SAARC Energy Centre

Special Reports

Developing Integrated Energy Policies in South Asia

by
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Report No. 1

March 2008

The South Asian Association for Regional Cooperation (SAARC) was established on December 8, 1985. It comprises eight countries of South Asia, namely, Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. SAARC provides a platform for the peoples of South Asia to work together in a spirit of friendship, trust and understanding. It aims to accelerate the process of economic and social development in Member States.

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SEC Special Reports

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Editor: Arshad M. Sheikh.

DEVELOPING INTEGRATED ENERGY POLICIES IN SOUTH ASIA

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Summary

The focus of energy policy in most countries of the world has usually been to ensure adequate energy supplies to meet their own demand, except for the energy resource rich countries with large export potential. The South Asian nations have traditionally been meeting their energy needs from domestic sources, such as firewood, biomass and hydropower in almost all of the countries, and coal as well in India. Oil became an important source of energy during the past 80 years, and natural gas during the past forty. In spite of a tripling of the region's population, and a doubling of per capita income over the last few decades, the South Asian countries have been able to meet their energy requirements largely from domestic resources. However, the the increased use of biomass, in general, and also coal in India are the major factors in rising air pollution, deforestation, land degradation, and loss of ecosystems. Switching over from "traditional" modes of transportation to motor vehicles that used oil products contributed not only to air pollution but also to greater dependence on imported oil. Further, it helped change the nature of South Asian cities by following the pattern of industrialized countries in the form of urban sprawl, clogged roads, and long daily commutes.

As in many other parts of the world, policies in South Asia are usually designed on a sector-wide basis, e.g. there is a policy for energy, one for environment, another for transportation, and yet another for technology development. Further, the relations between the South Asian countries were usually determined by political issues, rather than by those relating to economic development, where the role of energy is crucial. This paper suggests a more integrated approach to energy policy, both in terms of integration across sectors, and across the countries of South Asia, which are defined here to include the eight member countries of the South Asian Association for Regional Cooperation (SAARC) --- Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

Introduction

The pace of economic and technological development in South Asia has accelerated during the early years of the 21st Century. The announcement of India and Pakistan as nuclear weapon states has been followed by the recognition of India as a powerhouse in the Information technology area, and an awareness that it is now competing with the industrialized countries in ensuring its energy supplies for the future. Although India is by far the largest country in the region, the combined population of Bangladesh and Pakistan exceeds that of the United States. Even excluding India, the total population of the member countries of the SAARC is comparable to that of the European Union.

The availability of energy is an important factor for the further economic development of South Asia. How much more energy will the region need during the next 10-30 years, and from where will this energy be supplied? The answers to both questions depend on a lot of factors. In the limited space available here, we shall discuss only a few of these factors.

Energy and Economic Development

The per capita use of energy in South Asia is still very low, about half a ton of oil equivalent per year, only one-tenth of that in most European countries, and about 6% of that in the United States[i]. These roughly parallel the Gross National Incomes (GNI) of the countries mentioned, as shown in Table 1. Starting from a relatively low base, the GNI in the South Asian countries is growing at a rate exceeding 5% per annum. Increasing this rate of growth will require considerable increases in energy use.

It should be noted that Table 1 includes commercial as well as “Traditional” biomass fuels, mainly firewood, agricultural wastes, and animal wastes. Biomass fuels still provide more energy than commercial energy sources in Afghanistan, Bhutan and Nepal, and a substantial share of the total energy consumption in the remaining South Asian countries, as shown in Figure 1.

Table 1. Energy and Economic Indicators for the South Asian Countries

Country	Population[1,2]	Energy Use			Energy Use	Gross National Income[1]	
		Commercial[2,3]	*Biomass*[2]	*Total*	*Per Capita*	*Traditional*	*PPP*[#]
	(millions)	(million tons oil equivalent)			tons oil equivalent	(US$ per capita)	
Afghanistan[2]	22.2	0.4	6.9	7.3	0.33	186	N.A.
Bangladesh	141.8	18.5	16.6	35.1	0.25	470	2,090
Bhutan[2]	0.7	0.2	0.3	0.5	0.71	1,400	N.A.
India	1,094.6	423.2	106.0	529.2	0.48	730	3,460
Maldives[2]	0.3	0.3	0.2	0.5	1.67	1,800	N.A.
Nepal	27.1	1.1	7.4	8.5	0.31	270	1,530
Pakistan	155.8	58.0	23.4	81.4	0.52	690	2,350
Sri Lanka	19.6	3.8	3.6	7.4	0.38	1,160	4,520

Note: All data are for the most recent year available.

