Chapter 8
Regional Energy Cooperation in South Asia: Benefits of Integrating the Primary Energy and Electricity Markets

Energy security has had a major influence on world events during the past century. Efforts to control hydrocarbon resources strongly influenced issues of international peace and security. The demand for hydrocarbons during the last century came largely from the industrialized nations in the West. However, over the last decade the Asian region led by China and South Asia has emerged as the new growing consumer. The two regions along with Japan are likely to emerge as the world's largest energy markets.

An energy "demand heartland" has already emerged in Asia centered around China, South Asia and Japan. A "resource periphery" extending from Siberia, Central Asia, Persian Gulf region, Northern Indian Ocean, South and East China Seas exists around this heartland. Also, the area through which the resources are to be transported to consumers has assumed importance in this process. Energy cooperation among suppliers, consumers and transit states has become imperative. This study examines the role of cooperation in the primary energy and electricity sectors in enhancing both energy and environmental security in the South Asian region. It aims to ascertain benefits of cross-border trade in energy through integration of the energy markets in South Asia.

8.1 The Context

The South Asian region is characterized by diversity in geography, energy sources and in political and economic structures. In an area comprising 3% of the world total, the region holds about a quarter of the world's population. The geographical diversity in the region has not only given rise to diverse climatic conditions but has also resulted in the availability of diverse energy resources leading to a diverse energy use mix in the region. South Asia's commercial energy mix was 43% coal, 35% petroleum, 13% natural gas, 8% hydroelectricity, and 1% nuclear in 1999. India's share was about 83% in the region's total commercial energy consumption and 86% in total carbon emission. With close to 260 million metric tons of carbon released from the consumption and flaring of fossil fuels in 2000, India ranked fifth in the world. India's energy-related carbon emissions have grown nine-fold over the past four decades and its contribution to world carbon emissions is expected to increase in the coming years (EIA 2002).

One of the major issues facing South Asian nations today is the rising energy demand essential to facilitate economic growth in the region. However, South Asia today is grappling with energy shortfalls. Given this situation, improving the supply of energy in general, and electricity in particular, is a major concern among regional governments. In order to accomplish this goal, the region is faced with the challenges of diversifying traditional energy supply sources, promoting additional foreign investment for energy infrastructure development, improving energy efficiency, reforming energy sectors, and expanding regional energy trade.

South Asia's consumption of oil and gas is expected to increase significantly. The region is heavily dependent on oil imports. Some of the increasing dependence on external sources can be reduced by diversification to alternate sources of energy and through regional cooperation. Serious attention is required for a strategic policy to enhance cooperation in the region. Currently limited cooperation takes place in the region on a bilateral basis. Nepal exchanges power with India through isolated transmission lines while Bhutan exchanges power through the main Indian grid. Bangladesh has no links with any country in the region. On the primary energy front too, trade in resources within the region is limited. The coal produced in eastern Bhutan (figures on rates of production and reserve estimates are not available) is exported to India. Several proposals have been made to export gas from Bangladesh to markets in India.

In the next few decades the region is poised for a higher economic growth rate and consequently energy consumption and emissions are expected to increase. Future energy and emissions trajectory of South Asia will be influenced by the structure of the economies, population growth, dynamics of energy consumption, fuel-technology choice in various end-use sectors, and policy environments at the macro and micro levels.

8.2 Argument for Cooperation

The most compelling argument for cooperation lies in the fundamental energy dynamics in South Asia: India now relies on poor quality domestic coal and represents a large and expanding market for energy; Sri Lanka needs to import more fuel for power. Bangladesh and Nepal could realize significant economic benefits from the development and export of natural gas and hydroelectric power, and Pakistan's economy would benefit from both energy imports and exports.

Supporting and encouraging more robust trade in energy would have far reaching economic, development and security benefits. Nepal has an estimated capacity of 83,000

MW, of which 42,000 MW, are economically exploitable specially through the harnessing of the perennial rivers. Bhutan also possesses a potential for generating about 20,000 MW of energy of which 11,000 MW is identified hydropower potential (Boquerat, G. 2000). Exchange of electricity would also help the small nations set up larger plants and benefit from the economies of scale associated with such plants. The excess electricity generated may be exported to member countries. Such power transfers would be a means of improving energy diversity through the increased availability of hydroelectric power, and increasing the security of supply by diversifying supply sources.

