

DEVELOPMENT OF ELECTRICITY TRADE IN CENTRAL ASIA – SOUTH ASIA REGION¹

A. INTRODUCTION

Geography and history have either linked or separated South Asia from its north-western neighbors of Central Asia and Iran, depending on the historical context and perspective. Obstacles to integration frequently proved difficult to overcome and separating forces dominated more often than not, especially during recent times. In the energy sector, this is reflected in an almost complete absence of energy infrastructure linking the two regions, despite strong complementarities in energy resource endowments and in the balance and pattern of energy production and consumption, which give rise to significant but unexploited opportunities for energy trading and integration across these regions.

Afghanistan is a key country between Central and South Asia, and its ability to be a bridge between them is critical to development of any form of inter-regional cooperation, including in the energy sector. History has not been kind to Afghanistan, which is one of the least developed countries in the world, with a distorted economy heavily dependent on opium and basic agricultural production, weak institutions, and poor governance. Today there is an opportunity to overcome the legacy of the past and reverse the vicious circle of political violence and economic regression, into accelerated economic development and political stabilization. This will require a concerted effort of Afghanistan's people, politicians and entrepreneurs, international donors, and Afghanistan's neighbors. While the obstacles are formidable, there is a rare degree of alignment of interest and shared objectives between the country and its neighbors in creating a politically stable and economically more prosperous Afghanistan, contributing to political stabilization and economic development in the broader region of Central and South Asia. The country and the region should take advantage of this opportunity.

The alignment of regional interests and win-win opportunities for trade and cooperation should be particularly strong in the energy sector. Afghanistan links the areas of energy surpluses (Central Asian Republics and Iran) with those of energy deficit (Pakistan and India). Thus, it is in a position to facilitate regional energy trade, especially in natural gas and electricity, for the benefit of the region, as well as derive significant gains for its own economy from energy imports and transit.

This paper examines what these opportunities are and how they can be exploited, with particular focus on expansion of *electricity* trade. Section B presents a brief background on the region's energy sector, focusing on the elements most relevant for development of regional trade. Section C describes some bilateral electricity trade opportunities, with particular attention on Afghanistan, while Section D discusses opportunities for and challenges of multilateral trade. Section E offers some concluding remarks and recommendations.

¹ This paper has been prepared by Vladislav Vucetic and Venkataraman Krishnaswamy with inputs from William Byrd (on the structure of the paper) and Julia Fraser (on data and country details). The views expressed are those of the team and should not be attributed in any manner to The World Bank, its affiliated institutions, its Executive Board of Directors, or the governments they represent.

B. ELECTRICITY DEMAND AND SUPPLY, DISTRIBUTION OF ENERGY RESOURCES AND POTENTIAL FOR TRADE

B.1 Electricity Deficit in South Asia

South Asia is home to about 1.5 billion people and has one of the fastest growing regional economies in the world. India, the region's dominant economy, is targeting annual GDP growth of 10% and the growth rates of Pakistan and Bangladesh – the two largest countries after India – exceed 7%. Electricity demand in all three countries, and in the region as a whole, is outstripping supply. Afghanistan, Pakistan and India, the countries closest to Central Asia and Iran, are all looking for imports of gas and electricity as long term options for their energy supply mix.

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. Access to public electricity supply is limited to about 16% of the population (See the Annex for the status and dimensions of Afghanistan's power sector). Estimated unsuppressed demand at 363 MW outstrips the available capacity of about 270 MW and relentless daily load shedding has become inevitable. Supply shortages are so severe that even in Kabul supply is available for only a few hours a few days per week in the winter, with only marginal improvements during the rest of the year. In the first eight months of 2006, electricity imports 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%². 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 extension³.