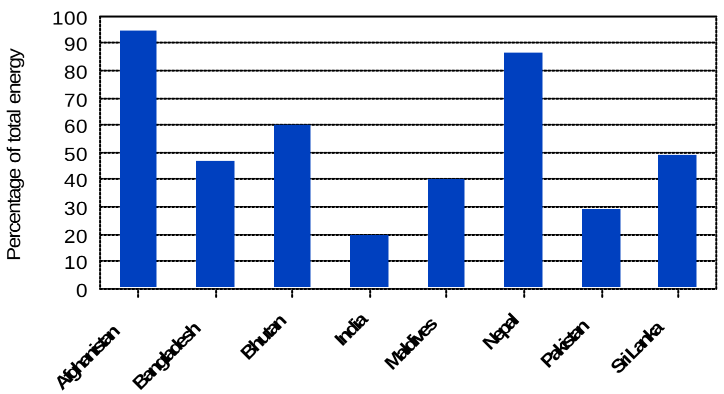
N.A. = Data are not available.

 # Puchasing Power Parity

Sources

1. World Bank (2007). World Development Indicators.
2. SARI/E (2005), Energy Security for South Asia.
3. BP (2007). BP Statistical Review of World Energy June 2007.

Figure 1. Share of total energy supplied by biomass in South Asia



Source: Toufiq Siddiqi, East West Center, based on data from SARI/E (2005) and BP (2007)

In discussions of energy policy, the focus is usually on meeting the needs of industry and the urban areas, but in the context of South Asia, we have to address the question of ensuring the availability of adequate amounts of energy for the rural areas as well, which currently rely heavily on firewood and agricultural and animal wastes. Firewood supplies are not increasing, and frequently decreasing, due to changes in land use from forests to agriculture and housing. As the population of the rural areas also increases in absolute numbers, in spite of the migration to urban areas, the rising energy needs of the rural population also will have to be met. In what form can the additional energy be supplied to both urban and rural areas needs an answer.

As far as commercial energy is concerned, every major source is used in South Asia, but the relative importance of each source varies from one country to another. The amount of energy provided by each commercial energy source is shown in Table 2. The Tables 1 and 2 reflect the most recent data available for each country. The data for the three most populous countries, Bangladesh, India, and Pakistan, are for 2006, from BP (2007)[ii], whereas those for the other countries are for 2003-2004 from SARI/E (2005)[iii] and EIA (2006)[iv]. The contributions of wind and solar energy are not included in the Tables, since these are still quite small, although increasing at a fast rate, particularly in India.

Table 2. Consumption of Primary Commercial Energy in South Asia

Country	Oil^	Nat. Gas	Coal	Hydro	Nuclear	**Total Cons.**
		(million tonnes oil equivalent)				
Afghanistan	1.8	0.3	0.1	0.1	0.0	2.3
Bangladesh	4.1	13.7	0.4	0.3	0.0	18.5
Bhutan	0.1	0.0	*	0.1	0.0	0.2
India	120.3	35.8	237.7	25.4	4.0	423.2
Maldives	0.3	0.0	0.0	0.0	0.0	0.3
Nepal	0.8	0.0	0.2	0.2	0.0	1.2
Pakistan	18.4	27.6	4.0	7.4	0.6	58.0
Sri Lanka	3.0	0.0	0.0	0.8	0.0	3.8

*= small amount.
^ oil includes oil products

Sources: BP (2007) for data on Bangladesh, India, and Pakistan for 2006.
ADB (2006) for Afghanistan data for 2002.
SARI/E (2005) for data on Bhutan, Maldives, Nepal, and Sri Lanka

Coal is by far the largest source of commercial energy in India, whereas oil plays this central role in the commercial energy supplies of Afghanistan, Maldives, Nepal and Sri Lanka. Natural gas is the largest source of commercial energy in Bangladesh and Pakistan. Bhutan relies about equally on oil and hydropower.

Options for Meeting Future Energy Needs

Energy use in South Asia has been increasing at over 5% per annum during recent years. The countries of the region are still a very long way from the economic stage where the growth rate of energy use can be expected to decline. Thus energy use is likely to double by 2020 when compared to that in 2005, resulting in a projected consumption of about 1,200 million tons oil equivalent (Mtoe) of energy per year by 2020.

