

Potential and Prospects for Regional Energy Trade In the South Asia Region

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Foreword

South Asian Region is enjoying unprecedented economic growth. The growth, however, is becoming constrained by significant shortages in energy supply and unless corrective steps are urgently initiated and implemented it may be difficult to sustain the achieved growth rates. Fostering of cross border energy investments and promotion of regional energy trade in order to take full advantage of the energy resources available within the region and its neighborhood are important elements of the solution to this problem. This is being increasingly recognized both by the region's political leaders and its business community. This study describes the potential and identifies the main opportunities for development of regional trade in electricity and gas. The study also identifies the policies that the governments should pursue to promote cross-border energy trade and describes the supporting role of the international financing institutions. We hope that the study will stimulate further interest and contribute to development of energy trade within South Asia Region and between the region and its neighbors.

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List of Acronyms and Abbreviations

ADB	Asian Development Bank
AES	American Electric Systems (of the US)
BEA	Bhutan Electricity Authority
BERC	Bangladesh Energy Regulatory Commission
BHPC	Basochu Hydro Power Company
BOO	Build, Own, and Operate
BOT	Build, Operate and Transfer
BPC	Bhutan Power Corporation
BPDB	Bangladesh Power Development Board
CAR	Central Asia Republics
CA-SA 1000	Central Asia - South Asia Electricity Trade Project 1000 MW Phase
CASAREM	Central Asia- South Asia Regional Electricity Market
CEA	Central Electricity Authority (of India)
CEB	Ceylon Electricity Authority (of Sri Lanka)
CERC	Central Electricity Regulatory Commission (of India)
CHPC	Chukkha Hydro Power Company
CNG	Compressed Natural Gas
DABM	Da Afghanistan Breshna Mossesa
DESA	Dhaka Electric Supply Authority
DESCO	Dhaka Electric Supply Company
DfID	Department for International Development (of the UK)
DOE-EIA	Department of Energy- Energy Information Agency (of the US)
EBRD	European Bank for Reconstruction and Development
ECO	Energy Cooperation Organization
EIA	Environmental Impact Assessment
ERCA	Energy Regulatory Commission Act
ETFC	Electricity Tariff Fixation Commission (of Nepal)
EU	European Union
GAIL	Gas Authority of India Limited

GEF	Global Environment Facility
GDP	Gross Domestic Product
GOA	Government of Afghanistan
GOB	Government of Bangladesh
GOI	Government of India
GOP	Government of Pakistan
GOSL	Government of Sri Lanka
GOTJ	Government of Tajikistan
GSA	Gas Supply Agreement
GTCC	Gas Turbine Combined Cycle
HPDP	Hydro Power Development Policy (of Nepal)
IDA	International Development Association
IA	Implementation Agreement
ICB	International Competitive Bidding
IDB	Islamic Development Bank
IFI	International Finance Institutions
IPI	Iran – Pakistan - India (gas pipeline)
IPP	Independent Power Producer
JBIC	Japan Bank for International Cooperation
KESC	Karachi Electricity Supply Corporation
KHPC	Kurichu Hydro Power Company
LECO	Lanka Electricity Company
LLA	Land Lease Agreement
LNG	Liquefied Natural Gas
MOP	Ministry of Power (of India)
MOU	Memorandum of Understanding
MTI	Ministry of Trade and Industry (of Bhutan)
NEA	Nepal Electricity Authority
NERA	National Economics Research Associates (of the US)
NEPRA	National Electric Power Regulatory Authority (of Pakistan)
NTPC	National Thermal Power Corporation (of India)
PFC	Power Finance Corporation (of India)
PGCB	Power Grid Company of Bangladesh

PGCI	Power Grid Corporation of India
PPA	Power purchase Agreement
PSMP	Power System Master Plan (of Bhutan)
PTA	Power Trading Agreement (between India and Nepal)
PTC	Power Trading Corporation of India since renamed as PTC Limited
RAO UES	RAO United Energy System (of the Russian Federation)
REC	Rural Electrification Corporation (of India)
REMP	Rural Electrification Master Plan (of Bhutan)
RER	Renewable Energy Resources
REDCO	Regional Electricity Distribution Company/ies
ROR	Run-of-River
SAARC	South Asia Association for Regional Cooperation
SARI	South Asia Regional Initiative (of the USAID)
SEB	State Electricity Boards (of India)
SERC	State Electricity Regulatory Commission (of India)
TAP	Turkmenistan - Afghanistan - Pakistan (gas pipeline)
UCTE	Union for the Co-ordination of Transmission of Electricity
WAPDA	Water and Power Development Authority (of Pakistan)

National Currencies and Exchange Rates

AFN	Afghani: \$ 1.00 = 49 AFN (2004 Average)
Nu	Ngultrum of Bhutan: \$ 1.00 = 44.42 Nu (as of March 30, 2006)
NRs	Nepalese Rupees: \$ 1.00 = 74.84 NRs (as of March 30, 2006)
PRs	Pakistan Rupees: \$ 1.00 = 59.83 PRs (as of March 30, 2006)
Rs	Indian Rupees: \$1.00 = 44.69 Rs (as of March 30, 2006)
LkRs	Sri Lanka Rupees: \$1.00 = 102.93 LkRs (as of March 30, 2006)
Tk	Bangladeshi Taka: \$1.00 = 73.04 Tk (as of March 30, 2006)

Note: (1) In this report Dollar (\$) and Cents refer to US dollar and cents. (2) In many countries in the South Asia Region (such as India, Pakistan, Nepal, Bhutan and Bangladesh) the fiscal year spans parts of two calendar years. In this report the fiscal year ends in the year indicated. Thus FY 2006 denotes the fiscal year which ends in the course of calendar year 2006. (3) The Indian Rupee has recently strengthened to Rs 40 to a dollar. This new rate has been used in many places in this report.

List of Measurement Units

bcm	billion cubic meters
bcf	billion cubic feet
EJ	exajoule (10^{18} joule = 0.95 quad = 0.95×10^{15} Btu)
ft	foot
ft ³	cubic foot
GJ	giga-joule (10^9 joule = 0.95 million Btu)
GWh	Giga-Watt-hour (one million or 10^6 kWh)
koe	kilogram oil equivalent
kV	kilovolt
kWh	kilo-Watt-hour
m	meter
m ³	cubic meter
MJ	mega-joule (10^6 joule = 847.8 Btu = 0.0238 koe)
Btu	British thermal units
Mcf/d	million cubic feet per day
Mtoe	million tonnes of oil equivalent (1 Mtoe = 39.68 trillion Btu = 41.8 PJ)
MW	Megawatt
PJ	peta-joule (10^{15} joule)
t	tonnes (metric, equal to 1000 kilograms)
tcf	trillion cubic feet
tcn	trillion cubic meters
toe	tonne of oil equivalent
t/y	tonnes per year
TWh	tera-Watt-hour (one billion or 10^9 kWh)

Note: To avoid confusion from the multiplicity of units and prefixes used in energy reports of various countries and agencies, the unit-usage in this report follows the rules of the Système International (SI). In this system, prefixes indicate as follows (letter case is significant):

m: 10^{-3} (mili)

G: 10^9 (giga)

k: 10^3 (kilo)

T: 10^{12} (tera)

M: 10^6 (mega)

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Executive Summary

After decades of insignificant volumes of cross-country electricity trade and absence of any trade in natural gas through pipelines among the countries in the South Asia, political leaders and businessmen of the region have recently evinced a great deal of interest and enthusiasm in cross border electricity and gas trade, not only within South Asia but also with its neighbors in the west (Central Asia and Iran) and in the east (Myanmar). This brief desk study welcomes this political commitment and advocates the rapid commencement (in the short term) of such trade in the simpler bilateral form, making the best use of the immediately available opportunities and the expansion and development of such trade into a more integrated regional energy market with multiple buyers and sellers over the medium to long term.

The Rationale for Regional Energy Trade

Such widespread regional energy trade provides a win-win situation to all the participants and is a logical and rational public policy choice because of:

- The mismatch between energy demand growth and energy resource endowments. Relatively smaller economies (Tajikistan, Kyrgyzstan, Nepal, Bhutan, Myanmar, Turkmenistan) and Iran have hydropower or hydrocarbon resources far in excess of their energy demand. The remaining countries (India, Pakistan, Bangladesh, Sri Lanka and Afghanistan) have energy demand growth far outstripping domestic supply and in the foreseeable future the demand-supply gap would become wider unless the domestic supplies are supplemented by imports.
- Implications of trade to energy security. Reliance on energy trade for meeting a part of the domestic demand can actually enhance national energy security by diversifying energy forms and supply sources and lowering the cost of energy supply.
- The substantial benefits to the smaller exporting economies. Energy exports could make dramatically significant contribution to the GDP growth of economies like Bhutan, Nepal, Myanmar, Tajikistan and Kyrgyzstan and enable their export led growth. For example, Bhutan's electricity export in FY2007 is expected to constitute nearly 25% of its GDP and 60% of its state revenues.
- The significant relief from energy constraints to rapid economic growth. This is especially true in the importing economies, India, Pakistan and Afghanistan. For example, in India alone, the volume of unserved electricity in FY 2007 is estimated at 54,916 GWh valued at \$12.1 billion on the basis of the short term marginal cost in the Indian grid. The value of the corresponding industrial production foregone would be several times more.
- The environmental imperatives. This is especially relevant for India which relies very heavily on domestic coal. Its carbon dioxide emissions will rise from 4% of the world total today to about 13% by 2030 unless low carbon strategies are adopted. Imported hydropower and natural gas would help in moderating this increase to some extent.

- Climate change imperatives. Carbon emissions are increasing and Himalayan glacial resources are shrinking. The management of regional water resources and the use of other primary energy sources have to be optimized for the benefit of the region as a whole, and trade enables such optimization for the benefit of all.
- Reduction of supply costs. Trade could reduce system development costs and enable lower cost supply. Nepal, for example, could dramatically reduce its cost of power supply (compared to its attempt to meet its demand by the expensive all-hydro generation option) by optimizing its power system with sale of hydropower to, and import of thermal power from, India.
- Cash flow implications. Often energy import options improve cash flow and enable postponement of lumpy and large domestic capital investment needs, to avoid crowding out other important investment needs (the classic make or buy choice).

Scope of the Study

This study seeks to highlight the potential and prospects for such trade, analyze the factors which have inhibited the trade so far and take note of the emerging favorable trends in the region. *It recognizes that trade is a logical corollary to the availability of opportunities for arbitrage and can take place under a variety of sector policies, structures and conditions (including the present conditions in the region), but that capacity building and sustained sector reforms would help to expand and sustain trade and enable the evolution of a more integrated regional energy market.* Against this perspective, it seeks to outline the regional trade opportunities and identify the role of the regional governments as well as the multilateral and bilateral development partners in promoting such trade, taking fully into account both global concerns (such as environmental impact and climate change) and regional concerns (such as optimal management and use of water resources and primary energy resources and benefit sharing among all participants).

Energy Constraint to Economic Growth

Driven by the first generation reforms relating to the correction of macroeconomic imbalances and the adoption of more liberal regimes relating to trade, investments and exchange rates South Asia has become one of the fastest growing regions in the world during the last several years. India is targeting an annual growth rate of 10 percent with Pakistan, Bangladesh and Sri Lanka following closely behind. Such buoyancy of growth is expected to continue through 2015, halving the regional poverty levels.

Such a dynamic growth in the past had been driven by global, rather than regional integration. The intra-regional trade in South Asia was only about 2 percent of its GDP compared to more than 20 percent in East Asia in 2005. Per capita income in the region was still less than \$700 in 2005 and the region's growth has to encompass not merely the services sector (in which remarkable progress had been registered) but also the industrial and agricultural sectors. The key impediment to achieve and sustain such broad based growth at the targeted rates is the lack of adequate infrastructure, which is especially acute in the energy sector and especially in the larger economies of India, Pakistan and Bangladesh as well as in Afghanistan.

Lack of adequate and reliable energy is proving to be a major constraint to growth in production and productivity. Relieving this through the sustainable provision of secure energy supply remains a significant challenge.

Mismatch Between Resource Distribution and Demand Growth Distribution

The region has an installed power generation capacity of about 152 GW and an annual generation of the order of 740 TWh and the demand is expected to grow annually in the range of 6.6 percent to 11.5 percent during the next 15 to 20 years, if supply growth could keep pace with the demand growth. Bhutan, Nepal, Myanmar and the Central Asian economies (such as Tajikistan and Kyrgyz Republic) have energy resources far in excess of their domestic needs. Total hydropower potential of these five countries exceeds 170,000 MW of which less than six percent has been developed. The combined peak demands of their systems amount to no more than 60 percent of the developed capacity. The development of even a part of their undeveloped resources for export would enable the export led growth of these relatively smaller economies.

India and Pakistan had a total annual gas consumption of the order of about 2.5 tcf (in FY 2006) divided approximately equally between them. Gas demand in India and Pakistan are forecast to grow annually at the rate of 8 percent and 7 percent respectively in the next 25 to 30 years. In Pakistan supply shortfall would be about 4 percent to 10 percent till FY 2010 and thereafter widen to 20 percent or more. India's import dependency for gas is expected increase from the present modest level of 7% to the 49%-58% range by FY 2032. Total gas reserves of Turkmenistan, Iran and Myanmar exceed 1000 tcf. Bangladesh is also believed to have significant potential for export of gas or gas fueled electricity.

India and Pakistan could provide the major import markets for the surplus energy from these countries as well as from Iran and Turkmenistan and secure additional energy supplies to relieve shortages and sustain economic growth.

Existing Level of Trade

Presently there is no cross border pipeline or trade in natural gas. Cross border electricity interconnections and electricity trade are insignificant except for the following:

- Bhutan's export of 5664 GWh in FY 2007 to India from three hydropower projects with total generating capacity of 1,416 MW constructed with substantial grant assistance from India;
- Import of about 430 GWh (or about 28% of the total supply) by Afghanistan from Iran, Turkmenistan, Uzbekistan and Tajikistan;
- Nepal's import from India of 266 .23 GWh (or 9.6% of its total supply) and its export of 101 GWh (or 5% of its total sales) to India
- Pakistan's import of about 25MW of power from Iran to the isolated grid of Baluchistan near Gwadar deep sea port

Factors which inhibited trade in the past

The most important among the factors which inhibited regional energy trade in the past relate to the political tensions, security issues and the past economic policy choices. These factors include:

- Prolonged political tension between India and Pakistan over Kashmir, war like conditions in Afghanistan, internal armed conflicts in Sri Lanka and Nepal as well as the political turmoil in Bangladesh;
- Past pursuit of inward looking, import substitution based policy approach aimed at the elusive goal of national self sufficiency. This approach regarded energy imports as diluting energy security;
- Lack of cross border transmission links and a lack of adequate transmission infrastructure even for transferring power among the various regions within the large countries such as India, Pakistan and Bangladesh. The dilapidated and war-damaged infrastructure in the key transit country of Afghanistan was a major constraint to trade between Central Asia and South Asia
- Poor operational efficiency and lack of creditworthiness (arising from inadequate tariffs, high system losses and poor collections) of most power utilities in the region, which did not encourage trade with them, as payment risks with them were perceived as unmanageable;
- Pervasive state ownership of the utilities, their poor earnings and the lack of resources to invest for their own domestic needs let alone the investments for export.

In addition, in a large country like India progress in sector restructuring, open access to transmission systems and fair and transparent sector regulation at least at the level of national and regional grids, as well as the emergence of licensed power trading firms were needed even for stimulating internal trade among the various regions of the country.

Emerging favorable factors

Since the late 1990s, several new factors favorable to trade have emerged. The most important of these factors is the change in the political mindset of the politicians away from inward looking import substitution based development strategies relying on controls on trade, investment and exchange rate regimes. Newer approaches to growth led by liberalized trade and investment regimes, and with an expanding role to the private sector and the markets are coming into vogue, resulting in a greater degree of global integration and significant growth dynamism, and increasing foreign exchange earnings and reserves, which in turn enable further liberalization. Increasing growth rates translate into rapidly increasing energy demand and the urgent need for timely supply augmentation to meet such demand both from internal and external resources. Other key factors include:

- Emergence of national transmission companies in India, Pakistan and Bangladesh paying special attention to increase the inter-regional transfer capacities within the country. In India such transfer capacities have nearly doubled during FY2002-FY 2006 to reach 9,450 MW. It would increase to 16,540 MW by the end of FY 2007 and further to 37,150 MW by FY2012. This would effectively enlarge the markets for imports, by giving the exporter a substantially wider choice of buyers.

- Emergence of national and regional power markets in India enabled by the new Electricity Law of 2003. The law has enabled the creation of regulatory bodies, the phased open access to the national and regional transmission grids and the emergence of licensed and regulated energy trading companies. The adoption of availability based tariffs with a frequency linked Unscheduled Interchange charge in the national and regional grids has led to the emergence of lively electricity trade and a spot market sending reliable price signals to the market. Such trade became possible, in part, by the special steps taken by the government and the central bank to reschedule the past debts of provincial power utilities and to enforce payment discipline.
- Increasing role of the private sector. Private sector has a total generation capacity of nearly 24,000 MW (or about 16% of the total installed capacity) in the region. Distribution systems in Delhi, Orissa, Bombay, Calcutta, Surat, Ahmedabad, and Karachi are in the private sector or have recently been privatized. The privately owned tiny distribution system in the city of Ghazni in Afghanistan and the rural electric cooperatives in Bangladesh are the heart warming examples in an otherwise bleak environment of the sector in these countries. The 400 kV transmission link between eastern and western regions of India (enabling the absorption of Bhutan power imports) has been constructed by a joint venture between a private investor and the Power Grid Corporation of India. There are more than 20 private sector licensed power trading companies in India besides the PTC Limited (in which both public sector and private sector hold shares). Indian private investors are actively looking for opportunities to invest in export power projects in Bangladesh, Bhutan and Nepal. Majority state-owned NTPC of India is considering investing in a large thermal power plant in Sri Lanka. The Tata group is pursuing investment in a 1000 MW plant in Bangladesh.
- Commercialization of the distribution segment, through enterprise reform, privatization and through regulatory prodding is going ahead, though often frustratingly slowly, in India, Pakistan and Bangladesh
- Structural changes involving the separation of transmission from generation and distribution functions, open access to transmission and creation of independent regulatory bodies are progressing at different speeds, with India leading the pack and with Pakistan, Bangladesh closely following.
- Political tensions between India and Pakistan are becoming less through a series of high level talks and confidence building measures. Internal conflicts in Nepal have subsided and that in Afghanistan still seems to be under control.
- There is an increasingly serious interest in discussing energy related cooperation, cross border energy investments and trade possibilities in a range of regional organizations such as SAARC, ECO and BIMSTEC.

Evolution of the Regional Trade

The nascent bilateral energy trade is expected to increase among the countries in the region and its neighbors. India, Pakistan and possibly Bangladesh would emerge as major importers while Central Asia, Iran, Nepal, Bhutan and Myanmar could emerge as significant exporters. Afghanistan would be both an importer and the important transit country. Experience and confidence gained through bilateral trade are expected to help

the evolution of regional energy markets with multiple sellers and multiple buyers. It is envisaged that initially trade would be clustered around two energy markets -- a Western Energy Market (in which Central Asia and Iran would sell electricity and gas to Afghanistan and Pakistan and possibly to India) and an Eastern Energy Market (in which Nepal, Bhutan would export hydropower to India, and Myanmar would export both natural gas and hydropower to India. Bangladesh could also export gas or gas based power and could import some hydropower from Nepal, Bhutan and Myanmar. Eventually interconnection of the grids of India and Pakistan would create the full regional electricity and gas market serving a population of 1.5 billion people. This market would be one of the largest in the world, whose sheer size would make it easier to mitigate the various risks, bear external shocks, reduce cost, create additional and more profitable trading opportunities, and attract investments.

Opportunities in the Western Energy Market

Energy trade opportunities currently being discussed or pursued include:

- Power imports to Afghanistan. Afghanistan's power demand is expected to grow to the level of 905 MW by 2020 and agreements in principle have been reached to import 300 MW each from Tajikistan, Uzbekistan and Turkmenistan. Arrangements for the reinforcement of transmission links with Tajikistan and Turkmenistan are in place and that for the link to Uzbekistan is being reviewed and is likely to be pursued in the context of projects to decongest the Uzbek grid. Imports from Iran of 60MW to 100 MW to serve the Herat and Nimroz provinces would continue and adequate transmission links for this have already been constructed. Funding is in place and construction is in progress for the North East Power System in Afghanistan to transmit the imported power to various load centers.
- Power import from Iran to the Gwadar port area in Pakistan will increase from about 25 MW now to about 100 MW when the proposed 220 kV link is completed.
- Hydropower import from Central Asia to Afghanistan and Pakistan. This prominent multilateral trade project is being currently discussed and formulated with the help of multilateral and bilateral development partners led by the World Bank. It relates to the export of 1000 MW of power from Tajikistan and Kyrgyz Republic to Pakistan and Afghanistan. A World Bank study (2004) showed that the completion of the partially constructed Central Asian hydropower projects (including new transmission links) would enable Tajikistan and Kyrgyzstan to supply power to Afghanistan and Pakistan at a delivered cost lower than the marginal cost of generation in Pakistan. Pakistan's present power demand at the generation level of about 14,000 MW is expected to reach 20,000 MW by FY2010 and 44,700 MW by FY2020. Among the several options to meet such growing demand import of power from Central Asia has a prominent place. About 670 MW would come from Sangtuda I hydropower project under construction by a joint venture between RAO UES of Russia and the Tajik government. Surplus power from the existing generating stations of Tajikistan and Kyrgyz republic would supply the remaining 330 MW. An MOU among the four governments had

been signed and a Council of Ministers and a multi-country working group have been set up to coordinate further efforts. Studies for the dedicated transmission line and other technical, legal commercial and risk mitigation related studies are ongoing under the technical assistance provided by the World Bank and the Asian Development Bank. Private participation in the transmission component is also envisaged. Should this initial project prove cost effective and reliable, Pakistan is expected to increase its import from Central Asia to about 4000 MW in the second stage.

- Natural gas import by India and Pakistan from Iran (IPI Gas project). This project, which is in an advanced state of negotiation, is for importing annually (for 30 years) 33 bcm of gas by India and 21.7 bcm of gas by Pakistan from Iran in two phases. In the first phase one pipeline with a diameter of 56 inch would be built to transport 21.7 bcm of gas. In the second phase the pipeline capacity would be doubled to transport the remaining gas. Iran would build the pipeline up to the Pakistan border and Pakistan would build it further up to the Indian border. Pakistan would buy the entire gas at the Iran-Pakistan border and transport it across its territory and sell to India the latter's share of gas at a price which would include Pakistan's transmission charges and transit fees. The total distance involved is about 2,670 km. Total pipeline costs are believed to be about \$7 billion. Many private investors appear to be interested in participating in the project. Russian Gazprom has also expressed interest to invest in this pipeline. Completion of the first phase is expected by 2013
- Natural gas import by Pakistan from Turkmenistan via Afghanistan (TAP Gas project). This project involves the construction of a 1680 km long 56 inch diameter pipeline at a cost of about \$5.3 billion to supply about 30 bcm of gas per year from Turkmenistan to Pakistan via Afghanistan. India has also been invited to join this venture and it has attended the steering committee meetings as an observer. Further progress would depend on the robustness of the gas reserves data, certification of the reserves, extent of possible private interest, ability and willingness of Turkmenistan to fulfill its commitments to Gazprom of Russia and still supply Pakistan and India, and finally on the gas pricing.

The overall prospects for energy trade in the Western Energy Market in the near term are summarized in Table ES 1.

Opportunities for Trade in the Eastern Energy Market

Rapid increase in the peak power demand of India (from 93,255 MW in FY 2006 at an annual rate of about 7% through FY2032) and the country's inability to meet it fully from domestic resources are key drivers for energy trade in the eastern market. Indian policy makers envisage import hydropower from Bhutan, Nepal and Myanmar and gas based power from Bangladesh as well as import of gas from Myanmar and Bangladesh. Key opportunities for trade in the eastern market include:

Table ES 1: Summary of the Prospects for Trade in the Western Energy Market

Importing countries	Exporting Countries					
	CARs	Turkmenistan	Iran	Afghanistan	Pakistan	India
CARs	x	Some gas exports are possible; mutual electricity support	Unlikely (uncompetitive)	No scope	Limited (some emergency support possible)	No scope
Turkmenistan	Mutual electricity support	x	Unlikely (similarity of resources – gas; little scope in electricity)	No scope	No scope	No Scope
Iran	Limited power exports possible	Power exports are ongoing	x	No scope	No scope	No Scope
Afghanistan	Power exports are ongoing and should grow	Power exports are ongoing and should grow	Power export ongoing and may grow	x	Small cross-border power export possible	No scope
Pakistan	Potential for power exports	Significant potential for gas exports	Significant potential for gas export; cross-border electricity trade could grow	No scope for trade; Transit of electricity and gas	x	Mutual short-term trading support in power
India	Gas and power exports possible	Significant potential for gas exports	Significant potential for gas exports	No scope; Transit of gas	Mutual short-term trading support in power; transit of gas	x

Notes on color coding for Tables ES 1 and ES 2: **Red Color** denotes that trade prospects are significant and are either being exploited or can be brought to fruition in the short-to-medium term. **Green Color** denotes that prospects of the trade are good and may materialize in the medium term. **Yellow Color** denotes that prospects for the trade are more limited and may materialize in the medium-to-long term, and **Grey Color** denotes that the prospects for the trade are weak.

- Hydropower exports from Bhutan. Bhutan’s unexploited hydropower potential exceeds 23,000 MW and there is a wide shelf of projects to choose from. Bhutan’s power system master plan envisages the construction of six new hydropower projects with a total capacity of 4,484 MW through 2024. The government has also signed an umbrella agreement with the government of India for the preparation of projects and feasibility studies for several hydropower projects and many of the studies are ongoing. Most large Bhutanese projects are run-of-the-river type with little firm energy and with substantial wet season energy and tend to have high capital costs and

modest internal rates of return not likely to be attractive to private investors. However, the evolution of the power trading market in the Indian grid provides an opportunity for Bhutan to choose that part of India which has a demand pattern matching its supply pattern and marginal costs exceeding its supply cost. Major increase in Bhutan's power exports to India in the medium to long term could materialize mostly in the context of the continuation of the present financing arrangement under which the Indian government provides a grant to cover 60% of the capital cost and soft loans for the remaining 40%. Modest increases through medium sized projects could come through investments by private investors.

- Hydropower exports from Nepal. Construction of two 220 kV links between India and Nepal, would help increase the present modest level of power exchange between the two countries and would also enable many of the privately owned IPPs in Nepal to export their surplus power to India. Nepal's unexploited hydropower potential exceeds 43,000 MW and it has a large shelf of proposals for run-of-the river and storage projects of large and medium sizes, which have been studied over the last several decades. They have not made much progress as intergovernmental agreements were not easy to reach. The situation has dramatically changed with the emergence of private sector investors with keen interest in investing in Nepal projects for exports to India. The government has recently invited RFPs in respect three hydropower projects(Upper Karnali, Arun III, Buri Gandaki) totaling about 1300 MW and several major Indian investors - - some, in collaboration with international investors- - have responded. The focus which is mainly on the simpler run-of-the-river projects needs to shift to storage hydropower projects to realize better values in the Indian market. In this context, it is heartening to note that after efforts lasting over 12 years, the 750 MW West Seti Storage Hydropower project, sponsored by SMEC of Australia appears likely to achieve financial closure in the next few months with equity participation from Australian, Chinese, Indian and Nepalese investors and debt substantially from China. Ninety percent of the electricity output (2,970 GWh) had already been contracted for export to India at a price of 4.95 cents/kWh.
- Grid Interconnections. Interconnection of the grids of India, Nepal, Bhutan and Bangladesh through the junction of the borders of these four countries has been shown by studies to be beneficial for all four parties to improve the reliability of their systems. Similar benefits are expected from the proposed interconnection between the Indian and Sri Lankan grid across the sea, for which preliminary intergovernmental agreement has recently been reached.
- Export of hydropower from Myanmar. Myanmar has unexploited hydro potential of about 39,000 MW and is developing about 10,400 MW of new capacity through joint ventures with Thai and Chinese businessmen and utilities mainly for export of power to Thailand. Indian and Myanmar governments have a history of cooperation in designing and building hydropower projects in Myanmar and are again collaborating in the design and formulation of Tamanti multipurpose project located near the Indian border initially with a power component of 1,200 MW, essentially for export to India. This is likely to be developed as a joint venture between Myanmar and Indian power entities.
- Power and Gas Exports from Bangladesh. Several proposals have been made by public and private sector entities of India and other countries for establishing large

gas fired combined cycle power projects in Bangladesh mainly for export to India, but perceived uncertainties about the volume of gas reserves in Bangladesh have led its government to hesitate to concur. Recent discoveries and development of coal in Bangladesh and the expected changes in the political condition of the country could perhaps lead to an early concurrence. Most observers believe that Bangladesh has abundant gas reserves and that it has the potential for significant gas exports to India. However the Bangladesh government is not yet fully convinced about the adequacy of its reserves.

- Gas Exports from Myanmar. ONGC and GAIL of India have invested in successful gas exploration in two blocks in Myanmar. In order to transport gas from those blocks to India they have designed alternative gas pipelines from Myanmar off-shore fields to India—one passing through Bangladesh and other bypassing that country. Depending on the outcome of discussions with Bangladesh one of these pipelines is expected to be selected. Meanwhile the government is also considering piping gas to China and exporting gas as LNG. Final decisions would be taken after the evaluation of the reserves in both the blocks during the next several months.

The overall prospects for energy trade in the Eastern Energy Market are summarized in Table ES 2.

Table ES 2: Summary of prospects of Trade in the Eastern Energy Market

Importing Countries	Exporting Countries					
	India	Bhutan	Nepal	Bangladesh	Sri Lanka	Myanmar
India	x	Significant quantities of hydropower (H)	Significant hydropower export possible	Significant amounts of gas or power possible. Some resource uncertainty	Some peak power support possible	Significant gas and power supply possible
Bhutan	Dry Season Support	x	Unlikely. Similarity of resources and seasonal shortages	Small amounts of thermal power and gas; connection via India (L)	No scope	Unlikely (far off; too small market)
Nepal	Thermal power support. Dry season support	Unlikely. Similarity of resources and seasonal shortages	X	Small amounts of thermal power and gas; Connection via India (L)	No scope	Unlikely
Bangladesh	Sharing reserves; Electricity swaps	Some hydropower. Connection via India (L)	Some hydropower. Connection via India (L)	x	No scope	Unlikely (although some potential in hydropower)
Sri Lanka	Dry season and thermal power support	Unlikely (far off)	Unlikely (far off)	Unlikely (far off)	x	Unlikely (far off)
Myanmar	No scope	Uncompetitive	Uncompetitive	Uncompetitive	No scope	x

What the Governments need to do to promote energy trade?

As noted earlier trade is a corollary to the availability of opportunities for arbitrage. Energy trade can take place even under the *present circumstances* and under a wide range of sector policies, structures and conditions and their levels of development and sophistication. The regional governments should make use of the present political consensus on the need for developing regional energy trade, in the light of the strong commitment expressed at the highest levels at the recent SAARC conference (April 2007) and SAARC Energy Ministers' meeting (March 2007). Some of the trade opportunities described in the earlier sections should be within reach. Based on their state of preparation, the priority deals for such immediate action would include: (a) Central Asia-South Asia 1000 MW electricity trade project; (b) West Seti Hydropower project in Nepal; (c) Iran-Pakistan-India gas pipeline project; (d) strengthening transmission interconnections between Nepal and India; and (e) the "four-borders" transmission interconnections linking the power systems of India, Bangladesh, Bhutan and Nepal. These projects could jump-start regional energy trade and lead the way for more active regional cooperation whose benefits would spill over into other economic areas.

While these and possibly some other energy trade projects could be implemented under the present circumstances, to facilitate a more vigorous pursuit of regional trade opportunities, the governments may have to focus in the *near term* on a number of measures:

- Articulate further and strengthen the public support for the emerging policy approach treating energy imports as enhancing energy security in the major importing countries such as India, Pakistan and Bangladesh and energy exports as driving rapid economic growth in the exporting and transit countries;
- Encourage both national and or international private sector to play a major role in the form PPP structures in cross border investments on export projects, as they have better credibility and are perceived as more neutral than pure state-ownership based arrangements;
- Subscribe to, and become members of the Energy Charter Treaty, as Pakistan has done, in order to place the cross border energy trade on a firmer multilateral footing in relation to investment protection, regulation of cross-border energy infrastructure and flows, provide additional comfort and confidence to all participants, and minimize the political risks to prospective investors;
- Reduce political tensions within and across the countries, with special attention to the integrity of transit countries (such as Afghanistan) and the viability and operational stability of their energy systems. Trade flourishes under peaceful conditions.
- Adopt a sustainable commercial approach to trade (rather than a political ad hoc approach) and use standard commercial contracts which allocate risks fairly. Let the private investors and market forces play a major role in actual buying and selling.
- Create the capacity in smaller economies such as Afghanistan, Bangladesh, Kyrgyzstan, Nepal and Tajikistan to prepare, negotiate, monitor and enforce such

commercial contracts. Solvent and regulated energy traders may have a very useful role to play.

- Keep the price expectations realistic based on reliable market signals and ensure that both the buyer and seller see advantage in the trade.
- Let the momentum of political commitment built by recent SAARC summit drive the prioritized available opportunities towards the conclusion of inter-governmental agreements and trade contracts.

To sustain and expand energy trade and minimize trade risks and to enable the evolution of a more integrated and more efficient regional energy market in the *medium-to-long term*, governments have to deepen and advance sector reforms aimed at creating appropriate sector structures, financially viable entities and an environment of predictable and neutral regulation. The governments may have to focus on the following initiatives:

- Review and re-optimize the least cost power and gas development plans of the individual countries with energy trade as an explicit option to meet part of the demand, minimize carbon emission and identify on the basis of such re-optimization priority regional energy projects to be constructed and operated.
- Carry out detailed feasibility studies, inter alia, to quantify trade benefits and to proceed with implementation.
- Construct the essential transmission links to move the imported energy to the demand centers, including the essential trans-border links and facilitate the technical coordination of interconnected systems and harmonization of grid codes and operational practices making the best use of the Energy Working Group of SAARC and its Energy Center securing for this purpose technical assistance and cooperation with UCTE, if needed. The same forum could be used to harmonize the regulatory practice and the evolution of a regional regulatory body.
- Complete the ongoing energy sector restructuring process especially, in separating the transmission systems (from generation and distribution) and ensuring their open access and enabling the evolution of national energy markets in which the distribution entities, large consumers and energy traders, could choose their suppliers and negotiate contracts with them. Indian lead in the power sector in this regard is noteworthy. Similar reforms in gas sector need to be undertaken urgently in India, Pakistan and Bangladesh
- Improve the operational and commercial efficiency and financial viability of the distribution entities through enterprise reform, inter alia, making the best use of technology such as remote/smart metering and GPS technologies and through privatization/concessions
- Adjust tariffs and cross subsidies to enable financial sustainability of the sector and shift subsidies from the utility to state budgets and evolve sustainable and targeted social protection schemes. This needs to be done both in exporting and importing countries to sustain trade.
- Make the best efforts to conclude international river basin agreements on a priority basis as storage hydropower projects are badly needed in the region to provide firm power and meet peak demands. These agreements which have a broader focus than mere power generation, have to take into account the concepts of benefit sharing and the imperatives of global concerns such as climate change

and the need to adopt low carbon strategies and the regional concerns such as integrated river basin management involving the regional optimization of the use of water and primary energy resources.

Possible Role for multilateral and bilateral development partners

Neutral parties such as the International Financing Institutions (IFIs) and their development partners have the significant role of an honest broker in facilitating cross border investments for export and associated trading arrangements. A World Bank study of 2004 identified the electricity export potential of Central Asia and demonstrated that export of power from Central to South Asia would be a win-win situation for both parties. This led to the relevant four countries coming together and pursuing the 1000 MW export project with the help of WB, ADB and other development partners.

