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Viable and Environment-Friendly Sources for Meeting South Asia's Growing Energy Needs

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SUMMARY South Asia's rapidly accelerating economic growth is accompanied by energy requirements that are increasing at a similar pace. The development of cleaner sources of electricity, such as hydropower; the establishment of reliable sources and transport of natural gas; and the linking of electrical systems within the region would help to ensure the continued supply of energy needed to fuel South Asia's expanding economy. Currently, most of South Asia's commercial energy demand is supplied by coal and oil. While the use of these fuels will continue, there is a need to reduce the rate at which coal and oil consumption is increasing and to expand the use of other energy sources that are environment-friendly, readily available, and reasonably priced. Much of the increasing demand can be met by natural gas and hydroelectricity, and while the necessary electricity can potentially be produced within the region, natural gas will need to come from both within South Asia and from neighboring countries. Regional cooperation among the countries of South Asia as well as with surrounding countries is essential for meeting the region's future energy needs.

Introduction

The economic development of South Asia has begun to accelerate during recent years, with gross domestic product (GDP) per capita growing at about 6 percent per annum. In keeping with this economic growth, energy use in South Asia has been increasing at over 5 percent per annum and is likely to double by 2020. The total current population of the member countries of the South Asian Association for Regional Cooperation (SAARC) is about 1.4 billion. The total energy consumed by this population is about 600 million tonnes of oil equivalent (Mtoe) per year.

SAARC member countries recognize the importance of addressing the region's rapidly increasing energy demands

How will this energy be supplied? If this question had been asked 20 years ago, the answer would probably have been that future energy needs would be supplied by coal and oil. India had one of the largest coal reserves in the world, and cheap oil was easily available from the Middle East. The situation is very different now. Serious air pollution problems in the cities of South Asia are largely the result of the growing use of coal and oil products. Further, the quadrupling of oil prices over the past few years has placed a severe strain on the foreign currency reserves of most of the countries of the region and has greatly reduced the resources available for the development of important sectors such as education, health, and infrastructure.

While coal and oil can be expected to continue to play an important role in the region, there is a need to reduce the rate at which the use of coal and oil is increasing and to expand the use of other energy sources that are friendlier to the environment, readily available, and reasonably priced. Although the cost of other renewable sources, such as solar and wind power, is coming down, the two environment-friendly and affordable energy sources for the region that could supply large amounts of energy are natural gas and hydropower.

All of South Asia's future energy needs except for transportation can be met from sources within the region or from imports of natural gas, which is plentiful in neighboring countries. Only the transportation sector, which is heavily dependent on oil, is particularly vulnerable to rising oil prices. Regional cooperation between the countries of South Asia is very important for meeting the future energy needs of the region in an environment-friendly way. Cooperation has been lacking in the past, but policymakers in the region are now more aware of its necessity for promoting sustainable development.

In the Declaration of the 14th SAARC Summit in New Delhi in April 2007, Heads of State or Government of SAARC member countries recognized the importance of addressing the region's rapidly increasing energy demands in meeting the developmental needs of SAARC countries. They also acknowledged the need for expediting the development of conventional sources of energy in a sustainable manner and for strengthening renewable energy development such as hydropower, biofuel, solar, and wind power.

The SAARC leaders identified water, energy, food, and environment as the four areas in which tangible progress in cooperation should be made at an early stage. This paper outlines an approach that could contribute simultaneously to two of these priorities —energy and environment.