Bangladesh can earn valuable foreign exchange and improve its balance of trade position with India by offering to export natural gas. Intensive exploration and production of natural gas and establishment of joint production facilities with transfer of technology can be potential areas of cooperation. There is also scope for import of natural gas from several middle-east countries, which would benefit both India and Pakistan. The interest of the supplying country, which could be Iran or Central Asian Republics, would be to have a pipeline connection extending up to India. This would however require cooperation between New Delhi and Islamabad for preventing any disruption of supplies en route.

In the absence of major export commodities in countries like Bangladesh, Nepal and Bhutan, primary energy resources and electricity have the potential to be developed as major commodities for export. The earnings from such exports would spur economic growth in these countries as these earnings are expected to be a sizeable proportion of their GDP.

Cooperation in Energy has a long-term horizon. Decisions like investing in building pipelines are long term, as a result of the huge investments required and the long payback periods. Also associated are issues of ownership of cross-boundary infrastructures, and the type of infrastructure to be built. Other important areas of cooperation include information exchange among member countries, cooperation in research and development, sharing of technology, training of personnel, and the development of appropriate regional institutions to facilitate future cooperation.

The architecture of cooperation is of interest to researchers and regional policy makers to assess the benefits of cooperation. A comprehensive assessment of benefits would require modeling exercise capable of assessing the long term transformation in the economic structure of each nation, their energy demand, technology penetrations and implications of alternate development scenarios and policies. Such an assessment can provide robust foundation to compare the alternate architectures of cooperation as well as future regimes of institutions and governance.

8.3 The Methodology

Economic activities, energy and natural environment have close linkages that manifest in diverse concerns like depletion of fossil fuels, global climate change and local air pollution. Some specific policy concerns for South Asia are the rising demand supply gap in the power sector, rising petroleum oil imports, low energy efficiency of industry as compared to international levels, and rising pollution levels in various urban centres. The synergy between economic policies, energy sector policies, and regional environmental policies is therefore vital for achieving sustainable development in the region.

These energy and environment policy issues have diversity at many levels. These include diversity in regional energy resource availability and consumption, sectoral, emission-type, technology, and future energy paths. The modeling requirements are therefore diverse and should be capable of capturing geographical diversities in energy and emission patterns in South Asia. The model should also be able to integrate short, medium, long and very long-term policy concerns since some of the policy issues require short-term analysis while some require medium-term analysis. However all of them have to dovetail into long-term dynamics of energy consumption and technology selection in various sectors since energy stocks have long life.

The South Asian analysis examines the benefits of integrating the primary energy and electricity markets in the region. The South Asian region for the study includes Bangladesh, Bhutan, India, Nepal, Maldives and Sri Lanka. The South Asian regional analysis does not include Pakistan, primarily due to the difficulties in getting data pertaining to the country.
The analysis deals with changes in technology mix under various scenarios and its impact on the energy mix of the South Asian region. A detailed bottom up model is used for the analysis. For the South Asian analysis it is important to understand the energy emission trends of each of the South Asian countries. This is accomplished using a top down trend model. The results from the trend model are used for a bottom up analysis of the region. The integrated modelling system developed for the Indian and the South Asian analysis uses the following set of models –

- ANSWER MARKAL - an energy systems optimisation model (Berger *et al*, 1987; Fishbone and Abilock, 1981; Shukla, 1996), which is used for overall energy system analysis.
- A demand model, which projects demands for each of the end use services.

- AIM/Trend - A top-down model that estimates energy and environment trends for the long run (Fujino, J. 2001). This model is soft linked with ANSWER MARKAL for the South Asian Analysis.

The ANSWER MARKAL model and the AIM/Trend models have been set up for the period 1995-2035 in steps of five years. The top-down AIM/Trend model provides GDP projections that are useful for projecting exogenous inputs like demand for the South Asian bottom up analysis. The bottom-up models provide future energy balance output and emission projections.

8.4 Status of current cooperation in the region

It is expected that cooperation among the South Asian countries in energy can improve the commercial energy map in the region. However at present regional energy trade is minimal. India the third largest world producer of coal, exports small quantities to Bangladesh, Nepal and Bhutan, which taken together accounts for much less than India's imports of coking coal.