The multilateral agencies have a key role in the structuring of PPP type projects and their financing arrangements and also in devising ways for mitigating a wide range of risks faced in such projects based on their world-wide experience. They could help the smaller low-income exporting countries to participate with some equity in the PPP arrangements. The presence of multilateral agencies in the project as equity holders and lenders (even with small amounts) discourages the parties from non-performance of contract obligations and thus provides a source of major comfort for both parties. They can also use their guarantee instruments to reduce a range of risks for the investors. MIGA could tailor transit country political risk cover to suit the needs of the project. Partial credit guarantees could extend effectively the maturity of debts and improve the cash flow of the projects.

The multilateral agencies could use their lending and non-lending services:

- To build capacity in the governments and the public and private sector energy entities of smaller economies such as Nepal, Bangladesh and Sri Lanka to negotiate, implement, monitor and enforce energy export contracts;
- promote the separation of the transmission (from generation and distribution) and its operation under an open access regime;
- help expand the inter-regional transmission capacity in large markets such as India, Pakistan and Bangladesh, and promote the evolution of national markets
- help the regulatory regimes to mature;
- encourage pricing reforms and support the enterprise reform and privatization of distribution entities, and
- help SAARC Energy Working Group and its Energy Center secure UCTE or other suitable assistance for technical coordination of regional power systems and also to develop regional regulatory oversight of the interconnected grids.

The multilateral and bilateral agencies need to give adequate priority to regional trade initiatives in their assistance strategies and need to fully coordinate among themselves to improve the synergy of their operations. The regional trade agenda should be appropriately integrated into the country strategies and country programs. Regional energy projects, as a rule, have higher risk profiles and may benefit from the involvement of the international agencies, which have complementary instruments that can

collectively cover wider range of risks, as well as help spread the risk over a large number of participants.

Reduction of political tension is usually considered a key requirement for cross-border investment and trade. Conversely, the world experience appears to demonstrate that cross border investments and trade and associated business interests help to lower political tensions. Entrepreneurial investment initiatives with imaginative financing and risk mitigation strategies – possibly with the involvement of multilateral financing institutions in some projects as neutral parties to help build the confidence and mitigate risks -- could help to start and strengthen the virtuous circle of trade growth and regional peace.

India, with its geographic position and the size and the buoyancy of its economy, plays a unique and critical role in regional integration in South Asia, including in the energy sector. Bilateral energy trade between India and its neighbors is a key building block of the integrated regional energy market. While it would be useful and perhaps necessary to develop an upfront understanding at regional (SAARC) level as to how such region-wide energy systems (regional electricity and gas grids) and trade could evolve, the pace of regional integration will be in large part determined by the pace of development of energy trade with India, especially on the eastern side of the region. In this context, it is very encouraging to see the reforms that are taking place in the Indian energy sector and the efforts which India is taking to strengthen its domestic electricity transmission grid. It is also encouraging to see that similar reforms are either under way or being planned in other countries in the region. This, with increased political consensus among the countries on the need to encourage regional integration in general, and regional energy trade in particular, should bode well for development of regional energy trade.

Chapter 1 INTRODUCTION

1.1 Context

This report seeks to review the potential and prospects for regional trade in the electricity sector in the South Asia Region (SAR), which -- for the purpose of the report -- includes Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka¹. Geographically, the region is bordered by the Himalayas in the north, the Baluchistan desert on the west, and a chain of mountains toward Myanmar on the east. Politically, the region borders with Iran and the three Central Asian States – Turkmenistan, Uzbekistan, and Tajikistan – on the west, with China on the north, and with Myanmar on the east.

India accounts for about 75% of the population and 64% of land area of the region and shares common borders with all other countries in the region, except Afghanistan. Bangladesh, India and Pakistan make up 95% of the region's population and GDP.

With a population of nearly 1.5 billion people (or about 23% of the world population), the region's combined GDP amounted to US\$996 billion in 2005 (or less than 3% of the world GDP). Though the region faced low rates of economic growth from 1950 to the late 1980s, largely on account of the pursuit of inward looking import substitution strategies, it is experiencing dynamic growth rates averaging 5.5% a year during the last two decades. Outward looking, export oriented reforms and liberalized trade, exchange rate and investment regimes have accelerated growth rates (especially in the services sector) in the recent years and in 2005 the region registered a GDP growth rate of 8.1%. It is now one of the fastest growing regions in the world, with India targeting annual growth rates of 10% and with the growth rates of Bangladesh and Pakistan exceeding 7%. Such buoyancy in growth is expected to continue through 2015, leading, inter alia, to the halving of the regional poverty levels.

Such economic growth was driven by global rather than regional economic integration. Adverse factors such as long standing dispute over Kashmir between India and Pakistan, internal political instabilities in Afghanistan, Nepal and Sri Lanka, and other political problems had overshadowed favorable factors such as geographic contiguity and shared languages, culture and history of the countries in the region, and inhibited the growth of regional trade.² Such a lack of regional trade is much more conspicuous in the networked energy sub-sectors (such as electricity and natural gas) since the necessary prerequisites such as electrical interconnections and natural gas pipelines across borders are practically non-existent or are limited only to a few instances. The situation of energy trade between the region and its immediate neighbors is not very different from that of the intra regional trade.

¹ Maldives, which also belongs in the SAR group of countries, is not considered in this report, given its geographic position which rules out electricity interconnections with other countries.

² The intra-regional trade in South Asia was only about 2% of its GDP compared to more than 20% in East Asia in 2005

Per capita income (based on World Bank Atlas methodology) in the region was still less than \$700 in 2005 and lack of investment resources and institutional constraints have resulted in supply constrained energy systems.³ In order to sustain dynamic growth rates in the medium to long term, growth has to be broad-based covering industrial production and productivity, and for this, lack of adequate infrastructure especially in the energy sector is proving a significant constraint.⁴

Securing adequate energy supply, thus, is one of the most important challenges facing most of the SAR countries, increasingly so, as their own significantly increasing energy demand growth is matched by neighboring countries such as China. While an adequate supply of coal and oil requires active participation in the *global* coal and oil markets, *regional* energy trade, especially in electricity and natural gas, is an important untapped resource which could be exploited to ensure energy security of the energy importing countries or add to economic development of those with energy export potential, offering win-win opportunities for all countries involved.

There are pronounced differences in energy resource endowments and energy consumption needs among the countries of the region and its neighbors. Nepal and Bhutan have hydropower potential far in excess of their domestic needs. Bangladesh and Myanmar are considered to have substantial reserves of natural gas which could be exported either as fuel and/or developed to generate electric power for export. India, Pakistan and to some extent Bangladesh provide major electricity and gas markets with considerable and growing demand. Further to the west and north, Iran holds significant oil and gas reserves, as do the Central Asian Republics-- Turkmenistan (gas), Uzbekistan (oil and gas) and Kazakhstan (coal, oil and gas). Tajikistan and the Kyrgyz Republic have large untapped hydropower resources relative to their needs, which could potentially be developed into competitive regional power plants. From the point of view of the energy resource endowments and energy markets, *prima facie* there appears to be a significant potential for electricity and gas trade within the region and with its neighbors on the east and the west.

The governments in the region are becoming increasingly aware of this potential and the win-win opportunities it offers. Modest bilateral electricity trade had been taking place between Nepal and India, Iran and Pakistan, and Afghanistan and its Central Asian neighbors as well as Iran. India had financed three medium to large hydro power projects in Bhutan, dedicated for power exports to India. Pakistan and Afghanistan are actively pursuing the possibility of importing 1000 MW of power from Tajikistan and Kyrgyz Republic. Similar initiatives in respect of gas imports from Central Asia and Iran are being discussed. Regional energy trade is a priority item in the Economic Cooperation Organization (ECO), as evidenced by the discussions in a number of regional meetings⁵.

³ For example Pakistan, Bangladesh and Russia have comparable populations while the power generation capacity of Pakistan at about 19,000 MW is about 10% of that of Russia. The generation capacity of Bangladesh at 5,500 MW is less than 3% of that of Russia.

⁴ Business surveys indicate that most responding firms have identified poor energy services as the most significant business constraint.

⁵ ECO (Economic Cooperation Organization) was created in 1985, first including Iran, Turkey, and Pakistan. The other seven members-- Afghanistan, Azerbaijan, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan – were added in 1992.

Similarly, energy trade within South Asia has been highlighted during the annual summit meetings of the South Asian Association for Regional Cooperation (SAARC) and related bilateral and regional meetings.⁶ In 2004 the seven countries agreed to create a South Asia Free Trade Area (SAFTA), which actually came into existence on January 1, 2006. SAFTA aims to reduce tariffs and other trade barriers to promote regional trade among member countries. Energy ministers representing SAARC countries have endorsed the concept that regional energy trade is a key element in ensuring energy security. The region appears to be poised for exploiting the latent energy trade potential.

1.2 Objectives and Scope

In this context, the present study of the potential and prospects for energy trade in the region is considered timely. Its objective is to highlight the opportunities for increasing cross-border energy trade, examine the factors which have inhibited such trade so far, take note of the emerging factors in the region which are conducive to such trade and identify the conditions that are necessary for increased regional cooperation in energy trade and investment.

The report is essentially a desk study, based on the readily available materials produced by the Bank and other aid agencies in the course of their operations. Its main focus is on electricity trade but it also deals briefly with natural gas trade by pipeline, which, in addition to being a relevant element of regional energy trade in its own right, holds particular significance in conjunction with electricity trade, given the trade-off between transporting natural gas and transmitting electricity generated using natural gas (Box.1.1)

Box 1.1: Electricity and Gas Transport Alternatives

Gas transport by pipeline is considered economic in relation to gas transport as LNG up to distances of about 3,500 km. Further, pipeline option confers greater supply security to the importer, since it is not easy for the exporter to shift the pipeline to some other country, which offers a better price. However the choice between import of gas by pipeline and import of electricity produced at the wellheads using gas is not always straightforward.

If at the importing end gas has multiple uses (such as electricity generation, industrial and domestic use, and fertilizer production, etc.) then clearly gas transport by pipeline is the only solution. If, however, at the importing end the only use for gas is for electricity generation, comparative studies indicate that generating gas at the well head and transmitting power through HVDC lines to load centers as far away as 1000 km to 5,000 km is less expensive than transporting gas to the load center and generating power at the load centers.⁷ This is especially true in respect of small gas fields located far away from the load centers.

The choice between the two options is influenced by gas prices, gas volumes for transport, the distances, and the various risks, including security. Gas pipelines have major economies of scale for carrying large volumes of energy. As a rule of thumb, gas pipelines tend to be more economic for distances greater than 1000 km and volumes above 5-10 bcm of gas. In a recent study entitled Study of Electricity Trade Potential in the Black Sea Region carried out for the Bank in 2006, consultants found that for distances of 1000 km and volumes below 5000 MW (about 7 bcm of gas/year) electricity transmission is more economic. For larger volumes such as 13,000 MW (or 16-18 bcm/year) gas pipelines are more economic even at distances of 500 km and became even more so for longer distances.

⁶ SAARC (South Asian Association for Regional Cooperation) includes Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka and, since 2005, also Afghanistan. The Islamabad Declaration of the SAARC Summit, states: "A study on creating a South Asia Energy Cooperation including the concept of an Energy Ring should be undertaken by the Working Group on Energy".

However in the South Asian energy trade environment cases requiring a choice of this kind are unlikely to arise. In India and Pakistan, there are severe shortages of both electricity and gas and gas is required for multiple uses. At least presently import of electricity options focus on low cost hydropower from Central Asia and India's neighbors such as Nepal, Bhutan and Myanmar. Hydropower imports confer also significant environmental advantages from the point of low carbon strategy. When thermal power imports develop from Central Asia to South Asia, they are most likely to be from low cost coal fired power stations of Kazakhstan and Kyrgyzstan and such power, in conjunction with the seasonal hydro power will enable Central Asia to supply "firm power" and improve their export value. India and Pakistan need import of *both gas and power*. They are thus following the strategy of importing LNG, piped gas, and electricity to minimize their energy demand –supply gap.

¹See Alessandro Clerici and Andrea Longhi, Competitive transmission systems as alternative to pipeline gas transport for electricity delivery, World Energy Council available at http://www.worldenergy.org/wec-geis/publications/default/tech_papers/17th_congress/2_2_08

The main report

- Reviews the resource base, existing sector status and current level of energy trade;
- Analyzes the factors inhibiting trade and emerging factors conducive to future trade in the potential importing, exporting and transit countries;
- Identifies and prioritizes emerging regional energy trade opportunities;
- Discusses the priority actions and initiatives which the governments need to take to promote regional trade; and
- Outlines the role of International Financial Institutions and the aid community in facilitating regional energy trade and related investments.

Country profiles for each of the seven countries in the region were prepared by the Bank staff on the basis of the reports and documents available in the Bank, reports produced by national institutions and authorities and also taking into account major studies and reports prepared by other IFIs and donors.⁸ Much of the information used in the main report is based on these country profiles.

⁸ For example see "Regional Electricity Export Potential in Central Asia," November 2004, of the ECA region of the Bank. It deals with export potential of the Central Asian Republics (Kazakhstan, Kyrgyz Republic, Tajikistan, and Uzbekistan) and analyzes electricity markets in the neighboring countries (Afghanistan, China, Iran, Pakistan, and Russia). Bank's other work, such as on the India-Nepal hydro power trade, has provided important inputs, as has the work performed by USAID (under the South Asia Regional Initiative-SARI), ADB, and IsDB, as well as by other bilateral and multilateral agencies involved in the region's energy sector (JBIC, DfID, EU).

Chapter 2 PRESENT STATUS OF THE ELECTRICITY SECTOR AND TRADE

2.1 Electricity Sector Dimensions

The South Asian Region consists of low income developing economies, growing at a rapid rate. The GDP elasticity of electricity demand in such economies tends to be higher than 1 with electricity demand growing at rates faster than the economic growth rate. In addition, unlike in the case of Central Asian States, the extent of electrification, both in terms of geographical coverage and in terms of the population coverage has still a long way to go to reach 100%. Given the constraints relating to financial resource and institutional capacity, supply growth tends to lag behind the demand growth resulting in the operation of supply constrained electricity systems. While the per capita consumption of electricity is very low by world standards, electricity consumption for each dollar of GDP tends to be high.

In 2003, for example, the region had 23% of the world population, but produced only 2.1% of the world GDP. Its per capita Gross National Income at \$524 was less than 10% of the world average (\$5,552). The region produced only about 4% of the world's electricity, while the average annual electricity consumption per capita at 394 kWh was only one sixth of the world average (2,348 kWh) (see Table 2.1).

Table 2.1: South Asia- Select Economic and Energy Indicators

Country	Population (million)	Land Area ('000 Square km)	GDP (\$billion) current	GNI per capita (\$) current	Electricity Consumption at the Generation Level TWh (year)	Per capita annual electricity consumption (kWh)	Overall Energy use per capita (kgoe)
Afghanistan	30	652	4.6	n/a	1.59 (2005)	53	n/a
Bangladesh	137	144	51.9	400	21.14 (2004)	128	159
Bhutan	1	47	0.6	720	0.67 (FY04)	665	n/a
India	1064	3,287	600.6	540	540.74 (FY03)	425	520
Nepal	20	147	5.9	230	2.26 (FY03)	68	336
Pakistan	148	796	82.4	520	76.66(FY04)	408	467
Sri Lanka	19	66	18.2	930	7.66 (2004)	325	421
Total SAR	1,425	5,139	764.2	524	650.72	457	474
Total World	6,290	133,941	36,835.2	5,552	15,852.41	2348	1734

Notes: (1) All data are from World Development Indicators for 2003 unless otherwise indicated. (2) Electricity consumption data are from country profiles. World consumption is from US DOE/EIA database. (3) Electricity consumption is given at the generation level (4) GNI per capita is on the basis of World Bank Atlas methodology.

The region had a total installed capacity of about 152 GW of which about 27% (or 41.6 GW) was hydroelectric subject to highly fluctuating seasonal and annual water flows. The availability of a substantial portion of the thermal power capacities was somewhat low on account of age of some of the units and problems arising from the use of poor quality coal with high ash and low calorific value. While Pakistan has been having some surplus capacity during the last few years, most other countries (and notably India) suffered from capacity and energy shortages arising from inadequate generation capacity, network problems, fuel related problems or lower than anticipated water flows in

hydropower facilities. The peak demand at 74% of the installed capacity is only partially indicative of the suppressed demand situation (see Table 2.2)

Table 2.2: South Asia- Select Indicators of Electricity Sector Dimensions

Country	Installed Generation Capacity (MW)	Peak Demand (MW)	Electricity Generation (GWh)	Imports and or Exports (GWh)	Past Annual Demand Growth Rate (%)	Forecast Annual Demand Growth Rate (%)	Access to Electricity
Afghanistan	Total 475 MW (of which hydro is 261 MW). Available capacity 270MW	215MW (Suppressed Demand) 363 MW (Unsuppressed demand estimate)	839 GWh	323 GWh import	n/a	6.6% through 2020	26% of the population
Bangladesh	Total 4120 MW (of which hydro 218 MW)	3,592 MW (FY 2005)	21,162 GWh (FY 2005)	None	9% (1996-2003)	About 8.2% per year through 2020	38% by area and 20% by population
Bhutan	Total 481 MW (of which hydro 469 MW)	105 MW (2003)	2,355 GWh (FY2005)	Imports 25GWh Exports 1764 GWh	7.3% (FY 19 98 to FY 2003)	11.5% through 2012	40% of the population
India	Total 124,287 MW (of which hydro 32,300 MW)	93,255MW (FY 2006) Actual Peak demand met: 81,792MW	617,510 GWh (FY 2006)	Imports 1764 GWh (Bhutan) Export 241 GWh (to Nepal)	4.2% during FY 2000 to FY 2004.	6.7% to 7.5% through 2032	55.8% of the households (Census of 2001)
Nepal	Total 684 MW (of which hydro 627 MW)	557 MW (FY 2005)	2,643 GWh (FY 2005)	Import 241 GWh Export 111 GWh	11% FY 1997- FY 2005	7.6% through FY 2020	40% of households (2001 census)
Pakistan	Total 19,505 MW of which hydro 6,500 MW	14,091 MW (FY 2005)	87,114 GWh (FY 2005)	Import 25 MW (from Iran)	About 5% (FY 1994- FY2003)	7.9% through 2025	55% to 60% of the population.
Sri Lanka	Total 2,426 MW of which hydro 1,247 MW	1,516 MW (2003)	7,662 GWh (2003)	None	5.1% 1999 to 2003	7.8% through 2024	73.4% of the population
Region	Total 151,978 MW of which hydro 41,622 MW	113,479 MW	739,285 GWh				

Note: (1) Source mostly country profiles and updated data from utility websites. (2) It is estimated by the CEA that India had a capacity shortage of 12.3% and energy shortage of 8.4% in FY 2006.(3) Since data may relate to different years for the member countries, the regional totals, while not accurate, is taken indicative of the order of magnitude. (4) Regional peak demand is an arithmetical total of the peak demand of the countries and thus may tend to overstate the peak demand.

Under the severely supply constrained situation, demand growth can only follow the growth in supply capacity. Within this limitation, demand for electricity at the generation level had been growing in the range of 5% to 11% during the last several years, but are expected to grow at a faster rate in the range of 6.6% to 11.5% in the next 15 to 20 years, if supply growth could keep pace. In most cases, this is based on GDP growth forecasts and the associated GDP elasticity of electricity demand.

To meet a demand growth of this order, substantial investments need to be made in generation, transmission and distribution facilities. The various options to increase the level of electricity supply include: (a) reduction of the high level of technical and non-technical losses in the power systems; (b) rehabilitation of the existing assets to restore their original capacity and prolong their useful lives; (c) increasing the transfer capacities in the national backbone transmission systems to enable better utilization of the existing generation capacities; and (d) construction of new generation assets. Imports from the countries within the region and from neighboring power and gas systems, had remained on the back burner largely on account of the pursuit of national self-sufficiency objectives till recently, but in the recent years are being discussed in the national and regional policy circles with some enthusiasm.

The energy resource endowments of the countries in the region and those of the region's neighbors in the east and the west would be a major set of determinants in the consideration of policy options based on intra and inter-regional trade and this aspect is addressed in the following section.

2.2 Resource Endowments

The energy resource endowments of the region and its neighbors are substantial, but are unevenly distributed among countries. This makes energy trade among them, prima facie, desirable for deriving optimum benefits from such a resource base. Readily available information on the energy resources of the region is summarized in Table 2.1

India and Pakistan have considerable energy resources by way of hydropower potential, coal, and natural gas, but are considered inadequate to meet the rapidly growing demand for the energy requirements of their large economies. Bhutan and Nepal have hydropower resources far in excess of the possible requirements of their modest power systems and economies and only a very small percentage of these resources have so far been developed. Investments in most of the identified large potential hydropower projects in Nepal (like, Karnauli, Pancheshwar, Sapta Koshi and West Seti) and Bhutan (like Tala and Punatsangchu) would make sense only in the context of export of power to India and possibly to Bangladesh (see Table 2.3).

Bangladesh is widely believed to have very substantial natural gas reserves. Recent studies by US Geological Survey concluded that the country has undiscovered reserves of 935 bcm (32.1 tcf) and that on this basis has a reserves-to-production ratio of over 104 years. The country may thus have a notable potential for export of gas or export of power generated using the gas.

Table 2.3: Energy Resource Endowments of the Region

Country	Oil Reserves (Mt)	Oil Production (Mt/y)	Gas Reserves (bcm)	Gas Production (bcm/y)	Coal Reserves (Gt)	Coal Production (Mt/y)	Hydro Power Potential (MW)	Hydro Power Developed (MW)
Afghanistan	10-15/100	0.025	28.3/142	0.114	0.1	0.044	745	262
Bangladesh	7.8	0.340	580/810	13.8	2.2	n/a	755	230
Bhutan	0	0	0	0	0	0	23,760/ 30,000	468
India	786 (2005)	33.000	948	32.680	25/285	409.000	84000/ 150,000	32,300
Nepal	0	0	0	0	modest	0	43,000/ 83,000	600
Pakistan	105	3.100	1300/5700	28.000	185	3.300	54,000	6,500
Sri Lanka	14-18	0	0	0	0	0	9,100	1,250

Note: (1) Under Oil and Gas reserves, proven / probable reserves are shown where available. Under hydro, economically viable potentials / technical potential are shown. (2) Production data relates to the most recent year data available during 2003-2005. (3) With the commissioning of all units of Tala hydropower project, hydro capacity developed in Bhutan will soon be 1,488 MW in 2006. Coal data includes lignite.

The energy resource endowments of the neighbors of the region, Myanmar, in the east and the Central Asian Republics and Iran in the west are summarized in Table 2.4. Myanmar and three Central Asian Republics (Kazakhstan, Turkmenistan, and Uzbekistan) as well as Iran have notable gas or (gas or coal based power) export potential, while two Central Asian Republics (Tajikistan and Kyrgyz Republic) have substantial hydropower export potential.

Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan which constitute the Central Asian Power System have a combined generation capacity of 38,000 MW and annual generation in excess of 135 TWh. Their present surplus generation is of the order of 11 TWh occurring mostly in the spring and summer seasons. This annual exportable surplus could increase to 30 TWh in next five years and to 50 TWh in the next ten years if the envisaged investment program is implemented.⁹ About 20% of this would be available in all seasons of the year.

Turkmenistan has an installed generation capacity of 3000 MW and annual generation of 12.3 TWh, of which it exported 10.5% to Iran, Turkey and Afghanistan. Iran's own generating capacity is about 34,000 MW with an annual generation in excess of 149 TWh. Its power system operates in the form of three isolated power systems which are to be interconnected in the near future. In 2005, Myanmar had a total installed generation capacity of 1,667 MW and annual generation of 6,064 GWh. Its main interest is in finding export markets for its abundant natural gas resources as well as for

⁹ Central Asian Republics: Regional Exports Potential Study, World Bank, December 2004

hydroelectricity from 10,398 MW of hydropower projects which are either under development or will be developed during the next 15 years.¹⁰

Table 2.4: Energy Resource Endowment of the Region’s Neighboring Countries

Country	Oil	Natural Gas	Coal	Hydro Power
Kazakhstan	<u>Reserves:</u> 29 billion bbl <u>Production:</u> 1.3 million bbl/day	<u>Reserves:</u> 65 to 70 Trillion Cubic feet (tcf) <u>Production:</u> 0.570 tcf/yr	<u>Reserves:</u> 37.5 billion tons <u>Production:</u> 95 million tons (2004)	<u>Potential:</u> 20,000 MW <u>Developed:</u> 2000 MW
Turkmenistan	<u>Reserves:</u> 546 million bbl. <u>Production:</u> 260,000 bbl/day	<u>Reserves:</u> 71 tcf <u>Production:</u> 2.1 tcf/year	Modest or negligible	<u>Potential:</u> Modest
Uzbekistan	<u>Reserves:</u> 594 million bbl. ¹¹ <u>Production:</u> 150,000 bbl/day	<u>Reserves:</u> 66.2 tcf <u>Production:</u> 2.07 tcf/year	<u>Reserves:</u> 4 billion tons <u>Production:</u> 2.8 million tons	<u>Potential:</u> Modest <u>Developed:</u> 1700 MW
Tajikistan	Modest or negligible endowment	Modest or negligible Endowment	<u>Reserves:</u> 3.6 billion tons <u>Production:</u> 32,000 tons (2002)	<u>Potential:</u> 40,000 MW <u>Developed:</u> 4000 MW
Kyrgyz Republic	Modest or negligible endowment	Modest or negligible Endowment	<u>Reserves:</u> 0.8 billion tons <u>Production:</u> 400,000 tons (2003)	<u>Potential:</u> 26,000 MW <u>Developed:</u> 3000 MW
Iran	<u>Reserves:</u> 132.5 billion bbl <u>Production:</u> 4.2million bbl/Day	<u>Reserves:</u> 971 tcf <u>Production:</u> 3.5 tcf/year	<u>Reserves:</u> 461million tons <u>Production:</u> 1.1 million to tons	<u>Potential:</u> 42,000 MW <u>Developed :</u> 2, 000 MW
Myanmar	<u>Reserves:</u> 3.2 billion bbl <u>Production:</u> 7.3 million bbl (During 11 months of 2005-2006)	<u>Reserves:</u> 18 tcf <u>Probable:</u> 89.7 tcf <u>Production:</u> 362 bcf (10.53 bcm) <u>Exports:</u> 0.28 tcf (8.06 bcm) (During 11 months of 2005-2006)	<u>Reserves:</u> Modest <u>Production:</u> Modest	<u>Potential:</u> 39,720 MW <u>Developed:</u> 747 MW

Source: World Bank documents and US DOE/EIA Country Briefs

The nature of supply-demand situation in the region and the distribution of energy resources in the region and its neighboring countries, prima facie seem to warrant consideration of electricity trade (both intra regional and inter regional) as one of the options to enhance energy security of the countries in the region.

2.3 Existing Interconnections and Electricity Trade

All over the world, interconnection of contiguous electricity grids (with adequate transfer capacity) and electricity trade among them are regarded as enhancing the energy security of the consumers, as they provide for a diversification of energy sources and energy suppliers. Equally, sole or substantial dependence on such imports is regarded as diluting

¹⁰ See presentation made on behalf of Myanmar in the BIMSTEC conference in New Delhi, India during 30-31 October 2006. See also News Item ‘Myanmar, Russia, India to explore gas in Myanmar’ in People’s Daily Online- <http://english.people.com.cn/>

¹¹ An Australian company exploring the Fergana valley area in Uzbekistan believes that area itself may have reserves of 1.2 billion barrels of oil and 5.5 tcf of gas.

energy security, because of the possibility of supply disruptions. Such interconnections generally lead to several other substantial benefits (see Box 2.1).

A well known example of this worldwide trend of interconnecting contiguous electricity systems and enabling their integrated operation through suitable agreements is the Union for the Coordination of the Transmission of Electricity (UCTE) in Europe, which covers most of the grids of the countries in West Europe. Many of the East European countries have also recently joined the UCTE and many others are working towards such membership. In 2004 international exchanges in electricity within UCTE were about 300 TWh. Other notable examples include New Jersey-Delaware-Maryland Power Pool, South African Power Pool, West African Power Pool, Nordic Power Pool and the Interconnected Electricity Systems of the Six Central American Countries (SIEPAC). In the South East Asia, electricity interconnections exist and electricity trade takes place among Thailand, Laos, Cambodia, Viet Nam and the southern provinces of China.

Box 2.1: Benefits of Interconnected and Integrated operation of Electricity Grids

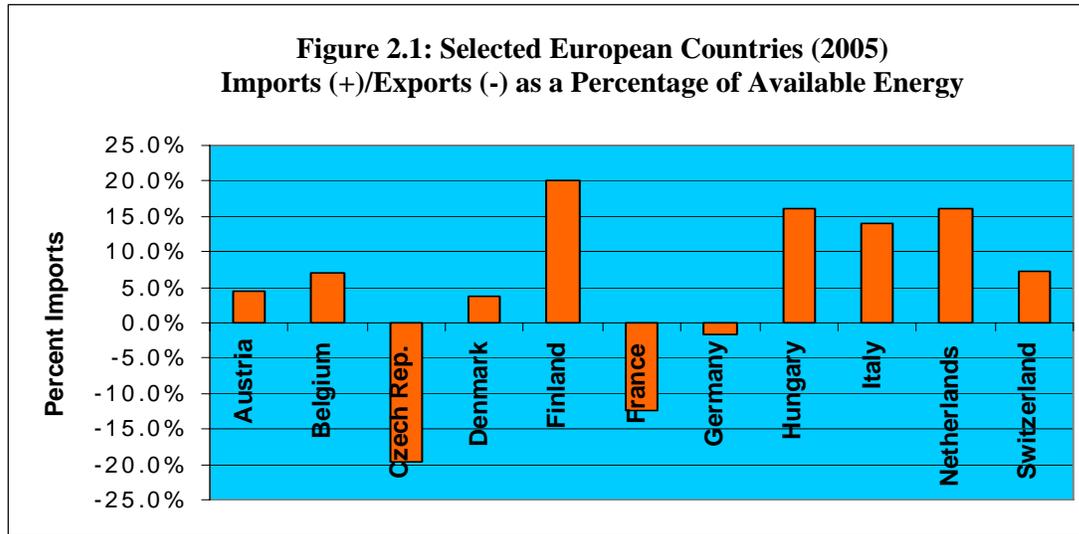
Apart from enabling the sale of electricity from the surplus to the deficit grids, interconnections and integrated operations¹² of the grids help to:

- Exploit differences in resource endowments and their development and operating costs
- Exploit differences in seasonal load and supply patterns
- Pooling of uncertainties: as demand and supply vary stochastically, the larger the system the smaller the fluctuations arising from imbalance (based on the Law of Averages). Thus it helps to improve the reliability of the system (and the load following capability) at a lower cost by ensuring a better balance between hydropower and thermal power units, and among base load, intermediate load and peak load units
- Lower the system capital costs by lowering the reserve margins for the given level of system reliability
- Lower the system operating costs by enabling the substitution of generation from units with high marginal costs of one grid by generation from units in other grids with lower marginal costs
- Lower emission levels by enabling substitution of generation from units with a high level of emissions/kWh of one grid with generation from units in the other grids with a much lower level of emission/kWh
- Enable the construction of large hydropower projects, which would make better economic sense in such interconnected grids and the larger markets they provide, than in the smaller individual grids.
- Enable less expensive peak load management, especially when the interconnected grids are located in different time zones with different peak hours.

In Appendix 1 details of the examples of such interconnections and energy trading projects are given. As an example the level of exports and imports in the European electricity market and in the South African Pool are given below. Figure 2.1 indicates the net annual imports or exports of select European countries as a percentage of their total available power for consumption. It may be seen that several countries have net imports amounting to 10% to 20% of their total consumption. France and Czech Republic export 10 to 20% of their available power. This data represent only the net annual exchange,

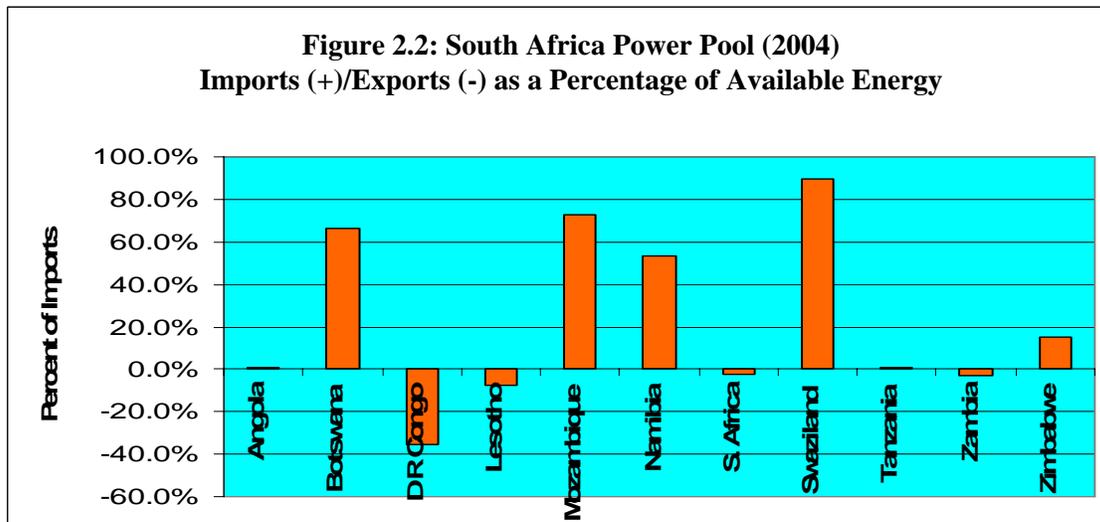
¹² Many of these benefits would accrue only in the case of synchronized and integrated operation of the interconnected grids. This involves the use of common grid codes and common rules of use and procedures designed to optimize the system operation and maximize benefits for the system participants.

while the actual exchanges during several parts of the day and the year are substantially higher.



Source:

Figure 2.2 provides similar data in respect of the South African Power Pool. Even under economic and political circumstances very different from that of Europe, electricity trade is flourishing in this part of the world with some member countries making use of imports to the extent of 50% to 80% of their total annual requirements.



Source:

Compared to such wide reliance on electricity trade in the various parts of the world, such trade in the South Asian region had so far been modest. The details of the existing interconnections and electricity trade are discussed below.

Afghanistan: The war ravaged and fragmented power systems of Afghanistan rely significantly on imports of electricity from Iran, Turkmenistan, Uzbekistan and Tajikistan. In 2005 such imports amounted to about 27.8% of the total supply, and this

share is expected to increase with the rehabilitation of the associated transmission links and the construction of the country's backbone transmission system called North- East Transmission System (NETS). The details of the existing interconnections and the volume of power imports are summarized in Table 2.5.

Table 2.5: Afghanistan: Existing Electricity Interconnections and Imports

Electricity Interconnection Details	Electricity Imports (GWh)		
	FY 2004-05	FY 2005-06	FY 2006-07 (3 months only)
<u>Tajikistan</u> : Geran (Tajikistan) to Kunduz (Afghan) 110 kV single circuit line, operated at 35 kV on the Afghan side	28.99	39.22	23.33
<u>Uzbekistan</u> : Termez (Uzbek) to Khulum (Afghan) and on to Mazar-e-sharif 220 kV line double circuit operated at 110 kV	118.18	149.71	24.18
<u>Turkmenistan</u> : Gushby (Turkmenistan) to Herat (Afghanistan), 120 km, 220 kV single circuit line completed in May 2004, but operated at 110 kV	49.27	95.63	35.39
<u>Turkmenistan</u> : Turkmenistan to Andkhoy-Jawzjan-Sheberghan, 110kV line in poor condition with high voltage drops	48.57	69.72	12.28
<u>Iran</u> : Torbat-e-jam (Iran) to Herat (Afghanistan) 150 km 132 kV double circuit line commissioned in January 2005. Financed by Iran <u>Iran</u> : Tayyebat (Iran) to Herat 2 x 20 kV single circuit lines. Financed by Iran	26.72	57.85	21.48
<u>Iran</u> : Zabol (Iran) to Zaranj (Afghanistan) 20 kV single circuit opened in March 2004	11.55	17.99	9.52
Total Imports	283.28	430.12	126.18

Source: DABM data

Notes: (1) The Fiscal year of Afghanistan ends on March 20. (2) According to the statistics of the Central Dispatch Center of the Central Asian Power System in Tashkent the exports of Uzbekistan to Afghanistan were 33.5 GWh, 129.6 GWh and 148 GWh in the calendar years of 2003, 2004 and 2005. (3) The Tajik power utility reports exports of 10.4 GWh, 27.7 GWh and 39.2 GWh during the calendar years 2003-2005 respectively. In the first 6 months of 2006 the exports amounted to 23.3 GWh.