Most of the South Asian countries can no longer meet the demand for energy from domestic resources, and will have to turn increasingly to energy imports. This is occurring at a time when the worldwide competition for energy supplies is the strongest it has ever been. South Asia thus faces an additional hurdle that was not faced by Europe, North America, and East Asia during their initial phases of modernization. The availability of energy at an affordable price is likely to be an important constraint on the rate of economic growth.

Further, there is an increasing awareness within the region of the adverse environmental consequences associated with specific energy sources such as coal and firewood. These represent additional considerations that need to be taken into account when deciding on energy supplies to meet future needs.

The rise in oil prices during the last two years has put a severe strain on the resources of all the South Asian countries. The energy imports of the South Asian countries are shown in **Table 3**. The cost of the oil imports during the year 2005-06 for Bangladesh[v], India[vi], Pakistan[vii], and Sri Lanka[viii] were $2.0 billion, $ 44.6 billion, $ 6.5 billion, and $ 1.6 billion respectively. For the other countries also, the oil imports represent a substantial part of their total imports. With the price of oil exceeding $100 per barrel as this Report is being printed, the import bills for the current year are likely to be much higher. Afghanistan, Maldives, Nepal, and Sri Lanka depend on imports for more than half of their commercial energy supply, a very high level by any standard.

Each of the countries in South Asia has a somewhat different situation with regards to meeting future energy needs, and this is discussed here briefly before moving on to regional approaches.

Table 3. Fossil fuel imports by South Asian Countries

Country	Oil^	Nat. Gas	Coal	Imported energy as % of total comm'l energy
	(Million tons oil equivalent)			
Afghanistan	1.40	0.00	*	64
Bangladesh	3.70	0.00	0.45	22
Bhutan	0.04	0.01	*	25
India	82.90	7.20	28.00	28
Maldives	0.27	0.00	0.00	100
Nepal	0.70	0.00	0.17	60
Pakistan	14.40	0.00	2.50	29
Sri Lanka	3.50	0.00	0.00	82

*= small amount.
^ oil includes oil products

Sources:

BP (2007) for energy consumption data on Bangladesh, India, and Pakistan and LNG imports for India; for 2006.
EWC (2007) for data on Bangladesh, Nepal, and Sri Lanka, for 2005.
ADB (2006) for Afghanistan data for 2002.
HDIP (2005) for Pakistan import data for 2004-05
SARI/E (2005) for data on Bhutan and Maldives for 2004.

Afghanistan

A quarter century of conflict has left Afghanistan in a very difficult situation with respect to all sectors, including energy. Power plants and transmission lines have been damaged, and only about 10% of the population currently has access to electricity[ix]. There are natural gas fields in the Northern part of Afghanistan, but it has not been possible to undertake further exploration and development. Even the three fields that had been in production at one time are now shut down. The rehabilitation of these fields, and the start of new fields, and additional exploration, could go a long way towards reducing Afghanistan's imports of energy. Such developments are contingent on a higher degree of peace and stability in the country, and until that happens, Afghanistan will continue to depend on oil imports to meet its growing energy demand.

Bangladesh

There is a good possibility that Bangladesh can keep on increasing its production of natural gas for many more years. About 94% of the 3.6 GW installed electrical capacity in the country is based on natural gas[x]. Only 20% of the country's population has access to electricity at present, and natural gas will continue to be required for additional electricity generation, as well as for domestic cooking, and other uses. As elsewhere in South Asia, the number of vehicles in the country is growing rapidly, and most of them are dependent on oil products for their operation. Oil imports are likely to continue growing, but the energy import bill can be reduced by converting more of the transportation fleet in the country to CNG. The first such project in the country was initiated in 1982, with the assistance of the World Bank, and similar projects have continued since then.

Bhutan

Bhutan is in the fortunate position of having a large hydropower potential, estimated at more than 30,000 MW[xi]. Only 1065 MW of this potential has been tapped so far[xii]. After meeting its domestic electricity demand of 105 MW, the remaining electricity generated is exported to India. Bhutan's growing, but still modest, requirements for oil could be met by imports through India, and it is expected that additional hydropower would be generated for export to India and possibly beyond it to other SAARC countries.