Pakistan and Bangladesh do not export their main indigenous resource i.e. natural gas. Being self-sufficient both countries could export gas to India but for the will to save on its main indigenous energy resource and more importantly the deteriorating political relations between India and Pakistan. The situation however could be different with Bangladesh, given the recent gas finds and estimation of reserves onshore and offshore. However no agreement between India and Bangladesh has yet been reached on the export of natural gas to India.

Regional power transactions are however taking place between India and the countries of Nepal, Bhutan and Bangladesh. Regional interconnection of transmission systems of Bangladesh, Bhutan, India and Nepal (referred to as the Four Borders Region) could provide significant benefits to regional economies through closer cooperation on regional power transfer, enhanced system reliability, improved security and diversity of supply, increased economic efficiency in system operation, reduced environmental impacts and lower costs to consumers. The Four Borders Project as part of the SARI/E programme provides information on the current power transactions in South Asia (USAID-SARI/E Program 2001).

About 75% of Bhutan's electricity generation is exported to India. India has been purchasing power from Bhutan's Chukha power plant. During the 1992-2000 period, India has purchased power at an average rate of 1,400 GWh per year. During the 1999-2000 fiscal year, exports amounted to 1,626 GWh. Bhutan also imported a small amount of electricity, about 27 GWh, from India. The majority of the Tala HEP output (approximately 1,000 MW) will be exported to India under a bilateral agreement. Bhutan does not directly transfer power to or from Nepal or Bangladesh.

The systematic power exchange between Nepal and India began in 1992 at an average level of 50 MW. During the year 2000, Nepal received 132 GWh of energy and 18 MW (minimum) of power from India under the Koshi and Tanakpur Treaties. Currently, there are 19 different interconnections for power exchange with India. These include three 132 kV, ten 33 kV, and six 11 kV connections with the Indian States of Bihar and Uttar Pradesh. The other connections are at 66 kV and 33 kV. With all these and other planned interconnections in place, the level of power transfer between Nepal and India will reach 150 MW by the year 2005. Nepal does not currently transfer power to or from Bhutan or Bangladesh.

Currently, there is no power exchange between Bangladesh and any of the other Four Borders countries. Bangladesh is surrounded by the Eastern region of India on the Western side and by the North-eastern region of India on the Eastern side and is in close proximity to Nepal on the Northwest side. Two 220 kV direct current (DC) interconnections are under consideration: Krishnanagar/Farakka-Ishurdi between the Eastern Region of India and the Western Region of Bangladesh; and Shahjibazar-Kumarghat (initially to be operated at 132 kV level) between the North-eastern Region of India and the East Zone of Bangladesh. These interconnections could transfer power to the tune of 150 MW.

8.5 Existing barriers to regional cooperation

In spite of the formation of the South Asian Association for Regional Cooperation (SAARC) in the mid-eighties, intra-regional trade between the member countries remains negligible. This can be attributed to existence of several barriers that hinder cooperation in the region. These barriers can be broadly divided into political, institutional and public policy, technical, and investment and financial barriers.

8.5.1 Political barriers to cooperation

India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, Maldives, joined hands in 1985 to establish the South Asian Association for Regional Cooperation (SAARC) to promote regional cooperation. The region while trying to achieve cooperation on the one hand has witnessed open hostilities among member countries on the other. India and Pakistan, have been observing open hostilities over decades, an undeclared war along the line of control in

Kashmir and an escalating arms race, becoming most terrifying with the Indian and Pakistani missile and nuclear tests of 1998. Any project aimed at cooperation between the two largest countries in the region must face the reality of antagonism between them. Importing natural gas to India from Central Asia is an example.

The Indian Prime Minister Rajiv Gandhi had imposed an economic blockade on the kingdom of Nepal in 1989. Bhutan knows and resents the fact that India can do the same to it. Sri Lanka too has reservations about the Tamil card in India, and though ties have been good of late, India will have to do some tightrope walking once the Liberation Tigers of Tamil Elam, accused of assassinating Rajiv Gandhi, is recognized as a political entity in the island nation. As for Maldives, while ties are normal, the alacrity with which India sent its paratroopers (albeit at the behest of the Maldives government) to crush a coup attempt by mercenaries in 1988, did rattle others in the region and sparked off a debate on New Delhi's desire to be the region's police.