Bhutan: The eastern part of Bhutan is linked to Bongaigon and Rongia of the State of Assam in India by 66 kV and 33kV lines and the western part of Bhutan is linked to Siliguri in West Bengal State of India by a 220 kV line. Through these lines Bhutan exports a substantial portion of the outputs from the hydropower station at Chuka (336 MW), Kurichu (60 MW) and Basochu (64MW). The export amounted to 1,764 GWh in FY 2006. Through 11 kV and 33 kV interconnections Bhutan imports about 25 GWh a year from India. A large new hydropower project (Tala 1020 MW) has been completed recently and the first unit of 170 MW had become operational.¹³ When all the remaining five units are commissioned during FY 2007, the project will generate 4,865 GWh of energy each year of which 3,900 MW is destined for exports to India. Two double circuit 220 kV lines connect the power station to Siliguri in West Bengal State from where the construction of a 400 kV double circuit line (1200 km long, 3000 MW transfer capacity) has been completed in August 2006 by Powerlinks Transmission Limited, a Joint Venture between Tata Power and Power Grid Corporation of India (51:49), inter alia, to

¹³ Chuka, Kurichu and Tala hydropower projects were financed by the Government of India with 60% of the cost as grant and 40% as long term debt.

transfer Tala power to the Eastern and Northern regions of the Indian power system. This will result in the annual export of Bhutan to India rising to about 5,664 GWh in FY 2007.¹⁴

Nepal: Nepal's power system is interconnected with the power systems of the states of Uttar Pradesh and Bihar in India by one 132 kV line, eleven 33 kV lines and one 11 kV line. Most of them have limited transfer capacity and, in FY 2005, Nepal exported to India a total of 110.7 GWh (or about 5.6% of its total sales) and imported from India a total of 241.39 GWh (or about 9% of its total energy supply).

Pakistan: Pakistan's electricity imports from Iran serve demand in the country's border areas of Balochistan, which are isolated from the main integrated national electricity grid. The cross-border interconnections comprise a 132-kV single circuit line and two 20-kV lines. The maximum allowed supply as per contract of 2002 was 39 MW. Maximum actual import recorded was 25 MW in December 2005. In June 2006, Pakistan's main power utility, WAPDA, signed an MOU with Iranian authorities for increasing the supply maximum to 100 MW to meet the forecast increase in demand in the Gwadar area where a deep sea port is being constructed with Chinese assistance. For this purpose a new 170-km long 230-kV line is planned to be built by Iran (70 km) and Pakistan (100 km).¹⁵

The power systems of Bangladesh and Sri Lanka have no cross border power interconnections. Similarly Pakistan's power system is not interconnected to those of India or Afghanistan. There are also no cross border gas pipelines in the region.

¹⁴ See Pricewaterhouse Coopers of India, *Hydropower Sector Study: Opportunities and Strategic Options*, July 2006 and also the presentation by Powerlinks Transmission Limited in the India Electricity-2006 Conference (Plenary Session III- Transmission), New Delhi on May 12, 2006.

¹⁵ Presentation made by WAPDA in the Central Asia/South Asia Electricity Trade Conference, May 8-9, 2006 in Islamabad. See also www.gulf-times.com, news item dated 15 June 2006 which among other things indicates that the price agreed for new supplies may have gone up to 6.25 cents/kWh. For the existing supply the price is 5 cents/kWh.

Chapter 3

FACTORS INHIBITING TRADE IN THE PAST

3.1 Political and Security Considerations

There is a wide range of factors which have hitherto inhibited the growth of intra regional and inter regional energy trade. The most important among them relate to the political and security situation prevailing in the region and its neighbors. Afghanistan is a key transit country sandwiched between the other South Asian countries on the east (potential markets for the imported energy) and the Central Asian Republics and Iran on the west (potential major energy exporters). The unstable political situation and armed conflicts in that country lasting for over three decades had been a major factor inhibiting energy trade between Central Asia and South Asia. The dispute over Kashmir had soured the relations between India and Pakistan for more than half a century. The political instabilities and circumstances in Nepal, Sri Lanka and Bangladesh and Myanmar had not provided an environment conducive for the evolution of regional energy trade. Central Asia itself had only recently recovered from the economic decline and political instabilities it faced upon the dissolution of the Soviet Union towards the end of 1980s.

Discussions in 1998-99 on the possible export of surplus power from the IPPs in Pakistan to India are believed to have stalled, partly on account of concerns over possible supply disruptions due to political uncertainties.¹⁶ The proposal to construct a pipeline through Bangladesh for transporting natural gas from an off shore field in Myanmar (in which two Indian state owned entities had a 30% stake) to India was stalled by Bangladesh's reluctance largely on political grounds. Proposals for export of gas (or power or fertilizer produced using gas) to India from Bangladesh by several international and Indian investors did not materialize largely on account of the hesitancy of the Bangladesh government.¹⁷

3.2 National Policies and Political Mindset

National policies and the political mindset towards the concept of energy security also proved to be major inhibitors of energy trade. Till recently the region followed inward looking import substitution strategies which regarded energy trade as reducing energy security by creating import dependency and by enhancing disruption risks. Macroeconomic policies pursued resulted in a persistent shortage of foreign currency resources which did not allow the countries to think in terms of discretionary imports. On the whole there was a pervasive perception which regarded national self sufficiency as a synonym for energy security. Energy trade was strictly limited to the inevitable import of oil and oil products only. Despite the serious problems faced by Indian power companies in the use of poor quality domestic coal, import of good quality coal from abroad for blending took several decades to materialize. Nepal has the highest average tariff in the region at about 9 cents/kWh and still is unable to cover its cost of supply, mainly on account of its choice to operate a high cost all hydro system, avoiding import of thermal

¹⁶ There were also other concerns such as price, and the ability of IPPs to offer firm and long term supplies with penalties for failure to supply. Further the surplus situation in Pakistan was perceived, with some justification, to be temporary lasting only for a few years.

¹⁷ Also the Government of Bangladesh had concerns about the adequacy of the country's gas reserves to meet domestic demand and export obligations.

power from India to balance its hydro power system or to encourage the construction of large hydropower plants, which will be cost effective on the basis of export of power to India.

3.3 Infrastructure Constraints

The absence of infrastructure in the region by way of electrical interconnections and gas pipelines across the borders (except in the case of the few interconnections between India and Nepal, India and Bhutan, and between Afghanistan and Central Asia and Iran) is a physical constraint to the energy trade. This is not attributable to any difficult terrain, except perhaps in the border areas between India and China and to a lesser extent between Pakistan and Afghanistan. There is no special geographical reason for lack of interconnections between India and Pakistan and between India and Bangladesh.

Such infrastructure constraints exist even within the large power systems of India, Pakistan and Bangladesh (the potential markets for imports). Power interconnections and power transfer capacities between the East and West zones of Bangladesh, between the North and the South of Pakistan and among the five electrical regions of India (North East, East, West, North, and the South) till recently was inadequate to enable the best utilization of the domestic generation capacities, let alone handling the transport of imported power from one part of the country to another. After several years of investment, the inter-regional power transfer capacity in India (a country with an installed capacity of over 124,000 MW) has reached 9,450 MW by FY 2006. Similar constraint exists to a great degree in Afghanistan, the major transit country. The main backbone 220 kV double circuit North-East Power System (NEPS) is still under construction and would be operational perhaps in a couple of years, as a partial solution to the problem. Within the Central Asian Power System bottlenecks in the national transmission networks have to be eliminated, and links to Afghanistan strengthened to enable trade growth (especially in relation to Uzbek power exports to Afghanistan). The present level of ability of the national power systems to coordinate dispatch, maintain voltage and frequency and keep international flows within the prescribed contract limits and to maintain the stability of the interconnected systems in the region is inadequate to manage large trade flows.

3.4 Poor Operational Efficiency and Lack of Creditworthiness of the Utilities

Absence of solvent utilities is a major constraint to trade. Power systems in the region operate in a supply constrained environment with a level of quality and reliability substantially lower than international utility standards. Load shedding and power outages are common during peak hours and during certain seasons of the year. Electricity utilities are used as vehicles of social policy and average tariffs are kept substantially lower than supply costs. Households and agricultural consumers are heavily cross subsidized by industrial and commercial consumers, who pay some of the world's highest prices for a very poor quality of supply. Consequently theft of power and nonpayment are extensive and most utilities are not solvent enough to access commercial sources of funds except on the basis of expressed or implied sovereign guarantees. Nonpayment of electricity bills by government entities had been a significant problem.

Afghanistan is estimated to have a system loss level of 35% to 45% of the total available energy (generation plus imports) by way of technical losses in the transmission and

distribution systems and non-technical losses arising from theft and poor metering and billing practices. Collection efficiency is estimated at 60% to 70% of the value of the bills issued. Its average tariff is believed to cover only about 50% of the cost of supply.

Bangladesh operates a power system with a total system loss level in the range of 20 to 32% and collection efficiency in the range of 80% to 90%. Its average tariff at about 5.2 cents/kWh is inadequate to cover the cost of supply and the key sector entities (BPDB and DESA) are insolvent.¹⁸ Bulk supply tariffs had not kept pace with the average of the cost of generation and the cost of power purchased from the IPPs. The financial losses of the BPDB alone were estimated at \$100 million in FY 2005 and it may have increased to about \$110 million in FY 2006. The accumulated financial losses of BPDB at the end of FY 2006 were about \$841 million.¹⁹

Bhutan operates a very small power system in which the system losses are contained at around 13.5%. Power supplied to the Bhutan Power Corporation is priced substantially lower than the export price to India. For example power from Chukka Hydropower Company is sold to India at 4.65 cents/kWh, while the sale price to BPC is around 0.78 cents. Still BPC makes only marginal cash surplus and makes book losses.

Nepal had a total energy loss level of about 25% in FY 2005 of which a significant portion is attributed to theft of power. Despite an average tariff of about 9 cents/kWh (which is perhaps the highest in the region), the Nepal Electricity Authority made a net financial loss of about \$25.9 million in FY 2005 and faced liquidity problems. While its collection of bills from other consumers were reasonable at a ratio of about 95%, collection from municipalities and other government entities was poor and arrears mounted to about \$20.3 million.

India operates a large power system in which the electricity distribution responsibilities are handled by the state government owned Electricity Boards in most states.²⁰ Most of them face high levels of system losses (a substantial part of which is theft of power) and low levels collection. Also un-metered supplies are provided to a variety of consumers such as agricultural pump sets and small rural households. Sales on the basis of metering ranged from 70% of the total energy input into the system in West Bengal state to about 45% in Haryana and Rajasthan states. As it is difficult to separately estimate the technical losses and commercial losses under these circumstances, the concept of Aggregate Technical and Commercial Losses (ATC Losses) is used.²¹ In well run utilities this should not exceed 10% to 12%. In India ATC losses in 2005 were higher than 40% in eleven electricity boards, 30% to 40% in seven electricity boards, and 20% to 30% in eight electricity boards. Only in two electricity boards (Tamil Nadu and Goa) the ATC losses were less than 20%.²² Tariffs lag substantially behind cost of supply. The Central

¹⁸ See The Final Report of the consulting firm Nexant to ADB under T.A No. 4379-BAN Power Sector Development Program II, June 2006

¹⁹ Based on information in the BPDB website <http://www.bpdb.gov.bd/index.htm>

²⁰ Provinces in India are called states with their own elected governments and legislatures. India is a Union of such states.

²¹ $ATC\ loss = [1 - (Billing\ Ratio \times Collection\ Ratio)]$, where, Billing Ratio = energy input into the system in GWh/ energy billed in GWh and Collection Ratio = energy billed in money terms/ collection in money terms

²² See *State Power Sector Performance Ratings, Final Report to the Ministry of Power, Government of India*, June 2006, (prepared by CRISIL and ICRA leading rating agencies of India) available at the website of the Ministry www.powermin.nic.in

Electricity Authority of India estimates that the average cost of supply/kWh in FY 2005 was 5.6 cents, while the average revenue/kWh was only 4.62 cents or about 82.5% of the cost of supply.²³ The total losses made by all electricity boards in FY 2005 amounted to \$4.9 billion or about 1.2% of the GDP. Apart from the inadequate level of tariffs, the structure of tariffs is highly skewed in favor of agricultural pumps and household consumers and penalizes industrial consumers severely eroding their competitiveness and inducing high levels of theft. In 2002, the industrial consumers of India had a tariff of 47 cents/kWh compared to 20 cents in China, 17 cents in Brazil, 12 cents in Japan, 5.5 cents in USA and 5 cents in Germany.²⁴ It is estimated that about \$4.5 billion of budget and cross subsidies are channeled through India's power sector mainly to farmers (who account for 25% of total consumption) and households (who account for another 20%) with monthly consumption ranging from 50 to 250 kWh. Of this, a sum of \$2.3 billion came from the budget of the state governments, and the rest came from cross subsidies. In many states subsidies for power supply exceed public expenditures on health and education.²⁵

Pakistan also faced significant system losses and financial losses. During the 10 years between FY1996 and FY2005, WAPDA's total system losses (including auxiliary consumption of generation plants, transmission and distribution losses) ranged between 24.13% (the lowest in the period) in FY1997 and 27.55% (the highest in the period) in FY1999. KESC's system losses during the same period ranged between 35.14% in FY1996 and 47.39 in FY2003.²⁶ Theft of electricity and non-payment of bills were so rampant in KESC area that the army was called in to prevent theft and enforce collections.

Collection had been particularly difficult in the Federally Administered Tribal Areas also. Tariffs have traditionally lagged behind costs of supply and both WAPDA and KESC had been accumulating substantial losses despite periodic financial recovery packages. One estimate places the annual financial losses of WAPDA and KESC at about \$585 million in the early years of this decade. The losses are increasing since WAPDA's losses alone were estimated at \$817 million for FY 06

Sri Lanka had a relatively moderate system loss at around 17.2% during 2004 and 2005. Its overall average revenue/ kWh covered only about 88% of the average cost in 2003. Its average revenue in 2004 at about 7.66 cents/kWh produced a net loss and a negative rate of return of (-) 5.11% on average net fixed assets in operation. Its internally generated cash was inadequate to service its debt.²⁷ Households, religious institutions, street

²³ See *Annual Report of the Central Electricity Authority of India for FY 2005-2006* available at its website www.cea.nic.in. The cost of supply is likely to be an underestimate and the gap may actually be wider.

²⁴ See *Integrated Energy Policy Report of the Expert Committee*, August 2006 of the Planning Commission, Government of India, New Delhi available at website www.planningcommission.nic.in. The data is calculated using PPP exchange rates. When market exchange rates are used, the gap between India and USA would be narrower, but still substantial, and Indian rate for the industrial consumers would continue to remain the highest.

²⁵ See South Asia Running Brief, pages 29-31 available at World Bank South Asia Website

²⁶ WAPDA Power System Statistics, NTDC, Lahore, December. 2005

²⁷ See CEB website at www.ceb.lk and also the Presentation by A.Perera of CEB in the BIMSTEC conference on Hydropower during 30-31 October 2006, New Delhi, India. A slight increase of average revenue/kWh to 7.71 cents in 2005 enabled CEB to achieve a debt service ratio of 1.07, though the rate of return still remained negative at (-) 1.15%.

lighting and low voltage industrial consumers were cross subsidized by the remaining categories of consumers, mostly commercial and large industrial consumers.²⁸

On account of such poor operational and financial performance of the power utilities and their lack of creditworthiness the entry of IPPs for generation in most cases could be only on the basis of “take or pay” obligations fully covered by sovereign guarantees. Even in such cases the inability of the utilities to absorb the rising cost of power from IPPs (indexed to variations in fuel prices, exchange rates, domestic inflation, and similar variables) resulted in disputes, cancellation, or renegotiations, which soured the investment climate. This environment was clearly not conducive for electricity trade among the countries.

3.5 Ownership Structures and Contracting Practices

Power sector in the region is predominantly state owned. Till recently, participation of the private sector was generally limited to a number of generation projects with sovereign guaranteed cash flows, established under the BOT or BOO models. Private sector involvement in the distribution segment is limited to a few states and cities in India. Given the poor financial performance of the utilities, investment resources had to come primarily from the state funds, which were scarce and which faced numerous other competing claims. In this context, the governments’ finding funds for export oriented power projects or for investing in a power project of another country (even on the basis of least cost considerations) for securing power imports was politically difficult.²⁹ In Nepal and Bangladesh, domestic power sector was perpetually facing supply shortages and in this context, politicians could not focus on power projects for exports. India’s aid for the construction of a few small hydropower projects in Nepal was essentially to help Nepal and not for generating power exports to India. India’s substantial grants and loans to finance one large and two medium sized hydropower projects (Chukka, Kurichi and Tala) in Bhutan for securing import of hydroelectric power can be considered an exception rather than the rule. The countries with export potential (Bhutan, Nepal, Bangladesh) were relatively small economies³⁰ with no investment resources of their own and with poor access to international capital and debt markets. Even their ability to raise resources from multilateral development banks and other sources of concessional funds was so limited that they could not finance large export projects, because of the limited allocations and prudent lending limits of these institutions (and the competing claims on them). Thus the ownership structure of the sector was not conducive to seize profitable export-import opportunities. In order to unlock the power export potential in small countries new types of ownership structures and new financing structures for the projects are needed. These are taking time to emerge.

Even the few transactions, such as those between India and Bhutan, India and Nepal, Afghanistan and Central Asia and Iran are more political than economic or commercial in character. There are no long term contracts with “take or pay” or “supply or compensate”

²⁸ Electrowatt-Ekono Study, 2003 for the Energy Supply Committee Tariff Study

²⁹ In the democratic polity of India, for example, various states compete furiously for ensuring that the power project sites in their state secure the scarce investment resources of the central government. In this context it is difficult for the central government to invest in projects abroad, while there are still plenty of potentially good sites within the country.

³⁰ In Nepal and Bhutan the cost of any single major hydropower project may be as high as the GDP of the country or even larger. The capital cost of Tala Hydropower project was more than 1.6 times the GDP of Bhutan in 2004

obligations, long term price adjustment mechanisms and formulae, and dispute resolution mechanisms.³¹ Prices are valid for short periods only and are subject to periodic negotiations. Such political agreements are acceptable in the nascent stages of trade, but unless they quickly evolve into sustainable commercial arrangement, are not conducive to growth in trade.

3.6 Sector Structures and Regulation

Trade between integrated utilities is possible and has been taking place in a small way (as indicated in Chapter 2) based on the availability and transfer capacity of the interconnection. In order to facilitate more widespread trade within and across large power systems (such as that of India), it is generally considered advantageous to unbundle the utility operation and the electricity tariff by function (generation, transmission and distribution) and provide for third party access to the transmission system and for transparent and predictable transmission tariffs. This is also especially important in transit countries. It goes without saying that at least the large consumers and distribution companies should have the freedom to choose their supplier in any of the interconnected systems and contract for their supplies. Regulation of the retail tariffs, enforcement of supply contract conditions, and resolution of the disputes are to be handled by independent regulatory bodies. In South Asia, restructuring in this direction commenced in the mid 1990s and had been progressing very slowly. Progress became somewhat noticeable only in the last few years, especially after the enactment of the new electricity law in India in 2003. The slow rate of progress in sector restructuring had been considered by many as an impediment to growth in electricity trade both within the large systems and across the systems. The actual progress and outlook are discussed in the next chapter which identifies and analyzes the emerging factors which would improve the prospects for electricity trade within the region and with its neighbors in the near future.

³¹ Even though India has financed the hydropower projects in Bhutan on such generous terms as 60% grant and 40% long term loan, the price/kWh for power from Chuka had been changed from Rs 0.19 in 1988 to Rs 2.00 in 2006 through several negotiations and the price for Tala power has not yet been agreed upon though the project had been commissioned in 2006 and power is being exported.

Chapter 4

EMERGING FACTORS CONDUCTIVE TO ELECTRICITY TRADE

Since the mid to late 1990s, major changes are taking place in the region resulting in a greater degree of global integration and increased growth dynamism. In this context, several factors have emerged which improve the prospects for electricity and gas trade within the region and with its neighbors. These are discussed in relation to the countries with import potential, countries with export potential and transit countries.

4.1 Changes in the Development Approach and Growth Dynamism

During the last decade, there has been a major change in political mindset of the politicians. The approach to development is no longer dominated by inward looking import substitution strategies, propped up by restrictions and control of trade, exchange rates, and investment regimes. Development approaches have a new outward looking orientation with greater reliance on trade encouraged by liberalization of trade, exchange rate and investment regimes. In the mixed economies of India, Pakistan and Bangladesh, private investments and market mechanisms are making major headway while the role of central planning approaches are becoming much more limited. Imports are no longer considered a necessary evil, but as inputs and stimulants for increasing the competitiveness of domestic production in the internal and export markets. Such an approach has resulted in greater growth dynamism, and increased foreign exchange earnings and reserves,³² which, in turn, enables a greater degree of liberalization of trade and investment regimes. Thus the economies have gotten into a virtuous cycle in which growth and liberalization mutually reinforce one another. India is looking at the prospect of an annual GDP growth of 10% for the next 10/15 years. Pakistan is looking at 7% to 8% growth while Bangladesh hopes to grow at around 5% to 6%.

The magnitude and urgency of such growth rates translate into the urgency of increased and timely availability electricity and gas (among other energy forms). On the basis that the GDP elasticity of electricity demand would fall from 0.95 during FY 2004 – FY2012 to 0.85 during the next 10 years and further to 0.78 during the last ten years, India estimates that average annual electricity demand growth at the generation level would be at 7.5% through the FY 2031 to support an annual GDP growth rate of 9%. For supporting a 10% annual GDP growth rate electricity generation has to increase even faster. Pakistan and Bangladesh are also envisaging similar growth rates for electricity needs. Given the natural resource constraints and time constraints to develop them, Indian policy makers advocate the import of electricity from Nepal and Bhutan and gas through pipelines from Myanmar, Bangladesh, Iran and Central Asia.³³ Such imports supplementing LNG imports, coal imports, and acquisition of equity oil and gas in the foreign fields are seen as diversifying energy forms and supply sources and thus

³² As of April 2007, the total foreign exchange reserves of India, Pakistan and Bangladesh have exceeded \$230 billion equivalent nearly to a year's import requirement

³³ See *Integrated Energy Policy- Report of the Expert Committee*, Planning Commission, Government of India, New Delhi, August 2006, available at www.planningcommission.nic.in

enhancing energy security of the country.³⁴ Based on an analysis of its electricity demand growth and supply options Pakistan has also come to the conclusion that import of electricity from Central Asia to the extent of 1000 MW to start with and growing to 4000 MW in the next stage makes economic sense. The emergence of a political mindset which regards electricity and gas imports as practical options to enhance national energy security is an important phenomenon which improves the prospect of regional trade.

Bhutan's development strategy is clearly based on achieving power-export-led economic growth and it has recently commissioned a study to examine its options for the diversification of its export markets and the strategies for obtaining the best value for its exports in the medium to long term. Tajikistan and Kyrgyz Republic have decided in the last few years to pursue vigorously their hydropower export-led growth options and diversify their export markets into South Asia.

4.2 Increases in Power Transfer Capacities

In the countries with import potential there is a major ongoing effort to increase significantly the capacity of the backbone transmission systems to transfer power from one part of the country to the other parts. Thus India, Pakistan and Bangladesh have set up separate state owned Power Grid Corporations which are making significant investments in the expansion of the backbone transmission system and dispatch facilities with assistance from World Bank, Asian Development Bank and bilateral donors.

The total interregional transfer capacity among the five regions of India (North, North-East, East, West and South) was about 5,050 MW in 2002 and it has reached 9,450 by FY 2006. At the end of FY 2007 the capacity will reach 16,450 MW upon completion of ongoing projects. By 2012 the interregional transfer capacity will reach 37,150 MW. This is being done to enable a much better utilization of the hydro and thermal capacity, facilitate the implementation of the open access transmission policy laid down in the new Electricity ACT of 2003 and assist in the evolution of a national power market. Three regions (East, North-East, and West) are already integrated and operate synchronously. Northern region will get integrated in FY2007. The Southern region is connected to Eastern and Western region in asynchronous mode with HVDC linkages. Further enhancement of this interconnectivity and synchronization with the rest of the national grid will take place in the medium term.³⁵

The most recent example of inter regional transfer capacity enhancement facilitating the absorption of 1,020 MW of power from Bhutan, is the construction of a 1,200 km long, 400 kV double circuit transmission line linking Siliguri in the Eastern region to Mandaula in the Northern region. It has enabled the power deficit Northern region to receive power from the Tala hydropower project of Bhutan (see Box 4.1).

³⁴ India has three LNG import terminals at Dahej, Hazira, and Dhabol. One more terminal at Cochin would be commissioned in 2009 (India Country Analysis Brief available at www.eia.doe.gov)

³⁵ See Annual Report of the Central Electricity Authority of India (FY 2006) available at its website www.cea.nic.in

Box 4.1: Transfer Capacity Enhancement Facilitates Absorption of Power from Bhutan

As a part of the Tala hydropower project in Bhutan two double circuit 220 kV lines will bring Tala power up to Siliguri in the state of West Bengal in the Eastern region which has a substantial surplus energy. The Northern region on the other hand has substantial shortage of energy and peak capacity. Thus the 1200 km long, double circuit 400 kV line linking the Eastern and Northern regions with a transfer capacity of 3000 MW and a capital cost of about \$358 million enables the absorption of the imported energy. This line is also noteworthy from the point of view of its construction on a BOOT basis by Powerlinks Transmission Limited, a joint venture between Tata Power- a private sector company (51%) and Power Grid Corporation of India Limited- the central government owned national grid company (49%), the first case of private sector involvement in the transmission segment. The joint venture raised funds from IFC and ADB and from domestic financing institutions (SBI and IDFC).

Source: The presentation by Powerlinks Transmission Limited in the India Electricity-2006 Conference (Plenary Session III- Transmission), New Delhi on May 12, 200

A 765 kV transmission system overlay (with 5,200 km in length and 24,500 MVA in transformation capacity) on the 400 kV backbone system is expected to be in place by FY 2012, further enhancing the transfer capacity and reliability. 800 kV HVDC lines are planned, inter alia, for receiving large volumes of power from Bhutan in the future.

Developments of this kind enlarge the market for imports. Developers of hydropower projects in Bhutan need not be constrained by the power surplus situation in the Eastern region, and can look for markets in the Northern, Western and Southern regions. This is clearly a major factor conducive to external as well as internal trade in India. Similar efforts in Pakistan to improve the north-south transfer capacity and in Bangladesh the east west transfer capacity represent positive development favoring regional trade.

4.3 Evolution of National Power Markets

The evolution of a nascent national power market in India in the last few years is a factor which will significantly improve the prospects of exports to India. This was facilitated by the enactment of the new Electricity Law in 2003 (which unbundled power trading from power transmission, provided for open access in transmission and recognized power trading as a separate licensed activity), the emergence of new, solvent and creditworthy power sector institutions (such as Power Grid Corporation and Power Trading Corporation), the adoption of Availability Based Tariffs (ABT) for bulk power sales in the national grid (mainly by central government owned large generating stations to the state electricity boards), and the special efforts to enforce payment discipline on the part of the electricity boards.

The Power Grid Corporation of India owns and operates the countrywide backbone transmission system at 400 kV level and above³⁶ and enables transfer of power from state to state and region to region and has undertaken the responsibility to provide open access and is adopting an electronic bidding system to resolve capacity congestion arising from

³⁶ As of March 2005, Power Grid Corporation of India owns operates and maintains one of the largest extra high voltage systems of the world, with more than 51,000 km of both AC and DC transmission network up to 765 kV level, and 85 substations with a total capacity of over 50,000 MVA. It also owns and operates five Regional Load Dispatch Centers. Over 45% of the power generated in India is transmitted through this national system which routinely operates at more than 99% availability each year. (see World Bank, Project Appraisal Document for a loan to Power Grid Corporation of India, December 2005)

demand from multiple short term customers. Power Trading Corporation is a joint stock company listed in the Bombay stock exchange. It buys power from surplus states and sells to deficit states. Its presence in the national power market greatly helped to increase the traded volume (Box 4.2).

Box: 4.2: Power Trading Corporation of India- A Major Solvent Buyer in the Market

Power Trading Corporation of India Limited is a listed company in the Bombay Stock Exchange. Its shareholders include Promoters such as NTPC, NHPC, PFC, PGCIL and DVC (39%), and Financial Institutions such as IDBI, IFCI, IDFC, LIC and GIC and Banks (14%), Mutual Funds (5.6%), Tata Power Company (10%), other Private Corporate bodies (4.6%), Foreign Investors (10.8%), and the General Public (16%). In FY 2006 it traded 10,119 GWh with a turnover value of \$695 million, and made a profit before tax of \$12.7 million. Its IPO in FY 2004 was oversubscribed to the extent of 42 times and its share is trading consistently at more than five times its face value.

After the enactment of the new Electricity Law in 2003 which recognized electricity trading as a separate activity to be licensed, the Central Electricity Regulatory commission had issued 20 licenses for power trading. About eight of them including Power Trading Corporation are authorized to trade over 1000 GWh annually and the more prominent among them include NTPC Power Trading Company, Reliance Energy Trading Company, Tata Power trading Company and Adani Exports Limited. While Power Trading Corporation continues to be a dominant player, other companies are making headway and secured a market share of 27% by FY 2005. The traded volume rose to about 3% of the total volume of power transmitted in the national grid. The existence of such credible, solvent and regulated trading companies in the market would greatly facilitate export of electricity to the Indian market. In fact, Power Trading Corporation is heavily involved in the cross border power trade among the utilities of India, Bhutan and Nepal.

The introduction of the Availability Based Tariffs (ABT) for bulk supplies in the national grid since mid 2002 has led to the emergence of significant trade in electricity within India (see Box 4.3). Trade in electricity in FY 2007 amounted to about 15,000 GWh or about 3% of the total volume handled by the national grid. Traded prices ranged from 12.5 cents/kWh (off-peak) to 13.7 cents/kWh (peak) in the third quarter of 2006. Payment discipline of the state electricity boards have improved substantially since the conclusion a Tripartite Agreement (TPA) of May 2001 among the States, the Government of India and the Reserve Bank of India. This was based on the one-time waiver of 60% of the interest/surcharges on delayed payments/dues as of September 30, 2001 and the securitization of the remaining balances through the issue of tax free bonds (with an interest rate of 8.5% and a maturity of 15 years including a moratorium of five years) by the states. Twenty eight states have signed the TPAs and have issued bonds for a total value of \$6.64 billion. The TPAs provide for incentives for the prompt settlement of future monthly bills. When payment default occurs, the supplier is expected to reduce the level of supply. If the default continues, the supplier is expected to approach the Ministry of Finance of the Government of India for direct payment of the dues by the Reserve Bank of India from central government's allocation of funds to the defaulting state. As a result of these arrangements payment discipline by the state electricity boards have greatly improved and most central government-owned power entities report collection

efficiencies of about 98%. Such an improvement in the payment discipline of the electricity boards, which have for long been considered major credit risks, is a factor which should favor the prospects of increased trade.

Box 4.3: Availability Based Tariff Promotes Trade in the National Grid in India

Central government-owned generating companies (such as NTPC and NHPC) own and operate about 39,900 MW or about 32% of the India's total installed generation capacity. The capacities of their various large generating units are allocated to the relevant state electricity boards at the time of their construction. The tariff for the sale of this electricity in the past used to be designated in terms of a composite kWh charge only and billing was on the basis of monthly net energy drawn from the national grid. This was not conducive to discourage the electricity boards from drawing substantially more or less than the allocated capacity. They could overdraw during peak hours and under-draw during off-peak hours without any financial consequences. This greatly interfered with the merit order dispatch and adversely affected the frequency in the grid. Also it provided no incentive to the states to trade the unwanted portion of their allocated capacity.

To overcome these problems, the concept of Availability Based Tariff was introduced in mid 2002. This involves: (a) a fixed capacity charge/kW/month payable by the electricity board, based on the capacity allocated to it and linked to the availability of the plant; (b) a regulated variable energy charge based on the actual scheduled consumption; and (c) a special unscheduled interchange (UI) charge for deviations from schedule.

The UI charge is linked inversely to the frequency in the grid and is high at Rs 6.00/kWh (or 14.3 cents) when the frequency goes down to 49.02 Hz (high demand situation) and becomes zero when the frequency is at 50.5 Hz or higher (low demand situation). For this purpose the energy is metered in 15 minute blocks and the average frequency is taken into account. In the range 50.5 Hz- 49.02Hz the UI charge increases from 0 by Rs 0.08 for each reduction in frequency by 0.02 Hz in a linear fashion.

Since the states pay a fixed capacity charge based on the capacity allocated to them, they have a strong incentive to draw the allocated energy or to sell the unwanted portion of such energy to other buyers. Overdrawing during high demand periods (frequency lower than 50.5 Hz) penalizes them heavily through a high UI charge. Similarly generators get high UI charge for extra generation during periods of high demand and have no incentive to generate extra energy during periods of low demand since the UI charge becomes zero.

The introduction of ABT has greatly improved the frequency conditions of the national grid, promoted intelligent load management of the part of electricity boards, enabled a more meaningful merit order dispatch and above all, facilitated the emergence of a significant volume of energy trade in the national grid (which grew from 1617 GWh in FY 2002 to greater than 15,000 GWh in FY 2007)

The maximum UI charge at 49.02 Hz was fixed in FY 2003 at Rs 4.2/kWh based on the cost of electricity from generating sets using high speed diesel (with a fuel cost of Rs 13.33/liter) as representing the short term marginal cost.

With changes in high speed diesel prices the UI charge went up to Rs 6/kWh, and then came down to Rs 5.7 in 2004. On the same basis the UI charge should be Rs 9.3 (23.25 cents) for FY 2008, but to avoid too steep a revision, the Central Electricity Regulatory Commission has fixed it at Rs 7.5/kWh (18.75 cents) with effect from April 30, 2007, as an interim measure, based on the cost of generation from combined cycle power stations using naphtha as fuel.

Sources: Bhanu Bhushan, ABC of ABT, A Primer on Availability Based Tariff, 27 June 2005 and CERC Order dated April 5, 2007 in Petition No.15/2007 available at www.cercind.gov.in

4.4 Increasing Involvement of the Private Sector

A greater degree of private sector involvement in the power sector is likely to improve the prospects of trade, as private businesses are constantly on the look out for cost effective supply additions and attractive markets to increase the volume of their business and their profits. During the last fifteen years, private sector involvement in the power sector of South Asia region had grown notably, though not as much as in other regions. In Pakistan, Bangladesh Nepal and Sri Lanka, private sector is involved to the extent of 20% to 30% of national generation capacity (see Table 4.1). India's percentage is lower at 12.1%, but the capacity, in absolute size, is large. Further, the data does not include about 18,740 MW of captive generating capacity owned by other businesses. Under the Electricity Law of 2003, generation activity no longer requires a license and transmission licensees are obliged to transmit electricity from captive generation units to other customers or to the grid to sell their surplus power. The Power Finance Corporation is putting together several "ultra mega projects" (4000 MW to 6000 MW each) packages for possible development either as private projects or in the form of public private partnerships. Some of them will be based on domestic coal and be integrated units with their own block of captive coal mines. Others will be based on imported coal. The experience that South Asian countries have gained in dealing with BOT/BOO entrepreneurs and in the varied contracting and guarantee and risk mitigation mechanisms should be of great relevance while they negotiate import and export contracts.

