thermal unit) per person. Developing countries of East Asia fare slightly better with China's figures at half of the world average, Thailand's at three-fourth, and Indonesia's at one-third of the world average. In the developed East Asian region, on the other hand, the situation is far better. Per capita energy consumption figures in Japan and South Korea are more than 2.5 times the world average. Almost all the West and Central Asian countries record very high per capita energy consumption due to their big oil and natural gas reserves. Despite the fact that the South Asian region is rich in coal reserves, per capita energy

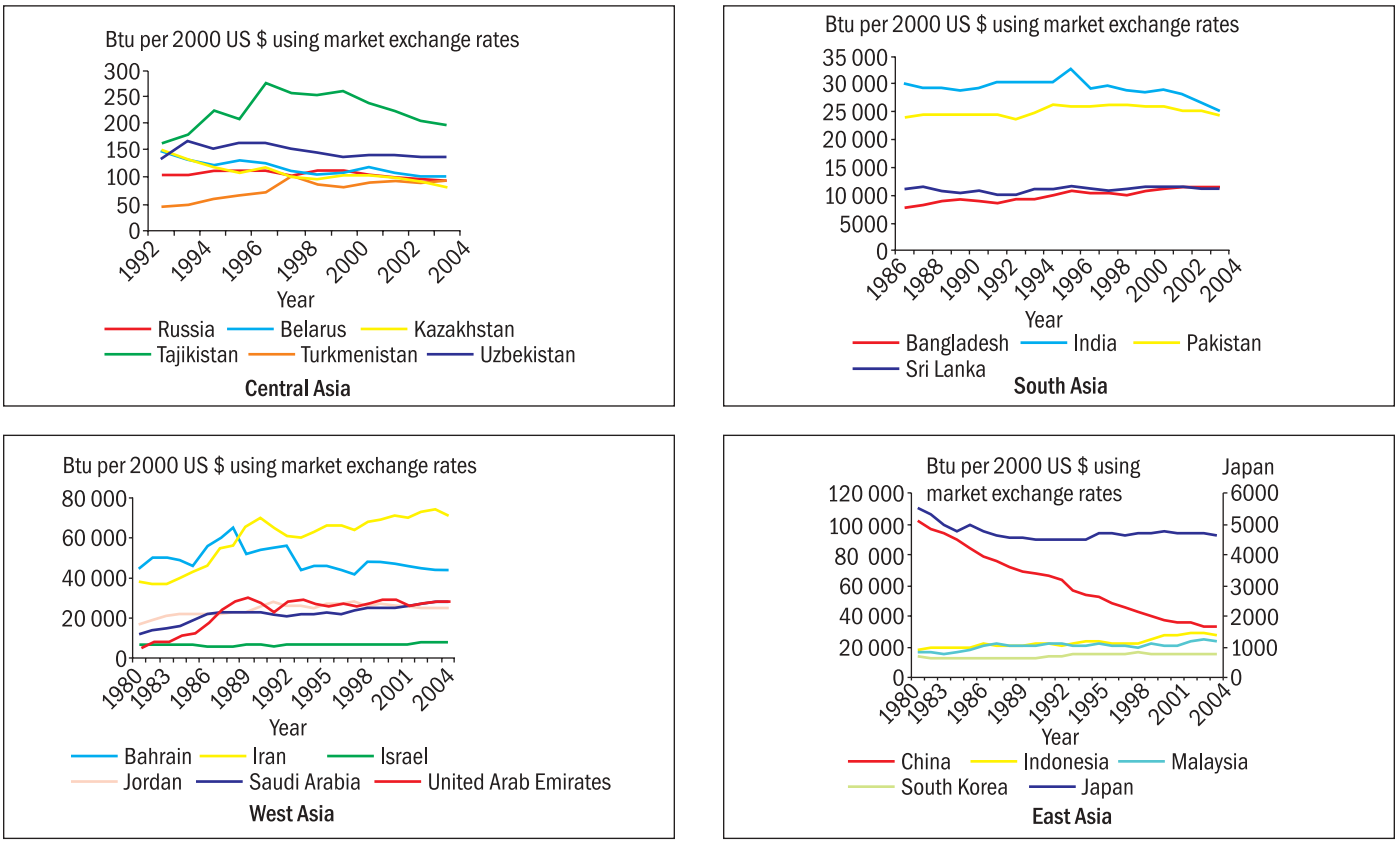


Figure 2 Energy intensities in the Asian region
Source EIA (2005)

consumption in these countries is much below the world average on account of very high population figures, with Nepal having the lowest per capita consumption of four per cent of the world average. India's and Pakistan's per capita energy consumption is about 20% of the world average. This clearly shows that the South Asian countries have a great potential towards increased future per capita energy demand.