India’s relation with Bangladesh of late has had irritants. To a large extent the political party in power in Bangladesh has dictated the degree of comfort between the two countries. While India has had warm political relations with Bangladesh during the reign of Sheikh Hasina’s Awami League, the same cannot be said to be true of the present BNP lead government of Khalida Zia.

It may be said that countries in the region are wary of the ‘Big Brother,’ status accorded to India. Thus any move towards cooperation is looked at with suspicion, for the fear that it may be beneficial to India at the expense of the smaller countries.

8.5.2 Institutional and public policy

One of the biggest barriers to achieving the full potential of regional cooperation in primary energy and power trade is the absence of a regional group or agency to provide leadership in achieving cooperation. Multilateral initiatives may be traced back to the August 1998 Dhaka workshop “Improving the Availability of Power in South Asia: Search for Optimal Technology Options” (Federation of Engineering Institutions of South and Central Asia) at which the Dhaka Declaration proposed the creation of a SAARC Power Grid. However, for various political reasons (principally involving unrelated disputes between the member states of India and Pakistan), SAARC has been unable to follow through and develop regional power trading initiatives. While the Dhaka workshop was supported by subsequent efforts initiated by the World Bank and Asian Development Bank, serious efforts to promote regional energy cooperation in South Asia have not progressed.

Presently, the regulatory process in South Asia does not provide for considering the utility planning of other countries in the region. Individual countries do not assess or compare plans of other countries in the region to ensure that their plans are consistent and meet the combined needs of the region. Nor do national and state utilities fully consider the sources of power (or revenues) outside their national service territory as potential sales or purchases of power. In the absence of predictable legal, regulatory, and trade frameworks in South Asia, present conditions for power trade are manifested by:

i). Cumbersome regulatory processes that lengthen the time for governments and investors to make decisions;
ii). Unclear and fluid regulations and requirements;
iii). Approvals and authorizations that must go to the highest levels of government;
iv). Policies and regulations that change arbitrarily and/or frequently; and
v). Discriminatory treatment in the application of laws, regulations, taxes, and required technical or operational standards.

To support development of regional trade, legal structures are needed in each country that provide a basis for the development of facilities dedicated to cross-border trade.

8.5.3 Technical barriers

Electric power transmission lines are linear facilities that affect natural and socio-cultural resources. The effects of short transmission lines can be localized; however, long transmission lines also can have regional effects. In general, the environmental impacts to natural, social, and cultural resources increase with increasing line length. As linear facilities, the impacts of transmission lines occur primarily within or in the immediate vicinity of the right-of-way. The magnitude and significance of the impacts increase as the voltage of the line increases, requiring larger supporting structures and right-of-ways. Operational impacts also increase. For example, electromagnetic field effects are significantly greater for 1,000 kV lines than for 69 kV lines. As well as these direct impacts, there are a number of cumulative and indirect impacts related to power transmission lines, for example, the way in which the power is generated. Environmental issues, too, must be addressed at a regional level to resolve conflicts and ensure that no country bears an environmental burden so that others can have clean power. Failure to mitigate the environmental impact of dams will become a barrier to hydro development and thus a barrier to trade.

There is no protocol to govern the operation of a regional transmission network. If as a result one system constructs facilities to a standard lower than that of another, it could impose a reliability risk on the system with higher standards. Lack of a protocol also puts the reliability and quality of service at risk if operators in different countries are unsure about what procedures govern routine and emergency operations. Also transmission construction needs to be coordinated to minimize the cost of long-term investment. There are plans to develop project-specific facilities to transmit output from one country to another. But developing a robust market will require a network of facilities rather than point-to-point links. A network would provide parallel facilities to ensure delivery of electricity in the event of outages.