Pakistan's peaked demand now exceeds 14,000 MW. Installed generation capacity is about 19,500 MW, of which 33% is hydropower, 65% thermal and 2% nuclear.⁴ The firm available capacity is lower by several thousand megawatts, as the capacity of hydropower plants vary with water availability. Pakistan's growth in electricity consumption has been increasing at a rate faster than the growth in sector investments, which has led to a tightening of the supply-demand balance and appearance of bottlenecks in transmission and distribution networks. Driven by consistent annual economic growth of 6% to 7% in the past four years and forecast growth at about the same rates for the next several years, its electricity demand (at the generation level) is expected to grow at around 7% to 8% per year, increasing to about 20,000 MW by FY 2010 and to about 44,700 MW by FY 2020.⁵ The country is already experiencing supply deficit during the peak demand periods. Firm power shortage of about

² Power Sector Master Plan, Transitional Islamic State of Afghanistan, October 2004; prepared by Norconsult and Norplan.

³ 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.

⁴ Pakistan's fiscal year ends on June 30; FY05 denotes the year ending on June 30, 2005.

⁵ Presentation made by WAPDA in the Central Asia/South Asia Electricity Trade Conference, May 8-9, 2006 in Islamabad.

5,500 MW is anticipated by FY 2010 if no capacity is added. In terms of energy, the demand is expected to increase from 85.6 TWh in FY 2005 to over 135 TWh by FY 2011, at an average annual rate of about 7.9%. The existing power plants could generate about 100 TWh. To meet the resulting gap, Pakistan is actively pursuing several options: improvements in supply and demand efficiency, construction of new hydro and thermal power projects in both the public and private sectors, and electricity imports from Central Asia, starting with 1000 MW. If the imports prove reliable and financially competitive, the volumes could increase in the subsequent phases. Pakistan's demand peaks in summer, when Central Asia has large surplus of hydropower, which makes electricity trade between them particularly attractive.⁶ In addition to electricity imports, Pakistan is interested in importing natural gas, since its domestic supply is tightening.

India operates a supply constrained power sector in which the shortage of peaking capacity and energy deficits in FY 2006 were estimated at 11.6% (13,400 MW) and 7.6% (54 TWh) respectively.⁷ Its power system at present has about 124 GW of installed generation capacity, of which 26% is hydropower, 2.5% nuclear, and the rest is thermal technology. The momentum of economic growth anticipated for the medium term is expected to lead to an electricity demand growth of the order of 7% to 8% per annum through the decade. Given the investment and implementation constraints, the capacity and energy deficits are expected to persist and may even worsen to some extent. Indian natural gas reserves and production were estimated at 854 BCM and 32 BCM respectively in FY 2004. Medium to long term forecasts indicate inadequate domestic supply in relation to rapidly growing demand. In this context the country's options for supply augmentation clearly include natural gas and electricity imports from cost effective and reliable sources.⁸

B.2 Electricity and Gas Surpluses in Central Asia and Iran

Kazakhstan, Kyrgyz Republic, Uzbekistan and Tajikistan, which presently constitute the Central Asian Power System (CAPS),⁹ 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 1.

In these countries, access to electricity is practically 100%. 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.¹⁰ 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

⁶ Although Pakistan's electricity consumption peaks in summer, it experiences supply deficit in winter as well, when natural gas is diverted from electricity production to households. Thus, Pakistan is interested in year-round electricity imports.

⁷ These are estimates by the Central Electricity Authority of India.

⁸ Report of the Expert Committee on Integrated Energy Policy, Planning Commission of India, August 2006.

⁹ 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.

¹⁰ 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.

electricity to meet the forecast demand and leave substantial surpluses for export. Presently the surpluses are on 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.

For these countries in general, and for Tajikistan and Kyrgyz Republic in particular, export of electricity 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.

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.

Box 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, which operate predominantly hydroelectric power systems, have large surplus generation in spring and summer (available for export) and 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.¹¹ 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.