Projections for energy demand in the Asian region are given in Table A.1 in the appendix. As far as the projections on primary energy demand are concerned, maximum growth is projected for South Asia between 2002 and 2030 at a compound annual growth rate of 2.5%. Among the various commercial fuels in this region, demand for renewables is projected to grow at the fastest pace followed by nuclear energy, gas, and oil. The US Department of Energy and the IEA (International Energy Agency) expect the Indian oil demand to be amongst the fastest growing in the world, growing at nearly four per cent annually, till 2025. Combined with essentially flat or declining oil production, imports will account for 85% of the total oil demand by 2025, most of which will have to come from the Middle East, Central Asia, and Africa (Herberg 2004/05). In the Central Asian region, demand for oil and gas is going to dominate over other fuels. In West Asia, demand for gas, biomass, and renewables is projected to grow very fast. In East Asia, apart from coal, demand for gas is estimated to grow the fastest. Demand for nuclear energy, hydropower, and other renewables is also expected to grow at a very fast pace.

In terms of hydrocarbon resources, Asia is amongst the most richly endowed regions in the world (Figure 3). It accounts for over 70% of the world's oil reserves, of which 84% are in West Asia. Other Asian countries that have some oil reserves are Russia and Kazakhstan in Central Asia, China, Malaysia, and Indonesia in East Asia, and India in South Asia. Asia accounts for over 75% of the world's natural gas reserves, of which about 51% are in West Asia and 41% in Central Asia. Similarly, Asia has the largest coal reserves (490 billion short tonnes) with majority existing in China, India, and Russia (EIA 2005). The Asian region is also richly endowed with hydropower. It accounts for about 35% of the world's technically exploitable potential (TERI 2002). Almost 45% and 15% of this potential lies in China and India, respectively. However, much of this hydropower potential remains unexploited due to high upfront

Table 2 Per capita energy consumption for Asia in 2003

Region	*Million British thermal unit*	*Per cent of world average*
Central Asia		
Azerbaijan	75.8	114
Russia	202.9	304
Turkmenistan	154.6	232
Uzbekistan	82.4	124
West Asia		
Qatar	812.9	1219
Iran	87.6	131
Saudi Arabia	235.0	352
United Arab Emirates	725.0	1087
East Asia		
China	34.9	52
Japan	175.6	263
Indonesia	21.5	32
Thailand	49.7	75
South Korea	181.0	271
South Asia		
Bangladesh	4.2	6
India	13.2	20
Nepal	2.5	4
Pakistan	12.4	19
Sri Lanka	10.3	15

Source EIA (2005)[5]

costs, environmental concerns, planning and management concerns, etc. In terms of electricity, the total generation in 2002 was to the tune of 5868 billion kilowatt-hours. Of this, about 74% was generated through conventional thermal power plants, 13% through hydroelectric power plants, and 12% came through nuclear generation.

Despite the vast energy resources that the region has as a whole, there are significant geographical variations and concentrations. Central and West Asia are rich in oil and gas resources, and southern and eastern Asian countries are big consumers of their oil and gas. South and East Asia (in particular, China and India) are among the fastest growing regions of the world and would require increasing supplies of energy to fuel their growth. At the same time, most nations in the region are facing increasingly insufficient energy supplies. A number of Asian countries are facing energy shortfalls, largely in the form of power shortage. Dependence on energy imports is fast becoming a concern, in particular in the South and East Asia. This trend raises concern over the issue of energy security for the Asian countries. While it is important for the individual countries to fulfil their energy requirements, it will be beneficial to pursue energy security through networking and following a collaborative process at the regional level.

[5]Details available at <http://www.eia.doe.gov/pub/international/iealf/tablee1c.xls>, last accessed on 23 January 2006.

Need for collaboration

The huge energy reserves of the Asian region are not yet fully tapped by countries in need. It is well known that Central and West Asia are large energy suppliers, whereas East and South Asia are large energy buyers. Thus, the major challenge is how to collaborate in the use and management of natural resources. Also, while East and South Asia are large buyers in the world energy market, they are not very influential. The reason for this is the lack of an effective collaborative mechanism. In most cases, importing Asian countries have their own strategies and policies, and act independently in terms of energy exploration, R&D in energy saving technology, etc. Since most of the South and East Asian countries are now facing the same situation of heavy dependence on oil imports, jointly exploring worldwide energy reserves and integrating energy infrastructure are the best ways to deal with the problem of energy insecurity. In recent years, many Asian countries have initiated various bilateral and multilateral energy cooperation programmes and proposals. It is felt that Asian countries should establish some sort of an energy community, which could serve as a platform to discuss ways to ensure constant, stable, and transparent energy relations.

Asia's energy security strategies

Various policy measures are already being worked out to secure energy supply in the region. A few policy responses and activities that have already contributed and can further contribute towards energy management in Asia in a much better way are discussed in the subsequent sections.