8.5.4 Investment and financial barriers

Power trading needs to be carried out on a commercial basis with the private sector. To do so, regional power trading will need to overcome many of the same barriers in the region that have limited private sector investment in national generation and transmission projects. For example, project developers will want to establish the need for the project, the ability to construct and operate the project, and, for gas-fired projects that also include cross-border trade, the ability to secure firm, long-term gas supply. Developers need to know all of the criteria they must satisfy to attract private investors, and they need to know that, upon compliance, their request for approval will receive prompt and efficient attention. Moreover, private investors need to know that, through sufficient training, regulatory authorities and other government officials are qualified to evaluate export projects and are able to assist developers through the development and approval process. Cross-border projects using clean fuels will compete with different fuels in different markets. Private developers need to know that the natural gas or hydropower they utilize will compete with other fuels on an equal basis, without the use of government subsidies for competing fuels or competing domestic sources of power. Participants in cross-border projects need the freedom to set prices at a level which is competitive with other fuels, as opposed to tying the price of clean fuels to the price of any particular other commodity.

The above-mentioned barriers, though prominent but not exhaustive have had a major influence on cooperation in the region. These barriers need to be overcome if the region has to benefit from cooperation in primary energy and electricity.

8.6 The South Asian Regional Analysis

The countries that represent the region in the analysis include those that make up the South Asian Association for Regional Cooperation, except Pakistan. The analysis first looks at the current status of cooperation in primary energy and electricity in the region. A chief component of this study has been collecting demographic, economic, energy and electricity sector data for each of the countries included in the study. This data was used to ascertain the energy and emission trends for each of the countries. This exercise was carried out using the AIM trend model. Energy emission trends for each of the countries were developed using this model.

Bangladesh's future primary energy supply would be dominated by natural gas, biomass and petroleum. The share of natural gas in the total primary energy supply is expected to increase from about 30% in 1995 to about 60% in the year 2030. The total electricity generated is expected to increase by about nine times during the period 1995-2030, and generation would be dominated by gas in 2030. Bangladesh currently (year 2000) emits about 8 million tones of carbon. These emissions are expected to increase five fold and reach about 41 million tones of carbon by the year 2030.

For Bhutan the primary energy supply is expected to double during the period 1995 to 2030. Traditional fuel wood and petroleum are expected to be the major sources of primary energy during the next three decades. The carbon emissions are expected to increase from 0.05 million tones of carbon in 2000 to about 0.08 million tones of carbon in 2030.

The primary energy supply of India is expected to increase by about two and a half times during the period 1995-2030 from about 17 exa joules in 1995. The share of coal, which is the highest, is expected to increase from about 33% in 1995 to about 37% in the year 2030. Electricity generation in India would be dominated by coal-based technologies. The carbon emissions for India are expected to increase by about 3.3 times during the period 1995-2030 and reach about 690 million tones of carbon by 2030.

In Maldives fuel wood has been the main source of energy, which is mainly used for cooking in the residential sector. The primary energy supply is expected to increase by about four times during the period 1995 to 2030. Like Bhutan, traditional fuel wood and petroleum are expected to be the major sources of primary energy during the next three decades. However emissions for Maldives are expected to grow at a much faster rate. While the emissions for Bhutan are expected to be less than double the current level (year 2000) of 0.05 million tones of carbon, the emissions for Maldives is expected to increase by about three and a half times over similar levels of carbon emissions for the year 2000.

The total primary energy supply in Nepal is expected to increase by about three times between 1995 and 2030. The share of oil in the total primary energy supply is expected to increase from about 8% in 1995 to about 45% in the year 2030. The share of biomass reduces from close to about 90% to about 35% in the next three decades. The economy's primary energy needs would be fueled by biomass, oil and coal. The current share of hydropower in the total electricity generated is about 95%. This domination by hydropower in the generation mix is expected to continue. Nepal's carbon emission in the year 2000 was about one million tonne of carbon. These emissions are expected to increase ten times and reach close to ten million tonnes by the year 2030.

Sri Lanka's future primary energy supply would be dominated by biomass and petroleum. The share of oil in the total primary energy supply is expected to increase from about 28% in 1995 to about 77% in the year 2030. The share of biomass reduces from about 53% in 1995 to about 16% by 2030. The share of hydro in the total electricity generated in the year 2000 was about 72%. However this share is expected to decline in future with Sri Lanka's hydro potential being exploited and also because of policy initiatives to reduce the heavy dependence on hydropower, which has caused problems in the past, such as in 1996, when a severe drought caused a major power shortfall. The share of oil increases from about 28% in 2000 to about 65% in the year 2030.