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

¹¹ 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).

areas from Turkmenistan are substantial (230 GWh), and there are small exports to Afghanistan (17 GWh) and Pakistan (47 GWh).¹²

B.3 Energy Resources and Trade Opportunities

Table 1 shows endowments of energy resources in the seven countries of the region.

Table 1: Energy Resource Endowment of the Region

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
Turkmenista	<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. <u>Production:</u> 150,000 bbl/day	<u>Reserves:</u> 66.2 TCF <u>Production:</u> 2.07 TCF/yea	<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 mill. Tons	<u>Potential:</u> 42,000 MW <u>Developed :</u> 2, 000 MW
Pakistan	<u>Reserves:</u> 28.8 million bbl <u>Production:</u> 60,000 bbl/ Day	<u>Reserves:</u> 26.83 TCF <u>Production:</u> 0.84 TCF/yea	<u>Reserves:</u> 185 billion Tons <u>Production:</u> 3.3 mill. Tons	<u>Potential:</u> Over 30,000 MW <u>Developed:</u> 6,500 MW
Afghanistan	<u>Reserves:</u> 100 million bbl <u>Production:</u> NA	<u>Reserves:</u> 5 TCF <u>Production:</u> NA	<u>Reserves:</u> 100 million Tons <u>Production:</u> NA	<u>Potential:</u> Modest ¹⁴ <u>Developed :</u> 262 MW

Source: World Bank documents and US DOE Country Briefs

¹² Data relate to 2003. For more recent data see Annex 2.

¹³ 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.

¹⁴ According to the Power System Master Plan of the country, the theoretical hydroelectric potential is believed to be 25,000 MW, of which more than 20,000 MW is on the Pyanj and Amu Darya rivers along the border between Afghanistan, Tajikistan and Uzbekistan and would call for inter-governmental water sharing agreements. Potential within the country is also complicated by irrigation priorities. Capacities studied for possible development in the foreseeable future probably total less than 800 MW.

The differences in the endowments and the historical development of energy resources, resulting in the surpluses of the electricity (and gas) in Central Asia and Iran and in the deficits in the adjacent South Asian countries, provide the basic rationale and the opportunities for an economically sound regional trade in electricity and gas. These opportunities, also potentially extending to India, are depicted in Figure 1.

Leaving aside oil, which is traded globally, of particular interest for regional energy trade are endowments of natural gas, hydropower, and coal, which can be traded directly (especially natural gas) or indirectly, through electricity (all three forms). Turkmenistan and Iran have significant natural gas resources and are looking for diversification of their export markets. Uzbekistan also has large gas reserves which it can potentially export (directly or through gas-based electricity exports), while Tajikistan and Kyrgyz Republic are looking for export markets for their hydropower based electricity production. Kazakhstan is rich in hydrocarbons, but its very competitive electricity production based on large fields of open pit mined coal can be of particular interest. As already mentioned earlier in this section, Afghanistan, Pakistan, and India – listed in the increasing order of their needs and export market size – are all interested in both electricity and gas imports. Their geographic proximity to Central Asia and Iran and their market size (especially India's) should make them attractive partners to the exporting countries, although they will compete against other potential import markets¹⁵.

B.4 Barriers and Risks to Energy Trade

Electricity can be traded only through physically interconnected electricity networks. Trading natural gas through integrated gas pipeline networks is also more economic up to certain, sufficiently large, distances. The absence of such integrated gas and electricity infrastructure between Central and South Asia is both a constraint to trade and an indication of the problems which have prevented development of trade in the past. One of the main problems has been the political and security fault line between the two regions, with Afghanistan being the main part of it. Thus, improving the security conditions in Afghanistan is a key component of the strategy for promoting regional energy trade. Other regional disagreements and conflicts, such as between India and Pakistan, complicate efforts to enhance energy trade, although common interest in pursuing regional energy projects may contribute to overcoming the conflicts. The lack of effective multilateral institutions, in spite of the multitude of regional organizations with various groupings, and limited track record and opportunities to develop mutual trust make overcoming regional political challenges more difficult.