Table 4.1 Private Participation in South Asia Power Sector

Country	Private Sector Involvement		
	Generation (% of national capacity) and Capacity in MW	Transmission	Distribution
Afghanistan	nil	nil	nil ³⁷
Bangladesh	30% (1,260 MW)	nil	Rural areas handled by RECs
Bhutan	nil	nil	nil
Nepal	21.75% (148.7 MW)	nil	nil
India	12.1% (15,431 MW) Source: www.powermin.nic.in	1200 km 400 kV double circuit line	States of Delhi, Orissa, cities of Bombay, Calcutta, Surat and Ahmedabad
Pakistan	31% (6,045 MW)	nil	KESC privatized as a VIU (11% of consumers and 14% of sales of Pakistan)
Sri Lanka	28.2% (718 MW) Leased 6.3% (160 MW)	nil	nil

The emergence of large and reputed business houses of India (such as Tata, Reliance and many others) with global reach, as key players in the energy scene, and the emergence of many reputed and regulated private sector power trading companies in the recent years improves the prospect of increased private sector involvement not only in the domestic private sector, but also in investments abroad (for example in Nepal, Bhutan, Bangladesh and Myanmar) in projects dedicated for exports to India, mitigating to a major extent the problem of public sector involvement discussed in section 3.5 earlier.

³⁷ There is one small exception. Privately owned Omar Electric Company with an installed capacity of 1.0 MW supplies about 8,500 consumers in the city of Ghazni (see *Lack of Access to Power (Energy) in Afghanistan*, World Bank, November 2006)

The proposal of the Tata Group made in 2004-2005 to invest \$2 billion to \$3 billion in Bangladesh in a 1000 MW gas fired combined cycle power plant, a 500 MW coal fired power plant, a fertilizer factory using gas and a steel finishing mill using gas, which would also involve export of electricity to India illustrates the possibilities of cross border investment and trade in relation to gas and electricity. Among other things the proposal would also enable the extension of gas pipeline to this westernmost part of Bangladesh enabling the conversion of a few oil fired power plants to switch to gas. The government has not yet been able to respond. The proposal is considered by the Tata Group to be still in the “pause” mode till the final decision could be given by Bangladesh after the elections scheduled for early 2007.³⁸

4.5 Proposals to Improve the Commercial performance of the Utilities

A major public enterprise reform is sought to be undertaken by reorienting the Accelerated Power Development and Reform program (APDRP) of the government of India.³⁹ The key elements of this reorientation are: (i) automatic meter reading of all distribution transformers and use of Geographical Information System that maps the distribution system in order to pinpoint the exact locus of power theft and the offender combined with staff incentives for the resulting additional revenue; (2) Use this data to split the ATC losses into its components, technical losses, billing losses, collection losses and theft losses to design corrective measures for each; (3) bifurcate agricultural pumping load from non-pumping load in all rural feeders and devise methods of measuring agricultural pumping load; (4) for all loads above 50 kW, introduce intelligent or smart meters which enable real time, remote recording of consumption data and allow remote control over the power supplied through each meter; (5) introduce time-of-day metering using the capability of the above mentioned smart meters; (6) link all assistance to the state power sector from the central government exclusively to loss reduction and viability improvement; (7) use the key baseline data thus generated for determining the transition funding needs under outcome driven privatization models that seek to restore the viability of distribution systems. Pursuit of the efforts along these lines would improve the financial viability of the electricity boards, which is seen as a key for the sector health and for improving the prospects for electricity trade. Similar efforts could be relevant in Pakistan and Bangladesh too.

4.6 Structural and Institutional Changes with Potential to Favor Trade

Sector reforms based on the concepts of distancing the government (separation of policy making, regulatory, ownership and operation functions), unbundling vertically integrated utilities into separate entities responsible for different business functions such as generation, transmission and distribution, introduction of the concepts of third party access to the transmission and distribution wires services, and liberalization involving the provision of the choice of supplier to at least distribution companies and large suppliers are known to be conducive to internal and external electricity trade. Such reforms in their

³⁸ See India /Bangladesh: *Tata deal breaks integration barriers*, Oxford Analytica, 25 August 2004 and also the Country Analysis Brief on Bangladesh (July 2005) available at www.usdoe.eia.gov. See also press reports in India and Bangladesh during September-November 2006

³⁹ This section is drawn from *Integrated Energy Policy- Report of the Expert Committee*, Planning Commission, Government of India, New Delhi, August 2006, available at www.planningcommission.nic.in

simpler forms have been going on for over a decade in the region. Though they have been progressing somewhat slowly and, in the eyes of many observers, somewhat ritualistically, they nevertheless represent a move in the right direction improving the prospects of national and regional trade. The situation in the region in this respect is summarized in Table 4.2

Table 4.2: Status of Sector Structural and Institutional Reform

Country	Distancing the Government	Unbundling	Third Party Access to Wires Services	Regulation
India	Complete at the Federal level. Formally complete in most states	Completed at the Federal level and in most states and ongoing in the remaining few states	Approved for national grid. Ongoing for state grids (early stages)	Central regulatory commission is functional. State regulatory commissions are functional in 27 of 29 states
Pakistan	Formally complete	Power wing of WAPDA had been unbundled into four generation companies, one transmission company and nine distribution companies. KESC had been privatized as a VIU	Not yet	Regulatory body NEPRA is operational. Its capacity for sector oversight is still evolving
Bangladesh	Formally Complete	Partially complete. The transmission function has gone to PGCB. Substantial generation and distribution is still combined in BPDB, though Dhaka area has DESA and DESCO. Rural area distribution is handled by rural cooperatives.	Not yet	Regulatory body established, but not yet fully operational
Bhutan	Formally completed recently	No vertical unbundling. The four generating companies also handle some local distribution. BPC handles some generation, transmission and distribution	No	Not yet. Bhutan Electricity Authority created under a 2001 law is not yet fully operational
Nepal	Formally complete	No. NEA is still a vertically integrated utility	No	NETFC exists. Its capacity and autonomy appear limited. It does not regulate bulk supply tariffs
Sri Lanka	Regulation has not been separated yet	No final decisions yet. CEB is still a VIU. LECO handles distribution in a small area.	No	Due to frequent change of governments no decision had been taken yet.
Afghanistan	Not yet	Not likely in the short term	No	No, though there are plans for the future

In the Indian national grid the dispatch is largely based on the bilateral contracts (long term PPAs based on prices regulated by central regulatory commission) between central government owned generating companies and the state electricity boards. As explained in Section 4.3 above the adoption of ABT and UI charges and the presence of power trading companies have led to lively interstate trading in electricity and the emergence of real time spot markets and short term contracts with UI rate acting as the price signal. Within the state grids the transmission companies had been acting as the single buyer buying from IPPs, central and state government generating companies and selling to distribution companies and large consumers in the state at the bulk supply tariffs approved by state regulatory commissions. Recently the transmission companies have been asked shed this

role and transfer this function to an appropriate trading body. In Pakistan, National Transmission and Dispatch Company (NTDC) acts as the single buyer, though there is provision for future trading among the distribution entities, generators and large consumers. In Bangladesh BPDB acts as the single buyer, buying power from all generators and selling it to DESA, DESCO and RECs at bulk power tariffs. It has also substantial distribution responsibilities of its own. When the structural reforms take root and become fully operational in the three countries with major import potential they will clearly improve the prospects of regional trade.

Structural reforms of this kind have been delayed in Sri Lanka on account of the frequent change in government and the differences in their approaches. Afghanistan's situation needs to be stabilized before it could start sector reforms. However, such reforms are crucial in this important transit country for promoting trade between Central Asia and South Asia. In such small systems as Nepal and Bhutan, structural reforms of this type may not be an urgent need.

4.7 Efforts to Lessen Political Tensions

Efforts are going on to reduce the political tension between India and Pakistan by undertaking a series of high level dialogues and confidence building measures such as enabling travel of businessmen, road, rail and air links, and common and cooperative programs to fight terrorism. Trade barriers are being reviewed to minimize their impact and facilitate trade. In Nepal the insurgency appears to have been overcome and the prospect for a stable democratic regime appears bright. After the elections of Bangladesh in early 2007, political disturbances are expected to subside and major decisions on cross border investments are likely to be made. Afghanistan situation which appeared to be moving towards stabilization in the last year or two seems to be facing a potential reversal of that trend. On the whole regional political tensions appear to be lessening.

4.8 An Increase in Regional Cooperation Efforts

South Asian Association for Regional Cooperation (SAARC) in which all the seven countries covered by the study and Maldives are presently members has been taking special interest in the energy cooperation in the recent years. In the Islamabad Summit meeting held in January 2004, a decision was taken to establish a Working Group on Energy to study South Asia Energy Cooperation including the concept of an Energy Ring. The Council of Ministers Meeting held at Islamabad during 20-21 July 2004 approved the report of the Working Group containing a range of topics related to energy cooperation. The Working Group thereafter decided to pursue action in respect of (a) Exchange of Energy Information, (b) Environmental friendly energy, (c) Creation of a regional Power Grid, and (d) cooperation on renewable energy. SAARC Energy Center had been established in Islamabad to carry out studies and coordinate energy cooperation and trade among the member countries. In the most recent SAARC Heads of State summit meeting (April 3-4, 2007) and the SAARC Energy Ministers meeting (March 7-10, 2007) the rapidly increasing energy demand to meet the developmental needs and the role of the regional energy trade to meet such demand figured prominently. The government leaders gave expressions of strong support to regional energy trade and reiterated their political commitment to promote such trade. They endorsed the concept of energy ring (which inter alia, focuses on electricity interconnections among the member

countries). The Energy Center will carry out a study on the concept of the Energy Ring with help from Asian Development Bank. The Second SAARC Business Conclave, a gathering of private sector business associations in the region took place in Mumbai during February 17-18, 2007. Its Mumbai Declaration calls for increased energy cooperation to enhance energy production and transmission among SAARC countries. There is strong private sector interest to make cross border energy sector investments, provided sector policy reforms are fully implemented, and mechanisms for managing cross border investments are put in place.

Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) in which Bangladesh, Bhutan, Nepal, Myanmar, India, Sri Lanka and Thailand are presently members is also active in the field of energy. The first Energy Ministers' Conference held in Delhi in October 2005 approved a BIMSTEC vision of Trans-border Power Exchange and Grid Interconnections country by country to enable eventual flow of electricity across the member countries. It also resolved to: (a) evolve a common regulatory framework for developing grid interconnections; (b) develop the hydropower potential of the region to support economic growth; (c) to further enhance cooperation in the development of various hydropower projects

ECO (Economic Cooperation Organization) was created in 1985, first including Iran, Turkey, and Pakistan. The other seven members-- Afghanistan, Azerbaijan, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan – were added in 1992. ECO has had a number of meetings devoted to energy trade, most recently in Bishkek, in May 2004 and in Teheran, in June 2005. The latter meeting was organized in cooperation with the World Bank and with participation of other donors such as Asian Development Bank (ADB) and Islamic Development Bank (IsDB). The participants agreed to pursue energy trade initiatives through two broad sets of activities: (i) promoting specific projects whose potential has already been demonstrated through analytical work; and (ii) undertake additional analytical work on the investment and policy fronts. ECO has launched a study of electricity interconnections among the ECO countries, financed by IsDB. Another study entitled *Trading Arrangements and Risk Management in International Electricity Trade in ECO Countries* is being carried out under the World Bank financing.

The regional Economic Cooperation Conferences in Kabul (2005) and Delhi (2006) discussed at length regional energy cooperation opportunities and the Kabul and Delhi declarations called for continued efforts to interconnect electricity systems and promote electricity trade within the region as well with the western neighbors of the region.

There are also several other regional cooperation organizations such as Shanghai Organization for Security and Cooperation in which Iran, India and Pakistan have observer status. It is increasingly focusing on economic cooperation in addition to security matters.⁴⁰ Such a surge in discussions on the regional cooperation in the electricity and gas sectors augurs well for regional electricity trade. Most of these organizations are making only a limited tangible progress mainly on account of the political tensions in the regions. Once the political tensions subside, the existence and the activities of such organizations would lead to faster progress in regional trade.

⁴⁰ See William Byrd, Martin Raiser and others, Economic Cooperation in the Wider Central Asia Region, World Bank Working Paper No.75, 2006 for a fuller listing of the various organizations.

Chapter 5

OPPORTUNITIES FOR REGIONAL ENERGY TRADE

In Chapter 2 we discussed the distribution of energy resources in the region and its neighbors, and also, briefly the energy use and the supply-demand situation and outlook. The opportunities for electricity trade emerging from these would fall under three groups:

- Central Asia- South Asia electricity trade
- Nepal, Bhutan, India, Bangladesh and Myanmar electricity trade
- Other opportunities such as Central Asia- Afghanistan bilateral trade, Pakistan-Iran bilateral electricity trade, India-Sri Lanka bilateral electricity trade, and India-Pakistan bilateral electricity trade

Similarly the opportunities for gas trade would fall under the following groups:

- Import of gas through pipelines into India and Pakistan from Iran and Central Asia (Turkmenistan, Uzbekistan and possibly Kazakhstan)
- Import of gas from Myanmar and Bangladesh into India and possibly to Bhutan and Nepal

Most of the trade (except the envisaged CA-SA electricity trade and gas trades) would be bilateral at least to start with and may later evolve into regional markets with multiple buyers and sellers. Bilateral cross-border trade is a natural starting point and an important long-term feature of regional trade, even in well developed multilateral regional markets. It helps develop physical infrastructure and commercial relationships in a gradual fashion, allowing participating countries to adjust, develop institutions and experience, build confidence and mutual comfort, and minimize risks.

One may envisage in this context the evolution of the regional market in the following geographic terms:

- The Western Energy Market in which energy trade would be among Central Asia, Iran, Afghanistan, Pakistan and India
- The Eastern Energy Market in which the energy trade would be among India, Nepal, Bhutan, Bangladesh, Myanmar and possibly Sri Lanka

India being in both would enable the eventual evolution of an integrated regional energy market.

Given the economic realities and outlook as well as the resource distribution across the region, India, Pakistan and perhaps Bangladesh would emerge as major importers, while Central Asia, Iran, Myanmar, Bhutan, Nepal would emerge as major exporters. Afghanistan and Pakistan would be key transit countries in the Western Energy Market, while Bangladesh could play that role in the Eastern Energy Market. Bangladesh has also the potential to emerge as an exporter of gas and electricity (see Map at the end of the document)

5.1 The Western Energy Market

As can be discerned from Table 2.4 Central Asia and Iran have considerable natural gas resources and surplus electricity to export. Kazakhstan, Kyrgyz Republic, Uzbekistan and Tajikistan, which presently constitute the Central Asian Power System (CAPS),⁴¹ have a combined generation capacity of about 38,000 MW and an annual generation in excess of 135 TWh. Their comparative advantage in terms of electricity exports arises from the factors summarized in Box 5.1.

Box 5.1: Comparative Advantages of Central Asian Republics in Electricity Exports

- Dramatic decline in electricity demand upon the dissolution of the Soviet Union rendered their generating capacity excessive. Annual generation of electricity, although increasing, still lags considerably behind the pre-1990 level.
- Tajikistan and Kyrgyz Republic have huge hydropower potential. They operate predominantly hydroelectric power systems, have large surplus generation available for export in spring and summer and face supply deficits in winter due to lack of thermal generation capacity or lack of fossil fuels.
- Generating facilities, including those whose construction had been initiated but then stopped after the break up of the Soviet Union, were designed or optimized on the basis of large regional markets within the Soviet Union, and became excessive to the needs of newly independent republics.
- There were a number of large power projects the construction of which commenced during the Soviet regime and later were suspended after incurring considerable amounts of sunk cost, for want of funds to complete them. When completed, their outputs would be far in excess of the needs of the host countries and thus their completion would make economic sense only if export markets could be found. Because of the large sunk costs already incurred in the Soviet era, the marginal cost of generation based on incremental investments could be attractive to prospective importers.
- Similarly, the incremental generation costs from the moth-balled thermal generating assets in Kazakhstan (upon their rehabilitation) would also be attractive.⁴² Export of surplus thermal power from Kazakhstan, Turkmenistan and Uzbekistan (with significant and developed fossil fuel resources) could complement the hydro power exports from Tajikistan and Kyrgyz Republic to make part of the supply firm year round.

In these countries, practically 100% of the households have access to electricity. Based on present high per capita consumption levels, income elasticity and effective price elasticity, the demand for electricity in these four countries during 2005-2025 is expected to grow at a very modest annual average rate of about 2% only, if the tariffs are to increase to full cost recovery levels and commercial discipline is strictly enforced.⁴³

⁴¹ Turkmenistan's power system also used to operate synchronously with the system of the other four Central Asian countries. During the time of the Soviet Union, the power systems of the five countries were developed as an integrated system, operated from a regional dispatch center in Tashkent (Uzbekistan). Since May 2003, the Turkmenistan system has been operating synchronously with that of Iran and not with the rest of the CAPS.

⁴² AES the owner of Ekibastuz Thermal power plant in Kazakhstan and related coal fields estimates power generation costs of 1.0 to 1.2 cents per kWh upon rehabilitation of units 3-7 (300 MW) (2005-2007), less than 2.0 cents/kWh upon rehabilitation of unit 8 (500 MW) (2009), 2.0 to 3.0 cents/kWh upon rehabilitation of Unit 2 (500 MW) by 2011 and unit 1 (500 MW) by 2013 (Presentation by Dale Perry of AES in Istanbul conference "Electricity Beyond Borders" on June 13, 2006).

⁴³ Price increases and substantial improvements in metering, billing and collection system and procedures to enforce payments, reduce theft and other commercial losses, should limit demand increase.

Supply options such as system loss reduction, rehabilitation of generating units and completion of the large projects presently languishing for want of funds, could produce enough electricity to meet the forecast demand and leave substantial surpluses for export. Presently the surpluses are of the order of 11 TWh but almost the entire surplus is in the spring and summer months. In winter there is actually a shortage of about 1 TWh. The total annual surpluses could exceed 30 TWh in the next five years and 50 TWh in the next 10 years if the envisaged investment program is implemented. The major portion of the surpluses would continue to be in spring and summer, while surpluses in fall and winter would be lower by about 10 TWh in comparison.

Further, the World Bank's Central Asian Regional Electricity Export Potential Study (2004) demonstrated that electricity exports from the projects (partially completed during the Soviet rule) would be competitive in possible export markets such as Afghanistan, Pakistan, China, Russia and Iran (see Table 5.1). These estimates were made on the basis of Central Asian fuel prices at \$35 per 1000 cubic meters of natural gas and \$20 per ton of coal. The world oil price levels at that time were around \$35/barrel.

Table 5.1: Comparison of Marginal Cost in the Export Market with Import Costs from Central Asia (Cents/kWh)

Target Market	Marginal generation cost in the target Market	Generation Options in Central Asian Republics (CARs)	Cost of Supply from CARs
Afghanistan	>10	Sangtuda I, Rogun I, Talimardjan I and II	2.26 to 3.43
Iran	3.6	Sangtuda I, Rogun I, Talimardjan I and II	2.29 to 3.46
Pakistan	5.6	Sangtuda I, Rogun I, Talimardjan I and II and Kamarata II	2.26 to 3.75
China	3.6	Sangtuda I, Talimardjan I	2.47 to 3.16
Russia	3.0	Sangtuda I, Talimardjan I	2.30 to 2.99

Turkmenistan has installed generation capacity of nearly 3000 MW. In 2005 it generated 12.3 TWh, of which nearly 10.5% was exported to Turkey, Iran and Afghanistan. Given its substantial natural gas resources, it could step up its capacity and generation for exports at an attractive marginal cost.

Iran has an installed power generation capacity exceeding 34,000 MW and an annual generation over 149 TWh. It operates three isolated power systems. The north eastern power system in Khorasan province and the southeastern power system in Sistan-Baluchistan province adjoining Turkmenistan, Afghanistan and Pakistan are isolated from the much larger western grid. Imports of power to these areas from Turkmenistan in 2003 were substantial (230 GWh), and there were small exports to Afghanistan (17 GWh) and Pakistan (47 GWh).

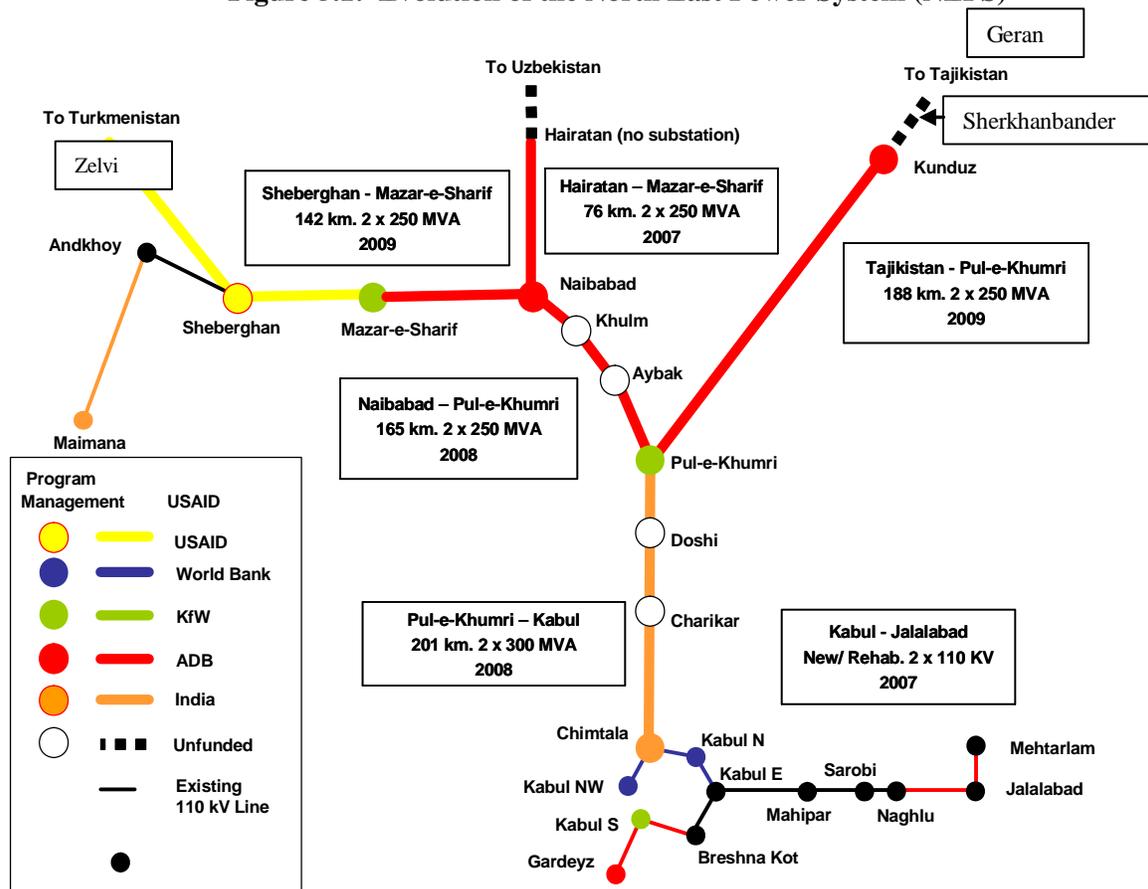
Iran and Turkmenistan have substantial natural gas resources for export and both (especially the latter) are looking for opportunities to diversify their markets and extend towards South Asia. Uzbekistan and Kazakhstan also envisage a rapidly growing production of natural gas and looking eastwards for new markets. Kazakhstan is also rich in low cost good quality coal and could offer competitively priced electricity generated

from such coal for export. For Tajikistan and Kyrgyz Republic, export of hydroelectricity could be a key driver of their economic growth. Such exports would also enable the two countries, heavily relying on hydropower, to pay for the fossil fuel imports needed to mitigate their winter supply shortages.

5.1.1 Central Asia – Afghanistan Bilateral Electricity Trade

Afghanistan’s modest-sized and extensively damaged power system is fragmented and includes four main isolated grids clustered around areas of Kabul in the east, Mazar-e-Sharif in the north, Herat in the west, and Kandahar in the south. Estimated unsuppressed demand at 363 MW outstrips the available capacity of about 270 MW and relentless daily load shedding has become inevitable. In the first eight months of 2006, electricity imports from Iran and Central Asia constituted 31% of the supply mix. Electricity peak demand is forecast to grow to 905 MW by 2020 at an average annual rate of 5.7%. Similarly, electric energy consumption is forecast to grow from 1,295 GWh to 3,868 GWh during 2004-20 at an average annual rate of 6.6%⁴⁴.

Figure 5.1: Evolution of the North East Power System (NEPS)



⁴⁴ Power Sector Master Plan, Transitional Islamic State of Afghanistan, (October 2004); prepared by Norconsult and Norplan.

Import of power is expected to remain an important cost-effective component in Afghanistan's supply mix for the foreseeable future, both because of its comparative cost advantage and the fact that reliance on imports would leave more funds to be available for electrification and distribution and transmission network extension⁴⁵.

Afghanistan's present levels of imports from Iran, Turkmenistan, Uzbekistan and Tajikistan have been given in Table 2.5. In order to increase the volumes of import and absorb them, Afghanistan needs to build its first stage backbone 220 kV transmission system called North-East Power System (NEPs) which will enable the flow of power to the key load centers. The various parts of it are under construction under the financing provided by a range of donors (WB, ADB, USAID, KfW, India and others). NEPs is expected to be completed by 2008-2009 (see Figure 5.1). Also transmission links within the Central Asian countries need to be strengthened. The details in respect of each country exporting to Afghanistan are discussed below.

Tajikistan has substantial surplus generation capacity during the spring and summer seasons and is looking for export opportunities. It has also partially completed large hydro projects such as Sangtuda I and Rogun, which when completed would provide very large volumes of surplus power for exports. It has a weak interconnection from Geran to Kunduz (Afghanistan) at 110 kV, operated at 35kV on the Afghan side. In an MOU signed in April 2005 and the subsequent agreements signed in December 2005, Tajikistan has agreed to supply 300 MW in spring and summer and whatever quantity it can, in fall and winter and construct a 220 kV double circuit line from Geran (Tajik) to Sherkhanbander (Afghan) to enable larger volumes of export. The double circuit 220 kV line from Sherkhanbander to Kunduz and then on to Pul-e-Khumri would be constructed by the Afghan side under ADB financing and would become a part of the backbone of the NEPS by 2008-09 (see Figure 5.1).⁴⁶ Tajikistan would also supply power from its system to some of the Afghan border towns. In addition, Tajikistan was planning to construct a double circuit 220 kV line from Lalazar to Kulab within Tajikistan and one circuit of which would be made available for extension into the Faizabad area in the Badakshan province of Afghanistan and perhaps eventually for interconnection with Kabul. Since the supply from Tajikistan would be seasonal it may have to be supplemented by imports from Uzbekistan and Turkmenistan during fall and winter.

Uzbekistan has an installed capacity exceeding 11,500 MW and an annual generation exceeding 49 TWh and a peak demand of about 7,700 MW. It has recently commissioned the first 800 MW unit of Talimardjan Thermal Power plant and three more units of the same size are expected to be constructed in the medium term. Uzbekistan has considerable natural gas and coal resources and its generation mix is predominantly

⁴⁵ Though the Power System Master Plan (2004) of Afghanistan calculates the long term average incremental cost of power generation at 5.0 cents/kWh, realistically short to medium term marginal cost of generation is most likely to be the economic cost of production by diesel generators, at around 10 to 15 cents per kWh. Imports from Central Asia and Iran presently are priced in the range of 2.0 cents to 2.65 cents per kWh, which probably reflects their short-term marginal cost and, at least in case of Iran, may contain a subsidy element as a form of external assistance. Given the general surplus of electricity in Central Asia, imports should remain cost-effective options for Afghanistan.

⁴⁶ ADB is also financing a dedicated 220 kV line from a substation near Sangtuda I to connect to the line in Afghanistan at Sherkhanbander.

thermal. Unlike Tajikistan and Kyrgyz Republic, it could provide year round firm supply of electricity to Afghanistan. Uzbekistan exports electricity through a 220 kV double circuit line from Termez to Mazar-e-Sharif presently operated at 110 kV. The supply which was suspended in 1999 during the Taliban rule was resumed in August 2002. In May 2003 a Protocol of Intentions was signed between the Afghan Ministry of Water and Power and Uzbekenergo, which indicated that Uzbekistan would provide up to 150 MW for a 10 year period. The price during the first year would be 2.0 cents/kWh. Prices for subsequent years had to be negotiated.⁴⁷ An Afghan delegation visited Tashkent in July 2006 with a request for imports up to 300 MW and for the establishment of the technical conditions. Uzbekenergo indicated the specific transmission constraints in its system which limit the supply capability to 85 MW. The Afghan side is following up with the Uzbek government for undertaking investments to eliminate these constraints to enable supply of 300 MW.

Turkmenistan is well endowed with natural gas resources and has a power system (with entirely thermal generation) capable of providing firm year round supply. With an installed capacity of nearly 3000 MW and a production level of 12.34 TWh of electricity in 2005 (an eight percent increase from 2004), Turkmenistan exported electricity in 2005 to Turkey (534.6 GWh), Iran (598.9 GWh) and to Afghanistan (160 GWh). Its total exports at 1.3 TWh were 13.8% more than in 2004. Turkmenistan is thus a good source of firm power to Afghanistan's western and north western provinces. In October 2003 Afghanistan is reported to have signed an agreement with Turkmenistan for supplying 165 GWh via the 110 kV line to Andkhoy –Jawzjan- Sheberghan area and another 160 GWh via the Gushby-Herat line (220 kV operated at 110 kV) to Herat area at a price of 2.0 cents per kWh. In an MOU of April 25, 2006, Turkmenistan has agreed to extend 220 kV lines to border towns and supply power. In principle Turkmenistan signed an MOU for the supply of 300 MW of firm power. On June 7, 2006 the Ministries of Energy of the two countries signed a protocol for the supply of 200 MW in the first stage However actual imports reported by DABM amounted only to 97.9 and 165.3 GWh in FY 2004-2005 and FY 2005-2006 respectively. In the first three months of FY2006-2007 the imports amounted to 47.7 GWh.⁴⁸ In order to increase the imports at least to the levels covered by the protocols, the operation of the Gushby to Herat line needs to be upgraded to 220 kV level and the proposed new 220 kV line from Zelvi (Turkmenistan) to Mazar-e-sharif should be completed. It is planned to build the 130 km long 220 kV double circuit line from Zelvi (Turkmenistan) to Sheberghan and then on to Mazar-e-sharif (Afghanistan) under USAID financing. The Feasibility Study for this would be completed in 2007. At that time arrangements will have to be in place to handle the situation arising from Turkmenistan operating synchronously with Iran and not with the rest of the Central Asian Republics.

Iran has an installed power generation capacity exceeding 34,000 MW and a generation exceeding 149 TWh. However the power systems in the provinces of Khorasan and Sistan Va Baluchistan provinces adjoining Afghanistan are isolated from the much larger

⁴⁷ Price was increased to 2.3 US cents the following year and currently is 2.65 US cents per kWh.

⁴⁸ The financial year of Afghanistan government ends on March 20.

interconnected western grid and actually import 599 GWh from Turkmenistan (2005). However supply of the relatively small volumes contracted so far (50 MW and 6MW) to Afghanistan have not presented a problem. Iran supplies power now through a double circuit 132 kV line (150 km) from Torbat-e-jam to Herat, which it financed and constructed and commissioned in January 2005. In addition, power also flows to the Herat area through two 20 kV lines from Iran. Further Iran supplies Zaranj, a border town in the Nimroz province through a 20 kV line opened by Iran in March 2004.

Khorasan province of Iran is already importing notable quantities of power from Turkmenistan. Iran has recently signed an agreement with Tajikistan to invest in the construction of Sangtuda II hydroelectric project (270 MW run of river scheme), the output of which will go to Iran (Mashad area of Khorasan province). The related transmission line would most probably pass through Afghanistan providing the latter an opportunity to earn transit fees. It may also provide an opportunity to integrate the Herat Grid with NEPS. Presently Iranian power is being supplied at a price of 2.25 cents / kWh, which is valid through 2006.

Actual imports of electricity in Afghanistan appear to run well behind agreed volumes of power largely on account of transmission and distribution constraints, and donors are doing their best in providing timely funding for the needed improvements. Construction seems to be impeded by the cost and time needed to clear the areas of mines as well as by the need to ensure that compensation amounts for the right-of-way are paid fully and recorded in a timely manner. Some special efforts appear to be needed to reduce the cost and speed up the operation. Costs of de-mining need to be more fully incorporated into the cost structure of the projects.

5.1.2 Iran-Pakistan Bilateral Electricity Trade

The details of the existing import of power by Pakistan from Iran had been given in Section 2.3. The supply by 132 kV line is mainly for the area around the deep sea port of Gwadar in Pakistan. Anticipating an increase in demand induced by the port related developments, WAPDA has negotiated for increased supply levels up to 100 MW and has made arrangements for a new 220kV link. Gwadar is the only deep sea port, other than Karachi in Pakistan and growth in its hinterland is likely to be substantial. The import price of power appears to have risen from 3 cents to about 6.25 cents/kWh. When the Iran-Pakistan-India gas pipeline project materializes, it will pass through this area and there may be a possibility of constructing here a gas based combined cycle power plant to meet the likely demand growth.

5.1.3 Pakistan-India and Pakistan-Afghanistan Bilateral Electricity Trade

Towards the end of the 1990s, Pakistan faced a surplus power situation when demand did not grow as forecast, and when WAPDA had to face financial problems arising from the “take or pay contracts” with a significant number of IPPs. In that context, both Pakistan and the IPPs explored the possibility of export of surplus power to India. Despite a great deal of discussions at various levels, the trade did not materialize because of the big difference in the power price WAPDA wanted (7.5 cents/kWh) and the price which the Power Grid Corporation of India was willing to pay (2.25 cents/kWh). It was, however,

recognized at that time that interconnections and operating agreements would present no major problems.⁴⁹

Presently there are no electrical interconnections and no electricity trade between the two countries. The western and northern regions of the Indian national grid, which adjoin Pakistan's grid in Punjab and Sind Provinces, presently have peak capacity shortages of 6000 MW and 3700 MW and energy shortages of 25TWh and 21TWh respectively. The Pakistan grid is short of firm power and suffers from peaking shortages in summer. The seasonal variations in demand are about the same on both sides. There is thus no immediate export/import advantage to either side by interconnecting the grids. Medium or low voltage links could help border villages and settlements. However, strong extra high voltage links (400 kV or above) from Pakistan Grid to both northern and western regions of the Indian grid would be warranted in the context of major power imports from Central Asia, perhaps in the context of the stage II of the proposed CA-SA electricity trade project. Apart from enabling the import of Central Asian power, the two grids would have the advantages associated with synchronous operation of adjoining grids, namely better system security and reliability at a lower cost and better ability to take care of unanticipated outages arising from accidents, and the better ability to balance the systems in real time. Such interconnections could conceivably enable Nepal (and possibly Bhutan) to diversify their export markets to Pakistan in the context of the transfer capacity in the Indian grid being stepped up to more than 30,000 MW in the medium term. The thaw in the political tensions between the two countries and the progress in confidence building measures would seem to indicate that future development along these lines is likely.

Pakistan-Afghanistan bilateral electricity trade had been discussed on several occasions and WAPDA had even prepared proposals for several cross border interconnections at 20 kV. However none of them materialized. Pakistan appears to be concerned about the payment risks. Pakistan is finding it difficult to collect payments and disconnect non-payers from its own Federally Administered Tribal Areas adjoining Afghanistan. In this context disconnecting supply to the customers in Afghanistan might become a politically sensitive issue. Thus the bilateral trade may have to wait till the CA-SA trade arrangements materialize.

5.1.4 Central Asia-South Asia Multilateral Electricity Trade

During the Soviet rule the power systems of the five countries of the Central Asia (Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan) operated synchronously. Upon the dissolution of the Soviet Union, this multilateral "pool" was replaced by a system of bilateral cross border transactions. As a result, the volume of trade declined by about 68% during the 1990s from about 25 TWh to 8 TWh. The decline was caused by a range of reasons which included a dramatic decline in electricity demand, the use of barter of electricity for fossil fuels and the quick rise in the traded

⁴⁹ Presentation by Dr. Mahendra P. Lama of Jawaharlal Nehru University, New Delhi, *Economic Reforms and Power Sector in South Asia: Scope and Challenges for Cross Border Trade* available at the website of USAID SARI-E Program.

fossil fuel prices to world traded level, while electricity prices stagnated. However the most important reason was the breakdown of the traditional regional water sharing agreements and the associated electricity trading arrangements. These impediments have to be overcome to improve the volume of mutually beneficial trading among the Central Asian countries. However, electricity surpluses are there in all Central Asian countries and internal trade among them and trade with Afghanistan alone can not absorb the exportable surplus.⁵⁰ It is in this context that the idea of exporting the surplus to Pakistan and in the later stages possibly to India in a multilateral framework emerged.