Resist supply shocks

The Asian economies are likely to become increasingly vulnerable to oil supply disruptions in the coming decades. The potential economic costs from oil supply interruptions can be limited through emergency preparedness and response measures, both long- and short-term in nature. Long-term measures include diversification of oil-import sources, improving oil efficiency, removing market impediments, investing in alternative energy technologies, maintaining dialogue with oil producers, and also exploring opportunities of

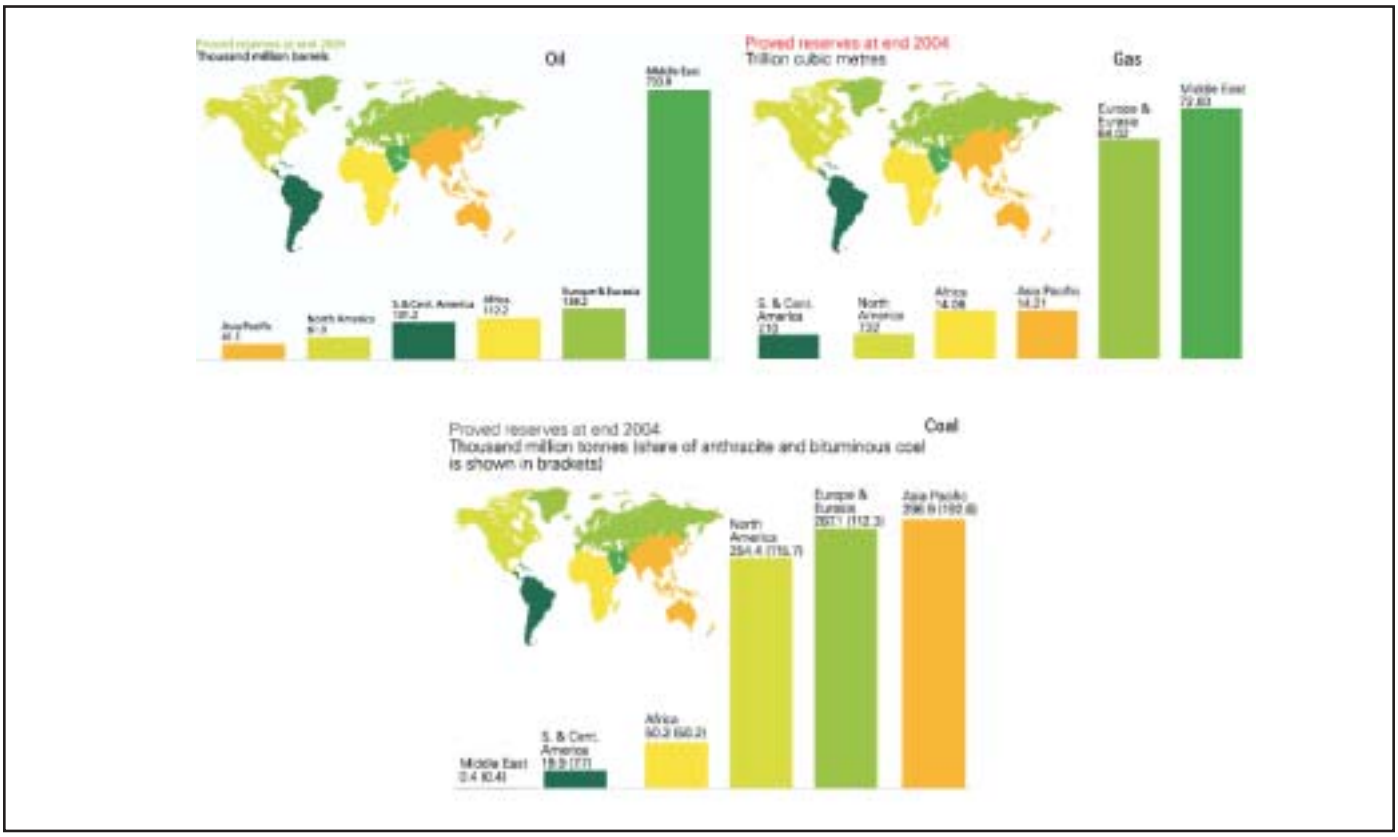


Figure 3 World proven oil, gas, and coal reserves by region
Source BP (2005)

cross-country oil and gas pipelines for meeting the increasing demands. While such long-term measures can reduce the likelihood or severity of oil supply interruptions, they are of limited help in the short term, once the oil supply is curtailed, prices skyrocket, and investments cancelled in the face of market uncertainty. Emergency response measures that could be implemented to alleviate the short-run oil supply and demand imbalance situations include fuel switching, surge production, and emergency oil stocks.