National policies toward energy security have significant impact as well. Whether regional energy trade is seen as contributing to the energy security through diversification and cost reduction or as reducing the energy security by creating dependencies and disruption risks will be critical to trade development. The countries, generally, would need to overcome the inclinations toward self-sufficiency as a synonym for energy security at the expense of trade.

In addition to the lack of cross-regional infrastructure, there may be bottlenecks in the national transmission networks of the Central Asian countries which would need to be removed to enable significant transit of electricity to South Asia. Similar constraints exist in the transit and importing countries, especially in Afghanistan. The ability of national systems to coordinate dispatch, maintain voltages and frequency, keep the international flows within the prescribed contractual limits, and maintain stability of the interconnected systems would need to be upgraded as well.

¹⁵ Natural gas will increasingly be traded globally in the liquefied form (Liquefied Natural Gas -- LNG). Turkmenistan is exporting its current gas surplus to Russia, but may be eager to diversify. Iran, in addition to LNG exports, may supply gas through pipelines to Europe, Pakistan, India, and perhaps even China. Potential markets for electricity exports from Central Asia include China and Russia.

There are other barriers, such as poor commercial performance of the national utilities in the region. This is caused by a number of factors -- the prevalence of tariff regimes which do not recover supply costs and which distort price signals; operational inefficiencies; tolerance of non-payments (often from the governments); etc. Electricity sectors in the region have traditionally been used as an element of social policy and an extension of fiscal instruments, especially when hard constraints were imposed on governments' budgets. In spite of the general move toward commercialization, the remnants of such use of the sector are still strong. The common effect of these factors is poor liquidity and ability of the utilities to pay for imports. Such payments may need to be guaranteed by the governments and possibly enhanced by risk mitigation instruments of international financing organizations. Involvement of credible, creditworthy private investors could help mitigate these risks.

Reliability and quality of domestic electricity supply is another potential constraint to trade. It would be difficult to sustain exports in the face of domestic shortages. Similarly, export prices would need to be consistent with the pricing in the domestic markets in order to be economically non-distorting and politically sustainable. Lower priced exports relative to the domestic supply would be resisted by domestic consumers.

The existing trading contracts (within Central Asia, between Central Asian countries and Afghanistan, between Iran and Afghanistan and Iran and Pakistan) are typically short-term (annual) deals, arguably as much -- if not even more -- influenced by politics as they are by commercial elements. This makes them strongly susceptible to the political forces and difficult to rely on for medium and long term planning. Independent regulation of the sector is a relatively new concept in this part of the world and has a long way to go to become a well established practice, even in the countries which have instituted "independent" regulatory agencies. The absence of longer term contractual arrangements and stable regulatory regimes with established track record create risks which need to be mitigated.

Riparian disputes or lack of agreements regarding the development and use of shared river basins dampen the efforts to promote electricity trade. Regional projects, on the other hand, could spur developments of such agreements and resolution of the disputes.

A number of other, "soft" constraints are present in varying degrees: governance arrangements and practices; the capacity to develop and implement sectoral policies; the capacity to prepare, negotiate, implement and enforce more complex multi-country arrangements and deals; corruption; red tape; internal procedures; etc., all come into play.

C. BILATERAL ELECTRICITY TRADE

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. A certain level of bilateral trade exists among the five countries of Central Asia, as well as between Central Asia and Iran (Turkmenistan-Iran). Cross border electricity trade between these countries and the countries of South Asia has also started to develop and expand, although the volumes are still relatively small. As shown in Figure 2, Pakistan is importing electricity from Iran and Afghanistan is importing electricity from all four of its northern and western neighbors.