India

Coal is India's largest source of commercial energy, and the country has sufficient domestic reserves to increase production further during the coming decades. There are several factors limiting the additional amount of coal that can be used by India: (1) Most of the coal is located in the Eastern part of the country, more than a thousand kilometers away from many of the major demand centers near Delhi, Mumbai, Bangalore and Hyderabad. The rail transportation system is already running at full capacity, and it would take a considerable amount of time, as well as expenditures, before it can be greatly expanded; (2) Much of Indian coal has an ash content exceeding 40%, which creates difficulties for burners, as well as for transportation. The Indian Government has recently promulgated a regulation that coal transported over long distances should have an ash content that is less than 40%; (3) Coal combustion is one of the principal sources of air pollution in the country, as discussed later in this paper. Further, it is the largest source of carbon dioxide emissions from the country, the greenhouse gas that is the largest contributor to global climate change.

The total number of motor vehicles in India has been growing very rapidly, increasing from about 1.9 million in 1971 to about 67 million in 2003[xiii]. Such growth ensures that India's imports of crude oil and oil products will continue to grow for at least the next few decades. Since 2004, India has begun importing liquefied natural gas (LNG), initially from Qatar, and then smaller amounts from Egypt and other countries. It has signed an agreement with Iran to import large amounts of LNG. It is importing some hydropower from Bhutan, and can expand the imports substantially from that country as well as Nepal. India also has a very active wind power program, with the fourth largest installed capacity in the world.

Maldives

Maldives has no indigenous hydrocarbon sources to meet its demand for commercial energy. Though the country has a sizeable solar and wind power resource, their exploitation will take time. Currently the country meets its energy needs from biomass and imported oil. Even though efforts are being made to use wind and solar energy, the country's heavy reliance on oil imports is not likely to decrease in the near future. Fluctuations in the price of oil thus have a large impact on the economy of the Maldives, which is heavily dependent on tourism.

Nepal

Nepal has a theoretical hydropower potential estimated at 83,000 MW, of which 42,000 MW can be economically developed at present[xiv]. This amount is way beyond the country's expected demand in the foreseeable future. This vast resource can be used for the benefit of Nepal, as well as India, Bangladesh, and possibly Pakistan, if satisfactory financial terms could be worked out. At the same time, Nepal has no oil deposits of its own, and will continue to depend on oil imports for its transportation needs, which are growing. Nepal has, with international assistance, launched an innovative program that is replacing oil-based three-wheelers with electric vehicles in the Kathmandu valley, to reduce severe air pollution. It is difficult at present to expand this system to the country as a whole, where the population is dispersed in mountainous areas, and service centers for recharging batteries are not available.

Pakistan

Pakistan was the first country in the region to make extensive use of natural gas, and this is now its largest source of energy. Natural gas production is beginning to level off, while the demand is expected to keep growing for the foreseeable future. Pakistan faces a large natural gas shortfall by 2009, and will have to start importing natural gas from Iran, the Gulf States, or Central Asia. It will also need to increase its oil imports to cope with the rising number of motor vehicles, whose number increased from about 2.7 million in 1990 to roughly 5.4 million in 2005[xv]. To reduce oil imports and to improve air quality, Pakistan has had an extensive program to expand the use of compressed natural gas in vehicles. It is now the third-largest CNG-using country in the world, with more than 700,000 vehicles in the country that run on this fuel. Most of these are converted vehicles that formerly ran on gasoline.

Pakistan obtains about 13% of its commercial energy from hydropower, and has the potential to expand energy supplies from this source. However, there has been considerable opposition to many of the large hydropower proposals, not only from the people who might be displaced, but from the Provinces downstream who fear a further reduction in the waters of the Indus that are available to them for agricultural use.

Sri Lanka

Sri Lanka is another country in South Asia that is heavily dependent on oil imports for meeting its commercial energy needs. About 20% of the total commercial energy is provided by hydropower, but the scope for increasing this is limited. Electricity from the grid is available to more than 73% of the population. An additional 3% of the households access electricity from solar power, community hydro, wind or biomass[xvi]. The country has recently started examining the full potential for making use of these sources. Since the existing rail system is antiquated, roads are by far the dominant transportation mode. The number of vehicles in the country has increased from about 600,000 in 1991 to about 1.5 million by 2004. Thus Sri Lanka's dependence on oil imports is likely to keep increasing for several decades.