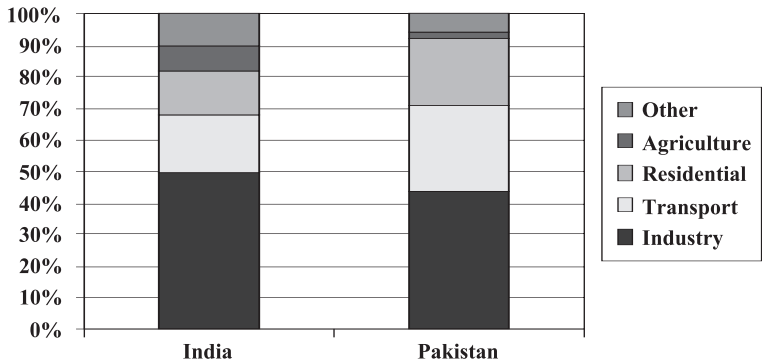
The Region's Energy Needs

South Asia's energy requirements are growing in industry, transport, residential, agriculture, and other areas. (For illustration, the current shares of commercial energy used by the various sectors in India and Pakistan are shown in figure 1.) Each of the sectors uses a different mix of energy sources and is growing at a different rate. The growing industries of the region need more electricity, oil products, and natural gas. The transportation sector will continue to require larger amounts of oil products for at least the next two decades during which time alternative fuels such as natural gas can begin to make inroads. The demand for electricity in the residential sector will continue to grow, along with the demand for cooking and heating fuels in the northern areas of South Asia. In addition, the rural areas now require access to electricity and also to cleaner replacements for the firewood and other biomass fuels that have traditionally been used. These demands can best be met by solar and wind energy where available and by natural gas or liquefied petroleum gas (LPG).

Rising awareness of the serious air quality and related health problems in the cities of South Asia, and of the need to improve this situation while also allowing energy use to increase, is an important consideration in the choice of sources for additional energy. From an environmental point of view, energy sources are definitely not equal.[1] Coal, oil, and biomass combustion are the least desirable sources as far as air quality and greenhouse gas emissions are concerned. Hydropower, solar, and wind energy rank at the top, with natural gas in the middle. Nuclear energy is difficult to rank, since it is excellent in routine operations, but the impact of the relatively rare accidents can be severe.

The use of natural gas is growing rapidly, constrained only by lack of supply

Natural gas and hydropower are environment-friendly and have the capacity to provide much of the large amounts of energy that will be needed in South Asia over the next three decades. There is a still large and untapped potential for hydropower in the foothills of the Himalayas in Nepal, northern India, Bhutan, and Pakistan. Where the demand centers are far from the hydropower locations, natural gas would be the environmentally preferred source of additional electrical capacity, supplemented by wind power in suitable locations. (India already ranks fourth globally in the use of wind power.) Greater use should also be made of solar heating and of solar photovoltaic energy for electricity generation in locations not already connected by an electrical grid. And while wind and solar power do have a role to play, this paper focuses on natural gas and hydropower, since these sources can contribute the largest amount of environment-friendly energy to South Asia's energy needs during the next two decades.



Data for India are for 2003–2004, from The Energy and Resources Institute (TERI); data for Pakistan are for 2005–2006, from the Hydrocarbon Development Institute of Pakistan (HDIP).

Fig. 1: Share of commercial energy used in different sectors in India and Pakistan

Natural Gas: A Versatile Solution

Natural gas is a relatively clean and versatile fuel and its use has been growing rapidly in South Asia. It already supplies about two-thirds of the total commercial energy in Bangladesh and about half of the total in Pakistan. Due to the dominant role played by coal in India's economy, natural gas only provides about 8 percent of the total commercial energy used in that country at present.[2] Its use, however, has been growing rapidly even in India and is only constrained by the lack of supply.

There are several advantages to using natural gas rather than coal or oil: it produces fewer pollutants when burnt, resulting in better air quality; for the same amount of delivered energy, it produces fewer emissions of carbon dioxide, the main greenhouse gas contributing to global climate change; domestically produced natural gas can be used as a substitute for oil for most purposes including transportation, thereby reducing the cost of importing oil and oil products; infrastructure can be built to supply it to households in urban areas as well as in rural areas where inadequate amounts of firewood and other biomass are available; and large reserves exist and can be imported from countries close to South Asia such as Qatar, Iran, Turkmenistan, and Myanmar usually at prices lower than those for oil.