C.1 Pakistan – Iran Bilateral Electricity Trade

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).¹⁶

C.2 Afghanistan's Bilateral Electricity Trade with Neighboring Countries

Afghanistan imports modest quantities of electricity from Iran, Turkmenistan, Uzbekistan and Tajikistan through existing interconnections, which have rather limited transfer capacity. Such imports play a significant role in stabilizing the sector operations in the country. The import volumes have risen from 283 GWh in FY 2005 to 430 GWh in FY 2006.¹⁷ In the first three months of FY 2007 they have already reached 126 GWh. Details of the existing interconnections, new interconnections with larger transfer capacity proposed or under construction, imports from each of the four countries mentioned above, and the prospects for further increases in these imports are outlined in the Annex.

The war damaged and dilapidated power sector assets need extensive rehabilitation and refurbishment in order to operate reliably. Short to medium term strategy adopted for Afghan power sector involves:

- (a) the rehabilitation and reinforcement of the existing transmission links to enable the immediately needed volume of power imports from Iran and Central Asian countries;
- (b) rehabilitation of Afghanistan's own generation, transmission and distribution assets;
- (c) interconnection of the presently isolated systems in the north and east to create the North East Power System (NEPS) by 2008-09 to improve supply reliability and coverage and to bring imported supplies down to the Kabul-Jalalabad area; and
- (d) building higher-voltage transmission links to Central Asian neighboring systems and Iran to increase the volume and reliability of electricity imports.

Given its geographic location as a transit country between the eastern and western parts of the Central Asia/South Asia region, strengthening the integrity and reliability of Afghanistan's power/energy sector (and its economy in general) and making it solvent and sustainable is key to the development of regional energy trade. Such development is, clearly, in the interest of Afghanistan, but also in the interest of its neighbors. Assistance to Afghanistan to increase its bilateral electricity trade would help its energy/power sector develop faster by enabling the greater use of the available scarce resources for development of the transmission and distribution systems, expanding the country's electricity access and customer base. The expansion of imports as a key component of supply also implies added internal compulsion to improve the commercial performance of the sector to secure the solvency and financial liquidity to pay for the imports. This in turn provides the rationale and motivation for the allocation of

¹⁶ 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.

¹⁷ In Afghanistan FY 2005 denotes the fiscal year ending on 20 March 2005.

internal and external resources for the development of the institutional capacity, necessary for sound commercial performance and for managing trade. There is immense scope and urgency for such efforts in the Afghan power sector (see the Annex). Several bilateral and multilateral donors thus focus on support to the development of electricity import infrastructure and institutional improvements in Afghanistan.

Stabilizing Afghanistan politically and economically, inter alia, through stabilization of its power systems would also have a favorable effect on the adjoining fragile border areas in Balochistan and NWFP in Pakistan. Provision of electricity to the western part of Balochistan through imports from Iran also serves the same purpose.

The electricity trade between Afghanistan and its western and northern neighbors is commercially still in the early stages of evolution. It would appear to be based on inter-governmental ad hoc agreements rather than on fully fledged commercial supply/purchase contracts. Progress is being made to evolve utility to utility contracts which spell out the type of supply, metering and billing arrangements and establishing coordinating groups to resolve problems and differences as they arise. Negotiations for the volume of supply and price still appear to be an annual event in many cases. Enforcement mechanisms in the event of failure to supply or failure to receive power or failure to pay the invoice need also to improve to commercial standards. In the past there had been some cases of suspension of supply for nonpayment. Donors have provided consultant assistance to the Afghan government to move the transactions to a more commercially standard format and strengthen the capacity of the relevant Government agencies and DABM (Afghanistan national power utility). Key elements for further attention would include:

- Identifying and incorporating the technical and operational improvements needed on the Afghan side to move away from the imports in an “island mode” to electricity trade through interconnected, “synchronized” networks;
- Pursuing steps on a priority basis to improve the liquidity and solvency of DABM and its ability to make timely payments for imports. Such steps would include much better containment of power theft, improvements in metering, billing and collection to utility standards, adjusting tariffs to cover supply costs, and improving the finance, accounts and internal control functions of DABM;
- Ensuring that the most recent commendable tariff increases translate into actual higher revenues for DABM through urgently needed improvements in billing and collection, including control of corruption in these activities; and
- Sorting out the technical problems of imports from Turkmenistan which does not operate synchronously with the Central Asian Power System. This will assume importance when the NEPS is extended to cover Mazar-e-Sharif which will have interconnections to the Tajik, Uzbek and Turkmen systems.