The APERC (2002) summarizes that because of low short-term price elasticity of oil demand, oil supply shortfalls would induce a disproportionately higher price increase. Under these circumstances, oil stockpiling generally has some advantages over other alternative response measures. First, as compared to fuel switching or stand-by production, oil stockholding is more openly available to many oil-consuming economies. Second, compared to the demand restraint, oil stocks are more visible and transparent, and would affect market perceptions more effectively. The IEA experience shows that its members' emergency reserve commitments are exclusively met by holding stocks. The ACD (Asia Cooperation Dialogue) Energy Working Group, established in 2001 with the objective of exploring possibilities of creating cooperation within the energy sector, agreed to study the possibility of joint stockpiling as one of the measures in ensuring a reliable supply of oil (Fui 2005). With the rising oil demand in Asia, equity stakes in oil are also seen as one of the major strategies to secure energy supplies.

Energy strategy for East Asian countries

China

China's strategy in securing its energy supplies has become increasingly coherent and wide-ranging over the past decade and is growing in reach and sophistication. The country has pursued its energy security on a wide range of fronts. Firstly, it has sought to strengthen its supply relationships in key areas such as the Persian Gulf, while diversifying the geographic distribution of its crude oil supply and transportation routes. For example, the Chinese state oil companies like CNPC (China National Petroleum Corporation) and Sinopec have broadened their crude sources by increasing imports from West Africa and

even Latin America. In the Persian Gulf, the Chinese have rapidly expanded their role in various phases of Iran's oil industry while boosting long-term crude supply contracts with Saudi Arabia, Oman, and Yemen. In the long run, China is seeking to increase the pipeline supplies from Russia's East Siberia and western Kazakhstan through long-distance pipeline projects, which would have the added advantage of reducing vulnerability to disruptions in tanker flows from the Persian Gulf and Africa (Speed and Vinogradov 1998). Secondly, state oil companies such as CNPC, Sinopec, and CNOOC (China National Offshore Oil Corporation) have been buying equity stakes in many existing or prospective oil fields around the world. China has also pursued an equity gas strategy getting upstream equity stakes in LNG (liquefied natural gas) projects destined to bring LNG to China beginning 2007, from Australia and Indonesia (Herberg 2004/05). The country has established a very strong position in its largest foreign operation in Sudan, including oil production, exploration, and construction of pipelines, refineries, and ports. Thirdly, China's energy strategy also involves extensive cross-investment and commercial ties between China and major exporting countries in order to cement strong long-term ties. China's state oil companies, with related construction and oil-service companies, have bid for oilfield development contracts, pipeline contracts, and refinery projects in Iran, Sudan, Kazakhstan, Kuwait, and many other countries.

Japan

Through its involvement in the IEA, Japan has helped coordinate member-country responses to the global oil supply disruptions and strategic stockpile releases. It is also involved with the APEC (Asia-Pacific Economic Cooperation) energy monitoring efforts. Japan has developed a large strategic stockpile of oil, equivalent to 120 days of import supplies, as part of its commitments with the IEA. The country has managed to acquire a number of other fairly modest equity oil supplies elsewhere, including a share in the ExxonMobil; Sakhalin 1 project in Russia through the Japanese consortium Sodeco; an approximate 100 MBD (million barrels per day) share for Inpex in Indonesia; and 200 MBD for the Japanese consortium Jodeco in the United Arab Emirates (Ibid). Despite a poor record for gaining national control over oil production abroad, Japan seems to be stepping up its efforts to compete with China's increasingly active efforts in the region and overseas.

South Korea

South Korea has recently joined the IEA and has taken on the commitments to coordinate the oil supply efforts with other industrial countries in the event of a supply disruption. It has also built a strategic oil stockpile equivalent to 90 days of import supplies, in line with its IEA commitments. This more cooperative approach to energy security is also evident in South Korea's leadership in forwarding proposals for a large regional gas pipeline to bring the Russian gas to China and South Korea, and possibly even to Japan.

Energy strategy for South Asian countries

South Asian countries are also deploying coherent energy securing strategies. The SARI-Energy (South Asia Regional Initiative for Energy) programme is working to expand and improve access to economic and social infrastructure in the energy sector. The SAREC (South Asia Regional Energy Coalition) established by the US Chamber of Commerce Coalition is a networking mechanism through which the public and private sector stakeholders can influence regional energy policy and reform throughout South Asia.