Pakistan's peak demand now exceeds 14,000 MW and the present installed capacity of 19,500 MW (33% hydro, 65% thermal and 2% nuclear) has become inadequate on account of the wide variations in the water availability which greatly reduces the firm capacity available. The economy had been growing at around 6% to 7% in the past four years and is expected maintain such growth rates during the next several years. Electricity demand at the generation level is forecast to grow at 7% to 8% per year to about 20,000 MW by FY2010, and 44,700 by FY 2020. The country, which had a comfortable supply position during the last several years, has already started experiencing shortages during peak periods and it is anticipated that if no new capacity is added, firm power shortages would amount to 5,500 MW by FY2010. By FY 2011 energy shortages would amount to about 35 TWh. The array of options considered to meet this demand include supply efficiency, demand management, addition of new hydro and thermal power capacities both under the public and private ownerships, *as well as electricity imports from Central Asia, starting with 1000 MW in the initial phase*. If the imports prove reliable and competitive, the volumes could rise substantially in the second phase. The particularly attractive feature of this proposal is that Pakistan's peak demand occurs in summer, when the Central Asian power systems have large surpluses from their hydroelectric generating stations.⁵¹

Efforts to develop the first trans-regional electricity trade project commenced at the regional conference in Islamabad, in May 2006 which was attended by the experts of power utilities and governments officials of Afghanistan, Kyrgyz Republic, Pakistan, and Tajikistan as well as representatives of a number of IFIs and bilateral donors (World Bank, IFC, Asian Development Bank, Islamic Development Bank, and USAID) and interested private sector investors (AES of USA and RAO UES of Russia). In this conference Pakistan formally expressed its interest in importing 1000 MW of power from Tajikistan and Kyrgyz Republic. Should the arrangement for the first stage prove reliable and competitive, Pakistan indicated it would consider further increasing the import volume, perhaps as high as 4,000 MW. Tajikistan and Kyrgyz Republic confirmed their desire to export and Afghanistan agreed to enable the transit of power and also to eventually import some quantities for its own market. A Multi-Country Working Group (MCWG) was set up to initiate analytical, institutional, organizational and other activities for the preparation of this Central Asia – South Asia 1000 MW (*CASA-1000*) project with

⁵⁰ For a more detailed discussion of these aspects see *Water and Energy Nexus in Central Asia*, World Bank (February 2004) and *Central Asia: Regional Electricity Export Potential Study*, World Bank (December 2004)

⁵¹ Pakistan also experiences supply shortages in winter months too, when natural gas supplies are diverted from electricity production to household use.

assistance from IFIs, led by the World Bank. The World Bank has financed the consulting services to assist the MCWG in the initial stages of the work. An important outcome of this meeting was the shared recognition that there are significant opportunities for, and advantages from, expanding the trade over time to include other countries both on the selling and buying sides, creating an integrated regional electricity market. At the subsequent regional conference in Dushanbe (October 26-28, 2006), the four countries signed a Memorandum of Understanding on Project Development for building a high-voltage transmission line between Tajikistan and Pakistan via Afghanistan, and created a Ministerial Council to coordinate the effort.

Several developments preceding the Islamabad conference are indicative of the potential for development of a broad-based electricity trade in the region:

- RAO UES of Russia has formed a joint venture (75% RAO UES and 25% Tajik Government) which has obtained the right to take over and complete the construction of the run-of-river hydroelectric project Sangtuda I (670 MW, energy 2,700 GWh/year, 60% of which would be in summer). The construction is under way, to be completed in 2009. The Joint Venture has approached the IFIs for possible equity participation and debt financing.⁵² The output is targeted for exports mainly to Pakistan.
- AES, a US-based strategic international investor in the power sector, which already has assets in Central Asia and South Asia, has reportedly signed an MOU with the Tajik government for undertaking transmission investments and hydro power station rehabilitation investments and also offering to *handle* the export of 1500 GWh (about 300 MW) from the existing summer surplus of Tajikistan to Afghanistan and South Asia.
- A study by NESPAK, a Pakistani consulting firm, completed a preliminary evaluation of possible electricity transmission routes between Tajikistan and Pakistan. Two main routing options were considered: (i) a 650 km route passing through Kunduz and Kabul/Jalalabad in Afghanistan, with 170 km of the route passing through Tajikistan, 430 km through Afghanistan, and 50 km through Pakistan; and (ii) a 700 km route that would minimize the length of transmission through Afghanistan, with only 30 passing through the narrow Wakhan corridor, with the rest of the route going through Tajikistan (360 km) and Pakistan (310 km). The technological options included 500-kV and 765-kV AC lines and 250-kV and 400-kV DC lines. The Wakhan route was estimated to be costlier by 40% to 60% on account of the very high elevation and the extremely difficult nature of the terrain and weather conditions.

It may be noteworthy to mention some other developments indicative of the interests of the countries and private sector in regional electricity projects:

- Iran has signed a MOU with Tajikistan to set up a joint venture to develop a run-of-river hydroelectric project, Sangtuda II (220 MW, 990 GWh). The output is intended for export to Khorasan province of Iran via Afghanistan.

⁵² Most probably, the equity of Tajik government would remain at 25%. RAO UES may divest a portion of its 75% shares to IFC and EBRD, but is expected to keep at least 50% of the shares for itself.

- A large Aluminum producer of Russia, Rusal, has evinced interest in investing in the Rogun storage hydroelectric project (3600 MW, 13000 GWh, incremental investment exceeding \$2 billion) and has carried out feasibility studies by a German consultant. As a storage hydro project, Rogun would need inter-governmental agreement among riparian states on water use and reservoir operating regimes and might therefore may take a longer time to materialize.

In order to supply 1000 MW to Pakistan, other suppliers may have to join the Sangtuda Joint Venture Power Company, which can provide only up to 670 MW. The summer surpluses of the existing Tajik system may provide another 300 MW even after setting apart the 300 MW which it had agreed to provide for Afghanistan through the 220 kV lines (see section 5.1.1 for details). Golovnaya Hydro power station in the Nurek cascade of Tajikistan could provide an additional 80 MW to 100 MW after its rehabilitation. Summer surpluses from the Kyrgyz system could provide up to 600 MW, provided that the present transmission constraint of the lines passing through Uzbekistan is eliminated by constructing a bypass 220 kV line (capital cost estimated at \$45 million) within the territories of Kyrgyz Republic and Tajikistan. Attractively priced thermal power from the northern parts of Kazakhstan (such as Ekibastuz) could flow to the Kyrgyz Republic through the second North-South 500 kV line, currently under construction in Kazakhstan, although it remains to be seen how much capacity would be available for exports vs. supplying the southern Kazakhstan. However, it could flow further south only if the above mentioned bypass line is upgraded to 500 kV level. In order to enable the Kazakh power and the Kyrgyz power to reach the Nurek cascade in the southern part of Tajikistan, a north-south 500 kV line has to be constructed in Tajikistan and this line has already been funded by the Chinese export credits of \$267 million and is expected to be ready by 2008-09. Thermal power supplies from Kazakhstan could help to increase the volume of firm (year round) power supply to Pakistan. Rogun storage hydro could provide this type of support, if and when the plant is built. Uzbekistan and Turkmenistan also may have a potential to add thermal power to the export surplus of the region.

The CASA-1000 project, as agreed at the Islamabad and Dushanbe conferences, will start with analytical studies to examine the merits and the scope of the potential trade and commercial options for structuring the project as a public-private partnership (PPP) arrangement. One study would focus on technical, economic, and safeguard issues, while another one would examine institutional, financial, legal, and risk mitigation issues of the possible commercial structural options.

Apart from carrying out the usual due diligence needed to satisfy the potential financiers (which may come both from the private and public sectors), the two proposed studies would analyze and enable decision making in respect of some key issues:

- The assessment of trade potential and the associated benefits: the studies should establish the volumes of electricity available for export over time (including through additional investments in generation), the cost range for these exports, as well as demand in the importing countries and the price range which the importing markets could or would be willing to bear.

- Selection of transmission corridor and technology: connecting a number of disparate power systems over difficult terrain would present significant technical challenges. The options involving High Voltage Direct Current (HVDC) technology may minimize initial problems, but are costlier and less flexible for further expansion in comparison with the High Voltage Alternate Current (HVAC) technologies. The trade-off would need to be carefully considered and evaluated.
- Institutional, financial, and regulatory issues: There would be a number of potential exporters: Sangtuda Power Company, Barki Tajik and the Kyrgyz Power Generation Company, to start with, and at a later stage private trading companies set up by investors; and possibly other countries (Kazakhstan and Uzbekistan). The importers would be the Pakistan power utilities, with the possibility of Afghanistan's DABM also becoming an importer, perhaps at a later stage. The trade volume would increase over time and there may be a need to expand the transmission capacity. There are the issues to be sorted out and agreed upon. They include: structuring the trade with multiple sellers and, at a later stage, multiple buyers; responsibility for transmission investments; allocation of the transmission risk; dealing with non-payment risks; ensuring the neutrality of the transmission system planning, ownership, operation and maintenance; allocation of the transmission capacity among the sellers (and buyers); determination, administration and oversight of transmission access rules; payment clearance and settlement; and, last but not least, the method of resolution of the potential dispatch conflicts between regional and domestic transactions.
- Risk mitigation strategies: The project would face a number of risks, some of them unique to this case, such as the nature and the level of security risks through Afghanistan and innovative risk mitigation strategies they would call for, combining financial risk mitigation instruments with social, technical, and operational measures.
- Intergovernmental agreement: An overarching intergovernmental agreement may have to be concluded covering the key aspects on which government approvals and cooperation are needed. The agreement, inter alia, would deal with institutional and regulatory arrangements, coordination and harmonization of policies and regulations, right of way issues, coordination of water releases and electricity generation, risk mitigation, and the rules for expanding the arrangements to additional players and volumes of trade. Laws may have to be enacted and rules under them may have to be issued in the relevant countries to enable the construction, ownership and operation of the project by transnational entities or their subsidiaries.

These are complex issues which need to be thoroughly investigated and analyzed to inform decision makers on the available options and their trade-offs. A number of similar projects carried out elsewhere in the world could offer valuable lessons and guidance. The region itself also has some relevant experience and expertise. Pakistan has extensive experience in dealing with private investors and IPPs in the power sector. The Tajik government also has some experience in dealing with private sector on the basis of the PPP arrangements in the Gorno Badakshan area in respect of Pamir Power Project. Central Asia has experience in operating interconnected systems. Considering the poor access of most of the countries to the capital markets and the limitations of the resources which the IFIs could offer, some form of public private partnership appears highly

desirable and even inevitable for the materialization of the project and its dependable operation with commercial discipline. Private interests have already materialized in the generation component and have been evinced for the transmission and trading components as well.

5.1.5 Turkmenistan, Afghanistan and Pakistan Natural Gas Trade (TAP)

The governments of Turkmenistan, Afghanistan and Pakistan have been examining since 2002 a gas pipeline project to enable Turkmenistan export about 30 bcm of gas per year to Pakistan via Afghanistan.⁵³ A series of related studies have been carried out with Asian Development Bank assistance.

The pipeline with a diameter of 56 inches would be 1680 km long and is estimated to cost \$3.3 billion and would have the capacity to transport 30 bcm of gas per year. Gas will come from the Daulatabad fields of Turkmenistan which is estimated to have a reserve of 1.4 trillion cubic meters of gas. Its present level of production is 20 bcm a year, while it is capable of producing 45 bcm of gas per year. In November 2006 the Turkmenistan government announced the discovery of a new gas field near Mary with a reserve of 1.0 trillion cubic meters. The TAP pipeline project would transport about one trillion cubic meters of gas over its life span of 30 years.

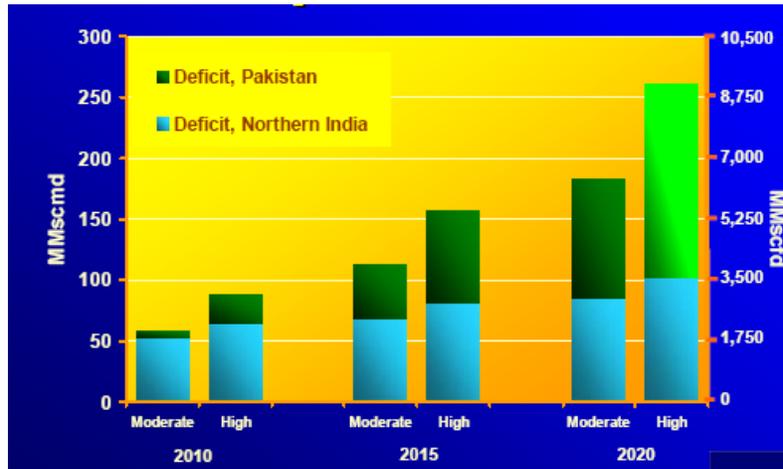
Gas market reviews in Pakistan indicate that Pak gas demand alone can support an import project of 20 bcm per year. The participants therefore are desirous that India should join the project as an importer to improve the economics of the project, and have formally extended an invitation to India, when it attended the Steering Committee Meeting on February 9, 2006 as an observer.⁵⁴

The study finds that the pipeline option compares favorably with LNG option and the option of importing gas from Qatar. Based on the gas input price at Turkmenistan of \$58 to \$51 per thousand cubic meters of gas (corresponding to \$1.63 to \$1.44 per million BTU) and sale price in Pakistan of \$77.5 to \$71.04 per thousand cubic meters (or \$2.18 to \$2.0 per million BTU) the project FIRR was estimated at 10.1% and 10.4% respectively. Using early 2005 range of border and end user prices, FIRR seems to be around 15%. Afghanistan hopes to earn transit fees in the range of \$100 million to \$300 million and has promised full cooperation.

⁵³ This section is drawn on the presentation made by ADB in the Second Regional Economic Conference for Afghanistan held in Delhi in November 2006 available at the website <http://meaindia.nic.in/srec/frame.php?s=internalpages/rbusiness.htm>

⁵⁴ Integrated Energy Policy Report (2006) of the Government of India envisages import dependence for natural gas from 0 to 49% during the period through FY2032, depending on the price of natural gas. At prices higher than \$4.5 per million BTU, natural gas is not believed to be competitive with coal (which remains at \$ 2.27 per million BTU even after blending with imported coals) even for peaking power.

Figure 5.2: Natural Gas Deficit Projections in Pakistan and India



Source: ADB presentation in the Delhi Conference of November 2006

Some of the key issues to be sorted out include: the robustness of the reserves data in Turkmenistan and the need to have it properly certified; possible need to associate Uzbekistan and Kazakhstan to provide supplemental gas resources; the ability and willingness of Turkmenistan to feed this pipeline while fully honoring its earlier commitments to Gazprom for the European and former Soviet Union markets; and the extent of possible private sector interest.⁵⁵ Further the sharp increases in gas prices delivered to the European markets could make the option of exporting to South Asia less attractive to Turkmenistan and thus the export price could also become a major issue. Challenges include mitigation of the security risk in Afghanistan, improvement in India-Pakistan relations, and programs to minimize or phase out fuel subsidies in both countries and finally the ability of the pipeline option to withstand competition from LNG in the long run (see Box 5.2).

⁵⁵ Bidas Corporation of Argentina, China National Petroleum Corporation, Gazprom, and OMV of Austria are believed to have shown interest in the project at different times.

Box 5.2: Gas Sector in Pakistan

Proven natural gas reserves of Pakistan as of January 2005, are reported as 26.83tcf (759.2 bcm) by the Oil and Gas journal. The website of the Ministry of Petroleum and Natural Resources, however, reports a slightly higher reserve figure of 28.51 tcf (807.4 bcm) as at the end of June 2005. More recent reports suggest a reserve level of 32.8 TCF (929.2 bcm). Production in FY 2005 amounted to 38.26 bcm. Total length of transmission pipelines was at 9,183 km and that of distribution and service lines amounted to 72,434 km as at the end of March 2006. There were a total of 4.5 million consumers with a total consumption of 32.89 bcm in FY 2005 and a consumption of 25.9 bcm in the first nine months of FY 2006. The largest share of consumption went to power (43.7%) followed by general industry (19.5%), fertilizer (16.4%), households (14.8%), commercial consumers (2.3%) and transport (2.1%). Gas losses in the system amounted to about 7% to 7.5% of the total input into the system.

Past demand growth in gas consumption was at about 8.5% a year. Future demand growth is forecast at about 7% a year. It is estimated that the domestic production will peak in FY 2010 and start declining rapidly after FY 2013. Supply shortfall is expected to be between 4% and 10% of the demand by 2010 and would thereafter increase rapidly to 20% of the demand. It is in this context that import options through pipelines from Iran, Central Asia and Qatar and LNG imports are being pursued. A LNG terminal with a capacity of 3.5 million tons will be built in Karachi by a project developer to be selected on a competitive basis. First shipments of LNG are expected by 2011. Attempts are also being made to discover new gas fields and improve yields from existing fields. An agreement has been concluded with Gazprom for research and development regarding future gas fields.

As per the tariff prevailing on January 1, 2006, the end-use gas tariffs per million BTU for the lowest block (below 100 cubic meters per month) and the highest block (above 300 cubic meters per month) of household consumption were \$1.35 and \$5.13 respectively. The tariffs for commercial consumers and general industries (including power) were at \$ 4.53 and \$ 4.03 respectively. Supply to the fertilizer industry for use as feedstock was at rates from \$0.61 to \$1.48. The tariff for the power companies at around \$3.95 does not appear to be unduly subsidized. The first block of household tariff covered 82% of the consumption in winter and 54% of the consumption in the remaining months. The tariffs for this block and for fertilizer factories were heavily subsidized and did not cover even the commodity cost of gas, let alone the transmission and distribution margins. In FY 2003 the total subsidy for these two categories amounted to Rs 23 billion (or \$397 million).

In the tariffs revised on 30 June 2006 one new block was introduced for households. The lowest block had a consumption ceiling of 50 cubic meters/month. The price for this block was increased by 5% while the prices for all other categories were increased by 10%. However in the revised tariffs notified effective from 1 February 2007, price for this category has been reduced by 7.8%. Commercial consumers had a reduction of 10%. In the context of the need for the expensive imports of piped gas and LNG further domestic price corrections would be necessary.

Sources: www.mpnr.gov.pk , www.dawn.com/2006/07/29/top16.htm , www.ogra.org.pk, Country Analysis Brief of US DOE available at www.usdoe.eia

5.1.6 Iran-Pakistan-India Natural Gas Pipeline (IPI)

The possibility of import of natural gas from the South Pars gas field of Iran to Pakistan and India by a 2,670 km long 48-inch diameter overland pipeline passing through Iran, Balochistan and Punjab provinces of Pakistan and then on to India, at a cost of around \$7 billion, had been discussed for over a decade now. It was originally intended to supply 150 million cubic meters per day (or 54.75 bcm/year) of gas to India and 60 million cubic meters/day (or 21.9 bcm/year) of gas to Pakistan for a period of 25 years. Gazprom of

Russia (with whom Pakistan has an agreement for research and development of future gas fields) has expressed its interest in investing in this project.

A Joint Working Group of the three governments was working out the details while financial, technical and legal consultants were advising each of the three governments. Pricing appeared to be a major issue in concluding the negotiations. Iran's approach seemed to adopt the same level of pricing, at which the government of India concluded a deal with the National Iranian Oil Company in January 2005, for the import of 5 million tons per year of LNG (later rising to 7.5 millions tons /year) for a period of 25 years commencing from FY 2010.⁵⁶ The buyers thought that this approach to piped gas was not happy. As of 28 November 2006, the price for piped gas had not been agreed upon and the consulting firm engaged by Iran had been requested by the buyers to come up with a revised offer.

However in January 2007, Pakistan and Iran signed a bilateral agreement in terms of which Iran will supply for a period of 30 years 2.1 bcf/day(21.7 bcm/year) of gas in the first phase and an additional 3.2 bcf/day (33.1 bcm/year) in the second phase to the Iran-Pakistan border at a price of \$4.93/mmbtu.⁵⁷ Iran has already commenced the construction of a 56 inch diameter gas pipeline from the Assaluyeh gas field (located 80 km north of the South Pars field) to Iran Shehr located within Iran 200 km west of the Pakistan border to meet the demands of its eastern provinces with a completion date of 2010. The supply to Pakistan border will be by one 56 inch diameter pipeline in the first phase. In the second phase the pipeline will be doubled.

Pakistan has proposed that it will construct a 1036 km long pipeline in its territory from its Iranian border to the Indian border (at an estimated cost of \$ 3.5 billion and a completion date of 2013) and supply Iranian gas to India as shown below:

⁵⁶ The FOB price of LNG per million BTU was stipulated in the contract as 6.5% of the average Brent crude price in dollars per barrel at the time shipping (subject to a maximum crude price of \$31 per barrel) plus a fixed charge of \$1.2 per million BTU. On this basis the maximum FOB price of LNG would be \$3.215 per million BTU. In the context of the massive increase in oil prices since then, Iranian government stated in August 2006, that the Supreme Economic Council had not approved the deal and wondered whether the contract was effective. Thus these prices are likely to be renegotiated, especially in the context of Iran having concluded a contract subsequently with China for supplying 3 million tons/year of LNG for 25 years at a price of \$5.0 per million BTU. It is understood that the Indian government has proposed the ceiling price to be adopted for Brent crude at \$55 per barrel resulting in the maximum FOB price of LNG at \$4.775 per million BTU. The Iranian side seems to be bargaining for a maximum LNG price of \$5.425 per million BTU adopting a ceiling price of \$65 per barrel for Brent crude. In addition LNG transportation cost from Iran to India, computed at \$0.30 per million BTU, has to be paid.

⁵⁷ The pricing formula is similar to that proposed for LNG export. It consists of a variable part linked to the specified crude oil price, a fixed component and a transmission charge. The variable part is 6.3% of the Japanese Crude Cocktail Price in the range of \$30 to \$70/barrel. Presently it is \$3.78/mmbtu corresponding to the crude price of \$60/barrel. The fixed charge is \$1.15/mmbtu and the transport charge to Pakistan Border is \$1.0/mmbtu. This results in the quoted price of \$ 4.93/mmbtu for Pakistan. When crude price is below the range of \$30-\$70, the fixed price will increase to \$1.54/mmbtu. When it is above the range the fixed price will be \$2.06/mmbtu. This has been found acceptable to both India and Pakistan. (see <http://timesofindia.indiatimes.com/articleshow/msid-186370> news item dated 6 April 2007)

Table 5.2: Planned Supply of Gas from Iran to India and Pakistan (mmcf/d)

Phase	Share of Pakistan	Share of India	Total from Iran
Phase 1	1.05	1.05	2.1
Phase 2	1.05	2.15	3.2
Total (both Phases)	2.1	3.2	5.4

Pakistan has proposed that India pay a transit fee and a transmission charge to Pakistan, since it will transmit the gas through its territory and will be responsible for the safety and protection of the pipeline. India appears to have made a counter proposal (see Table 5.3). These are under discussion and likely to be settled in the next few weeks.

Table 5.3: Price proposal for the supply of Iranian gas to India (\$/mmbtu)

Proposal of	Gas Price at Iran/Pak border	Pakistan Transit fee	Pakistan Transmission charge	Total landed cost at the Indian border
Pakistan's proposal	4.93	0.49	1.57	6.99
India's proposal	4.93	0.25	0.50	5.68

Source: <http://timesofindia.indiatimes.com/articleshow/msid-186370> News of April 6, 2007

The issue of price thus seems to be close to a resolution. The problem of transit through Balochistan seems to have been lessened by Pakistan assuming responsibility for transport and protection of the pipeline. The project seems to be poised for implementation on a priority basis. Other matters to be resolved would include the implications of the US law which bars transactions with Iran valued at \$20 million or more, and the UN sanctions regime, as these might discourage the participation by international contractors. To sustain this trade on a commercial basis and to expand trade on similar lines, Pakistan and India may need to improve their domestic gas price regimes and minimize subsidies (see Box 5.2 and Box 5.3 and also Chapter 6).

Box 5.3: Gas Sector in India

Indian natural gas reserves were estimated at 1101 bcm in FY 2006. With annual production of about 32.2 bcm the reserve-to-production ratio is about 34 years. In addition, LNG imports have just commenced at the rate of 2.3 million tons/year. The largest share of the total gas consumption was in the power sector (37%) followed by fertilizer (35%), transport (9%), steel (6%) and others (14%).

About 79% of the gas production in the country is by the state-owned companies Oil and Natural Gas Corporation (ONGC) and Oil India Limited (OIL). The remaining 21% is by the private investors and Joint venture companies. The reserve data does not include the significant and recent discoveries in the Krishna Godavari basin off India's eastern coast. In this basin Reliance Industries Limited (RIL) and Gujarat State Petroleum Corporation (GSPC) are believed to have reserves of 396.6 bcm and 566.57 bcm respectively. RIL would produce 29.2 bcm of gas per year. Production of GSPC would be about 25.5 bcm per year.

On the basis of GDP growth rate of 9% per year, the demand for natural gas is forecast to grow at the compounded annual growth rate (CAGR) 8.0% from 31 bcm in FY 2004 to 267 bcm in FY 2032. Gas demand for power would grow faster at 9.34% from 11 bcm to 134 bcm, while the gas demand for non-power uses would grow at 7.0% from 20 bcm to 133 bcm during the same period.

The Integrated Energy Policy Report of the Expert Committee of the Planning Commission of India (August 2006) conservatively assumes that the annual domestic gas production would increase to about 111

bcm by FY 2032. On this basis the import dependency would be about 156 bcm or about 58%. At 8% annual GDP growth rates the import dependency may fall to about 108 bcm or 49%. The recent sharp increases in the price of oil and the associated price of traded LNG, as well as piped gas from abroad may affect the gas demand growth especially in the power sector, as, at prices of \$4.5 per million BTU of gas or higher, gas is not considered competitive in relation to coal, even for peaking power as long as coal price remains at \$ 2.27 per million BTU (\$45/ton of imported coal with 6000 kcal/kg).

The gas pipeline infrastructure in India is rapidly expanding. GAIL is constructing the various links to create the national gas grid to handle the expanding domestic gas production as well the gas from the several terminals importing LNG. Reliance is constructing the pipelines to transmit gas from Krishna Godavari basin area to Mangalore in the south, Jamnagar in the west and Dadri in the north. RIL, GAIL and ONGC are forming a joint venture to set up gas distribution projects. Reliance has applied for gas distribution rights in 100 cities. Many other domestic and foreign investors too have applied for distribution rights in other cities. GSPC will carry out gas distribution and CNG distribution (for vehicles) in 40 cities and towns of Gujarat.

LNG terminals at Dahej (5 million tons/year) and Hazira (2.5 million tons/yr) are in operation. The one at Dabhol (5 million tons/yr) is expected to be in operation any time now. The terminal in Cochin (5mt/yr) will be in operation by FY2009 and that in Ennore (2.5 million tons/yr) and Phase II of Dahej during 2009-2012. By 2010 LNG re-gasification capacity would be 25 million tons/year. One half of this is already tied up through long term contracts with Qatar and Iran. Rest will be tied up by FY 2010.

ONGC of India is involved in exploration, development and production of oil and gas in at least 12 countries abroad. These countries include: Myanmar, Russia, Vietnam, Qatar, Sudan, Nigeria, Ivory Coast, Libya, Egypt, Syria, Iraq and Iran. In Myanmar GAIL of India is also involved in exploration and production of offshore gas. Equity oil and gas from these investments are expected to improve the energy security of India. In addition the supply strategy relies also on imported LNG and imported piped gas from Myanmar, Iran, Central Asia and possibly also from Bangladesh.

A substantial body of public opinion exists both in India and Pakistan that this would be a “peace pipeline” somewhat like the gas pipeline between Egypt and Turkey creating mutually beneficial economic interdependencies and thus pave the way for speedier normalization of bilateral relations.

The project was first put together by BHPBilliton, a subsidiary of BHP of Australia, and subsequently several parties such as Petronas, Total, Shell, British Gas and Chinese National Petroleum Corporation have expressed investment interest in the project at different points in time.⁵⁸

5.1.7 Qatar-Pakistan-India Submarine Gas Pipeline

Another proposal to construct a gas pipeline from the Dome gas field of Qatar to India via United Arab Emirates, and Karachi of Pakistan had also been considered for a long time. The 1,830 km long pipe line from Dome to UAE would be under the sea. It will cross UAE on land and go under the sea up to Karachi and then again go under the sea till it reaches the west coast of India. It has the advantage of avoiding the risk of possible supply disruption faced by surface pipeline passing through Balochistan, but is considered expensive in relation to the overland pipeline alternative and even in relation

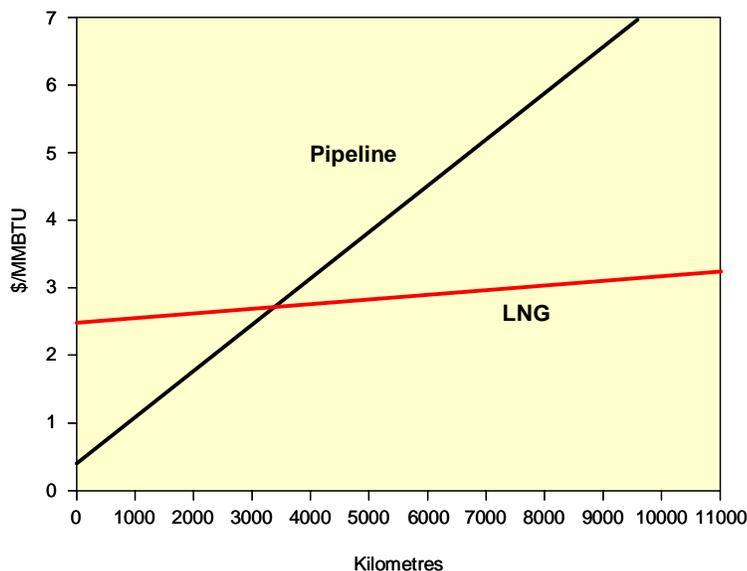
⁵⁸ This section is based on various sources including: www.indiadaily.com/editorial/3149.asp www.petroleum.nic.in, www.atimes.com/atimes/South Asia/GA11Df07.html, www.hinduonnet.com (August 12, 2005) and (August 5, 2006) www.atimes.com/atimes/South Asia/HC28Df06.html (May 28,2006) www.dawn.com/weekly/encounter/encounter3.htm, www.stratfor.com

to the LNG option. It is worth noting that India has already concluded contracts with Qatar for the supply of 7.5 million tons of LNG per year for 25 years commencing from 2003. Qatar has recently indicated that most of its gas is committed for LNG trade and could not spare the 2.6 bcf/day of gas required for the pipeline project during the next 8-10 years.

5.1.8 Summary of Prospects in the SAR Western Energy Market

The collection of the bilateral electricity trade deals and the emergence of the multilateral projects such as CASA-1000 could become the stepping stones for the eventual creation of an integrated Central Asia – South Asia Electricity Market (CASAREM), which could over time extend from the Central Asian republics and Iran to Afghanistan, Pakistan, and possibly India, linking with the large neighboring markets of Russia and China and creating a new paradigm for regional development and integration in the once divided region. The same hope holds good for the emergence of a similar gas market also, especially when the distance between Iran or Central Asia and India is less than 3500 km up to which gas through pipeline is competitive with LNG imports and re-gasification (see Figure 5.3)⁵⁹

Figure 5.3: Gas Transport Economics (Piped Gas Vs LNG)



A summary of the prospects for energy trade as perceived at present in the Western Energy Market is given below in Table 5.4

⁵⁹ Options for Gas Supply for Sri Lanka- Presentation by Nexus (June 2003) available at www.sari-energy.org/resourcereports.asp?cat=2

Table 5.4: Summary of the prospects for trade in the Western Energy Market

Importing countries	Exporting Countries					
	CARs	Turkmenistan	Iran	Afghanistan	Pakistan	India
CARs	x	Some gas exports are possible; mutual electricity support	Unlikely (uncompetitive)	No scope	Limited (some emergency support possible)	No scope
Turkmenistan	Mutual electricity support	x	Unlikely (similarity of resources – gas; little scope in electricity)	No scope	No scope	No Scope
Iran	Limited power exports possible	Power exports are ongoing	x	No scope	No scope	No Scope
Afghanistan	Power exports are ongoing and should grow	Power exports are ongoing and should grow	Power export ongoing and may grow	x	Small cross-border power export possible	No scope
Pakistan	Potential for power exports	Significant potential for gas exports	Significant potential for gas export; cross-border electricity trade could grow	No scope for trade; Transit of electricity and gas	x	Mutual short-term trading support in power
India	Gas and power exports possible	Significant potential for gas exports	Significant potential for gas exports	No scope; Transit of gas	Mutual short-term trading support in power; transit of gas	x

Note: CARs in this table denotes Tajikistan, Uzbekistan, Kyrgyz Republic and Kazakhstan only.

Red Color denotes that trade prospects are significant and are either being exploited or can be brought to fruition in the short-to-medium term. **Green Color** denotes that prospects of the trade are good and may materialize in the medium term. **Yellow Color** denotes that prospects for the trade are more limited and may materialize in the medium-to-long term, and **Grey Color** denotes that the prospects for the trade are weak.

5.2 The Eastern Energy Market

In the potential Eastern Energy Market Bhutan, Nepal and Myanmar have significant undeveloped hydropower potential and are likely to emerge as major exporters of hydroelectricity mainly to India and possibly to Bangladesh (to a small extent). Major gas resources of Myanmar and Bangladesh could enable them to export natural gas mainly to India and to a much smaller extent to the border areas of Bhutan and Nepal.

The Indian power market is large and the demand growth is constantly outpacing supply growth. In FY 2007 India faced a capacity deficit of 13,727 MW (or 11.9%) and an energy shortage of 54,916 GWh (or 7.6%). Within India only the Eastern region had an energy surplus of 8,500 GWh (or 12.2%) and all other regions had shortages of capacity

and energy. Internal trade induced by the ABT and UI rate regime discussed in the earlier chapter in the national grid amounted to about 15,000 GWh or 3% of the total volume handled in the national grid. The deficit is expected to widen in the foreseeable future. The average traded price ranged from Rs 5.5 (12.5 cents/kWh) (off-peak) to Rs 5.75 (13.7 cents/kWh) (peak) in the third quarter of 2006. Bids under ICB for large power stations based on indigenous coal from captive mines indicate a levelized price of Rs 1.196/kWh (2.99 cents/kWh) and such bids for plants based on imported coal show levelized price of Rs.2.29/kWh (5.72 cents/kWh). Gas based power with gas prices of \$7/mmbtu is expected to cost Rs 3.7.kWh (9.25 cents/kWh). Prices from large hydro projects constructed or under construction range from 3.5 to 6 cents/kWh. While domestic coal will continue to play an important role in India, it will not be possible to meet the entire demand for power in the country by domestic coal alone because of the difficulties relating to the expansion of coal mining and transport bottlenecks. The need for imported fuels (coal, LNG and piped gas) and imported electricity will remain significant. Thus India is an attractive power market from the point of view of volume and power prices.