Air Quality, Transportation, and Energy Use in South Asia

If serious air quality problems in South Asia were not a major and growing concern, one could continue with the recent trends in energy use and transportation. India, for example, could meet most of its non-transportation energy needs, particularly for electricity generation and industrial uses, from coal. The cities of the region could go on with the use of two-stroke engines for 3- wheelers and diesel based buses and trucks. However, most of the larger cities in South Asia suffer from serious air pollution, most of which is caused by coal combustion or by the oil products used for transportation. Much of the air pollution concern in South Asia relates to the very high levels of total suspended particulate matter (SPM) in the air, as well as the respirable suspended particulate matter (RSPM), which can go deep into the lungs. The ambient levels of SPM and RSPM in a number of Indian cities are given in Table 4.

The levels of other important air pollutants such as sulfur dioxide and nitrogen oxides in the Indian cities are rising, but are still within the Indian standards most of the time[xvii]. Carbon monoxide and several other pollutants are being monitored at only a few sites.

High levels of air pollution exist in other South Asian cities, including Dhaka, Karachi, Kathmandu, and Lahore, but systematic data for these cities are only partly available. In Dhaka, for example, annual average levels of particulate matter less than 10 microns in diameter (PM_{10}) in the ambient air increased from about 115 micrograms per cubic meter ug/m^3 in 2002 to about 160 ug/m^3 in 2006[xviii]. The corresponding numbers for particulate matter less than 2.5 micron in diameter ($PM_{2.5}$) are 70 ug/m^3 and 85 ug/m^3. These greatly exceed the guidelines established by the World Health Organization as well as Bangladesh itself, which are 50 ug/m^3 for PM_{10} and 15 ug/m^3 for $PM_{2.5}$. In Pakistan, a study undertaken by ENERCON and UNDP for six cities in Pakistan showed high levels of PM_{10} exceeding WHO guidelines for all the cities, with the highest 48-hour mean levels of 290 ug/m^3 being shown in Quetta, 260 ug/m^3 in Lahore, and about 200 ug/m^3 in Karachi.

The health impacts of air pollution have become large enough in terms of mortality, morbidity, and the associated economic loss that policymakers are under pressure to address the problem. According to a recent study by the World Bank, air pollution in Pakistan, for example, kills 22,000 persons each year, and the economic losses due to deaths and sickness exceed $ 1 billion annually.

Table 4. Ambient levels of particulates in selected cities of India

City	Total Suspended Particulate Matter (SPM)* (micrograms per cubic meter)	Respirable Suspended Particulate Matter (RSPM)# (micrograms per cubic meter)
Jalandhar	364	287
Jamshedpur	262	206
Lucknow	367	169
Ahmedabad	256	154
Delhi	355	151
Pune	395	142
Jaipur	307	133
Kolkata	251	121
Chandigarh	275	106
Varanasi	302	97
Chennai	155	86
Bangalore	163	76
Hyderabad	164	64
Cochin	118	58
National Ambient Air Quality Standards in India		
Residential areas (annual avera	140	60
Industrial areas (annual average	360	120

* SPM data are annual averages of all the monitoring stations in the city mentioned, for which data are available.
# are average annual concentrations of particulates smaller than 10 microns, at all stations in the city for which data are available.

Source: TERI (2004). All data are for 2003.

Reducing air pollution in the cities of South Asia would require a combination of limitations on coal use in or near urban centers, and the widespread use of clean coal technology, improving the energy efficiency of electric power plants, industry, and vehicles. Further, it would mean switching to cleaner fuels wherever feasible, in all of the sectors mentioned earlier.

Indoor air pollution, primarily from the burning of fuel wood and other biomass, is a very serious problem in much of South Asia, particularly for women who usually cook at home, and for the young children nearby. Substantially more than 70% of the total energy consumed in the rural areas of South Asia comes from firewood, as well as agricultural and animal wastes. Alternate and cleaner forms of energy, such as natural gas or solar cookers, need to be supplied to these areas to protect the health of the people, as well as to reduce the loss of forests.

As mentioned in earlier sections of this paper, the transportation sector is the fastest growing energy user in essentially all the countries of South Asia. The combustion of petrol and diesel in the vehicles of the sub-continent is, in most cities, the largest source of air pollution. Switching to less polluting fuels would not only reduce oil imports, but also contribute greatly to the improvement in air quality in the region.

Due to the wide availability of natural gas since the 1960s, Pakistan was able to initiate at an early date the use of compressed natural gas (CNG) as an energy source for buses, taxis, and private vehicles, and has one of the largest such programs in the world. In India, the highest court has required that all buses in New Delhi run on CNG. Bangladesh is also pursuing the CNG option, whereas Nepal has been very active in replacing highly polluting motor rickshaws in Kathmandu with electric powered vehicles.