Environment and health benefits of using natural gas. 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. Most of the larger cities in South Asia suffer from serious air pollution caused largely by the oil products used for transportation and, in India, by coal-burning power plants. Indoor air pollution, primarily from the burning of fuelwood and other biomass, is also a very serious problem in much of South Asia. More extensive use

of natural gas in industry, electricity generation, for transportation, and for residential use could make an important contribution to improving air quality in the cities as well as in rural homes.

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 subcontinent is, in most cities, the largest source of air pollution. Due to the wide availability of natural gas since the 1960s, Pakistan was the first country in the region to encourage compressed natural gas (CNG) as an energy source for buses, taxis, and private vehicles and has one of the largest programs of its kind in the world.

In the first such decision in the developing countries, the Supreme Court of India issued an order in 1998 requiring all public vehicles in Delhi to switch from diesel to CNG. As a result, there has been some improvement in air quality in the capital. The results would have been more noticeable if the number of vehicles overall had not increased so much in the meantime. Bangladesh is also pursuing the CNG option, and Nepal has been very active in replacing highly polluting motor rickshaws in Kathmandu with electric powered vehicles.

Accelerated use of natural gas would result in cleaner air and reduce regional dependence on imported oil

An accelerated use of CNG for transportation, combined with hybrid and electric vehicles in specific locations, would result in cleaner air for South Asia and would reduce the rate of growth of greenhouse gases from the region. These changes would also enhance energy security by making the region less dependent on imported oil.

The developing countries of the world, including all the countries of South Asia, are not required to reduce their emissions of greenhouse gases. Starting from a very low base, it will be several decades before their per capita emissions become comparable to those of the more industrialized countries. In terms of totals, however, India's emissions of carbon dioxide from the use of fossil fuels, particularly coal, are the fifth largest in the world. In another decade, they could exceed those of Japan. Even if the emissions are not capped, it is likely that future agreements on climate change will ask the developing countries to reduce carbon intensity (the amount of carbon emitted per dollar of gross national income [GNI]). Natural gas emits about 56 percent as much carbon dioxide as coal and about 70 percent as much as oil for the same amount of energy delivered.[3]

Natural gas imports for Pakistan and India. The need to import energy greatly reduces the foreign currency reserves available in South Asia for meeting other national priorities. Most of this energy is imported in the form of oil. In 2005–2006, the costs of oil imports by Bangladesh, India, Pakistan, and Sri Lanka were $2.0 billion, $44.6 billion, $6.5 billion, and $1.6 billion respectively.[4] Oil imports also represent a substantial part of total imports for the other South Asian countries.

Natural gas has been used in Pakistan for more than 50 years, and it currently provides 60 percent of the commercial energy for households in Pakistan. It is also used to a lesser extent in Bangladesh. Its use in India has been limited by availability, but is likely to expand as imports of the fuel increase. The logistics of laying natural gas pipelines is the major obstacle to providing natural gas to rural areas, but once the pipelines are built, it would be easier to continue the supply then to pay the ongoing costs of transporting oil products to rural locations.

Bangladesh and Pakistan have been able to meet their requirements for natural gas from domestic fields, and the former may continue to do so for many more years. India, however, has started importing natural gas as LNG (liquid natural gas), and its imports are likely to reach 40 percent of total natural gas demand by 2030.[5] Pakistan will also need to start importing natural gas, probably within the next five years, and may have to import about two-thirds of its gas demand by 2025.[6]

The proved natural gas reserves of India, Pakistan, and Bangladesh are relatively small, about 38, 28, and 15 trillion cubic feet (Tcf) respectively.[7] At current rates of production, the reserves would last about 30 years in each country. There is little potential for meeting additional demands from these reserves. The demand for natural gas is so high, however, that India and Pakistan will have to depend on imports. Iran and Qatar have the second and third largest reserves

of natural gas in the world (940 and 910 Tcf respectively) and could supply most of the import requirements of India and Pakistan.