5.2.1 Bhutan-India Bilateral Electricity Trade

Bhutan-India bilateral trade had been going on for several decades and is the largest in the region in terms of volume. Bhutan exports more than 75% of its generated electricity to India. Power export receipts constitute 45% of the Bhutan Government revenue and 12% of Bhutan's GDP. When all the six units of Tala Hydropower project are commissioned by the end of 2006, the export receipts would provide 60% of the government revenues. India had provided 60% grant and 40% loan for the capital costs of Chukka (336 MW), Kurichu (60 MW) and Tala (1,020 MW) hydropower projects during 1974-2006 and has been purchasing all the surplus power at prices negotiated between the parties (currently 4.07 cents/kWh for Kurichu and 4.65 cents per kWh for Chukka). The price for Tala power is still being negotiated.⁶⁰

Out of the total hydropower potential of Bhutan, 23,760 MW is considered techno-economically feasible. Of those about 1,490 MW had been developed. India has signed an umbrella agreement with Bhutan under which the former provides project investigation, design and engineering services as well as construction supervision services for hydropower projects, apart from providing highly concessional finance. In return it would be entitled to import all the surplus power, after meeting the needs of Bhutan. Under the umbrella agreement, the Indian authorities have prepared detailed project reports for four major projects: Punatsangchu I (1095 MW), Wangchu (900 MW), Bunakha (180 MW), Sankosh Multipurpose project (4,060 MW). Detailed Project Reports are under preparation for two more projects: Punatsangchu II (1000 MW) and Mangdechu (360/600 MW). Pre-feasibility Report has been prepared for one multipurpose project, Manas (2,800 MW)⁶¹

⁶⁰ A price of Rs 1.8/kWh (or 4.5 cents) is reported to have been agreed for FY 2007 only (see *Power in Asia*, Issue # 459 August 17, 2006).

⁶¹ Inter-Country Cooperation in Development of Hydropower, a presentation by the Central Electricity Authority of India in the BIMSTEC Workshop on Sharing Experience in Developing Hydropower Projects in New Delhi, held during 30-31 October 2006 available at www.powermin.nic.in

Bhutan government has updated in 2004 its Power System Master Plan (2003-2023) with technical assistance from Norway. This examined 76 sites in all 3 river basins with a total capacity of 23,760 MW and prioritized six projects with a total capacity of 4,484 MW and total energy output of 21,085 GWh at an average capital cost of \$835/kW for construction through 2024. Using a discount rate of 12% the average economic unit cost of generation was computed as 2.87 cents/kWh in 2002 prices.⁶² Overall generation investment needs work out to \$200 million a year to add 244 MW a year during the period 2007-2024. All are run-of-river projects with little adverse environmental consequence, but about 70% to 76% of the annual power output would be seasonal.

Bhutan power is delivered in the eastern region of India which will not be able to absorb it both from the price point of view and from the point of view of system needs. Thus simultaneous with the commissioning of Tala project the transfer capacity from the eastern region to northern region is being raised (see Chapter 2). Recent studies (assuming that the sale price of Tala power at the generation station would be the same as in the case of Chukka, 4.65 cents/kWh) indicate that the cost of Tala power when transmitted to Delhi will be comparable to the price of power from coal fired units in the northern region, but will be lower than the LNG based thermal power there. The northern region has severe shortages of both capacity and energy in all seasons and would be able to absorb Tala power despite its seasonality of supply and its price.

The rapid expansion of the inter-regional transfer capacity in India (see Chapter 2), the development of real time balancing using availability based tariffs and UI charges in the national grid should greatly improve the chances of the Bhutan power being absorbed in any part of the national grid, whose requirement matches the supply pattern from Bhutan.

Given the cost and the seasonal output structure of the Bhutan hydro projects, a recent study concludes that large hydropower projects such as Tala would not be attractive to the private sector and that therefore they are best pursued as before based on bilateral cooperation with India or as joint ventures with Indian public sector entities. Medium hydropower projects (25 MW to 300 MW) could be pursued on the basis of public private partnership basis with the involvement of IFIs and that small hydropower projects (below 25 MW) could be pursued with bilateral and multilateral donors.⁶³ However, in the context of the gradual liberalization of the Indian power sector with third party access to the national and regional grid and with the availability of a number of licensed power trading companies, it should be possible for some of large entrepreneurs in India to be interested in the generation investments in Bhutan.

A significant problem which would adversely impact on the growth of electricity exports from Bhutan is the very high level of subsidy provided to the domestic consumers and the incentive schemes it operates for attracting power intensive industries. Such distorted price signals would lead to serious misallocation of resources and cut into the surplus

⁶² These economic calculations are based on preliminary desk studies averaged over a range of project sizes. Financial analysis of the completed Tala Hydropower project (assuming an export price of 4.5 cents/kWh) seems to show financial internal rates of returns of 7% to 8% which would not be attractive to private investors.

⁶³ Parts of this section are drawn from the Pricewaterhouse Coopers' recent draft report, *Bhutan Hydropower Sector Study: Opportunities and Strategic Options* (June 2006).

available for export. Development of power projects exclusively for export should be considered to mitigate this risk. In the medium to long term the level of subsidy should be phased out substantially.

5.2.2 Nepal-India Bilateral Electricity Trade

Although discussions about the Nepal-India electricity trade have been going on for over five decades, and many of the major Nepal hydropower sites and related project proposals have been studied by wide range of consultants over that period, electricity trade/exchange between the two countries remains insignificant, with Nepal being the net importer (see Chapter 2). Nepal's hydroelectric potential is estimated at 83,000 MW, of which 43,000 MW is considered techno-economically feasible. Only 627 MW have actually been developed. Bilateral assistance from India helped in the construction and financing of Pokhra (1MW), Trisuli (21 MW), Western Gandaki (15 MW) and Devi Ghat (14.1 MW) during 1968-1983, mainly for meeting local demand. Other major projects under discussion between the two governments at various levels include: Karnali-Chisapani Multipurpose Storage Hydropower Project (10,800 MW), Sapta Kosi High Dam Multipurpose Project (3,300 MW) along with Sun Kosi Storage/Diversion Project, Pancheshwar Multipurpose project (5,600 MW), Burhi Gandaki (600 MW), Upper Karnali (300 MW).

Nepal's peak demand is forecast to grow from 580 MW in FY 2005 at the rate of 7.6% per year to 1,750 MW by FY 2020. During the same period the energy needs are forecast to grow from about 2.8 TWh to 8 TWh. This calls for an addition of 220 MW by 2010 and another 1000 MW by 2020 raising the total capacity in the country to about 1900 MW. Demand growth of this size would not be able to accommodate large sized cost effective hydropower stations unless the domestic demand is supplemented by substantial export demand. Construction of medium and small sized hydropower stations with a high cost per KW installed has resulted in the provision of a very high-cost-power supply system in Nepal. It is also a system with very little thermal power capacity (less than 8.5%). It is thus in the economic interests of Nepal to promote the construction of relatively large sized cost effective hydropower projects in Nepal mainly meant for export to India and import from India thermal power to meet its dry season power needs. Given the relative sizes of the north Indian power system and that of Nepal this should not present any major problem, despite the capacity and energy deficits in the Indian system.

Unfortunately the transmission capacity of the existing 132 kV and 33 kV lines between the two countries limit the exchanges to about a third of the agreed level of 150 MW. The IPPs of Nepal complain that on account of this they are forced to spill water. There is thus an urgent need to increase the transfer capacity to the Indian northern and eastern regional grids. Proposals to construct four 220 kV single or double circuit links: Butwal-Ghorakpur, Dhalkebar-Muzafferpur, Duhabi-Purnima, and Anarmani-Siliguri, need to be

pursued on both sides.⁶⁴ The distances involved are all small and cost levels should present no major problems. Even more importantly the Nepalese parliament needs to ratify the Power Trade Agreement between the two countries. The recent formation of a Joint Technical Committee consisting of the Power Trading Corporation of India, NEA and the Nepal Government for preparing the term sheets and for scheduling the exchanges should greatly help Nepal in marketing its power and receiving its imports without having to deal with the various electricity boards of India.

Recent restoration of democracy in Nepal, ending of the armed conflicts and domestic turbulence, the agreement of “maoists” to work as a part of the parliamentary democracy, and the announcement by the “maoist” leader that his party welcomes foreign investment in power facilities has created a political climate conducive to attract investors. The liberalization of the Indian power sector at the level of the national and regional grids and the emergence of major private sector investors and traders in the power sector has created fresh opportunities for power export projects in Nepal. The serious power cuts which Nepal faced in the last one year and the more liberal approach of the new government appear to have resulted in a strategy of attracting Indian private sector for investing in Nepal hydropower projects.

In the “Power Summit” organized by the Independent Power Producers of Nepal (IPPAN) and PTC of India in September 2006, a wide range of Indian private sector companies and investors participated and expressed serious interest in pursuing the opportunities. Subsequently in November 2006 US Embassy in Nepal, USAID, Nepal US Chamber of Commerce and American Chamber of Commerce in India organized a seminar “Powering Nepal- Connecting Markets” attended by leading prospective investors, businessmen and officials. A great deal of enthusiasm was displayed by the investing community to develop power export projects.

The government has prioritized three project sites for private sector investment, namely, Upper Karnali (300 MW), Burhi Gandaki (600 MW) and Arun III (402 MW) and has issued a request for proposals for them from the prospective investors recently with a closing date in the last week of December 2006. Bids are expected or have already been received from several reputed Indian firms (Reliance, GMR Group, Jaypee, Larson & Toubro, Avantika, KSK Energy Ventures and NHPC) one investor from Singapore (SN power) and one from Turkey (Nepal Energy) either by themselves or in the form of consortia.

Overall, the Nepal’s strategy seems to be (a) to focus on run-of-the-river projects (with a daily peaking pond), (b) implement the projects on the basis of public private partnerships, (c) gain experience in the new realities of the Indian power market and, (d) based on such experience and familiarity, scale up the project sizes and operations.⁶⁵

⁶⁴ USAID financed consultants International Resource Group have analyzed these options and consider the first two lines to be a priority. They will have transfer capacities up to 800 MW and would cost about \$55.6 million and \$52.4 million respectively.

⁶⁵ This section draws from the information found at websites of IPPAN namely www.ippan.org and of the Department of Electricity Development www.nepal-doed.org on the two conferences. Also useful were: www.siliconindia.com/shownews/34218

It is also worth noting that Snowy Mountain Engineering Corporation of Australia received a license way back in 1994 to develop West Seti storage hydropower project (750 MW; 3,300 GWh). Ten percent of its output was to be provided to NEA free of cost (as royalty) and the remaining 90% was destined for export to India. The cost was estimated in 1997 at \$1,098 million. Power Sales Agreement was reported to have been executed with PTC of India in 2003 at a price of 4.95 cents/kWh. The project will include a double circuit 400 kV transmission line from the project site to Bareilly in India (190 km). The license was renewed annually and it was announced in May 2005 that SMEC has secured financing from Chinese Export-Import Bank and Asian Development Bank and that construction would commence in September 2005. However the ADB loan to enable the government to hold equity in the company is expected for approval in the course of 2007 and financial closure is expected soon thereafter with equity participation from investors of Australia, China, Nepal and India and debt mainly from China. A Chinese company had already been awarded the EPC contract for the project.

Hydropower projects in Nepal tend to be expensive because of the geological and seismic problems of the Himalayan region, remote and inaccessible terrain, unfavorable hydrology, and unusually high sediment loads. Power from such projects (especially from the run-of-projects) is not necessarily very competitive in the Indian market. Careful and intelligent marketing is necessary to find the niche in the Indian grid which could absorb it. It may not be marketable in Bhutan and Bangladesh at all. Projects therefore have to be selected to have a large size and economy of scale, resulting in competitive prices. West Seti project represents one such case.

5.2.3 Myanmar-India Bilateral Electricity Trade

Myanmar has a total hydropower potential of 39,720 MW of which 747 MW (2%) had been developed. Another 10,398 MW is reported to be under various stages of preparation or construction. By FY 2009, nine projects with a total capacity of about 916 MW are expected to be commissioned. Another four projects with a total capacity of 1,172 MW are expected for completion by Fy 2010. The rest would be commissioned by FY 2021. Most of this capacity is being developed as joint venture projects with EGAT and MDX Group of Thailand, and YMEC of China for export to Thailand. Indian government organizations have cooperated in the Sedawyagi and Yeywa Hydropower projects. The Central Electricity Authority of India prepared in 2005 the pre-feasibility study for the Myanmar government for developing the Tamanti multipurpose project with a hydropower component of 1,200 MW in the first stage. It is located in the northern portions of Myanmar, fairly close to the Indian border and will have substantial irrigation, navigation and flood control benefits for Myanmar. Power is mainly for export to India. The second and third stages of the project will have a 400 MW and 700 MW power stations down stream. A transmission line has to be constructed to the Indian border as a part of the project. The power will be fed into the NE region of India which is synchronized with eastern and northern regions. Given Myanmar's approach favoring

Joint Venture mechanisms for power development mainly destined for export it is likely that this cooperation will materialize and Myanmar-India electricity trade will commence with the commissioning of this project around 2014. BIMSTEC related initiatives would help in this regard.

5.2.4 Bangladesh-India Bilateral Electricity Trade

Bangladesh has been experiencing an annual power demand growth of about 9% during the last decade and is expected to have a similar growth rate (8% to 9%) through FY 2020. Financial resource constraints (arising mostly from poor operational efficiency) slow down the pace of capacity additions in generation, transmission and distribution, resulting in a perpetual shortage situation.

Import of power from the Eastern and North Eastern regional grids of India had often been considered an option to meet the shortages in Bangladesh and bilateral discussions between the two countries during the last 15 years focused on interconnections from Jessore, Rangpur, and Sylhet, but did not result in any action. In March 1999 Power Grid Corporation of India made a feasibility study for enabling an exchange of power between India and Bangladesh of the order of 150 MW proposing transmission links between Farakka (India) and Ishurdi (Bangladesh) and Kurnarghat (India) and Shahjibazar (Bangladesh).

Subsequently the focus shifted somewhat towards the possibility of exporting gas based power to India, while augmenting supplies in Bangladesh. A pre-feasibility study prepared for the government of Bangladesh under the USAID SARI-E program in 2000 demonstrated that a gas fired combined cycle power plant of 500MW to 1000MW capacity located at Bheramara or Sirajganj and exporting a minimum of 400 MW to the eastern grid of India would be competitive in the Indian power market with a delivered power cost of about 4.4 to 4.7 cents/kWh and supporting a well head price of gas of \$1.5 to \$1.85 per million BTU. Similar power plants located at Sylhet or Fenchuganj exporting power to the northeastern grid of India would also be economic and competitive.

Since then several proposals have been made to the government for similar power plants in Bangladesh which will be primarily for export to India and partly for meeting local demand. In 2000, NTPC of India proposed to build a 1000 MW thermal power plant at Bheramara. The most recent and spectacular example is the proposal of the Tata Group of India (see section 4.4 for details). However the Bangladesh authorities have not been able to respond positively to any of these proposals. Natural gas is the only energy resource (apart from the recently developed coal resources) available to meet domestic energy demands and the government did not want to make any export commitment till it is sure of the true size of the recoverable reserves of gas in the country. Discovery of significant coal resources and its recent development for a coal fired power plant might have a (favorable) bearing on such decisions.

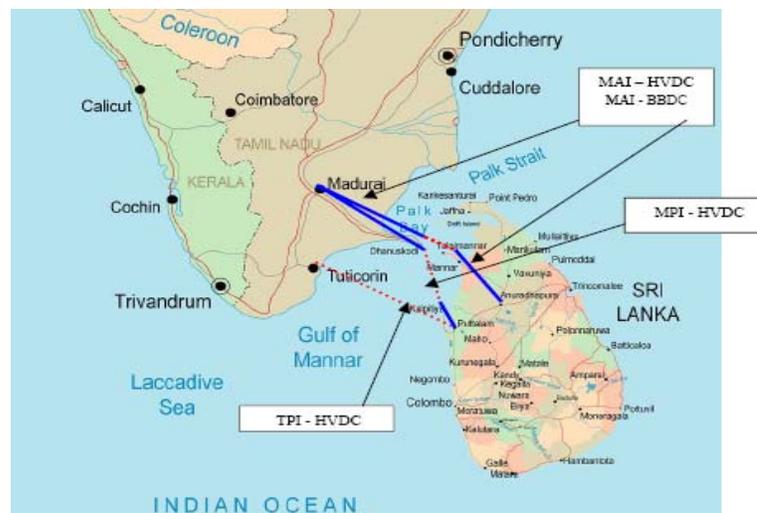
Increasing the use of coal for power generation, and importing hydropower from Nepal and Bhutan, might release gas or gas fired power for export. Electrical interconnections and trading agreements are, however, essential prerequisites for exploiting such opportunities.

5.2.5 India-Sri Lanka Bilateral Electricity Trade

Sri Lanka has already exploited most of the economic hydropower potential and has to depend on imported fuels to create additional thermal power capacity and move the hydroelectric generation to meet the peak demand. Given the relatively short distance between the south-east tip of India and the northern tip of Sri Lanka (about 30 km) one option would be to build a sub-marine cable to interconnect the CEB power system and the southern regional grid of India, which will be fully synchronized with the other four regional grids of India by FY2012. Once this is done, CEB could use the imported power from India for base load and the domestic hydropower for meeting the peak demand. It may even be able to sell some peak power to India at a good price. SARI-E program of USAID carried out a pre-feasibility study in 2002 covering four alternative technically feasible HVDC interconnection options and demonstrated that benefits would accrue to both sides in terms of least cost dispatch, peak displacement and reliability.

Madurai-Anuradhapura 400 kV HVDC bipolar interconnection at a capital cost of \$133 million appeared to be the best solution. This transmission link would consist of 200 km of overhead line in India and 150 km of overhead line in Sri Lanka and a 30 km under sea cable to connect them both. It will have a transfer capacity of 1000 MW with indicative levelized transmission charges of 0.6 to 0.9 cents/kWh at loads above 500 MW and a plant load factor of 85%. The delivered cost of power in Sri Lanka could be about 6.5 to 8.0 cents/kWh compared to its marginal cost at 7 to 9 cents/kWh.

Figure 5.4: Proposed India-Sri Lanka HVDC Interconnection



Source: USAID SARI-E Program Study carried out by Nexant (February 2002)

This proposal seems to be making some progress. The Power Grid Corporation of India has made a fresh feasibility study for a HVDC link between Madurai and Anuradhapura. A specially appointed task force with representation from Ministry of Power, CEA and Power Grid Corporation of India and their counterparts from Sri Lanka will review the feasibility report and advise the Steering Committee of the two Secretaries of Power from Indian and Sri Lanka, which hopes to have the agreement between the two countries

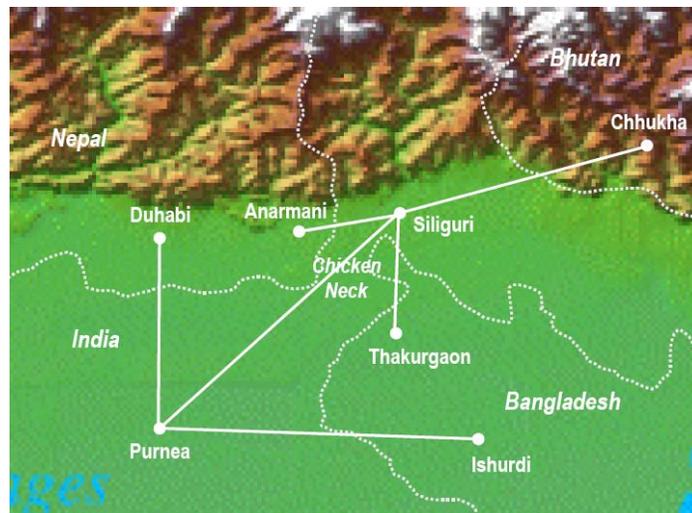
signed by early 2007.⁶⁶ For a small system like that of Sri Lanka this may be a better option than the import of LNG.⁶⁷

5.2.6 Bangladesh, Bhutan, Nepal and India Multilateral Electricity Trade

Bangladesh had been desirous of being able to import hydropower from Bhutan and Nepal. Bhutan had been desirous of diversifying its markets. Nepal had been desirous of being able access hydro power from Bhutan and gas-based thermal power from Bangladesh. India is already interconnected to Bhutan and Nepal. The geographic location and the country aspirations as well as energy resource distribution (hydropower in Nepal and Bhutan, Gas in Bangladesh, and coal in India) are conducive to establish a power exchange among all four countries in some form of multilateral electricity trade. The borders of Nepal, Bhutan and Bangladesh converge near Siliguri of the state of Assam in India and the distances involved are very short.

The SARI-E program of USAID carried out a study “Four Borders Project: Reliability Improvement and Power Transfer in South Asia (November 2001) which suggested connecting Siliguri (India) to Anarmani (Nepal) and Thakurgaon (Bangladesh) initially by 132 kV lines capable of being upgraded to 220 kV as the volume of interchange increases. It also suggested the alternative of connecting Purnea (India) to Duhabi (Nepal)⁶⁸ and Ishurdi (Bangladesh). Connections from Chhukha (Bhutan) to Siliguri and then on to Purnea already exist (see Figure 5.5).

Figure 5.5: Suggested Interconnections among India, Nepal, Bhutan, and Bangladesh



System studies confirmed the technical feasibility of the option, which was considered better than the option of constructing 220 kV lines from the beginning or having 132 kV

⁶⁶ http://www.hindustantimes.com/news/181_1860601.0008.htm news item dated December 6, 2008.

⁶⁷ NTPC of India and the government of Sri Lanka have signed an agreement in December 2006 for the construction of a 500 MW coal fired thermal power project in Sri Lanka by a Joint venture company to be formed by NTPC and CEB. An agreement for another 300 MW coal fired power station is believed to have been made with a Chinese company also. The impact of these (on the justification for the India-Sri Lanka power interconnection) needs to be assessed.

⁶⁸ Duhabi-Purnea 220 kV line is also required to enable higher volumes of exchange between Nepal and India (see section 5.2.2)

lines all the time. It could support power transfer capacities in the range of 50 MW to 500 MW and capital costs would range from \$9.0 million to \$52.0 million. Cost of transmission could fall to 0.2 cents/kWh when interchanges amount to 500 MW. The project is expected to have acceptable rates of return, easy to implement in a five year time frame and had no major environmental issues.

Possible problems of synchronous operation of the four systems have to be identified and resolved. The ABT and UI interchange pricing in the Indian regional grid should help in facilitating such exchanges, especially when power trading companies handle the business. It will be useful to follow up with detailed studies and discussion among the three utilities and the Power Grid Corporation of India. Given the modest cost and the modest scope, this may be a good beginning for the multilateral electricity trade in South Asia.

5.2.7 Myanmar-India Natural Gas Trade

Myanmar has estimated natural gas reserves of 89.722 tcf, of which 18.012 tcf are considered proven recoverable reserves. It has three main large off-shore and 19 on shore oil and gas fields. In the first 11 months of FY 2006 natural gas production and exports amounted to 10.53 bcm and 8.06 bcm respectively. Gas related export receipts amounted to \$942 million. Investors from Australia, Britain, Canada, China, Indonesia, India, South Korea, Malaysia and Thailand are engaged in the oil and gas sector of Myanmar. Sun Group of India and Itera of Russia have signed recently a production sharing contract with Myanmar Oil and Gas enterprise for exploring off-shore Block M-8. ONGC and GAIL of India have a 30% stake in the partnership with Daewoo of South Korea(60%) and South Korean Gas Corporation (10%) in the off-shore gas exploration of Blocks A-1 and A-3 off the western Rakhine coast. These blocks hold a recoverable reserve of 5.7 to 10 tcf of gas. GAIL(30%) in partnership with Silver Wave (70%) signed a deal with Myanmar to drill in the A-7 block.⁶⁹

To transport this gas to the state of West Bengal in India, negotiations were held with Bangladesh government to provide transit facilities. In January 2005, Bangladesh agreed to allow the 559 mile pipeline to pass through its territory. Bangladesh Gas Transmission Company will have the responsibility to manage the 180 mile pipeline in its territory and would receive an annual transit fee of \$ 125 million. Such acceptance by the Bangladesh government, however, was subject to several conditions such as: grant of several trade concessions including removal of tariff, non-tariff and administrative barriers to Bangladesh exports to India, provision of access to hydroelectricity from Nepal and Bhutan and an establishment of the free trade corridor to these countries. As Bangladesh continued to press for these wide ranging trade concessions, Myanmar and Indian companies have begun considering alternative options such as (a) overland route to India bypassing Bangladesh⁷⁰ (b) under sea pipeline to India, and (c) LNG shipments. As

⁶⁹ See news item dated December 14,2006 at www.business-standard.com/general/printpage.php?autono=267844

⁷⁰ In June 2006 GAIL completed a feasibility study for a 1,573 km pipeline which will bypass Bangladesh and passing through North eastern territories and Assam of India terminate in Gaya of Bihar state. Its initial capacity would be 18 million cubic meters per day which can be increased to 28 million cubic meters per day by the installation of additional compressors. The capital cost is estimated at \$3.0 billion.

negotiations with Bangladesh government continue the prospects for a pipeline through Bangladesh appear uncertain.

Meanwhile GAIL of India has finalized a feasibility study for a 1,573 km long overland pipeline bypassing Bangladesh, from Myanmar to Gaya in India through Mizoram, Assam and West Bengal with an initial capacity of 18 million cubic meters /day. This could be increased to 28 million cubic meters /day by adding more compressors. The project was expected to cost about \$3.0 billion.

If Bangladesh and India could find their way to have the much shorter pipeline passing through Bangladesh approved, it could possibly pave the way for the multilateral gas trade among the eastern nations of the South Asia.

However latest news reports from India indicate that the Myanmar government is reviewing the possibility of exporting this gas as LNG or of selling it as piped gas to China. A decision in this regard is likely after the independent audit of the reserves of the A-3 block.⁷¹

5.2.8 Bangladesh-India Bilateral Gas Trade

Bangladesh has substantial gas reserves. However estimates of reserve from different sources vary. Oil and Gas Journal indicated a proved reserve level of 10.6 tcf as of January 2005, but has revised it downwards to 5 tcf as of January 2006. The reasons for this are not clear. In mid 2004 Petrobangla estimated the proved reserves at 15.3 tcf In the same year the Ministry of Finance estimated a total reserve of 28.4 tcf of which 20.5 tcf were considered recoverable. In June 2001, US Geological Survey estimated that Bangladesh contained 32.1 tcf of additional undiscovered reserves. At the present levels of production this should last for over 100 years.

A recent report *Gas Strategy for Bangladesh* (January 2006) prepared for Petrobangla by Wood Mackenzie Ltd assumes a proved level of 9.2 tcf, proven plus probable reserve of 14.4 tcf, and a proven plus probable plus possible reserve of 22.2 tcf. This appears to be the most conservative estimate. The government has been reluctant to make any commitment for the export of gas or gas based electricity on account of the uncertainty of its reserves position and the fear that the country may run out of its only major energy resource sooner than expected. It is claimed that if coal mining and coal based power development takes root, and if the country has access to the hydropower of Nepal, Bhutan and Myanmar, it might adopt a little more liberal approach to gas exports or the exports of gas based power or fertilizers and steel products made using gas as fuel.

5.2.9 Summary of the Prospects in the SAR Eastern Energy Market

A summary of the prospects for energy trade as perceived at present in the Eastern Energy Market is given below in Table 5.5.

⁷¹ See <http://www.hinduonnet.com/thehindu/thscrip/print.pl?file=2007032203941500.htm&date=2007>
<http://www.saag.org/%5Cpapers23%5Cpaper2210.html>
<http://www.zeenews.com/articles.asp?rep=2&aid=361252&ssid=51&sid=BUS>

Table 5.5: Summary of the Prospects for Trade in the Eastern Energy Market

Importing Countries	Exporting Countries					
	India	Bhutan	Nepal	Bangladesh	Sri Lanka	Myanmar
India	x	Significant quantities of hydropower (H)	Significant hydropower export possible	Significant amounts of gas or power possible. Some resource uncertainty	Some peak power support possible	Significant gas and power supply possible
Bhutan	Dry Season Support	x	Unlikely. Similarity of resources and seasonal shortages	Small amounts of thermal power and gas; connection via India (L)	No scope	Unlikely (far off; too small market)
Nepal	Thermal power support. Dry season support	Unlikely. Similarity of resources and seasonal shortages	X	Small amounts of thermal power and gas; Connection via India (L)	No scope	Unlikely
Bangladesh	Sharing reserves; Electricity swaps	Some hydropower. Connection via India (L)	Some hydropower. Connection via India (L)	x	No scope	Unlikely (although some potential in hydropower)
Sri Lanka	Dry season and thermal power support	Unlikely (far off)	Unlikely (far off)	Unlikely (far off)	x	Unlikely (far off)
Myanmar	No scope	Uncompetitive	Uncompetitive	Uncompetitive	No scope	x

For notes on color coding see Table 5.4

Chapter 6

GOVERNMENT ACTIONS AND INITIATIVES FOR PROMOTING ENERGY TRADE

In the previous chapter, the various potential opportunities for trade in electricity and natural gas both in the eastern and western energy markets were outlined. Studies and preparation for most of the related projects have either already been completed or are under way at different stages. Based on the status of preparation, it would appear that the regional trade projects for priority consideration and action would include: (1) Central Asia-South Asia 1000 MW electricity trade project; (2) West Seti Hydropower project in Nepal; (3) Iran-Pakistan-India gas pipeline project (4) strengthening transmission interconnections between Nepal and India (the 220 kV transmission line projects)⁷²; and (5) the “four-borders” project to link the power systems of Bangladesh, Bhutan, India and Nepal. Further analytical work may help to identify specific priority projects on the basis of quantification of economic and environmental benefits (see Appendix 4 for some initial impressions of possible benefits).

Regional trade in electricity and gas should be an important element of a solution to address the mismatch between demand growth and energy resource endowments in South Asia and its neighbors. The trade deals and cross-border projects could be arranged even under the present circumstances and under different levels of development or sophistication of the sector policies, structure, commercial conditions and regulatory arrangements. Trade is essentially a function of the opportunities of arbitrage when lower cost surplus energy is available in one country for sale to another with significant supply deficits and with higher marginal economic costs of alternative supply. Poor commercial performance of the buying entities in the importing country could be mitigated, e.g., through sovereign guarantees, as is being done in the cases of IPPs. Lack of financial and technical resources in the export country can be handled through partnerships with international private sector and measures to attract such investors. Absence of or imperfections in regulatory arrangements could be managed through appropriate contractual instruments (“regulation by contract”). Similarly, other risks can be handled through project-specific arrangements, rather than wait for development of a general trading framework.

Trade commenced with a single bilateral contract or agreement could in course of time evolve into an increasingly integrated regional market through a series of bilateral and multilateral contracts, based on the experience and confidence level gained under each of the transactions, and as the sector reforms advance and capacity for sustainable trade grows. Such “bottom-up” approach, starting from individual bilateral (or multilateral) projects would allow for better risk mitigation through learning and experience and lead to a more integrated, increasingly commercial regional market, to the benefits of all participants. The governments therefore should focus early on the factors which encourage the emergence of the simpler forms of trade (such as bilateral trade), and later, on the factors which would help to sustain and expand such trade and to enable its evolution into multilateral, market oriented and more complex forms of competitive trade.

⁷² The first line will connect Butwal (Nepal) and Ghorakpur (India) and the second will connect Dhalkebar (Nepal) to Muzafferpur (India).

6.1 Facilitate Emergence of Trade

While the energy projects listed in the previous section, and possibly some others, could be implemented under the present circumstances, to facilitate a more vigorous pursuit of regional trade opportunities, the governments may have to focus in the near term on a number of measures, as described below. These measures would signal to the investors the clear political commitments of the governments and would contribute significantly to the mitigation of key risks for investors in such trade projects.

6.1.1 Energy Trade to be perceived as Enhancing Energy Security

National energy policies should analyze and demonstrate how cross border energy trade would actually enhance energy security, by diversifying the forms of energy (fuels) and the sources of supply, apart from augmenting supplies *in the time frames needed* and in a least cost and environmentally sound manner.

The Integrated Energy Policy Report of the Expert Committee of the Planning Commission of India published in August 2006 after a detailed public review process, for example, advocates clearly (a) import of coal not only whenever there are shortfalls domestic supply, but also whenever imports are cost effective; (b) imports of LNG from different sources (c) reduction of supply risks by policy coordination among importing and exporting countries by importing gas through pipelines or getting hydropower from neighboring countries. It views gas pipelines as providing greater security of supply, as the supplying country which usually builds the pipeline has vital stakes in maintaining the supply, as pipelines, unlike the LNG tankers, can not be diverted to other consumers. To find alternate buyers along the route would be normally difficult.

Pakistan's energy documents, likewise, clearly consider electricity imports from Central Asia as an important, cost effective, and timely component of its supply options to meet forecast demand. They also seem to advocate import of piped gas from Central Asia, Iran, and Qatar, as well as LNG imports to meet anticipated decline in domestic production of gas.

Bangladesh on the other hand is somewhat ambivalent about its gas or electricity export ambitions.

Nepal and Bhutan policy documents prominently consider hydropower export as an important source of income for their economies and a major driver of their economic growth, though the former is trying to operationalize the concept for long without much success.

Sri Lanka has looked upon electricity interconnection to the Indian grid as enhancing its energy security, though as a relatively last stage option. Afghanistan has clearly recognized electricity import as a key strategy for consolidating its war damaged economy.

Myanmar has been pursuing the policy of building hydropower projects for electricity export to Thailand and export of gas to Thailand for several years now. It is also looking at export of hydropower and gas to India

The governments may yet need to publicize widely their policy choice and its rationale within their countries and build a base of popular support for the trade policy and the

sector reforms such a policy choice implies. The evolution of such a political consensus within the country and a political commitment to trade greatly helps to conclude successful trade deals. This seems to be rather important in Nepal and Bangladesh.

6.1.2 Encourage the Private Sector to Play a Greater Role in Cross-Border Investments and Trade

The countries with export potential (such as Nepal, Bhutan, Tajikistan, Kyrgyzstan and Myanmar) do not have the public financial resources to make the capital investments in the export projects and may have to rely on foreign investors for the construction and operation of the export facilities. Since the countries themselves do not have much access to the world capital markets and do not enjoy investment grade credit rating, they may need special assistance from the IFIs by way of guarantees and other mechanisms of credit enhancement to access the capital markets. Especially in respect of hydropower projects and dedicated export transmission lines a public-private-partnership type approach may work best. It would be advantageous for any government to select such private partners on the basis of open competitive bidding based on criteria such as their ability to provide investment funds, managerial know-how, successful experience in similar transactions, and credibility of the proposals in terms of construction, operation, export marketing and export prices. It may also be advantageous to associate IFIs in identifying and formulating projects and preparing the bid documents for the issue of RFPs and the evaluation of the received proposals, as environmental aspects (including climate change concerns), resettlement issues, and benefit sharing issues will have to be dealt with adequately in these stages. Governments could also consider proposals initiated directly by entrepreneurs, provided such proposals address adequately all the above concerns. Governments need to create a liberal policy environment conducive to attract and retain such foreign investment. There should be clarity and consistency on royalties on water use, taxation of electricity sales, corporate tax on profits and remittance of post tax profits.

Similarly in respect of transmission lines dedicated for exports such as in the case of the CA-SA 1000 project public-private-partnerships should make it more practical to ensure a neutral transmission operation.

6.1.3 Seek Accession to Energy Charter Treaty

In order to attract private investments in the energy sector for export production and transmission as well as to provide a level of comfort and confidence for the trade partners, it will be useful for the countries in the region to accede to the Energy Charter Treaty.

International trade is carried out under the framework of the treaty, rules and regulations of the World Trade Organization, which supplement and influence the national rules. In order to accede to WTO, each country has to harmonize its laws, rules and regulations with the WTO framework.

A similar organization to provide the multilateral framework specifically for the energy sector cross-border trade and investment has come into existence since 1991 when the Energy Charter Declaration was made. The Energy Charter Treaty provides a broad multilateral framework of rules governing energy cooperation. The fundamental aim of

the Energy Charter Treaty is to strengthen the Rule of Law on energy issues, by creating a level playing field of rules to be observed by all participating governments, thus minimizing the risks associated with energy-related investments and trade.

The Treaty's provisions focus on five broad areas: (i) the protection and promotion of foreign energy investments, based on the extension of national treatment, or most-favored nation treatment (whichever is more favorable); (ii) free trade in energy materials, products and energy-related equipment, based on WTO rules; (iii) freedom of energy transit through pipelines and grids; (iv) reducing the negative environmental impact of the energy cycle through improving energy efficiency; and (v) mechanisms for the resolution of State-to-State or Investor-to-State disputes.