An accelerated use of CNG for transportation, combined with electric vehicles in areas with adequate supplies of electricity, would result in cleaner air for South Asia, as well as reducing the rate of growth of greenhouse gases from the region. These would also enhance energy security in the long term by making the region less dependent on imported oil.

Enhancing Regional Cooperation for Energy, Environment, and Transportation

In the previous section, we have focused on the need for integrating policy making for the energy, environment, and transportation sectors within individual countries. In this section, we discuss the benefits of integrating, to some extent, energy supply options between the countries of South Asia. There was only limited cooperation between the countries of the region during the first fifty years of independence from British rule. The tense relationship between India and Pakistan, the separation of

Bangladesh from Pakistan, and the ongoing civil war in Sri Lanka, have all contributed to deter regional cooperation in almost all fields. Recent improvements in the relations between the two largest countries of the region, and strengthening of the South Asian Association for Regional Cooperation (SAARC) could contribute to improving the situation. The SAARC Energy Centre was established in Islamabad in 2006 to facilitate some of the planned activities dealing with energy.

The potential for cooperation between groups of South Asian countries is illustrated here by looking at two large-scale projects for supplying energy that could improve the environment and transportation concerns in the region. The first project has been discussed and assessed in great detail during the past 12 years, whereas the second is still a glimpse of what may be possible.

Building a Natural Gas Pipeline linking Pakistan and India

The Sui natural gas field in Pakistan was discovered in the early 1950s, and natural gas has been contributing a growing share to the energy supply of the country since 1955. It now contributes just over 50% of the total commercial energy used in the country[xix]. However, the production is leveling off, and a natural gas shortfall of about 325 million cubic feet per day (MMcfd) or 3 mtoe/y[1] (1 MMcf = 25.5 toe[2]) is expected by 2009, rising to 6.3 billion cubic feet per day (Bcfd) by 2020[xx].

In India, natural gas has been produced in Gujarat and Assam since the 1960s, but its use accelerated greatly with the start of production from the offshore Bombay (Mumbai) area in the late 1970s. The demand for this clean and easily transported fuel has always exceeded supply, but the availability of cheap coal and oil did not provide adequate incentives for importing it. This situation began to change during the 1990s, when a combination of coal transportation bottlenecks, a rise in oil prices, and growing awareness of environmental pollution made it attractive to consider importing natural gas. Consumption in India increased from 19.4 Billion cubic meters (Bcm) or 17.5 mtoe (1 Bcm = 0.9 mtoe[2]) in 1995 to 36.6 Bcm in 2005. During the same period, natural gas consumption in Pakistan increased from 14.6 Bcm to 29.9 Bcm, and in Bangladesh from 7.4 Bcm to 14.2 Bcm.

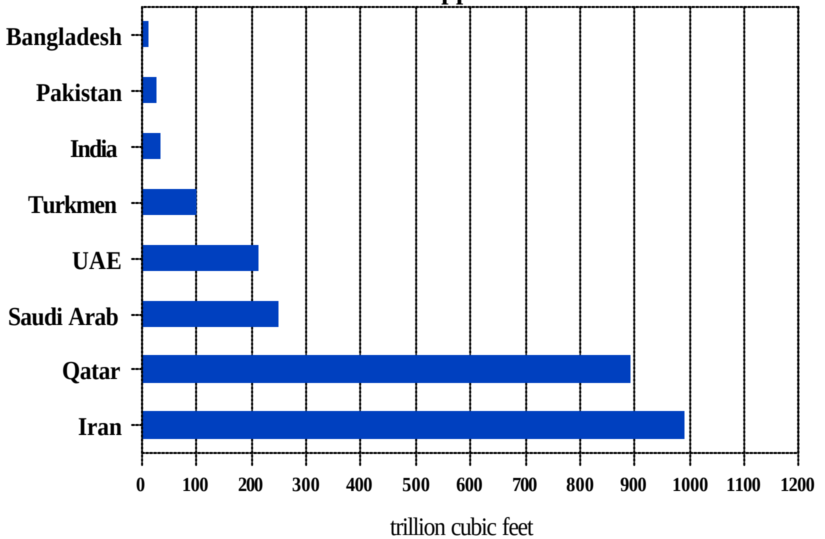
The current proven reserves of natural gas in South Asia are relatively modest, compared to their demand, and to the reserves available in some of the neighboring countries, as shown in Figure 2.