It is possible that private trading companies may enter the business of exports of electricity from Central Asia, as they could gather the available surplus of hydro power and thermal power from two or more countries and offer firm power contracts backed by adequate reserves. In order to facilitate this and deal with them effectively, the institutional framework and regulatory arrangements in Afghanistan need to be developed in the medium term. Involving private sector in development and management of Afghanistan’s power system could significantly contribute to its commercialization and accelerate its regional integration.

The experience gained in placing the bilateral power import regime on a clear commercial basis will come in handy when a Central Asia-South Asia power trading regime emerges and when Afghanistan may have an opportunity to earn valuable transit revenues and be an effective partner in that regime.

Afghanistan could, in principle, strengthen electricity supply to its eastern and southern areas through cross-border imports from Pakistan. Such interconnections have been studied by Pakistan's power utility (WAPDA) and several potential extensions of Pakistan's power grid into Afghanistan's border areas have been identified. However, the security concerns in the border areas between the two countries have prevented development of these projects.

D. MULTILATERAL ELECTRICITY TRADE

Bilateral electricity trade, while very important per se and a fundamental pre-requisite for developing regional cooperation, has its limitations and does not allow for exploiting full regional potential. For this, a multilateral framework is needed. There are many examples in the world where such multilateral framework has developed. The Energy Charter Treaty¹⁸, which has a broad membership, is one example of an instrument providing a broad multilateral framework. Even if trade is commercially based on bilateral contracts which could involve non-adjacent states, there is a need to deal with transit issues and interconnected operation of more than two systems, and thus the need for a multilateral agreement for technical and commercial coordination. The Union for Coordination of Transmission of Electricity (UCTE) in continental Europe is such an example¹⁹. Once the physical connections and operating rules are in place, commercial arrangements can also include more complex multilateral forms, such as exchanges and pools (Nordpool in the Nordic countries or the South Africa Power Pool, for example).

¹⁸ 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. For further details, see www.encharter.org.

¹⁹ The "Union for the Coordination of Transmission of Electricity" (UCTE) is the 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

D.1 Multilateral Trade in Central Asia

A form of multilateral trade existed also among the Central Asian Republics during the time of the Soviet Union, when the power systems of the five countries (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 the trade declined by about 68% during the 1990s, from about 25 TWh to about 8 TWh. Although this decline came for a variety of reasons – such as a dramatic decline in electricity demand, the use of barter of electricity for fossil fuels in the initial stages, the rise of traded fossil fuel prices to world levels and the stagnation of electricity prices – important reasons for the decline included the breakdown of the traditional regional water sharing arrangements and the attendant electricity trading agreements. Clearly there is a need to overcome these impediments and increase the volume of mutually beneficial electricity trading among the member countries of the Central Asian Power System.

D.2 Central Asia – South Asia (CASA) Multilateral Trade

Electricity surpluses of Central Asia are not confined to a single country and cannot be absorbed by *intra*-Central Asia trade or by export to Afghanistan alone. As described in Section B, there is a potential for exports of electricity to South Asia beyond Afghanistan²⁰. Such exports to Pakistan (and, in the subsequent stages, possibly to India) involve several countries and, thus, require development of a multi-lateral framework.²¹

CASA-1000 Project. An effort to develop a first trans-regional electricity trade project has been initiated at the regional conference in Islamabad, in May 2006. The expert-level conference was attended by governments officials and power utilities of Afghanistan, Kyrgyz Republic, Pakistan, and Tajikistan, a number of IFIs and bilateral donors (World Bank, IFC, Asian Development Bank, Islamic Development Bank, and USAID) and interested private sector investors (AES and RAO UES). Pakistan formally expressed its interest in importing 1000 MW of power from Tajikistan and Kyrgyz Republic. 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 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.