Although India initiated LNG imports from Qatar in 2004, transporting natural gas via pipelines is usually about 25–30 percent cheaper than importing it in liquefied form. The possibility of bringing natural gas via pipeline from Qatar, Iran, or Turkmenistan to Pakistan and India has been discussed for more than a decade,[8] but tensions between India and Pakistan have delayed the implementation of the projects for several years. In early 2007, India also signed (still not ratified) a 25-year agreement with Iran to import about 3.2 billion cubic feet (Bcf) of gas per day through the Iran-Pakistan-India pipeline. The total cost of this agreement to India is estimated at $145 billion. 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. If the pipeline were to be completed by 2010, Pakistan would initially expect to import about 350 million standard cubic feet per day (MMscfd) rising to 2,100 MMscfd by 2015. India would initially import 2,100 MMscfd rising to about 3,200 MMscfd within three years.[9] There continue to be many delays in the final go-ahead for the project, the most recent is due to Iran's periodic price adjustment demands.

Nepal and Bhutan have great potential for generating hydropower far beyond domestic demand

A Turkmenistan-Afghanistan-Pakistan-India pipeline to tap the substantial (102 Tcf) reserves of Turkmenistan has also been discussed between the four countries, and a feasibility study has been carried out by the Asian Development Bank for a pipeline that is 1,680 km long and able to deliver 3.2 Bcf per day. Improved security is needed within Afghanistan before the pipeline could be built. There are also growing doubts about the adequacy of Turkmenistan's reserves to support all the export options that Turkmenistan is exploring.

The possibility 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[10] of Bangladesh are generally estimated at about 15 Tcf, the additional reserves in place have been estimated by the U.S. Geological Survey[11] as being about 31 Tcf. According to estimates by Petrobangla, the demand for natural gas in Bangladesh is projected to increase from 0.35 Tcf per year in 2000 to 1.3 Tcf per year by 2020. The cumulative demand in that country by 2020 would thus be around 14 Tcf by 2020, an amount comparable to the present proved reserves. If substantial additional reserves are proven, exports to India could become a reality.

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 expressed its willingness to approve the pipeline through the country, it has asked for trade concessions and other benefits in return, which are not acceptable to India.[12]

Electricity From Hydropower

Electricity is a high quality form of energy and many of the services it provides, such as the use of computers, television, and instant communications, cannot be provided by any other form of energy. The demand for electricity far exceeds available capacity in many parts of South Asia and is expected to more than double by 2020, as shown in table 1.

One of the advantages of electricity is that essentially any source of energy can be used to generate it. The largest source of electricity in India is coal, whereas natural gas is the fuel of choice in Bangladesh and Pakistan. Nepal and Bhutan depend mainly on hydropower, whereas Afghanistan, the Maldives, and Sri Lanka are primarily using oil products for electricity generation. Nepal and Bhutan have great potential for generating hydropower far beyond their foreseeable domestic demand. Nepal is estimated to have an annual potential of about 43,000 megawatts (MW)[13] that can be economically developed, and Bhutan has an estimated potential of about 16,000 MW.[14] (To put these numbers in some perspective, the total generation capacity in Bangladesh was 4,710 MW

Table 1. 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: 2006 data for Bangladesh, India, and Pakistan from BP; 2003 data for Afghanistan from Energy Information Association; all other data and projections from South Asia Regional Initiative/Energy (see note 15).

in 2005.) Only about 1 percent of the potential hydropower potential of Nepal and Bhutan has been developed so far. The two countries are in an excellent position to contribute to the energy security of the entire region by developing their hydropower resources for domestic use, as well as for export to India, and possibly to Bangladesh and Pakistan.

Until 1988, Bhutan was importing electricity from India. Following the completion, with India's help, of the Chukha Power Plant, Bhutan in turn now exports electricity to India. This export has become 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. The electricity is 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 the two countries have not been able to agree on a selling price.