India imported about 8 Bcm of liquefied natural gas (LNG) during 2006, with imports likely to keep growing for decades. However, transporting natural gas via pipelines is substantially cheaper than importing it in liquefied form. The cost differential is

[1] Million tons of oil equivalent per year.
[2] See conversion factors on page 17.

usually of the order of 25-30%. The possibility of bringing natural gas from Oman, Iran, Qatar, or Turkmenistan to India and Pakistan has been discussed for more than a decade[xxi], and several Memoranda of Understanding (MOU) have been signed with potential suppliers. Tensions between India and Pakistan delayed the implementation of the projects for several years, but the two countries are now in agreement on the need to build one or more common pipelines for the benefit of both.

Figure 2. Proved Reserves of Natural Gas in South Asia and Potential Supplier Countries



Source: Toufiq Siddiqi, East-West Center and GEE-21, based on data from BP(2007).

After many ups and downs, and continuing opposition from the United States against any projects involving Iran, it appears likely that work on at least the Pakistan-Iran part of the pipeline will start soon, with India possibly joining at a later date. The IPI pipeline project will be a mammoth undertaking. The length of the pipeline from Iran to India would be about 2,600 km. The cost of building it is estimated to be around $8 billion.

The feasibility of building a natural gas pipeline from Bangladesh to India has also been extensively discussed in the two countries. Questions about the size of potential reserves and their adequacy for domestic needs have been major obstacles to implementation of the project. While the proven reserves[xxii] of the country have been variously estimated at between 15 trillion cubic feet (Tcf) or 382 mtoe (1 Tcf = 25.5 mtoe) and only 5 Tcf[xxiii], the additional reserves in place have been estimated by the U.S. Geological[xxiv] survey as being about 31 Tcf. According to estimates by

Petrobangla, the demand for natural gas is projected to increase from 0.35 Tcf per year in 2000 to 1.3 Tcf per year by 2020. The cumulative demand by 2020 would thus be around 14 Tcf by 2020, an amount comparable to the present proved reserves. Such a figure for reserves would leave little scope for exports of natural gas to India.

India is also exploring the option of importing natural gas from Myanmar, either through Bangladesh, or directly from Myanmar. The 560-mile pipeline through Bangladesh would be more economical than the 870-mile direct pipeline from Myanmar through Northeastern India. Although the Bangladesh government has approved the pipeline through the country, it has asked for trade concessions and other benefits in return, but India has not yet indicated its willingness to accept the terms [xxv].

The current proven reserves of Myanmar are about 18 Tcf, compared to 38 Tcf for India and 28 Tcf for Pakistan. Myanmar currently exports 90 billion cubic feet (Bcf) of gas per year to Thailand, and could export some to India since its own domestic consumption is still relatively small.

Developing the hydropower resources of the Himalayas

Transportation and electricity are the two fastest growing uses of energy in South Asia. We have already discussed the need for ensuring the availability of transportation fuels, as well as natural gas for several purposes, including power generation. In this section we consider some of the options available to the South Asian countries for meeting their burgeoning demand (Table 5) for electricity.

Table 5. Recent and Projected demand for electricity in South Asia.

Country	Recent Terawatt-hours	Year	2010 Terawatt-hours	2020 Terawatt-hours
Afghanistan	0.73	2003	1.13	3.88
Bangladesh	24.60	2005	31.60	72.80
Bhutan	0.64	2002-03	1.70	6.88
India	726.70	2005	893.00	1,756.00
Maldives	0.15	2003-04	0.36	1.57
Nepal	2.36	2003-04	3.81	8.08
Pakistan	113.50	2005	130.00	251.00
Sri Lanka	7.09	2002-03	11.20	23.90

Sources: BP (2007) for the Bangladesh, India, and Pakistan data for 2006.
EIA (2006) for the Afghanistan data for 2003.
SARI/E (2005) for all other data, and projections.

Nepal, and Bhutan have large potentials for generating hydropower, much beyond their foreseeable domestic demand. Nepal is estimated to have economically developable potential of about 43,000 MW[xxvi], and Bhutan of about 16,000 MW[xxvii]. (To put this in some perspective, a large nuclear power plant has a generation capacity of about 1,000 MW). Only about 1% of the potential hydropower potential of Nepal and Bhutan has been developed so far. The two countries are thus in an excellent position to contribute to the energy needs of the entire region by developing these hydropower resources for their own use, as well as for exports to India, and possibly onwards to Bangladesh and Pakistan.