In the case of Sri Lanka and Nepal a perceptible shift away from traditional fuels like biomass is expected over the next three decades. Thus an important spill over effect is the reduction in exploitation of forest cover in these countries which augers well for the protection of the regions biodiversity.

The results from individual country analysis were used to set up the South Asian ANSWER MARKAL model for regional cooperation scenarios. The regional cooperation scenarios include the Dynamics as Usual scenario, the Medium Cooperation Scenario and the Accelerated Cooperation Scenario. The regional cooperation storyline construction depends on an understanding of how the economic structure and the energy sector dynamics of each of the countries have been evolving in the past, as well as an analysis of the present situation, and their most likely future trajectories. Each scenario construction incorporates population growth, structural changes in the economy, energy resource supply in the region, energy prices, and local environmental concerns. These would drive the future technology-fuel mix for the South Asian energy and environment systems.

In the Dynamics as Usual (DAU) scenario, regional cooperation is minimal. It is expected to continue along the present lines. There is no special initiative on the part of the member countries to engage into a cooperation regime. There is minimal trade in primary energy and electricity. The current level of cooperation is expected to continue.

In the Medium Cooperation Scenario (MCS) there are special initiatives on the part of the member countries to enter into a cooperation regime. However due to several of the existing barriers, only a medium level of cooperation can be achieved. There are attempts to overcome the barriers, and this results in more of bilateral cooperation rather than full-fledged multi lateral cooperation.

The Accelerated Cooperation Scenario (ACS) assumes a full-fledged cooperation regime between the member countries. The barriers to cooperation are overcome over time and strong regional cooperation is achieved in primary energy and electricity. Each of the above mentioned scenarios are translated into model inputs through changes in the critical model parameters. Table 8.1 gives the key drivers for each of the scenarios and the implication of changes in them on the critical model parameters.

Table 8.1: Key Scenario Drivers and Model Parameter

Scenario	Key drivers	Model Parameter
Dynamics as Usual Scenario	Economic growth, population growth, access to finance and technology, trade in primary energy resources, primary energy prices	**Status quo**: Technology costs and efficiency, fuel availability, fuel prices
Medium Cooperation Scenario	Availability of primary energy resources, resource prices	**Medium Improvement**: Better technology and technical efficiency, some barriers exist but there is a higher supply and availability of primary energy especially natural gas and hydro, more supply of gas at lower prices
Accelerated Cooperation Scenario	Availability of primary energy resources, resource prices	**High Improvement:** Availability of the best technology and hence better technical efficiency, no barriers to primary energy supply especially natural gas, higher capacity of hydro available, lower fuel prices.

The critical parameters in the ANSWER MARKAL model, which differentiates each scenario from the other, are demand and supply side technology specifications, which include efficiency parameter and emission coefficients, primary energy (fuel) availability, and fuel prices.

With stronger cooperation regimes the total energy consumption in the region reduces. This is due to the improvements in efficiency in the supply and demand side technologies. As regional cooperation grows, better technologies become available to less developed countries in the region. As a result of these efficiency improvements, the total energy consumption in the region reduces. The efficiency benefits for the region in the accelerated cooperation scenario is the sum of the benefits accruing as a result of savings in primary energy consumption, and savings in investments in both demand side and supply side technologies. The sum of these benefits is about US $ 321 Billion or about 0.9 % of the regions GDP over this period. This may be considered as the cost to the region for not cooperating.

It is evident that as a result of cooperation there is a shift from the consumption of fossil fuel like coal, to cleaner fuels like natural gas and hydro. The consumption of coal is expected to decrease beyond the year 2010 with stronger cooperation regimes. This is due to greater availability of natural gas in the region and development of cleaner sources of energy like Hydro. However, coal still continues to be a major source of energy for the region.

Figure 8.1 gives the percentage reduction in consumption of coal in the medium cooperation scenario (MCS) and the accelerated cooperation scenario (ACS) over the dynamics as usual scenario (DAU).