²⁰ The economic potential for the Central Asian Republics (CARs) to export significant volumes of electricity to Iran, Russia, Afghanistan, Pakistan and China was initially identified and discussed in the World Bank study, Central Asia- Regional Electricity Export Potential Study, finalized in December 2004.

²¹ Similarly, exports of natural gas from Turkmenistan or Iran to Pakistan and India would involve more than two countries.

This initiative is based on the expectations that the quantities of electricity available for trade (including those available upon completion of several new power plants whose construction had started during the Soviet Union period) and the differences in the cost of electricity between the exporting and importing countries are sufficient to justify the necessary investments in the generation and transmission infrastructure and tolerate the risks associated with such an undertaking. Table 3, adopted from a World Bank study (see footnote 19), presents preliminary estimates of the relevant prices.

Table 3: Comparison of Marginal Cost in the Export Market with Import Costs from CARs (US Cents/kWh)

Target Market	Marginal generation cost in the target Market	Generation Options in 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 Kambarata 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

* See footnote 3.

Note: Computations were made with oil prices at \$30/barrel

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.²² 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 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.

²² 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.

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.
- 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 the Annex 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-Import Bank credits of \$166 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 possibly more -- private trading company set up by investors; possibly other countries joining as well. 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 of how the trade could be structured with multiple sellers (and possibly buyers); who would invest in the transmission infrastructure; who would bear the transmission risk; how the non-payment risks would be handled; how the transmission lines would be planned and operated and by whom; how the transmission capacity would be allocated among the sellers (and buyers); what would be transmission access rules and how they would be administered and overseen; how would the settlement be done; how the potential dispatch conflicts between regional and domestic transactions be handled; etc.
- Risk mitigation strategies: The project would face a number of risks, some of them idiosyncratic, such as the nature and the level of security risks through Afghanistan and innovative risk mitigation strategies may have to be adopted, which would combine 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, the rules for expanding the arrangements to additional players and volumes of trade, etc. 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 undertakings 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.

D.3 Central Asia – South Asia Regional Electricity Market (CASAREM)

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 even India (see Figure 1), 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. A similar market could emerge in natural gas as well.

E. CONCLUSIONS AND RECOMMENDATIONS

The fault line between Central Asia and South Asia has incurred significant economic and political costs for the countries on either side of the line and even globally. It has isolated Afghanistan for decades and suppressed its economic development. It has provided a fertile ground for illegal drug production and fermentation of extremist political ideologies and movements, at the expense of both the Afghani population and the world at large. It has deprived the region from the benefits of integration and movement of people, goods, and ideas. The lack of energy trade across the region is one illustration of these costs.

Afghanistan is at a cross-road and so is the region. The events of the past five years have brought up again a sharp awareness of the problems which the autarky, isolation and poverty could bring. This creates an opportunity for helping Afghanistan to overcome its economic and political woes, which should be in the interest of the country and its neighbors alike. The financial and human resources needed to support this opportunity are considerable, as are the risks, exceeded only by the potential benefits of success and the costs of failure to take action.

Cooperation in the energy sector is an important element of the opportunities for the region. The tangible benefits of the first cross-regional, Central Asia – South Asia, electricity trade project (dubbed above as CASA-1000) could be significant, but the “intangible” ones – the multiplier effects on the non-energy sectors, on the environment for furthering energy cooperation, etc. -- could be much larger.

The general strategy for promoting regional energy trade has two main, mutually supporting directions:

- (i) promoting bilateral trade, especially with Afghanistan, and helping Afghanistan develop its energy sector; and
- (ii) pursuing regional projects which link the stronger energy systems of the Central Asia/South Asia region.