India

India's growing dependence on imported oil supplies has recently catalysed a credible strategy to secure supplies overseas. India's first LNG import terminal Petronet, a joint venture between India's state oil and gas companies ONGC (Oil and Natural Gas Corporation), GAIL (India) Ltd, IOC (Indian Oil Corporation), BPCL (Bharat Petroleum Corporation Ltd) along with Gaz de France began operation in the late 2003 and is importing gas from Qatar. ONGC, India's major state-owned oil exploration and production company, is beginning to stake out new overseas oilfield investment plans through its international subsidiary ONGC Videsh Ltd. Lately, the Iran–Pakistan–India pipeline has received a lot of attention, which is a proposal to connect the South Pars Gas field with HBJ (Hazira–Bijaipur–Jagdishpur) pipeline in India. Yet another pipeline that is being discussed in the South Asian region is the India–Bangladesh natural gas pipeline. However, each of these proposals has serious geo-political implications, and the outlook for pipeline supplies will depend upon resolving key regional geopolitical rivalries and constraints. The large majority of India's future gas imports will necessarily come from the Persian Gulf, with lesser amounts possible from Central Asia and

neighbours like Pakistan and Bangladesh. India's largest oil stake to date is its 25% share in the Greater Nile Oil Project in Sudan in partnership with CNPC (*Petroleum Intelligence Weekly* 2004). India has also bought 20% share of the ExxonMobil-led Sakhalin 1 project for 1.7 billion dollars, which is an oil and gas development project on the north-east shelf of Sakhalin island. Through this project, India has acquired oil equity and participation in 15 projects in over a dozen countries. In an attempt to create a sense of Asian identity in the global oil market, a round table was convened by the ex-petroleum minister Mr Mani Shankar Aiyar in 2005, for the principal West and South East Asian suppliers, four principal North and Central Asian suppliers, and Asian oil consumers. With more than 50% of its total oil supplies now sourced from the Middle East, India has announced plans for a strategic oil stockpile, but it has not moved ahead as yet.

While the countries mentioned above have undertaken several initiatives, it is felt that many more such measures can be implemented to solve energy security issues in the region. Moreover, many investment measures are independent government initiatives, and not strictly collaborative. Governments need to be more proactive in collaborating not only for long-term policies such as building of an oil/gas pipeline, or diversifying amongst importers but also for measures, such as stock draw downs, maintenance of sufficient foreign exchange reserves to face any acute energy shortage, etc.

Promoting cleaner use of coal

Coal is a legitimate source of energy in Asia for both economic and security reasons. Relatively cheap and regionally abundant, it accounts for 40% of the Asia's energy consumption (compared to 24% globally), driven by China and India, where coal accounts for roughly two-thirds and one-half of the total energy needs, respectively. Asia's demand for coal has increased at an annual average rate of six per cent between 1980 and 2002 as compared to the world average of 1.5% (Herberg 2004/05). The US Department of Energy forecasts that Asia's coal consumption will nearly double by 2025 and will still account for 38% of the region's energy consumption. Asia alone, mainly China and India, is expected to account for 80% of the world increase in coal demand between 2001 and 2025 (Figure 4).

In view of the significant environmental impact of coal usage, cleaner use of coal should be promoted.

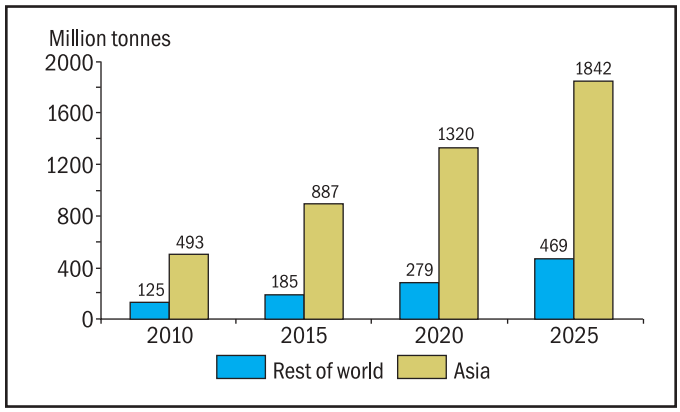


Figure 4 Projected growth in coal consumption in Asia
Source EIA (2004)

However, among the developing Asian countries, except China, not many countries have adopted clean coal technologies. In India, efforts to embark upon such technologies have not been very substantial due to insufficient R&D and also due to the quality of Indian coal. Recently, NTPC (National Thermal Power Corporation) and BHEL (Bharat Heavy Electricals Ltd) are conducting feasibility studies on the usage of clean coal technologies for heat generation.

China has undertaken bilateral efforts to facilitate access to clean coal technologies. Multilateral institutions, such as development banks and the GEF (Global Environment Facility), have also been active in this field. China has been host to the largest-ever GEF project launched in 1996 to introduce efficient industrial boilers in the country. As noted by the designers of the original GEF project: 'If the thermal efficiency of the current stock of industrial boilers in China could be raised to those of similar sizes in the developed countries, coal consumption by small boilers could be reduced by 60 million tonnes per year: a saving of about 17%' (GEF 1996). In 2001, China expressed its desire to explore measures to accelerate the deployment of clean coal technologies and requested the IEA to look into this and help develop recommendations on the same. A study was carried out in collaboration with the World Bank, the Asian Development Bank, and the United Nations Development Programme as well as with the European Union, Australia, Germany, Japan, the Netherlands, the UK, and the US for promoting clean coal technologies in China. All such programmes considered aimed at assisting China in improving the environment (OECD 2005).