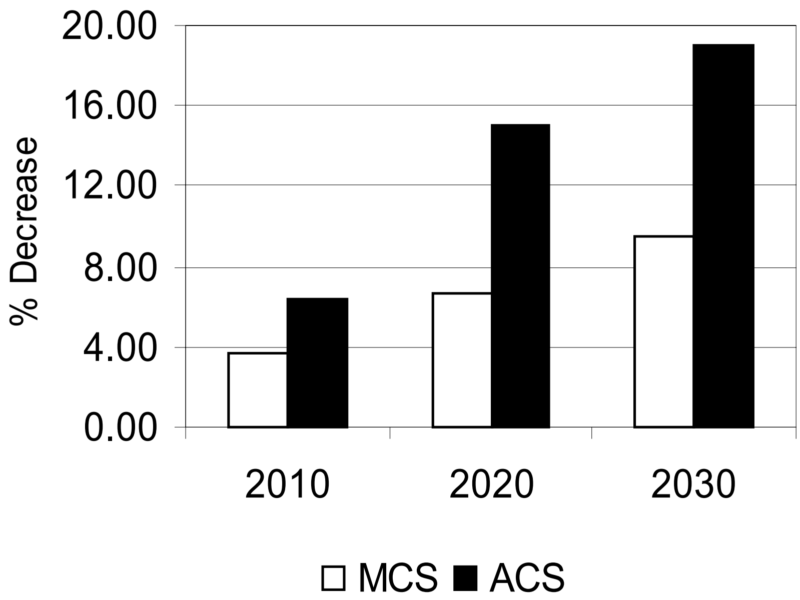

Figure 8.1 Decrease in coal consumption over DAU scenario

Bangladesh is rich in gas reserves, and with new reserves of gas being discovered in India, natural gas consumption is expected to increase in the period under study. The percentage increase in natural gas consumption in the two cooperation scenarios over the dynamics as usual scenario is given in Figure 8.2.

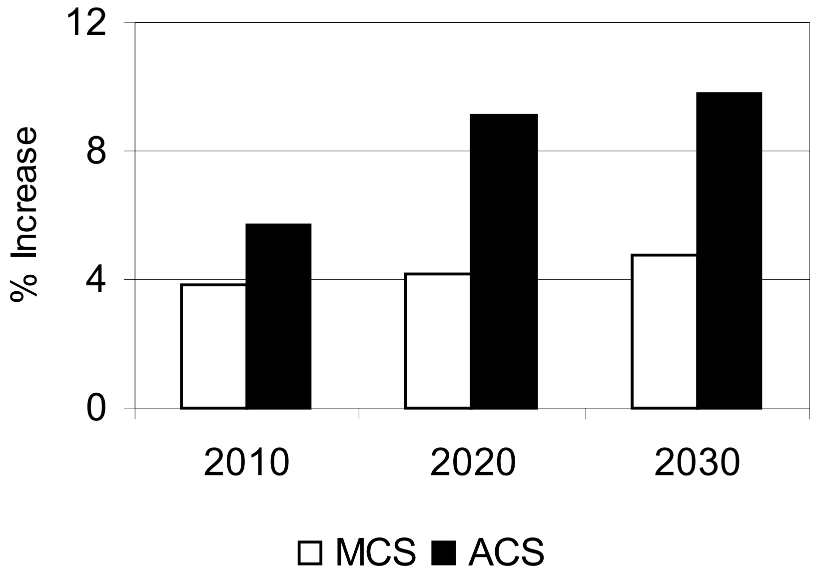

Figure 8.2 Increase in gas consumption over DAU scenario

With stronger cooperation regimes, the availability of natural gas increases. The increased supply of cleaner fuels like natural gas leads to reduction in coal consumption and contributes to reduction in carbon emissions in the region.

The South Asian region has limited reserves of oil. All countries in the region are major importers of crude oil from West Asia. Cooperation between countries in South Asia is does not change the consumption trajectory of oil significantly. However there are marginal reductions in oil consumption. This results from availability of better technologies - as a result of cooperation - in the oil consuming sectors (chiefly transport) of relatively less developed countries in the region.

Nepal and Bhutan have high potentials for Hydro electricity development. With increasing cooperation among the countries, it is expected that increasing investments would help in the development of hydro electricity in the region. Figure 8.3 gives the increase in hydro capacity over the DAU scenario.