Until 1988, Bhutan was an importer of electricity from India. Following the completion of the Chukha power plant with the help of India, it is now an exporter of electricity to the latter country. Additional projects with Indian participation are being implemented. The export of electricity is now the single largest source of revenue for Bhutan.

The International Finance Corporation is providing financial assistance to Nepal to build its second private sector hydropower plant, with the electricity to be used within Nepal. Negotiations between India and Nepal for the sale of electricity from the latter have been going on for a decade, but they have not been able to agree on a sale price for the electricity to be delivered to India.

Like all energy sources, generating hydropower has environmental impacts, mainly the displacement of people living close to the dams and the potential flooding of ecologically valuable lands. With careful planning regarding the right size for the dams and the involvement of the people who might be adversely affected, the contribution of hydropower can be increased substantially. The potential impacts need to be compared with those from other energy sources, and hydropower usually compares quite favorably with coal- or oil-burning power plants. There will, of course, be sites where the potential social and environmental costs exceed the economic benefits, and the option of building large dams there to generate hydropower may create considerable political opposition. This has taken place, for example, in connection with the Narbada dam in India and the Kalabagh dam in Pakistan. Both countries still have untapped hydropower potential in the North, but the pace of developing these has slowed due to growing environmental and social awareness, and the differing interests of upstream and downstream states and provinces.

Further development of hydropower in Nepal and Bhutan could make a large contribution to the energy needs of those two countries, as well as to that of India. If the electrical grid of India could be connected to those of Bangladesh and Pakistan, electric power from Nepal could also be provided through India to the other two large consuming countries of South Asia. This could also help in reducing India's concerns that Pakistan might disrupt the flow of natural gas via pipeline at times of political tension, since Pakistan would also be depending on India for continued transmission of electricity from Nepal through India.

Conclusion

Policies for addressing energy needs, environmental quality, and transportation are usually addressed separately in most countries, including those in South Asia. It is important that these policies be integrated so that meeting the needs of one sector does not make it more difficult to meet the goals of the other sectors. It is thus important that senior representatives of these sectors meet on an ongoing basis, and especially before new projects are initiated. For example, when a new fossil fuel power plant is to be built, it would be important that the organization building the plant get inputs from the environment, health, transportation and other sectors before a site is selected. This type of interaction would enable the priorities of the various sectors to be met at the same time.

The two fastest growing categories of energy use in most developing countries, including all of those in South Asia, are electricity generation and transportation. Any source of energy can be used for generating electricity, but the transportation system is almost entirely dependent at present on oil products, mainly gasoline and diesel oil, although use of compressed natural gas in road transport is on the rise in Pakistan, India and Bangladesh. South Asia's imports of oil are likely to continue increasing as the number of automobiles keeps growing. Regional cooperation in developing an integrated pipeline system for importing natural gas to South Asia can not only meet demand for household use and electricity generation, but also be of great help in accelerating the switching over of buses, taxis, and private vehicles to this cleaner and more abundant fuel.

Integrating the energy, environment, and transportation policies within the countries will benefit each of these sectors, as well as providing a strong rationale for integrating the supply of natural gas and electricity in many parts of South Asia

Conversion factors for Natural gas (NG)

	Billion cubic meters NG	Billion cubic feet NG	Million tonnes LNG	Million tonnes oil equivalent	Million barrels oil equivalent	Trillion British thermal units
1 billion cubic meters NG =	1	35.3	0.73	0.90	6.29	36
1 billion cubic feet NG =	0.028	1	0.021	0.026	0.18	1.03
1 million tonnes LNG =	1.38	48.7	1	1.23	52.0	8.68
1 million tonnes oil equivalent =	1.111	39.2	0.805	1	7.33	40.4
1 million barrels oil equivalent =	0.16	5.61	0.02	0.14	1	5.8
1 trillion British thermal units =	0.028	0.98	0.12	0.025	0.17	1

Source: BP (2007). BP Statistical Review of World Energy. London: BP.

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Received: 31 August 2007, revised: 11 March 2008, accepted: 17 March 2008.

About SAARC Energy Centre

In recognition of the role of energy in development, the Heads of State or Government at the 13th SAARC Summit held at Dhaka on November 13, 2005 agreed to the recommendation of the SAARC Energy Ministers to establish the SAARC Energy Centre (SEC) in Islamabad.

The SEC is envisioned to be a catalyst for the economic growth and development of the South Asia region by initiating, coordinating and facilitating regional, joint and collective activities on energy.

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