With proper planning, impact of generating hydropower compares favorably to that from coal- and oil-burning power plants

Like all energy sources, generating hydropower has environmental impacts. The two main impacts are the displacement of people living close to the dams and the potential for flooding of ecologically valuable lands. With careful planning and the involvement of the people who might be adversely affected, the size of the dams can be selected to minimize the adverse impacts. The potential impacts need to be compared with those from other energy sources. Hydropower usually compares favorably when measured against 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 to generate hydropower may create considerable political opposition. There has been a great deal of opposition, 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 that potential has slowed due to growing environmental and social awareness and the differing interests of upstream and downstream states and provinces.

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 connection 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

While other sources of energy will also need to be tapped to meet the region's total energy needs, a large portion of the demand for additional energy for the continuing economic development of South Asia can be met by natural gas and hydropower-generated

electricity. There are adequate reserves of natural gas available in the countries neighboring South Asia to enable the region to meet its demand, but there is a need to lock in long-term supplies at a reasonable cost. The costs of importing natural gas via pipeline is about 25–30 percent lower than importing it as LNG and would be the economically preferred option. The development of a pipeline would require increased cooperation between the three most populous countries of the region—India, Pakistan, and Bangladesh. Increased cooperation over energy supply is such an urgent necessity that it may also provide a major incentive for the three countries to cooperate in other areas as well. Natural gas can be used to provide energy to all sectors, including in many rural areas.

The demand in South Asia for electricity during the next few decades can be largely met from resources within the region. Domestic coal is likely to continue to be the main source of electricity for India, with hydropower, large and small, playing a growing role. The hydropower potential of Nepal, Bhutan, and northern India, could be tapped to meet not only the needs of those countries, but of Bangladesh and Pakistan as well by linking electrical grids. The linking of electrical systems would require an agreement between Nepal and India on a suitable price for electricity and between India and the other countries to link their electricity systems in the northern part of South Asia. India and Pakistan also expect to make substantial additions to their electrical capacities based on imported natural gas and nuclear power. New and renewable energy sources are also becoming contributors to India's electricity supplies. India now has the fourth largest wind power capacity in the world, after Germany, the United States, and Spain, and additional wind generation capacity is planned in India and several other South Asian countries. With all of these options available, cooperation between the countries can ensure that the availability of electricity is not an obstacle to the continued economic development of South Asia.

If these programs move forward, energy availability is not likely to constrain the region's continued economic development

The availability of oil at an affordable price will continue to be a concern, but for most uses it can be replaced by natural gas. The transportation sector is still almost exclusively dependent on oil products and will remain exposed to considerable fluctuations in oil prices. The larger countries of the region already have a viable industry for converting vehicles to use natural gas, but this process needs to be accelerated greatly to make the countries less dependent on oil. Providing comprehensive infrastructure to support vehicles using compressed natural gas (CNG) throughout South Asia will require at least two decades. Once refilling and servicing stations are available throughout the region, the countries of South Asia can require that new vehicles be supplied with engines that use CNG as well as gasoline.

Fluctuations in the price of oil or natural gas may affect the rate of economic growth in South Asia, as it does in other countries. If the major projects to build natural gas pipelines to import gas and to make use of the hydropower resources of Nepal and Bhutan, as well as of India and Pakistan are implemented, energy availability is not likely to constrain the continued economic development of South Asia. Political considerations have delayed the start of multicountry projects in the region for decades, but the situation seems to be improving.

In April 2007, the SAARC Energy Ministers recommended that a study be undertaken to examine the viability and modalities for development of transnational energy links in electricity and oil and gas. Such a study was initiated in early 2007, and will be carried out by the recently established SAARC Energy Center, in cooperation with the member states of SAARC, and with the financial support of the Asian Development Bank.[16] It is possible that some of the projects discussed here for promoting regional cooperation and making greater use of environmentally preferred energy sources may soon be realized.

Notes

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