Mixed successes of bilateral efforts to bring clean coal technologies to China, and the impressive success of

the GEF project on industrial boilers in China suggest that coordinated, sustained, and systematic efforts are needed, and that they must be driven by host countries' needs and take into account diverse national circumstances. For India, there is an urgent need to identify, develop, and commercialize advanced coal technologies suitable for India's high-ash and low-sulphur coal. It is worth mentioning at this point that world's four largest coal-consuming nations have announced a pact to share technology for limiting greenhouse gas emissions. The pact known as Asia-Pacific Partnership for Clean Development and Climate has been signed by Australia, China, India, and the US along with Japan and South Korea.[6] The partnership aims to promote development and transfer of cleaner, more efficient technologies that can address emission mitigation and energy security issues that are crucial not only to the region but to the entire world as well.

Basic research needs to be encouraged in all aspects of coal combustion, gasification, CO_2 (carbon dioxide) capture and storage, as well as material technology. Greater international cooperation in technology development and deployment in Asian markets can be pursued through knowledge sharing as well as technology transfers.

Developing alternative sources of energy

Renewable energy has accounted for five per cent of the world's TPES (total primary energy supply) in 1999. Over the next decade, renewable energy is projected to increase at an average annual rate of 2.3% globally. According to the IEA estimates (IEA 2001), over the next decade, maximum growth in renewables is expected to occur in the Asian region. In nuclear energy, maximum growth is expected to take place in China, Japan, South Korea, and India. Hence, while there is marked potential to explore renewable energy, there are significant obstacles in the form of structural, policy, and financial barriers to the accelerated development of clean and renewable energy technologies. Present status of renewables in some of the countries are discussed below.

China

China is rich in hydropower, wind, solar, geothermal, and biomass resources. At the end of 1993, the Chinese government estimated that it had approximately 77 MW (megawatts) of installed renewable capacity, with wind and geothermal accounting for the largest shares. In 2003, China's renewable-energy-based power generation was equivalent to just 52 million tonnes of standard coal, about three per cent of the country's total power generation. By 2020, it is expected to increase to 10%.[7] China has established nuclear cooperation agreements on the peaceful use of nuclear energy with approximately 20 countries. Some of these countries are Bangladesh, Indonesia, Iran, Japan, Pakistan, Russia, South Korea,[8] etc. China is also partnering with South Korea for R&D on hydrogen production. China's landmark Renewable Energy Law took effect on 1 January 2006, prompting the government to issue a number of pertinent new rules and technical criteria. In particular, financial subsidies and tax incentives for development of renewable energy sources – including wind power, solar energy, biomass, and others – are in the enactment process.[9]

India

In order to meet its growing energy needs, India has adopted a blend of thermal, hydroelectric, and nuclear sources for power generation, as well as such alternative energy sources as solar, wind, and tidal energy. The MNES (Ministry of Non-conventional Energy Sources) has laid out a series of financial incentives to attract investors.

Bhutan and India have established bilateral exchange of hydropower. India has been purchasing most of the energy generated from the 336-MW Chukha hydroelectric project in Bhutan through the 220-kV (kilovolt) transmission lines. Another 1020-MW Tale hydropower project is under construction under the technical and economic cooperation between India and Bhutan.

South Korea

South Korea had an ambitious programme on RETs (renewable energy technologies) and 32 projects have been taken up by the government during 1989–95, with a budget of about 3.2 billion won allocated for solar thermal applications. This resulted in indigenously developed solar water heaters, 26 700 units of which have been installed so far (Song 1996). South Korea has a one-billion-dollar R&D and demonstration programme aiming to produce

[6] Details available at <http://www.newscientist.com/channel/earth/climate-change/dn7744>. Last accessed on 8 December 2005.
[7] Details available at <http://www.chinaembassy.org.in/eng/ssygd/China%20in%20Diagrams/t190356.htm>. Last accessed on 1 February 2006.
[8] Details available at <http://www.nti.org/db/china/nca.htm>. Last accessed on 31 January 2006.
[9] Details available at <http://www.worldwatch.org/features/chinawatch/stories/20060118-1>. Last accessed on 28 January 2006.

commercial hydrogen using nuclear heat by about 2020.[10]

Nepal

In Nepal, the commercial production and marketing of flat-plate solar collectors for domestic water heating is becoming a mature industry with more than 40 manufacturers in the field. Nepal also has a total of 933 units of micro-hydro turbines, with an installed capacity of 9 MW, majority of which are used for agro-processing. Bilateral cooperation also exists between India and Nepal in case of electric power. The power exchange agreement signed by India and Nepal in the 1970s provides for an exchange of up to 50 MW. Nepal also utilizes about 70 GWh (gigawatt-hours) of energy over a 132-kV transmission line from the Tanakpur project in India in accordance with the provision made under Mahakali treaty between Nepal and India.