The Energy Charter Treaty and the Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects were signed in December 1994 and entered into legal force in April 1998. To date the Treaty has been signed or acceded to by fifty-one states plus the European Communities (the total number of its Signatories is therefore fifty-two). The Treaty was developed on the basis of the Energy Charter Declaration of 1991. Whereas the latter document was drawn up as a declaration of political intent to promote energy cooperation, the Energy Charter Treaty is a legally-binding multilateral instrument, the only one of its kind dealing specifically with inter-governmental cooperation in the energy sector.⁷³

The Treaty is open for accession by any country that wishes to participate, that is ready to take on the obligations in the Treaty, and whose application is accepted by the Energy Charter Conference. In order to join the Energy Charter Treaty, a country has to take the first step of signing the 1991 Energy Charter Declaration thus committing itself to the principles of the Charter. By doing this it becomes an observer to the Energy Charter with access to all its meetings and documents. The next step is the actual accession for which the country and the Energy Charter Secretariat must assess the compatibility of its domestic legislation with the provisions of the Treaty. Once the assessment reports are found satisfactory by the Energy Charter Conference, the country is invited to accede to the Treaty and become a full member.

While the Central Asian Republics are already members, Afghanistan, Iran, Pakistan and China are observers.⁷⁴ India is believed to have initiated action to become an observer. Bangladesh, Bhutan, Nepal, and Sri Lanka are not yet associated with this Treaty. Since they have substantial potential for energy trade and the need for cross border investments and for attracting capital for such investments to enable and sustain trade, it will be advantageous for them to become members of the Energy Charter Treaty. In particular, the membership of the regional countries in the Treaty would greatly facilitate the private investors in the region making investments at home and abroad to create regional energy import or export opportunities.

⁷³ For further details, see www.encharter.org.

⁷⁴ Pakistan has recently been made a member of the Energy Charter Treaty.

6.1.4 Pay Special Attention to the Integrity of the Transit Countries

When energy trade takes place between two countries separated by a third country – referred to here as a transit country – it is necessary to ensure the integrity of that country and its facilities to enable and sustain trade. By virtue of its location, Afghanistan is a key transit country for the Central Asia-South Asia energy trade and it is in the interests of all the potential participants to ensure the integrity of that country and the viability and operational stability of its energy systems, by providing maximum possible cooperation, assistance and funding. The sooner Afghanistan situation becomes peaceful and the sooner its energy systems are restored, the less will be the risk to the energy trade across that country. Pakistan itself will be a transit country when India imports gas by pipeline from Iran or Turkmenistan. Similarly Myanmar has the potential to be the energy bridge between South Asia and ASEAN energy systems and in the context of interregional trade development might need special attention from all participants.

6.1.5 Prepare for the Commercial Approach to Trade

The existing electricity trade of Afghanistan with Central Asia and of India with Bhutan and Nepal are based more on *ad hoc* inter-governmental agreements than on commercial contracts. In the case of the former, negotiations for the volume and price of supply still appear to be annual event. Enforcement mechanisms for payment defaults and consequences of failure to supply or receive the agreed volume of energy do not appear to have been spelt out. The transactions between India and its neighbors also appear somewhat informal. Prices are renegotiated periodically without reference to any formal PPA and a set of agreed parameters for price escalation. There is some uncertainty regarding the volume of supply. Bhutan appears to have the freedom to consume whatever it needs and have the obligation to supply only whatever turns out to be the surplus. Transactions with Nepal are under an umbrella agreement allowing power exchange up to 150 MW and settlement is on the basis of whatever is actually exchanged. Sustainable large volumes of electricity trade would be possible only on the basis of a formal and commercial footing involving an explicit contract between the buyer and seller. The contract needs to spell out the volume and pattern of supply, metering and billing arrangements, price details as well as parameters and formula for price revisions. It also needs to specify the obligations of the buyer and seller relating to such aspects as payment defaults, failure to supply or receive the agreed volumes of power. It should also contain provisions for dispute resolution and arbitration. Attention has to be paid to developing such contracts with the help of experienced experts and adopt them for trade related transactions.

With the entrustment of the trade with Nepal and Bhutan to PTC limited, India appears to have initiated the process of commercializing its electricity trade transactions with these countries. It is necessary that the relevant organizations in the governments of the region develop the capacity to prepare, negotiate, implement, monitor and enforce such commercially oriented electricity and gas trade contracts. This type of capacity building would be important for all countries in the region and for the relevant countries in Central Asia, but especially so in smaller economies such as Afghanistan, Bangladesh, Kyrgyzstan, Nepal and Tajikistan with notable export potential. It is worth noting that Pakistan has developed this capacity in relation to the IPP transactions based on its range of experience.

6.1.6 Keep the Price Expectations Realistic

Many of the past attempts for cross border investments or electricity trade could not come to fruition on account of the wide and unrealistic divergence between the price-expectations of the buyer and seller. When Pakistan desired to export surplus power to India, the offered price was 7.2 cents/kWh and the counter offer was 2.5 cents/kWh. In respect of power export to India, Nepal had very high price expectations based on the avoided peak power costs in India, while India was considering a price based on reasonable return on investments relating to the generation project. In the absence of reliable economic price signals from the power markets, which had several layers of subsidies masking true costs, negotiations perhaps could not be meaningful. In respect of India, there is now a range of recent cost data relating private hydropower projects, thermal power projects based on coal, gas and diesel. On top of this there is spot and contract market in the national/regional grids which send reasonably representative price signals at the grid level. The UI rate range, contract prices for interstate trading, and regulated prices of centrally owned large generation utilities do provide a valuable database from which one can judge the price appropriate for different area segments of the Indian electricity market. Similar build up of price data and cost signals in each country would be helpful but probably not easy under the present market conditions. In respect of Pakistan the price paid to the IPPs used to be considered a good indicator of the marginal cost, but they may have become outdated. With the improved competitive bidding and contract procedures, fresh bids for IPP supply could perhaps be lower than the prices agreed to earlier.

Trade materializes and is sustained when both sides perceive gain by the transaction. It is therefore more practical to review all price related information with expert help and keep the divergence between the offer and the counter-offer as narrow as possible.

6.1.7 Political Commitment to drive the prioritized Trade Transactions

Good sector policies and supportive environment are necessary for energy trade initiatives, but not sufficient. Continued and consistent political commitment to enable actual investments in energy trade related assets and their sound operation over their economic lives is an essential key ingredient. Each government has to agree on the prioritization among the available trade opportunities and pursue the priority ones with the establishment of empowered joint ministerial level committee of the relevant governments, underpinned by a joint working group dealing with the details of technical, commercial, financial and legal issues and work towards a time table for concluding the overarching inter-governmental agreement under which the actual transaction between the public sector or private sector entities can take place and result in cross border investment and trade. Between the signing of the inter-governmental agreement and the actual trade flow, myriads of problems and risk perception will be encountered and their resolution would primarily depend on the continued and consistent political commitment to realize trade and perhaps the continued use of the joint ministerial level committee and the joint working groups.

6.2 Enabling the evolution of competitive Regional Energy Market

In order to sustain and expand energy trade on a sound footing and minimize trade risks in the medium to long term, as well as to promote the evolution of bilateral trade into multilateral trade involving market oriented competitive elements, the sector reform efforts of the governments have to focus on creating more appropriate sector structures with financially sustainable entities and predictable and neutral regulatory environment. The key elements to be pursued in this regard would include the following:

6.2.1 Create Technical and Commercial Coordination for Regional Trade

In the regional energy trade there is always a need to coordinate the technical conditions and interconnected operation of two or more systems and the associated transit issues (Box 6.1).

Box 6.1: Interconnection Options for Electricity Trade

Bilateral electricity trade between two adjoining countries is the least complicated option from the technical point of view. If a relatively small part of one country has power shortage and needs import, that part of the grid is disconnected from the main country grid and connected in the “island mode” to the grid of the exporting country. The frequency of the interconnected grid is then regulated by the exporting country grid. This is referred to as the “synchronous island mode operation”. Trading here would be governed by bilateral trade contracts.

When the grids of the two adjoining countries are compatible and fulfill certain technical criteria (such as principles of voltage and frequency regulation, level of reserve capacities, quality standards of supply to customers, communication and protection systems) they can be fully synchronized and operate on the same frequency and submit themselves to the unified common rules of system operation and control. This is referred to as fully synchronized operation, which maximizes the benefits of interconnection. Trading here would be governed by contracts and the bilateral agreement on grid operation and discipline.

Interconnection of two non-adjacent countries through a transit country or interconnection among more than two countries would call for synchronizing all the connected grids with all the discipline going with such synchronous operation and would thus become more complicated as common criteria for system operation and control will have to be agreed among several parties and observed continuously. Trading here would be governed by contracts and multilateral agreements on grid operation and discipline.

When the systems to be interconnected are electrically incompatible, then they could be interconnected by Direct Current (DC) transmission. Converters in the exporting country convert the Alternating Current (AC) into DC and it is then transmitted through DC line. In the receiving country converters convert DC back to AC for normal supply. Such DC options used to be expensive, but in the recent years costs are coming down due to cost effective technology upgrades. Nonetheless the DC interconnection options are more expensive and would require a much larger volume of electricity transmission to become economic than in the case of AC interconnection.

The Union for the Coordination of Transmission of Electricity is a well known example of an arrangement for coordination of the operation of a number of power systems in Europe. Fifty years of joint activities laid the basis for a leading position in the world which the UCTE holds in terms of the quality of synchronous operation of interconnected power systems. Through the networks of the UCTE, about 450 million people of Europe are supplied with electric energy; annual electricity consumption totals approx. 2300 TWh. It is an association of transmission system operators (TSO) in continental Europe, providing a reliable market base for electricity trade by efficient and secure electric "power highways". Each TSO is individually committed: (i) to a common set of rules for

the operation of the interconnection, its development and reliability standards; and (ii) to support the principles of the common electricity market. There is no supra-regional "UCTE control centre" governing the whole system. Rather, the integrated, synchronously connected grids are operated in a decentralized way, with adherence to strict technical and organizational rules and standards by all UCTE members (For more details, see www.ucte.org).

Figure 6.1: UCTE Area of Operation in Europe



Source: www.ucte.org

The volume of electricity exported and imported in relation to domestic generation in a respect of a few select European countries is given in Table 6.1.

Table 6.1: Imports/Exports (TWh) in Selected European Countries in 2005

Country	Net Generation	Imports	Exports	Net Exchange as % of Avail. Energy
Austria	63.9	20.4	17.4	4.5%
Belgium	82.3	14.3	8.0	7.1%
Czech Rep.	76.2	12.4	24.9	-19.6%
Denmark	34.3	12.9	11.6	3.7%
Finland	67.7	17.9	0.9	20.1%
France	547.8	7.2	67.6	-12.4%
Germany	533.7	53.4	61.8	-1.6%
Hungary	32.3	15.0	8.8	16.1%
Italy	300.2	49.8	1.0	14.0%
Netherlands	96.0	23.7	5.4	16.0%
Switzerland	57.9	43.9	39.4	7.2%

The EU is currently considering whether there should be a regulatory oversight of the operation of the interconnected system at the EU level in the light of some of the

problems recently emerging. UCTE is not the only model available for this purpose. Other models available for consideration include the reliability councils models followed in North America, NORDEL model followed in Nordic countries, Greater Mekong Power Trade Organization model in East Asia, South African Power Pool model enabling multilateral trading and West Africa Power Pool enabling the optimal use of hydro and thermal generating facilities.

6.2.2 Strengthen the Role of Regional Cooperation Organizations

SAARC had been functioning since 1985. It has constituted a Working Group on Energy to focus on regional energy cooperation. Among other things it has decided to give priority to the creation of an interconnected regional power grid. It may be the most appropriate organization for promoting and facilitating regional trade in energy. It has set up a SAARC Energy Centre (SEC) in Islamabad as the regional institution for the initiation, coordination and facilitation of SAARC programs in the energy sector. It is already working on the concept of Energy Ring covering the SAARC countries as such a ring is perceived by SAARC ministers as a key to promote regional energy trade. It could draw on the technical talents in each country and set up a group of officials who could work with consultants and experts provided under funding by the IFIs to harmonize grid codes and evolve common codes and binding technical procedures for the operation of interconnected grids, perhaps, somewhat on the lines of UCTE. Alternatively the energy center group could study the various models of technical and commercial coordination among interconnected grids mentioned in the earlier section and determine which of the models would fit the South Asian situation best and explore the possibility of evolving such common operational conditions and codes of behavior of the interconnected systems, to facilitate the evolution of regional electricity markets.

This group could also gather the regulators from the member countries and set up a regulators forum to harmonize the regulatory practices among them and also pave the way for creation at the SAARC level a regional regulatory body to regulate the regional electricity and gas trade to the extent such regulation becomes necessary.⁷⁵ It may also be productive to arrange for cooperation of this SAARC group with the UCTE secretariat to enable a transfer of knowledge, experiences and best practices in this area. This group should further coordinate its activities with BIMSTEC secretariat and ASEAN energy group to ensure that the interconnection of the Myanmar grid with those of India and Bangladesh is compatible with ASEAN practices. The governments need to make the best use of the existing regional cooperation organizations for the purpose of developing the common rules and operational procedures and codes which should underpin and foster regional energy trade on orderly lines.

⁷⁵ South Asia Forum of Infrastructure Regulators founded in May 1999 with World Bank assistance to serve as a forum for the regulators of infrastructure in the region to exchange views and experience and to provide training and capacity building programs may have a useful role to play in this regard. See its website at www.safirasia.org

6.2.3 Strengthen Transmission Links and Complete the Ongoing Sector Restructuring Process

In large importing countries the backbone transmission system should be strengthened and expanded to enable imported power to flow to the load centers with demand characteristics appropriate to absorb the imported power. The tariff for transmission service should be fair and transparent.

Going forward, separation of the generation, transmission, distribution, and supply functions, providing open access to the transmission and distribution wire services is generally believed to enable wide spread competitive trade within and across the interconnected power systems.⁷⁶ Liberalizing the sector by allowing at least the large industrial consumers (who are forced to pay very high prices for a low quality of supply and thus subsidize agricultural consumers and households in most of the region) the freedom to contract for their supplies with electricity traders or the generating companies is an important step to promote trade.

India is moving rapidly in this direction by creating a new class of licensed electricity traders, increasing the interregional power transfer capacity, enabling third party access in the national and regional grids and creating a power trading market using the ABT and frequency dependent UI charges as well as transparent transmission charges for national and regional grid services. This needs to be followed up by similar reforms by the state electricity boards within each of the five regions and by the state regulatory commissions for maximizing the impact.

The Indian Electricity Act of 2003 obliges the state regulatory commissions to provide transmission and distribution open access within five years to all consumers with a maximum consumption exceeding 1 MW and in a phased manner for other consumers. It also provides for a “cross subsidy surcharge” (to be added to the wheeling charges), to be phased out in line with the phased removal of cross subsidies. These steps designed essentially to promote trade within the country, actually reduce risks for the exporters to India and would accelerate investment in the neighboring countries for exporting power to India. Exporters to India in the next few years should be able to strategically select the area to which they want to sell on the basis of a match between their generation pattern and the demand pattern of the area and be in a position to secure attractive prices. Power from Bhutan which can not be absorbed in the adjoining eastern region of India is being sold a few thousand miles away in the northern and in the western regions.

Similar reforms in Bangladesh and Pakistan would be appropriate and desirable. They need to evolve their own methods based on the structures they have chosen to enable the distribution utilities and large consumers to buy from the generators, traders and importers on the basis of long, medium and short term contracts. Also Bangladesh needs to ensure the autonomous and independent operation of the Power Grid Company and separate fully the distribution function from BPDB. The desirability of separating generation function also from BPDB and allowing it to function purely as a market

⁷⁶ The term “supply” is used to denote retail sales function as distinct from the physical distribution network related functions (construction, operation and maintenance). When the distribution network functions and supply functions are separated and third party access to transmission and distribution networks are ensured, retail consumers could choose their suppliers.

operator should be reviewed. Open access to the transmission grid in Nepal would be needed to enable existing privately owned hydropower projects in Nepal to export their surplus power to India.

6.2.4 Step up the Operational and Commercial Efficiency of the Utilities

Distribution utilities are the major ultimate bulk buyers of the imported power, and unless they become financially viable and capable of adhering to the payment discipline, it will be difficult to sustain energy imports in the medium to long term, despite the use of transmission companies and power traders as intermediaries. The governments desirous of resorting to sustainable energy trade need to focus on the operational and commercial efficiency of the distribution utilities. Metering, billing and collection efficiencies of the South Asian utilities are far below the industry standards eroding their financial soundness and creditworthiness for trade and investment.

India is trying to tackle this at two different levels. At the central government level the generating companies, the national and regional grid and dispatch operate at industry standards of efficiency. Payment discipline by the state electricity boards to the centrally owned generation, grid services and fuel supply companies has been significantly raised by the one time restructuring of past debts, through bond issue and system of recourse to the state funds in the Reserve Bank for payment defaults (see Section 4.3). At the state level reforms are sought to be achieved through reorienting the Accelerated Power Development and Reform Program (APDRP) to tackle comprehensively the consumer and system metering using smart meters and billing and collection problems through the introduction of better technology and incentives (see section 4.5 for details). The base line data generated by these efforts can also be used to design meaningfully distribution privatization models to achieve viability more speedily. These efforts need to be pursued with determination and with the full cooperation of the state governments in a federal polity. The privatization of the distribution system in the Delhi State seems to have resulted in significant reduction of overall ATC losses and improvement of the sector in the state. Recent attempts by the Ministry of Power and the Power Finance Corporation of India to use outside bodies such as the Indian credit rating agencies CRISIL and ICRA to measure annually efficiency improvements and financial viability of all the electricity boards and rank them on the basis of over a hundred criteria seems to have a salutary effect instilling a sense of competition among the electricity boards to do better. Generation of such reliable evaluative data comparable over time and across the utilities would greatly aid the task of improving their performance and needs to be kept up.

Pakistan has privatized KESC and the performance of the new owners in terms of governance and operational improvements needs to be closely monitored. The nine new distribution companies created in the rest of Pakistan have yet to emerge as entities responsible for their performance. Their finances are wholly in the hands of WAPDA which receives all their revenues and pays most of their bills. Some of the senior managers are still in WAPDA's payroll rather than the payroll of the distribution companies. At current tariffs at least four of the distribution companies will not be viable and the rest will be marginally viable. Though these companies were created as far back

as 1998, the sector still operates largely as vertically integrated. Though financial restructuring had been done through debt to equity swaps, to enable them to have a reasonable balance sheet to start with, the tariff framework, subsidy framework and revised tariffs have not been finalized. The thorny question of whether the retail tariff will be uniform all over the country or whether it will vary as a function of the cost of supply faced by each company has not yet been fully resolved. These matters need to be resolved to make these entities capable of operating in a sustainable manner. Meaningful privatization would be possible only thereafter. NEPRA should have full authority and support to promote efficiency upgrades of the distribution companies through devices such as performance benchmarking. Achieving a measure of financial solvency and payment discipline on the part of the distribution entities is a necessary requisite for sustainable and expanding trade.

In Bangladesh, the distribution operations of BPDB and DESA are still far below industry standards and the institutions are not financially viable. Bhutan's BPC gets a very low price from the generating companies and yet is not financially sound. In all these cases, governance improvement is necessary to reduce losses and improve collection. The arrears of the government agencies and public sector entities must be settled and continued payment discipline ensured.

Programs focusing on the use of GPS mapping, smart meters capable of remote reading (and with ability to disconnect supply to the defaulters through remote controls) and the use of computerized metering, billing and collection system are likely to be productive when combined with effective laws against electricity theft providing for speedy trials and stern punishments. Governance focusing on operational and commercial improvement of the distribution segment appears to be most urgently needed in most of the countries in the region.

6.2.5 Adopt Sustainable Tariff and Social Protection Framework

Electricity tariffs broadly reflecting the true economic cost of supply in both electricity exporting and importing countries is conducive to the financial viability of the parties to the transaction and therefore is also conducive to sustainable and expanded electricity trade. Practically all the countries in the region and its neighbors in Central Asia have levels of tariff well below costs of supply and structures of tariff skewed heavily in favor of households and agriculture. In the case of exporting countries there is a tendency to keep the overall level of domestic tariff substantially lower than the export tariff. In Bhutan, for example, the supply tariff for BPC is only 15% of the export price to India. Such a distorted tariff base will not promote efficient consumption and would soon seriously erode the surplus available for export. In Bhutan things are made even worse by the adoption of a policy of attracting power intensive industries with a low electricity tariff to make up for labor costs and a lack of raw materials. The sustainability and wisdom of this type of industrialization is open to question. These approaches are somewhat similar to those followed in the hydropower rich countries such as Tajikistan and Kyrgyz Republic.

In the countries such as India, Pakistan and Bangladesh (potential importers) tariff below cost of supply and extensive subsidies seriously cut into the financial soundness of the

sector, thereby reducing the attractiveness of the market and eroding the sustainability of trade. Programs to raise the tariffs (in a phased manner over a reasonable time frame) to cover the cost of supply and to minimize the cross subsidies by carefully tailoring the lifeline block and the lifeline tariff and making it available only to the consumers in the lowest block and not to all consumers need to be carefully considered for adoption. Further, subsidies to any particular class of consumers should come directly from the state budget without distorting the price structure. To ensure credible energy accountability all consumers whether subsidized or not (or even if they receive free power) should be metered. *Inter alia*, this is necessary for effective governance of the utility and the sector.

Introduction of time-of-day metering and differentiated peak and off-peak electricity prices at least for larger consumers in all the countries would be helpful not only as a load management tool, but also to trade intelligently for peak or off-peak energy and capacity. These considerations are equally important for importing and exporting countries. The use of smart/intelligent meters providing the remote meter reading capability should be of great help in this regard.

Similarly there is a clear need to reform the pricing of gas in India and Pakistan. In India a very complicated administered pricing mechanism is adopted for the use of domestically produced gas and relatively market oriented approach for the imported LNG. In the context of private investors entering the business with substantial quantities of their own production and in the context of the anticipated large increases in LNG imports and gas imports by pipeline, the pricing approach has to be made more market oriented. Present postage stamp methodology for gas transmission tariff is not conducive to transmission system expansion or for industries to locate themselves closer to the sources of supply. For the domestic gas, re-gasified gas from LNG terminal and the imported gas by pipeline a cost plus regulation needs to be considered. Transmission tariffs should be reoriented to take into account the distance and congestion aspects. More importantly GAIL being the owner of the transport network and the largest marketer of gas is not conducive to competition and nondiscriminatory third party access to the pipelines. Third party access question needs to be sorted out and separation of transmission operation and sale of gas should be carried out to derive the full benefits from gas trade. Further, a medium term strategy needs to be worked out to phase out the massive gas price subsidies enjoyed by the fertilizer and power industries.

In Pakistan gas supply for power at around \$4 per million btu does not appear to be unduly subsidized, while the households and the fertilizer industry are heavily subsidized. Till mid 2006 the price for the lowest block of gas consumption for household had a tariff which did not even fully cover the commodity price of gas. The lowest block then accounted for 85% of the total consumption by households. Corrective action for these appears to have been initiated in the tariff revision of June 2006 when the number of blocks for households was increased from four to five and the new lowest block was defined with an upper consumption limit of 50 cubic meters per month, compared to the previous limit of 100 cubic meters. The rate for the new lowest block has been increased by 5% while all other rates have been increased by 10%. However in the most recent

price revision of March 2007, the prices for all categories appear to have marginally declined, while the structure has been retained. Further reforms towards cost reflective tariffs need to be pursued.

6.2.6 Improve the Credibility, Competence and Accountability of Regulation

Fair, independent and neutral regulatory bodies functioning on the basis of principles incorporated in energy law can be of great help in promoting the health of the domestic energy sector as well as the energy trade. They could ensure the separation of generation, transmission and distribution business and their arms-length and contract-based relationship. They could provide transparent tariffs for transmission and distribution wires services. Apart from the obvious role they play in tariff setting, they could use regulatory incentives and penalties to improve the sector operational efficiency, especially in the distribution segment and help sustainable trade. They have a key role in fostering competition and regulating the power market, which among other things, can buy from and sell to the interconnected adjoining country power systems. They can regulate the orderly functioning of electricity traders. They can ensure the adherence to the grid code and technical standards by all market participants. Sound and efficient regulatory arrangements promote expanded trade in a sustainable manner.

The central electricity regulatory commission and the state electricity regulatory commissions (in 27 out of 29 states) have been operating in India during the last several years. The central commission and many of the state regulatory commissions are maturing rapidly and the Electricity Act of 2003 has provided the basic content for their role in promoting trade and competition and more importantly, for their improved accountability by creating the Appellate Tribunal for Electricity (ATE) to hear appeals against the orders of the central and state regulatory commissions.⁷⁷ The existence of such a tribunal is widely perceived as improving the accountability of the regulatory bodies.

Many of the state regulatory commissions still need significant capacity upgrades in terms of modern approaches to promote competition, sector efficiency and trade and in areas relating to finance, accounts and economics. The capacity building task in the regulatory commissions should be the focus of the central government perhaps with technical assistance from the aid-community or through cooperative arrangements with the regulatory bodies in select developed countries.

Gas sector regulation in India still appears to be in the nascent stage and needs to be built on a sound basis.

The electricity regulatory organization in Pakistan would still need substantial improvement in its capacity and the scope of its functions needs to be expanded to include monitoring of the sector performance. Another major area for reform relates to

⁷⁷ The ATE has a chairman with the rank of a Judge of the Supreme Court and three members with the rank of a judge of the High Court. Two of these are to be from the judiciary and the remaining two are to be persons with a distinguished technical background. Each bench constituted to hear appeals must have at least one judicial and one technical member. Since July 2005, when it started functioning, it has decided on 108 of the 249 appeals filed. See the website of ATE www.aptel.gov.in for more information

the fact that decisions on tariff by the regulatory body are not binding without government approval and notification, although the Government may not notify tariffs without receiving the regulator's decisions. Pakistan had succeeded in getting the formal structural reform right. It now needs to put substance in the reform effort and make all the new entities function in the manner they are expected to function, if it has to reap the full benefits of the reform. Bangladesh's regulatory body is dormant since its creation and needs to be made fully operational as soon as possible.

Nepal's regulatory body has only a limited role of fixing the retail tariff of NEA and is not widely perceived to be doing a credible job. In the context of the existing IPPs and the future IPPs wanting to trade directly with export markets, transmission access and transmission tariff questions will gain significance and the regulatory body needs to be involved in providing the answers to them. Also there is a good case for Nepal to have licensed electricity traders. A thorough review of the regulatory system with a view to enhance the scope of regulation and upgrade the capacity and independence of the regulatory body needs to be undertaken and the findings followed up.

The newly created regulatory body in Bhutan from the ministry needs to be made operational soon. The four borders project which seeks to link the systems of Bhutan, Nepal and Bangladesh to the Indian system will make sense in the context of the four countries having autonomous and competent regulation. The autonomy and competence of the regulatory bodies in Tajikistan and Kyrgyz Republic need also to be improved to enable investments needed to increase their export supplies.

Sri Lanka needs to make up its mind on the regulatory reform and implement it before the interconnection project to India materializes to enable meaningful trade in base-load, intermediate-load and peak-load power with India and derive optimal benefits from such interconnection.

For regional trade to expand there should be effective electricity market regulation developed throughout South Asia and its neighbors. For India the basis of such market regulation, including cross border electricity trading, is provided by the Electricity Act of 2003. Similar legislation may be needed in the other countries of the region, broadly compatible with the Indian Electricity Act 2003 and the general principles it is based on.⁷⁸ Such compatibility of regulatory frameworks, trading rules and grid codes across the countries is important to foster trade.

6.2.7 Make the Best Efforts to Reach International River Basin Agreements and Improve Water Management Capacity and Practice

The most urgent need of the importing countries of the region is for peaking and load-following capacity, to cope with both daily and seasonal variations in load demand. This need could in part be met by import of power from storage hydroelectric projects. Though the region has significant storage hydropower potential, little progress has been

⁷⁸ See *Indian Electricity Act, 2003- Implications for Regional Electricity Trade* (September 2004) prepared for USAID SARI-E program available at the program's website <http://www.sari-energy.org/> for a further discussion of these aspects.

made with any of them.⁷⁹ The focus has shifted heavily towards run-of-the-river projects. While run-of-river schemes are needed and have a number of important advantages (generally lower environmental and social impact; simpler to develop, implement, and operate; lower safety risks; etc.), a disproportionate shift away from storage projects may result in the potentially sub-optimal utilization of water resources, decreased flexibility in managing hydropower production, and more costly balancing of the electricity supply and demand. Hydropower storage projects offer multiple uses and benefits, such as irrigation, flood control, sediment management, drinking and industrial water supply, tourism, fisheries, etc., which often have a higher priority over power generation. They also help manage hydrological variability, the feature which is likely to assume even greater importance over time as the variability could increase as result of climate change.

Storage projects, on the other hand, may also have potentially significant adverse environmental, social and economic impact, especially in the reservoir area and downstream, which needs to be mitigated and which make the planning, design, and operation of such projects a very sensitive matter. The allocation of costs and benefits among the various uses and beneficiaries, and compensating those that are adversely affected can be – and usually is -- very contentious. While in the 1970s policies were adopted to compensate people and communities impacted by such projects (the so-called safeguard policies which mandate that development should “do no harm”), there is an increasing recognition that policies based on the principle “do no harm” are not good enough, and that communities should unambiguously benefit from the exploitation of their territory for hydropower generation. There is experience throughout the world with various benefits-sharing mechanisms, ranging from “one-off” payments and construction of community assets, to streams of payments such as royalties, to equity-sharing. The concept of benefits-sharing can be extended spatially to include regional development or river-basin-wide development.

Clearly, individual reservoir projects on the same river basin cannot be considered in isolation of each other, not when the river basin is within the same country, and even much less so when the river basin crosses international boundaries. Problems relating to reaching agreements on water sharing and benefit sharing, river basin planning, selection of reservoir location and size, reservoir operation and water release regimes, and other issues related to exploitation of international rivers, have to be tackled with determination and a spirit of cooperation, to make any progress in building storage hydropower projects.⁸⁰ It should be recognized that, in order to maximize economic and social returns of such a key resource, comprehensive river basin agreements among all relevant riparian governments is necessary for much broader set of concerns than power generation alone, whether for domestic use or for export.

The Indus River Basin Treaty between India and Pakistan with the World Bank in a mediatory role has proven a good example over a period of several decades. It will be advantageous for the governments of the region to undertake similar river basin and reservoir agreements in the areas where the potential storage project sites exist. These

⁷⁹ A notable exception would be the West Seti Storage Hydropower Project in Nepal, which is expected to reach financial closure in the next few months after 12 years of preparation by the sponsors.

⁸⁰ See World Bank, *Water and Energy Nexus in Central Asia*, February 2004 for a discussion of these concepts in relation to Central Asia.

agreements should be environmentally and socially responsible and fully recognize the links with global issues (clean energy agenda, climate change, changes in precipitation patterns, the shrinking of Himalayan glaciers with disastrous consequences to the people in the hills and plains). They should also create a framework for meaningful benefit sharing among all water users and riparian states/provinces in respect of projects, built for domestic use or for export of energy and water services. They should further be consistent with regional strategy for the integrated river basin management.

An important issue is building sufficient expertise and institutional capacity to tackle these problems, both at the national and regional levels.

Pricing of hydropower, especially for peaking and firm supply, is another key issue that needs to be properly addressed in order to induce optimal use of water potential for power generation, at national as well as regional level. The resources that can meet peak demand should command higher price, as they have higher value. Similarly, storage projects that could offer some firm power should also be properly compensated, taking into account higher value of such power in comparison with run-of-river generation, whose availability is completely driven by hydrology and is, thus, subject to a greater degree of uncertainty.

Chapter 7

THE ROLE OF IFIs AND BILATERAL DONORS

7.1 Identifying Trade Opportunities and Facilitating Inter-Country Agreements

The IFIs like the World Bank Group and the Asian Development Bank as well as bilateral development assistance programs of US, UK, Canada, Japan and Germany have been involved in the energy sector programs of South Asian countries for several decades and are well placed to undertake sector analysis in each country and identify electricity trade opportunities which, *prima facie*, would be attractive to the concerned governments, and persuade the relevant countries to pursue these opportunities further. The IFIs are uniquely placed to play the part of honest broker and facilitate the parties to reach the initial Inter-Country Agreements articulating the specific interest of the parties, constituting high level decision making bodies and working groups to carry out and review further detailed analytical and technical work to arrive at key decisions.

In 2004 the World Bank carried out an analysis of the power sector of Central Asian Republics, identified their export potential, reviewed the power sector in potential markets and demonstrated how the Central Asia-South Asia electricity trade could be a win-win situation for both. This has led to the Inter-Country Agreements and further action towards the realization of the CA-SA 1000 project. The Asian Development Bank had similarly been active in promoting the Turkmenistan-Afghanistan-Pakistan pipeline project and the trade between Central Asia and Afghanistan. The USAID SARI-E Program in South Asia has carried out a large number of studies to identify and analyze various electricity and gas trade opportunities and trade related issues in South Asia.

7.2 Structuring Project Investments

IFIs have a major role in appropriately structuring the bilateral and multilateral trade projects based on their experience relating to similar projects in other parts of the world. In South Asia and Central Asia most of the countries with hydropower export potential do not have the public resources for investment in the generation and transmission facilities of the export project. They have little access to commercial sources and capital markets. Even their ability to borrow from the IFIs is limited by country allocations of scarce IFI funds and prudent lending limits adopted by these institutions. Under these circumstances investment projects may have to be structured on a Public-private-partnership basis involving foreign private sector (especially from within the region if available and willing), local private sector, the IFIs with equity and debt positions and the government. Some degree of the government's joint ownership is desirable, especially in respect of hydropower projects and transmission lines, as they involve interaction with various aspects, such as land acquisition, right of ways, rural development issues, flood control and irrigation in all of which the government is deeply involved. In addition some amount of equity by the government in the company would enable it to get dividend income from the exploitation of its major natural resource, in addition to royalties on the use of water, tax on electricity exports and corporate tax on profits. Soft fund windows of the IFIs could be used to lend to such governments for investment as equity in the PPP

project dedicated for export.⁸¹ The private partners should have management and operational control and the percentage of shareholding necessary for this purpose. The presence of the IFIs with some equity and debt would make it easier for the private owners to raise debt from the commercial market and on more favorable terms. It also provides comfort to both the importer and the exporter. The structure of the Theun Hinboun Project and Nam Theun 2 Project in Laos illustrates the type of structure considered appropriate for such export projects (see Appendix 1). In the Sangtuda I Hydropower Project which will export about 670MW is sought to be structured on similar lines with the majority shareholding being with RAO UES, and remaining shares being distributed among the government and the IFIs, when they formally decide to participate.

7.3 Structuring of Transmission and Trading Facilities.

If a dedicated transmission corridor has to serve multiple exporting countries (and possibly multiple exporters from some of those countries) and multiple importing countries (and possibly multiple buyers in some of them), then its ownership structure and operating arrangements have to ensure independence from and neutrality towards all participants in the trade. Decision making on whether to allow new buyers and sellers and whether to expand the capacity of the corridor and how to pay for it have to be taken also in a manner fair to all. For this, structuring of the transmission corridor ownership and operation and the arrangements for trade regulation have to be designed with a neutral party suitably embedded in the decision making structures. The IFIs (through their participation) may have a role in helping to structure these arrangements and to ensure their fair working.

In order to develop a multilateral electricity trading market functioning on the basis of synchronized operation of all participating system, a great deal of work has to be done by way of harmonizing grid codes, regulatory regimes and evolution of common system operation and control rules. In section 6.12 we have suggested SAARC Energy Center as the locus of this work and also cooperation with UCTE. The IFIs and bilateral aid programs need to support such initiatives with technical assistance programs and also enable cooperation with UCTE. Similarly the IFIs may have a useful role in helping the countries which wish to accede to Energy Charter Treaty, with the associated review process, and helping the countries in the task of making appropriate changes/reforms to their laws and policies to conform to the Charter principles.