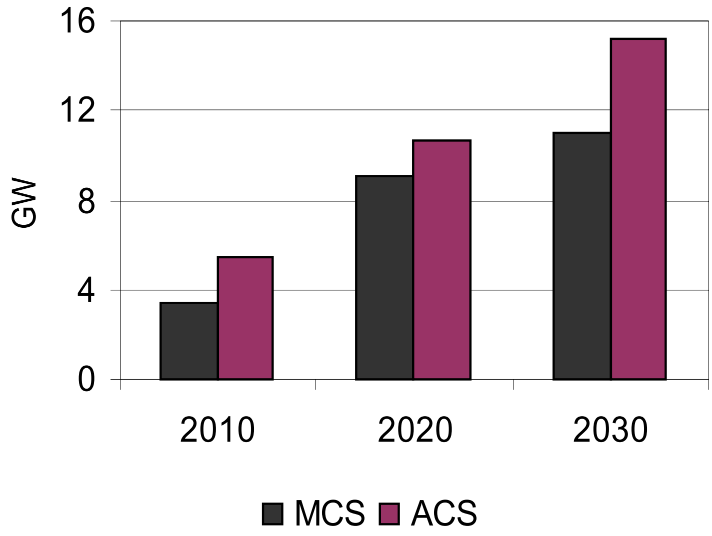

Figure 8.3 Increase in hydro capacity over DAU scenario

The increase in hydro capacities is well below the identified hydro potential of Nepal and Bhutan. The increase in hydro capacity in the year 2030 is about 15 GW.

As a result of cooperation there is a shift from the consumption of fossil fuel like coal, to cleaner fuels like natural gas and hydro. This results in an overall reduction in carbon emissions. With the cooperation regime becoming stronger the energy system becomes cleaner. The total cumulative reduction in carbon emissions for the period 2010-30 amounts to 1.4 billion tones of carbon or US$ 28 billion (at an average price of $20 per tonne of carbon). The reduction in coal consumption also leads to reduction in SO_2 emissions. SO_2 emissions reduce by about 50 million tones cumulative during the twenty-year period. Assuming an average price of $ 200/ ton of SO_2, the savings on SO_2 emissions is about $ US 10 billion for the period 2010-2030. The total environmental benefit through reductions in emissions is about $US 38 billion. This is about 0.1% of the regions GDP over this period. Table 8.2 summarizes the benefits of the accelerated cooperation scenario.

Table 8.2: Benefits of South-Asia Regional Cooperation (Cumulative for period 2010-30)

Benefit (Saving)		**$ Billion**	**% of Region's GDP**
Energy (Direct Benefits)			
Energy	60 Exa Joule	180	0.49
Investment in Energy Supply Technologies		72	0.19
Investment in Energy Demand Technologies		69	0.18
Environment (Indirect Benefits)			
Carbon	1.4 Billion Ton	28	0.08
Sulfur Dioxide (SO_2)	50 Million Ton	10	0.03
Total Direct and Indirect Benefits		359	0.98
Spillover Benefits			
Water	16 GW additional hydro capacity		
Flood Control	From additional dams		
Competitiveness	Reduced unit energy/electricity cost		

Apart from the benefits mentioned above, regional cooperation also results in several indirect benefits. Prominent among them is the development of water markets. Development of hydropower through construction of large dams, establishes water markets in the region. These provide indirect benefits like agriculture productivity increase due to better irrigation, higher forestation and associated forest economy development, fishery development, drinking water security, lower flood incidences down the rivers and related damages to crops and human establishments.

8.7 Conclusion

Benefits that arise through cooperation in the energy sector are already being reaped in other regions of the world. The South African Power Pool (SAPP) and the initiative among the Nordic countries in forming the Nord Pool to create international power pooling mechanisms have several common characteristics that are relevant to promoting regional energy trade and cooperation in South Asia. These include a diverse resource base, consisting of hydro and thermal based generation that provides opportunities for significant benefits from regional power trade; significant differences in short-term production costs and availability of supplies that also provide opportunities for trade.

However to achieve the desired level of cooperation it is imperative to have a sustained and high-level of political support, and a regional coordinating body. Confidence building measures among countries in the region is the need of the hour. The study has clearly shown the magnitude of benefits from energy cooperation. Policy makers should realize that these benefits are also the cost the region incurs for not cooperating. It is time that regional forums like SAARC are revived with active participation from all countries.