Viet Nam

Viet Nam has completed a village electrification project, which was carried out by the Viet Nam Women Union in collaboration with the SELF (Solar Electric Light Fund), USA (Bhattacharyya and Kumar [undated]). In this project, 200 homes were provided with a 22-watt solar home lighting kit with DC/DC couplers for portable radios and connections for DC black-and-white TVs. All the systems were sold to the customers who paid a 20% down payment and a monthly repayment of about six dollars. Training, technical, and maintenance assistance to the local technicians were provided, which is seen as vital for the success of the programme. Viet Nam has also signed a nuclear cooperation agreement with South Korea. It is undertaking a pre-feasibility study on a nuclear power plant with two 1000-MWe reactors to come on line by 2012.

The South Asian region, in particular, has a great potential for renewable energy, which has not been tapped to a substantial extent. Natural resources, such as water potential of Bhutan, India, Nepal, and Pakistan and natural gas of Bangladesh and Pakistan, are in abundance for generation of power, which can be of tremendous benefits to the region. Collaboration in this sector can include comprehensive resource assessments of material, manpower, and technology in the region; joint R&D, consultancy; human resource development activities, and sharing of experiences for mutual benefit.

[10] Details available at <http://www.uic.com.au/nip02.htm>. Last accessed on 31 January 2006.

Taking the 'top-runner' approach in energy conservation and efficiency

Asian countries, with their growing energy consumption, need to concentrate on actions aimed at improving energy efficiency and conservation. In this context, it should be mentioned that in China, considerable efforts have been taken in developing institutional capacity for promoting energy efficiency from the 1990s. Over 200 energy conservation technology service centres were created and attached to various ministries and municipal governments. These service centres worked most closely with the end-users. In May 1994, a national centre, The Dalian Chinese Energy Conservation Education Centre, was established and is apparently China's largest and most advanced efficiency training facility. In 1998, the National Energy Conservation Law came into force, codifying the country's approach for promoting energy efficiency under a more market-oriented economic system (Sinton, Levine, and Qingyi 1998). It is worth noting that between 1990 and 2003, China's energy intensity declined at a rate of 5.5% on an average annual basis.

In Korea, the MoCIE (Ministry of Commerce, Industry and Energy) is responsible for developing and implementing energy policies and programmes, maintaining energy security, administrating energy industry, supporting R&D of new energy technologies, and formulating international cooperation on energy-related matters (APEC 2003). The Ministry has promulgated the REUA (Rational Energy Utilization Act) in December 1979 in an attempt to ensure energy security in an emergency situation as well as to promote energy efficiency and conservation.

Considering the vast potential of energy savings and benefits of energy efficiency, the Government of India enacted the Energy Conservation Act, 2001. The Act provides for a legal framework, institutional arrangement, and a regulatory mechanism at the central and state levels to embark upon an energy-efficiency drive in the country. The central government formally appointed a bureau called the BEE (Bureau of Energy Efficiency) to implement the Act. The primary objective of the BEE is to reduce energy intensity in different sectors of the Indian economy.

It is essential to vigorously pursue a bold 'top-runner approach' where sectors, such as heavy industries, including steel, paper and pulp, cement, and products such as automobiles and home appliances should aim at the highest possible standards of energy efficiency. The approach could include both legally binding regulation, voluntary

targets for businesses, and economic incentives. Japan, for example, offers not only a model for others to follow but also can provide expertise in this effort. Exchange of ideas through case studies and best practices might help in suitable energy-efficient policy formulation in various sectors within the region.

Summary and conclusion

To summarize, it can be said that energy security in the Asian region remains a complex and multifaceted challenge due to the diverse scale and scope of national interests. This paper has highlighted the Asian energy outlook and the major strategies in place and those that need to be undertaken to secure regional energy security through collaboration. The policy responses discussed in this context include strategies such as resisting supply shocks; promoting cleaner fuel use; harnessing huge renewable energy potential that exists in the region, and finally demand-side-management issues like energy conservation in energy-intensive sectors. It is felt that in years to come, there will be a need to further emphasize intergovernmental partnerships on energy security issues; diversify energy resources to include nuclear and renewables; maintain strategic oil stocks in a regional context, focus on R&D; and further explore the scope for India–China energy partnerships. Hence, it is urgent for the Asian countries to establish an effective mechanism for collective action on the energy front.