7.4 Promoting Strategic Sector Reforms in Participating Countries

IFIs and bilateral programs have a major role in promoting strategic sector reforms to enable and foster trade in the participating countries, through technical assistance, sector studies and provision of adjustment loans and or investment loans for related investments. Such strategic reforms include separation of transmission function and its independent operation, third party access to wires services, adoption of transparent pricing policies for transmission services and wheeling services, tariff reforms to minimize cross subsidies and remove the subsidy burden from the utilities to the state

⁸¹ In the South Asia Region all the countries with export potential are small low-income countries eligible to borrow from the soft funds window. In appropriate cases soft loans blended with regular loans could be considered.

budget, introduction of time of day tariffs, operational efficiency improvements in metering, billing and collection, and improving the content, competence and accountability of sector regulation. Financing of export project(s) may be linked to advancing the domestic sector reform agenda.

7.5 Building capacity for export transactions and Evolution of Export/import Contracts and Dispute Resolution Mechanisms

The IFIs have an important role in building the capacity of the governments, public and private sector energy entities in the smaller economies such as Nepal, Bangladesh, Sri Lanka, Tajikistan and Kyrgyzstan to negotiate, monitor, and enforce export trade contracts. The IFIs and other donors may also an important role in more or less standardizing the template for export/import contracts or supply/purchase contracts with a fair and proper allocation of risks among the parties and with fair dispute resolution mechanisms, and a similar contract template for transmission services in trade projects.

7.6 Supporting Transmission and Distribution Expansion

Increasing the power transfer capacity even within the country is a major need before a country embarks on external trade involving large take or pay contracts. Such projects enhancing power transfer capacity enables the optimal use of the existing generating capacity and the transfer of the imported power to any part of the country. Financing or co-financing such major expansions of transfer capacity should have priority in the IFI lending plans. A similar focus on the distribution capacity expansion to reduce losses and facilitate the efficient absorption of the imported power would be of equal importance.

7.7 Risk Mitigation

IFI lending and guarantees and insurance arrangements with MIGA would reduce a range of risks to the project and the sponsors and the trade participants. Involvement of IFIs in a electricity trade project would discourage the transit countries from disrupting supply on political grounds. MIGA insurance suitably tailored to the project could provide a cover for most cases of transit country and supply disruption risks. IFI presence in the project with equity and debt would discourage non adherence to contracts thereby reducing risks all around.⁸² World Bank's guarantee mechanism when properly designed can mitigate a range of risks. Examples will include Brazil-Bolivia gas Pipeline project and Mozambique-South Africa gas pipeline project. The full set of instruments at the disposal of the World Bank could be used for risk mitigation purposes in complex electricity trade projects. The instrument of Adjustable Program Lending can be used effectively to support the evolution of the regional market stage by stage, as is sought to be done in the Energy Community of the South Eastern Europe. It is a flexible instrument which had been used for power market/power pool related lending operations (West African Power Pool, South African Power Pool, and Greater Mekong Sub-regional Power Trade).

7.8 Priority in the Country Assistance Strategies

The IFI country assistance strategies and country lending and non-lending programs could be reoriented to give high priority for regional energy trade integration programs,

⁸² It is interesting to note that the Integrated Energy Policy Report of the expert Committee of the Planning Commission of India (August 2006) suggests that for pipeline projects for import of gas, one should get equity and debt from multilateral agencies for risk mitigation.

especially in the South Asia region where regional integration is negligible. Regional trade strategy and financing preferences should be suitably incorporated in the country strategies.

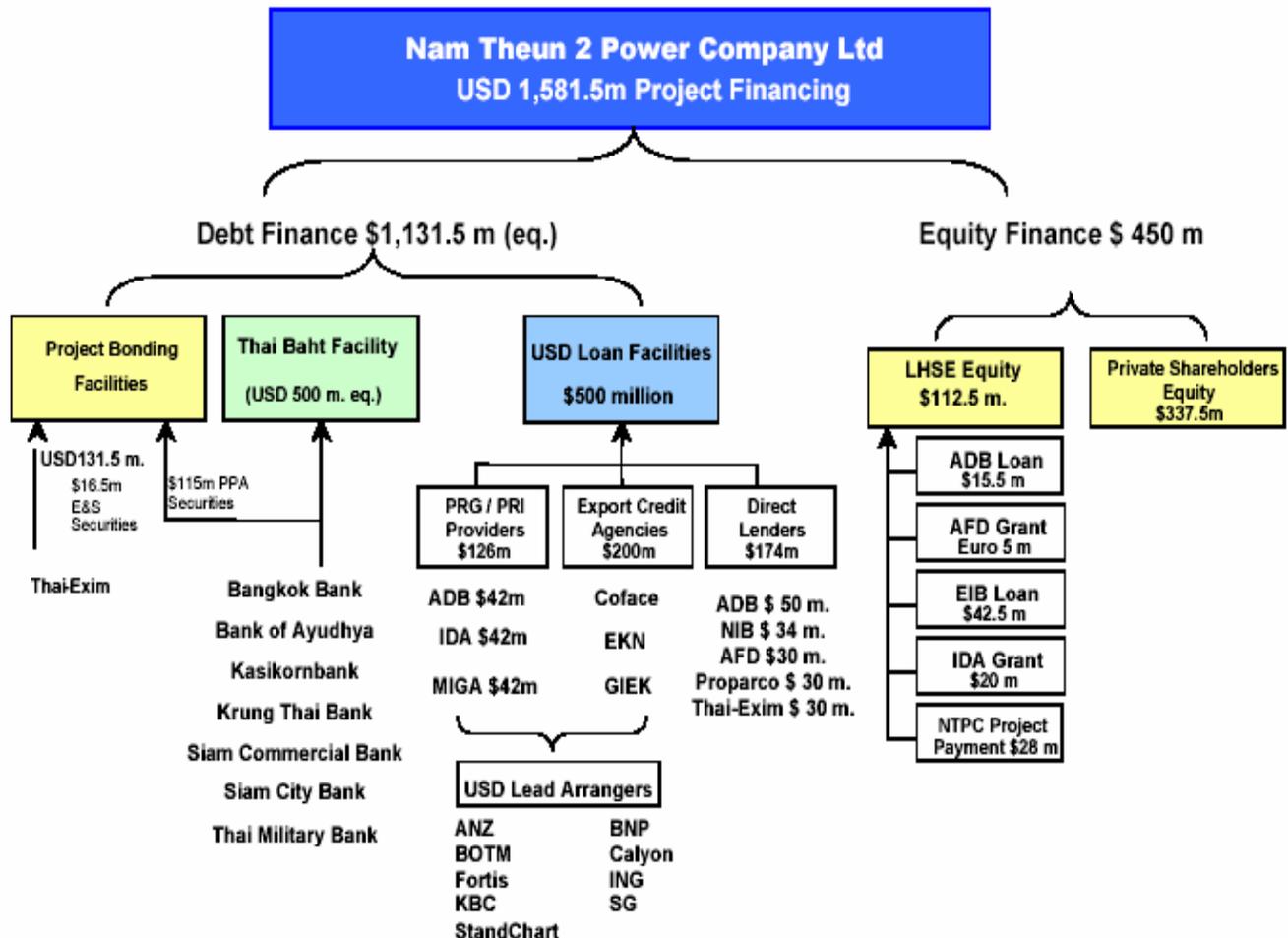
7.9 Coordination among IFIs and bilateral Donors

Given the nature of the countries in which export projects would be located, it will be essential for all relevant IFIs and bilateral donors to participate in a well coordinated manner. Such a coordinated approach would not only enable these large projects to proceed by overcoming allocation limitations and by spreading the risk of large investment among many parties, but will also create a tremendous synergy which will benefit all the participants and the project.

Appendix 1: Examples of Structuring of Energy Trade Projects

Nam Theun 2 Project is a storage hydropower project in Laos with a capacity of 1,080 MW and an annual energy of 5,936 GWh which will export 95% of its generation to Thailand and sell the remaining 5% to EDL, the power company of Laos. Thai grid and Laotian grid do not operate in synchronism. In order to handle this situation, the project will have a separate penstock and two generating units of 43 MW each with their own switch yard and 115 kV line to supply Laotian grid, while the other penstocks and larger generating units will have a separate and larger switch yard with a double circuit 500 kV line to feed the Thai grid.

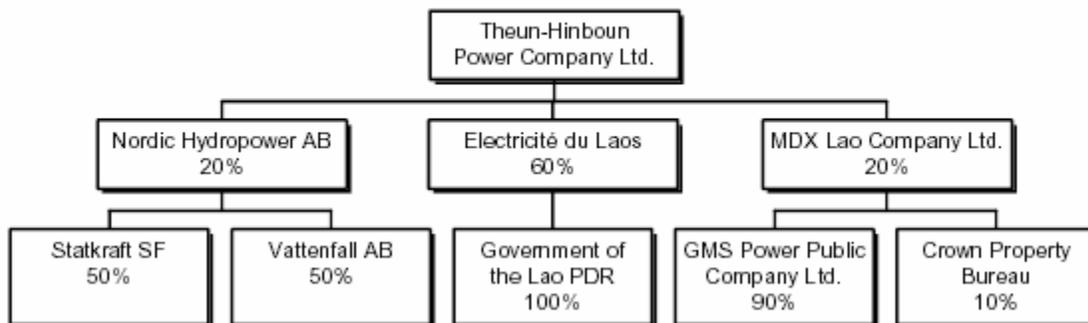
The total financing required for the project was \$1,581.5 million. The project was structured as a PPP project on a BOT basis. The equity holding in Nam Theun 2 Power Company consisted of Electricite du France International (EDF) (35%), Thai Electricity Generation Public Company (EGCO) (25%), Government of Laos through Lao Holding State Enterprise (LHSE) (25%), and Ital-Thai Development Company (ITD) (15%). In order to enable the Laotian government to invest \$112.5 million as equity, grants or soft funds to the government were provided by IDA (\$15 million grant), ADB (\$15.5 million soft loan), AFD (Euro 5 million grant) and EIB (\$42.5 million loan). The remaining \$28 million came from Nam Theun 2 Power Company's payment for the preparatory expenses and facilities provided.



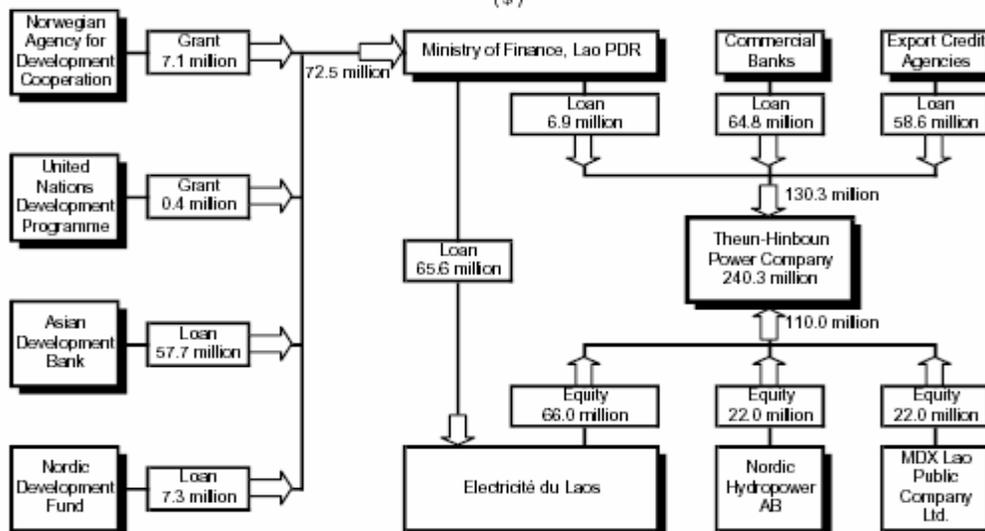
agencies and 16 international and Thai commercial banks. The average tenor for US\$ loans was 16.5 years and that for Thai baht loans was 15 years. Nam Theun 2 Power Company holds the concession for 25 years. The tariff is approximately 50% in Thai Baht and 50% in US\$ (or indexed to US\$) to match the financing currency structure. Long term PPAs were concluded with EGAT of Thailand and EDL of Laos. Royalty will be charged at 5.2% during 2009-2024, 15% during 2025-2029 and at 30% thereafter. Corporate tax will be payable by NTPC at 0% during 2009-2014, 5% during 2015-2021, 15% during 2022-2027, and at 30% thereafter. These graduated rates are used because of the need for the project to repay debt in 15 years while the concession will last for 25 years.

Theun-Hinboun Hydropower Project (210 MW, 1,645 GWh) of Laos was constructed in early 1990s as a PPP project with BOT arrangements mainly for export of 95% of the output to Thailand. The total project cost was \$240 million (46% equity and 54% debt). 60% of the equity in the Thein-Hinboun Power Company was held by Laos government through EDL. The remaining 40% was held by Nordic and Thai investors. Laos government was enabled to invest \$66m in equity by loans and grants from ADB, UNDP, and Nordic agencies. Debt financing came from several commercial banks and export credit agencies.

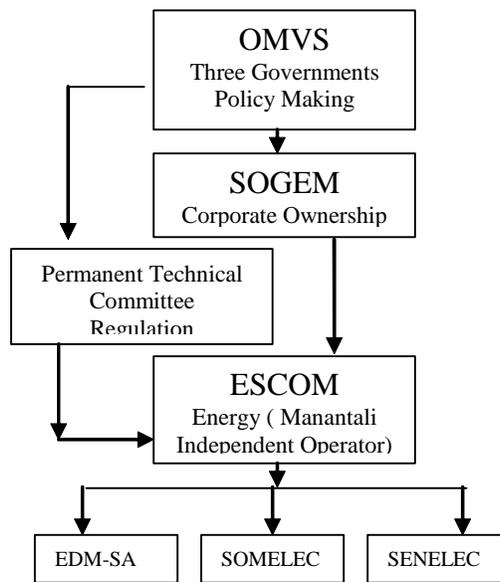
OWNERSHIP STRUCTURE OF THEUN-HINBOUN POWER COMPANY



FINANCIAL STRUCTURE OF THEUN-HINBOUN POWER COMPANY (\$)



Manantali Hydropower project (200 MW, 800 GWh) along with 1500 km of 220kV transmission line was built jointly by the governments of Mali, Mauritania and Senegal. The power station is located on the Senegal River in Mali and the power generated was to be sold to all three countries. Total project cost was \$445 million and financing was provided by IDA, AfDF, KfW, CIDA, and IsDB. This was structured as joint public sector project. The three governments set up a high level policy making body OMVS which organized a corporate entity SOGEM jointly owned by all three governments to construct and own the project. An independent private operator, ESCOM of South Africa was selected through ICB to operate and maintain the project facilities. The World Bank provided three loans to the three governments simultaneously to finance a part of the project costs.



It is interesting to note that OMVS was established in 1972, the related dams were built in 1986-1988, hydropower units and transmission lines were funded in 1998 and that the project was completed in 2003.

Mozambique Transmission Company (MOTRACO) was established to build, own and operate two 300 km long 400 kV overhead lines and associated transmission facilities to supply 860 MW of power from South Africa to an Aluminum smelter in Mozambique as well as 175 MW each to the grid of the transit country Swaziland and the southern portion of the grid of Mozambique. It buys power from the South African utility and sells to the Aluminum smelter in Mozambique. It also wheels power from South African utility to the utilities of Swaziland and Mozambique. The total capacity of the transmission facilities of MOTRACO is 1,348 MW. Since its commissioning in 2001 its network availability had been well in excess of 99% of the time. It has concession contracts and licenses to carry on transmission business from the three countries. It has a 25 year PPA with the South African utility and a 25 year sales contract with the Aluminum smelter and also a 25 year wheeling agreements with the three utilities.

The three national power utilities have equal shares in the company, which is managed by a Board with two representatives for each country. It adopts an aggressive policy of outsourcing its work and has only a total manpower of 7 full time employees.

The total cost of the project facilities was \$112 million, which was financed by about \$30 million of equity and \$ 82 million of debt from EIB and JBIC and Standard Bank of South Africa. ESKOM Holding of South Africa guarantees the debts to MOTRACO to the extent of \$ 75 million, via a special arrangement with MIGA of the World Bank Group mitigating a range of political and other risks. The company has been operating profitably from year 2 of its operations.

South African Power Pool covers the grids of twelve member countries. The general details of these grids are given below.

**General Information on the Member Grids of the South African Power Pool
(April 2005 to March 2006)**

Country	Utility	Installed Capacity MW	Maximum Demand MW	MD Growth %	Sales GWh	Sales Growth %	Generation sent out GWh	Net Imports GWh	Net Exports GWh	Transmission system losses %
Angola	ENE	745	397	9	1,843	12.7	2,649	0	0	25
Botswana	BPC	132	434	7.96	2583.7	7.5	977	2,006.50	0	10.96
DRC	SNEL	2,442	1012	2.53	4,656	13	6,904	0	1,800.00	6.3
Lesotho	LEC	72	90	0	354	12	446	8	11	20
Malawi	ESCOM	285	242	6.5	970	4	1,177	0	0	19
Mozambique	EDM	233	285	7.1	1,308	11.8	147,418	1,501	1,496	5
Namibia	NamPower	393	491	6.51	2,976	6.5	1,660	1,703.0	0	8
South Africa	ESKOM	42,011	33,461	-2.2	207,921	0.8	221,985	8,730	13,107	8.9
Swaziland	SEB	51	172	1	852.8	2.5	103.5	916.8	0	16
Tanzania	TANESCO	839	531	4.3	2,549	10.3	3674	43	0	24
Zambia	ZESCO	1,732	1,330	2.8	8,457	3.1	8,884	0	69	3.6
Zimbabwe	ZESA	1,975	2,066	-0.1	10,480	3.5	9,391	2,666	255.5	12.6

Trading had been going on for thirty years on the basis of bilateral contracts, though the formal inauguration of the pool was in 1995 through the SADC treaty. It was at that time the Southern network (mainly thermal) of Namibia, South Africa, and Mozambique and the Northern network (mainly hydro) of Congo, Zambia, Zimbabwe were interconnected by a 400 kV link. Such contracts cover 95% of the volume of traded power; have durations in the range of one to five years and a price in the range 0.85 to 2.95 cents/kWh. Since 2001 there is short term energy market covering about 5% of the volume traded by way of monthly, weekly, daily and hourly contracts. These relate mostly to off-peak with prices in the range of 0.40 to 1.75 cents/kWh. The SAPP is governed by an inter-governmental agreement (establishment of SAPP), an inter-utility MOU (establishes Management and operating principles), agreements between operating members (specific rules of operation and pricing) and Operational Guidelines (standards and operating guidelines).

It has been functioning as a cooperative pool. In the context of the member grids being restructured it is trying to evolve gradually into a competitive pool. Short term energy

Appendix 2: Examples of World Bank Group Support for Regional Energy Trade

Region/Project	Countries	Details
Europe / Caucasus		
Energy Community Of South East Europe	Seven countries in South-East Europe	<ul style="list-style-type: none"> • \$1 billion from World Bank
Baku-Tbilisi-Ceyhan Oil Pipeline	Caucasus: Azerbaijan, Georgia, Turkey + private sector	<ul style="list-style-type: none"> • \$125 million IFC loan • \$125 million IFC-syndicated loans • IBRD TA loan to Turkey (pipeline feasibility study) • IDA TA loan to Georgia (capacity building)
South America		
Bolivia-Brazil Gas Pipeline	Bolivia, Brazil + private sector	<ul style="list-style-type: none"> • \$130 million investment loan • Partial Credit Guarantee for \$180 million
South Asia		
Indus Waters Treaty (1960)	India, Pakistan	<ul style="list-style-type: none"> • WB-arranged development fund (raised \$893.5 million) • World Bank responsible for dispute resolution and a court of arbitration.
Southeast Asia		
Greater Mekong Sub-region Program (including Nam Theun 2)	Cambodia, China, Lao PDR, Malaysia, Myanmar, Thailand, Vietnam	<ul style="list-style-type: none"> • WB financed initial study • A GEF grant
Africa		
Southern Africa Power Pool	Angola, Botswana, Congo (Dem Rep), Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe	<ul style="list-style-type: none"> • \$440 million in investment support: planned (some loans already active)
West Africa Power Pool	Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo	<ul style="list-style-type: none"> • West Africa Power Market Development Project (two loans approved, more planned)
West African Gas Pipeline	Benin, Ghana, Nigeria, Togo + private sector	<ul style="list-style-type: none"> • IDA Credit and IDA Partial Risk Guarantee planned • MIGA breach of contract insurance Global Gas Flaring Reduction Initiative grant
Chad-Cameroon Petroleum Pipeline	Chad, Cameroon + private sector	<ul style="list-style-type: none"> • IDA Credits to Chad and Cameroon IFC: \$100 million A and \$100 million B loan) • Funding for capacity-building of over \$40 million

Nile Basin Initiative (cooperative water resources management, including power generation among other aspects)	Burundi, Congo (Dem Rep of), Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda	<ul style="list-style-type: none"> • IDF grant for capacity and institutional building • ESMAP scoping study • IDA \$35 million for Ethiopia-Sudan transmission interconnection Project
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Appendix 3

Electricity Tariffs in South Asia

The latest available tariff information for each country of the South Asian Region has been collected and reviewed and the key elements are presented here. Most of them have lifeline rates and increasing block tariffs for households. Most countries charge the industrial consumers and commercial consumers a tariff generally higher than that for households even when such consumers draw power at medium and high voltages. Finally in a majority of cases the average revenue collected per kWh is significantly lower than what one might expect from the rates notified for various categories of consumers on account of theft of power and inefficient metering, billing and collection practices.

Afghanistan

Tariffs in Afghanistan are location specific depending on the relative costs of imports or local supply. They are highest in areas served by local diesel fired small generating units and lower in areas which receive domestically generated hydropower. In the areas which depend mainly on imported power they are in between. In the areas served by hydropower the households are divided into three blocks. Households in the first block consume less than 300 kWh per the billing cycle of two months. In the second block the consumption is between 301 and 700 kWh. Households of the third block consume 701 kWh or more. In FY 2005 it was estimated that the average tariff covered less than 50 percent of the cost of supply.

Table A3.1: Tariffs in Afghanistan Effective January 31, 2006 (cents/kWh)

Provinces	Households			Industries	Others
	Block 1	Block 2	Block 3		
With hydropower supply (10 provinces such as Kabul, Kandahar, Helmand)	3.00	8.00	12.00	12.0	20.0
With imports from Uzbekistan (Bulkh province)	6.00	6.00	6.0	12.0	16.0
With imports from other countries (7 provinces such as Heart, Nimroz, Kunduz)	4.0	4.0	4.0	12.0	12.0
With supply from local diesel fueled generators. Tariffs among provinces vary as a function of diesel cost and size (12 provinces such as Ghazni, Khost, Uruzgan)	36.0 To 62.0	36.0 To 62.0	36.0 To 62.0	36.0 To 62.0	36.0 To 62.0

Source: DABM records. Note: Exchange rate US 1 = 50 Afghani

Bangladesh

The overall weighted average tariff/kWh covering the retail sales of BPDB, DESA and DESCO has gone up from Tk 2.8 in FY 2000 to Tk 3.4 by FY 2006. However the tariff has fallen in terms of dollar equivalent during the same period from 5.4 cents to 5.2 cents.⁸³ The last notable tariff revision was in September 2003. Since then fuel costs and other costs have increased and BPDB and DESA are making significant losses. Households have three blocks and industrial tariffs are by voltage of supply (see table A3.2).

⁸³ Final Report of June 2006 by Nexant produced under TA No.4379-BAN: Power Sector Development Program II of the Asian development Bank, Manila available at www.adb.org

Table A3.2: Tariffs for Select Category of Consumers in Bangladesh

Consumer Category	Sub- Category	Tariff in cents/kWh
Households	Monthly consumption below 100 kWh	4.16
Households	Monthly consumption 100-400 kWh	5.00
Households	Monthly consumption above 400 kWh	8.33
Irrigation		3.06
Commercial consumers		8.40
Small Industrial consumers	Low voltage	6.38
Industries and others	Medium voltage 11 kV	6.03
Industries and others	Medium voltage 33 kV	5.68
Industries, others and for DESA	High Voltage 132 kV	3.53
Supply to rural electric cooperatives	Medium Voltage 33 kV	3.41
Supply to DESCO	Medium Voltage 33 kV	3.62

Source: Tariff schedule available at www.bpdb.org.bd Exchange Rate: \$1= TK60

Peak and off-peak rates are available for large consumers. Peak rates are 40% to 80% higher than the regular tariffs, while the off-peak rates are about 15% to 20% lower.

Bhutan

Electricity tariffs were revised last on July 1, 2006. Bhutan exports power to India at 4.65 cents/kWh, while the same generating plants sell power to Bhutan Power Corporation at 0.78 cents. The retail tariffs of BPC are summarized in table A3.3.

Table A3.3 : Retail Electricity Tariffs in Bhutan

Consumer Category	Demand charge \$/kW/month	Energy charge Cents/kWh
Households with a monthly consumption up to 80 kWh	-	1.52
Households with a monthly consumption of 81-200 kWh	-	2.61
Households with a monthly consumption exceeding 200 kWh	-	3.15
For supply at 6.6 kV/11 kV/ 33 kV	1.17	2.71
For supply at 66 kV and above	1.17	2.61

Source: www.bpc.com.bt Exchange Rate : \$1= Nu 45.98 (as of July 1, 2006)

Nepal

The average revenue /kWh realized by NEA in Nepal for FY 2006 was 8.79 cents. Even at this tariff NEA was making a loss of \$33.5 million in that year. Tariffs for select retail consumers are summarized in Table A3.4 below:

Table A3.4: Retail Electricity Tariffs in Nepal

Consumer Category	Demand charge \$/kW/month	Energy charge Cents/kWh
Households with a monthly consumption up to 20 kWh		5.4
Households with a monthly consumption of 21-250 kWh		9.9
Households with a monthly consumption exceeding 250 kWh		13.4
Industries at low voltage	1.22	8.9
Industries at medium voltage	2.57	8.0
Industries at high voltage	2.37	6.2
Commercial at low voltage	3.01	10.4
Commercial at 11 kV	2.89	10.3
Commercial at 33 kV	2.89	10.0

Source: www.nea.org.np Exchange Rate: \$1= NRs 74.84

For the larger consumers peak and off-peak tariffs are available. The peak tariff is about 14% to 15% higher and off-peak tariff is about 30 lower than the regular tariff. Notably lower tariffs are provided for irrigation, water supply, and transport. Further a 10% is given to those in the government approved industrial districts and a 25% discount is given to hospitals and health centers.

India

India has a large number of states and union territories each of which has a regulatory body and its own schedule of electricity tariffs. The Central Electricity Authority (CEA) has computed that in FY 2004 the overall average revenue /kWh realized in the country was about 4.4 cents compared to the overall average cost of supply of 5.2 cents at the exchange rate of Rs 45.98 to a dollar. For each of the states and union territories, the CEA has also computed the cost per kWh for a range of consumers taking into account the tariff parameters such as capacity charge, energy charge, electricity tax and other applicable taxes as well as load profiles. This information for select consumers in five states of India is given in Table A3.5 below. They relate to the tariffs prevailing in FY 2006

Table A3.5: Tariffs (Cents/kWh) for Select Consumers in Select Sates of India

Typical Consumer Categories with monthly consumption of electricity in kWh	Cost to the consumer/kWh in Cents				
	Delhi	Tamil Nadu	Gujarat	West Bengal	Andhra Pradesh
Household 100 kWh/month	6.03	2.61	8.52	4.75	5.19
Household 400 kWh/month	7.54	4.70	11.23	6.51	8.63
Household 1000 kWh/month	9.45	5.86	12.80	8.02	10.71
Commercial consumer 300 kWh/month	10.04	13.09	12.81	7.89	13.03
Commercial consumer 1500 kWh/month	11.42	13.21	13.62	11.44	13.59
Commercial consumer 7500 kWh/month	11.42	13.24	13.76	13.01	13.7
Agricultural pump sets (5 HP) 1000 kWh/month	NA	0.00 (free)	1.26	4.15	0.52
Industry 7500 kWh/month	12.18	10.58	10.13	10.91	9.91
Industry 4.38 GWh/month	12.19	10.06	12.12	9.62	9.10
Industry 8.76 GWh/month	11.90	9.83	12.11	9.62	8.87
Railway Traction 25 GWh/month	11.25	11.45	11.94	9.87	9.14

Source: www.cea.nic.in

Tamilnadu, Punjab and Pondicherry provide free power for all agricultural pump sets. The structure of tariff does not reflect the structure of costs for supply at different voltages. The over all average revenue per kWh is very low on account of high level of theft and inefficient metering, billing and collection.

Pakistan

According to the power wing statistics of WAPDA for FY 2006, average sale price/kWh was 3.99 Rs/kWh (6.65 USc/kWh) for WAPDA and 4.59 Rs/kWh (7.65 USc/kWh) for KESC.⁸⁴ In February 2007, NEPRA determined new tariffs for the eight WAPDA distribution companies, with end-user tariffs being different across the companies. The government, however, notified different end user tariffs which are the same for all eight

⁸⁴ At the exchange rate of PRs 57.57 to a dollar prevailing then

companies and generally lower (or the same for some companies and consumer categories) than NEPRA-determined tariffs. The difference between the two sets of tariffs – those determined by NEPRA and the ones notified by the government (which the companies are allowed to charge to consumers) -- will be paid by the government budget to the companies as subsidies to consumers. Table A3.6 shows tariffs *notified* by the Government (the table is not exhaustive, as there are some additional consumer categories not included for simplicity).

Table A3.6: Electricity Tariffs in Pakistan

Category of Consumer	Fixed Charge \$/kW/month	Energy charge cents/kWh
Households 0 to 50 kWh/month		2.33
Households 0 to 100 kWh/month		4.42
Households 101-300 kWh/month		6.06
Households 301 to 1000 kWh/month		10.25
Households above 1000 kWh/ month		12.35
Commercial for peak loads up to 20 kW		12.47 to 12.68
Commercial for peak loads exceeding 20 kW	\$4.45	7.65
Industrial low voltage		9.37
Industrial medium and high voltage	\$5.67 to \$5.87	5.25 to 8.35
Agricultural Tube wells in Punjab and Sindh	\$1.46	5.47
Railway Traction		9.48

Peak and off-peak tariffs are available for large industrial consumers and bulk supply. Assuming consumer mix as in FY06 and projected sales for FY07, average end-user tariff notified by the Government is estimated to be 4.26 Rs/kWh (7.1 USc/kWh), while average NEPRA-determined tariff is estimated at 5.12 Rs/kWh (8.53 USc/kWh) and ranges from 4.66 Rs/kWh (7.77 USc/kWh) for Islamabad distribution company to 7 Rs/kWh (11.7 USc.kWh) for Hyderabad distribution company (serving Sindh province, except Karachi).

Sri Lanka

The average revenue/kWh (excluding value added tax) for Sri Lanka was reported at 7.57 cents for 2004.⁸⁵ Despite this CEB had negative 4.86% rate of return on its average net fixed assets in operation and a negative debt service ratio. Salient details of the tariffs in effect from September 1, 2006 are summarized below using the average exchange rate of for 2006 indicated in the website of the Sri Lankan Central Bank.

All rates are subject to a fuel adjustment charge of 20% except in the case of households and religious institutions consuming less than 90 kWh per month. Religious consumers pay a rate lower than households.

⁸⁵ At the exchange rate of LkRs.101.1884 to a dollar the average rate for 2004 as reported at www.cbsl.lk

Table A3.7: Electricity Tariffs in Sri Lanka

Consumer Category	Fixed Charge \$/month	Demand Charge \$/ kVA/ month	Energy Charge Cents /kWh
Households 0-30 kWh/month	0.58	-	2.89
Households 31-60 kWh/month	0.87	-	4.52
Households 61-90 kWh/month	1.16	-	4.91
Households 91-180 kWh/month	1.74	-	11.64
Households above 180kWh/month	2.32	-	16.64
Industrial low voltage contract demand up to 42 kVA	2.32 to 4.81	-	8.18
Industrial/hotel low voltage contract demand above 42 kVA	28.86	3.85	7.79
Industrial/hotel at 11kV/33kV/132kV	28.86	3.66	7.70

Source: www.ceb.lk Exchange Rate: \$1= LkRs 103.9623 (average rate for 2006)

Appendix 4

Benefits of Electricity Trade At a Glance -- Some Illustrative Numbers

Country	Details
Afghanistan	Imported 430.12 GWh of electricity or 27% of total supply in FY 2006. Marginal cost of electricity was 22 cents, while the average import cost was 2 cents. Savings to economy amounted to \$86.02 m (or 1.2% of GDP in 2005 of \$7.3 billion).
Bangladesh	Bangladesh sheds loads at around 694 MW in FY 2004. The unserved energy amounted to 3,900 GWh valued at \$171 million on the basis of the system AIC of 4.38 cents/kWh and substantially more when valued at the system marginal costs. Bangladesh marginal price during the peak period is estimated at Tk2.03/KWh (2.8 cents) in the east zone and Tk 11.642(16 cents) in the west zone. By linking west zone with the eastern regional grid of India which has an energy surplus, Bangladesh can hope to lower the marginal cost in west zone substantially. Conversely gas supply to west zone could be stepped up across river Jamuna to set up large plants (1000 MW) in the West zone partly to meet the demand in WZ(600 MW) and to lower the marginal cost there (from 16 cents to about 4-5 cents or even lower) and to export power to India (400 MW or 2453 GWh at 4.7 cents/kWh and earn \$115.3 million annually).
Bhutan	Exports in FY 2007 amounted to 5664 GWh @ 4.65 cents/kWh. Export receipts at \$263.4 million would be equal to 24 to 25% of GDP. Tala capital cost was \$1082 million or a little over 100% of the country's GDP
India	The energy shortage in FY 2007 was 54,916GWh valued at the marginal cost of Rs 9.3 or (22 cents) is equal to \$12.082 billion (valuation by CERC). If it gets imported electricity at 6 to 7 cents and imported gas based electricity at 8 to 9 cents, the saving would be of the order of \$7.7 billion. On the basis of recently received bids in the ICB for Ultra mega projects, the levelized cost of power from the new 3500-3800 MW power stations using domestic coal from captive coal mines would be 2.85 cents/kWh and the cost of power from a similar size power station based on imported coal would be 5.45 cents per kWh. Cost of power from most large hydro projects recently constructed or are under construction is around 3.5 to 6 cents/kWh. Gas based generation using gas at \$7/mmbtu will cost 9.25 cents/kWh. These figures give a flavor of the attractiveness of the Indian market for exporters and the likely volume of benefits to India from trade.
Nepal	West Seti HPP: Capital cost \$1,098 million, exports to India 2970 GWh (90% of production) @4.95 cents/kWh valued at \$147 million (or 2% of GDP). Upper Karnauli, Buri Gandaki, and Arun 3 HPPs with a total capacity of 1302 MW could possibly export 4562 GWh (at 40% PLF) at 6 cents/kWh. Value \$274 million or 4% GDP. All four projects will yield export earnings of 6% of GDP WS HPP cost alone amounts to 15% of GDP of the country. This would be a significant investment benefit.
Pakistan	Unserved energy in FY 2007 amounted to 17,704 GWh and may rise to over 27,000 GWh by FY 2010 and to 35,000 GWh by FY 2011 if no capacity is added. When valued at the assumed Pakistan system average incremental cost of about 7cents/kWh, the cost of these shortages are of the order of \$1.9 billion for FY2010 rising to \$ 2.5 billion for FY2011. Power and gas imports could help reduce these shortages significantly. In general new IPP projects are expected to have a levelized tariff of 5.9 cents to 13.8 cents/kWh based on the fuel they use. Use of domestic gas results in the lowest and high speed diesel in the highest levelized tariffs. The gas price to IPPs in 2007 is \$4.23/mmbtu and as it rises to match import parity prices of around \$6.8 to \$7/mmbtu, the levelized power tariffs would be higher.

SOUTH ASIA SOUTH ASIA REGION AND ADJACENT COUNTRIES

- ENERGY FLOWS:**
- ELECTRICITY
 - NATURAL GAS
- PROSPECTIVE VOLUME:**
- ↑ LOW
 - ↑ MEDIUM
 - ↑ HIGH
- SELECTED CITIES
 - ⊙ NATIONAL CAPITAL
 - MAIN ROADS
 - RIVERS
 - - - INTERNATIONAL BOUNDARIES

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