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Appendix

Table A.1. Energy demand projections for Asia (million tonnes of oil equivalent)

Year	*1971*	*2002*	*2010*	*2020*	*2030*	*CAGR 2002–30* (%)
Central Asia*						
Total primary energy demand	**814**	**1030**	**1186**	**1358**	**1499**	**1.3**
Coal	302	194	219	227	217	0.4
Oil	278	222	265	312	362	1.8
Gas	197	504	578	685	782	1.6
Nuclear	2	69	77	80	71	0.1
Hydro	13	24	29	31	32	1.0
Biomass and waste	24	16	17	19	25	1.6
Other renewables	0	0	3	4	8	13.6
Power generation	263	527	591	656	702	1.0
West Asia						
Total primary energy demand	**51**	**407**	**524**	**695**	**809**	**2.5**
Coal	0	8	9	12	14	2.0
Oil	38	206	257	325	374	2.2
Gas	11	189	250	349	405	2.8
Nuclear	0	0	2	2	2	–
Hydro	0	1	2	3	3	4.0
Biomass and waste	1	2	2	3	7	4.6
Other renewables	0	1	1	2	3	4.0
Power generation	8	118	153	198	244	2.6
East Asia						
Total primary energy demand	**850**	**2496**	**3158**	**3936**	**4684**	**2.3**
Coal	275	944	1184	1483	1794	2.3
Oil	301	819	1038	1281	1498	2.2
Gas	8	217	318	455	573	3.5
Nuclear	2	124	174	216	263	2.7
Hydro	12	39	52	72	89	3.0
Biomass and waste	251	334	360	378	392	0.6
Other renewables	0	21	33	51	75	4.7
Power generation	126	881	1241	1697	2154	3.2
South Asia						
Total primary energy demand	**211**	**644**	**797**	**1024**	**1283**	**2.5**
Coal	36	181	211	277	369	2.6
Oil	28	144	197	271	345	3.2
Gas	3	52	82	134	190	4.7
Nuclear	0	6	14	21	32	6.2
Hydro	3	8	15	21	24	4.0
Biomass and waste	141	252	278	299	318	0.8
Other renewables	0	0	1	2	4	10.5
Power generation	14	180	247	361	513	3.8

Source IEA (2004)
**Note* Central Asia includes all transition economies.[11]

[11] Transition economies as defined by the IEA include Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Estonia, Georgia, Kazakhstan, Kyrgyszstan, Latvia, Lithuania, Macedonia, Moldova, Romania, Russia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, and Yugoslavia.

REEEP–South Asia Secretariat hosted by AEI

What is REEEP

REEEP (Renewable Energy and Energy Efficiency Partnership) is a public–private partnership and was launched by the UK along with other partners at the Johannesburg World Summit on Sustainable Development in August 2002. In June 2004, REEEP was formally established as a legal entity in Austria with the status of an international non-governmental organization. The partnership actively structures policy initiatives for clean energy markets and facilitates financing mechanisms for sustainable energy projects. The partnership is funded by a number of governments, including Austria, Canada, Ireland, Italy, Spain, the Netherlands, the UK, the US, and the European Commission.

Goals

By providing opportunities for concerted collaboration among its partners, REEEP aims to accelerate the marketplace for renewable energy and energy efficiency. Its goals are to

- reduce greenhouse gas emissions,
- deliver social improvements to the developing countries and countries in transition by improving access to reliable clean energy services and by making REES (renewable and energy efficiency systems) more affordable, and
- bring economic benefits to nations that use energy in a more efficient way and increase the share of indigenous renewable resources within their energy mix.

REEEP regional secretariats

REEEP's regional secretariats provide access to best practice in policy and finance to promote renewable energy and energy efficiency. At present, REEEP has eight regional secretariats in Central Europe, East Asia, Latin America and Caribbean, North America, Russia and the former Soviet Union, South Africa, South Asia, South East Asia, and the Pacific.

REEEP–South Asia Secretariat

REEEP activities have been initiated in South Asia with the formal launch of the South Asia Secretariat on 30 November 2005 at TERI premises, New Delhi, India. REEEP South Asia Secretariat is hosted by the AEI.

The REEEP–South Asia Secretariat endeavours to provide a fillip to the regional activities built around renewable energy and energy-efficiency development. This will be achieved through

- creating a forum for leading energy experts and decision-makers to discuss and promote the role of renewable and energy-efficient technologies,
- communicating relevant information and data to governments, financial institutions, and industry leaders, and
- developing cooperation with relevant international and regional organizations and financial institutions.

In order to increase the reach as well as to share information within partners and with other stakeholders, a REEEP South Asia website has been been set up.* The website would provide a platform to share information on best practices, case studies, policies and regulations, and achievements in energy efficiency and renewable energy in the countries of the region; and also generate discussion on pertinent issues in the South Asian context. It also links with the REEEP International website.

*www.aeinetwork.org/reeep

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