In the electricity sector, the promotion of Afghanistan’s bilateral electricity trade and the Central Asia-South Asia multi-country electricity trade initiative would benefit all stakeholders in a variety of ways. It would enable the Central Asian power utilities to make fuller utilization of their power assets. In the medium term, it would enable Tajikistan and Kyrgyz Republic to achieve electricity export revenues needed to improve sector viability and to pay for the fossil fuel or thermal power imports (needed in winter) from their neighbors. In the longer term it would stimulate their hydropower export-led economic growth. It would help to stabilize the power system of Afghanistan and increase electricity access to its population and upgrades its power system to facilitate regional transit. It would help Pakistan to close the anticipated supply gap in a cost effective manner.

The possibility of substantial electricity exports may strengthen internal incentives to solve water/power issues among the Central Asian countries and achieve – so far elusive -- sustainable water sharing agreements, necessary for the completion of many attractive large hydroelectric projects.

Thus, in several ways the electricity trade initiatives could contribute to the broader objectives of economic cooperation and political stabilization of the region. The cooperation in the electricity sector could help bring the region closer together and become harbinger of a wider integration, encompassing other economic areas.

To succeed in these trading initiatives the countries need sustained strong high level political commitment and support. The countries should involve private investors to help finance, construct, and operate the needed transnational facilities. The financing and risk mitigation instruments, as well as the knowledge sharing, capacity building, and facilitation which international multilateral and bilateral financing institutions offer, could be used to help mitigate the risks to private investors and enable more rapid realization of regional projects.

Key actions at this stage would include:

- Secure for Afghanistan some price stability and commitment to supply over the medium to long term from its Central Asian suppliers and Iran, to the extent that such arrangements have not yet been formalized.
- Support Afghanistan in developing its domestic electricity system; improving services and expanding access (both on-grid and off-grid, perhaps initially through smaller private franchises and on the basis of renewable generation); strengthening domestic generation where economic (rehabilitation of the existing assets, new hydropower and possibly gas generation in the medium to long term); improving the financial performance of the sector; and strengthening the institutional capacity of the Government agencies and power sector enterprises to create a better enabling environment for investors.
- Continue with power sector reforms and investments in all countries in the region, aimed at strengthening customer services, physical infrastructure, financial performance, governance, and policy and regulatory framework and institutions. The power sector reforms in India and Kazakhstan are good examples of such reforms in the region.
- Attract private investors, whose financial resources and managerial, commercial, and technical know-how should help strengthen domestic sectors and develop bilateral and multilateral regional trade projects.
- Continue developing and enhancing bilateral electricity trade.
- Continue pursuing the project for electricity exports from Central Asia to South Asia (Pakistan and Afghanistan), as agreed at the Islamabad and Dushanbe conferences. Special attention should be given to mitigating the transit risk through Afghanistan. The options could include, inter alia:
 - a donor funded revolving trust fund to make initial and periodic payments to an escrow account, which may be set up for this purpose and which may be subsequently funded from the transit fees which Afghanistan would receive in respect of the power flowing to Pakistan;
 - ensuring supply of electricity to the population along the route of the line;
 - enhanced security, surveillance, and rapid-deployment repair crews;
 - appropriate physical design and construction measures.
- In relation to the Central Asia-South Asia initiative, develop a multilateral framework for cooperation, which would deal with institutional arrangements for preparing and implementing the trade project. The framework should be oriented toward attracting private investors and open to expanding the trade, with the aim of creating conditions for development of an integrated region-wide electricity market.
- Consider including other countries early on, if it would help develop and implement the case for multilateral electricity trade (e.g., by improving the seasonal profile and

economics of electricity trade and attractiveness to private investors; strengthening institutional capacity to prepare, negotiate, implement, and enforce the contracts; etc.).

Figure 1: Potential Trade Flows of Electricity and Gas between Central Asia/Iran and South Asia

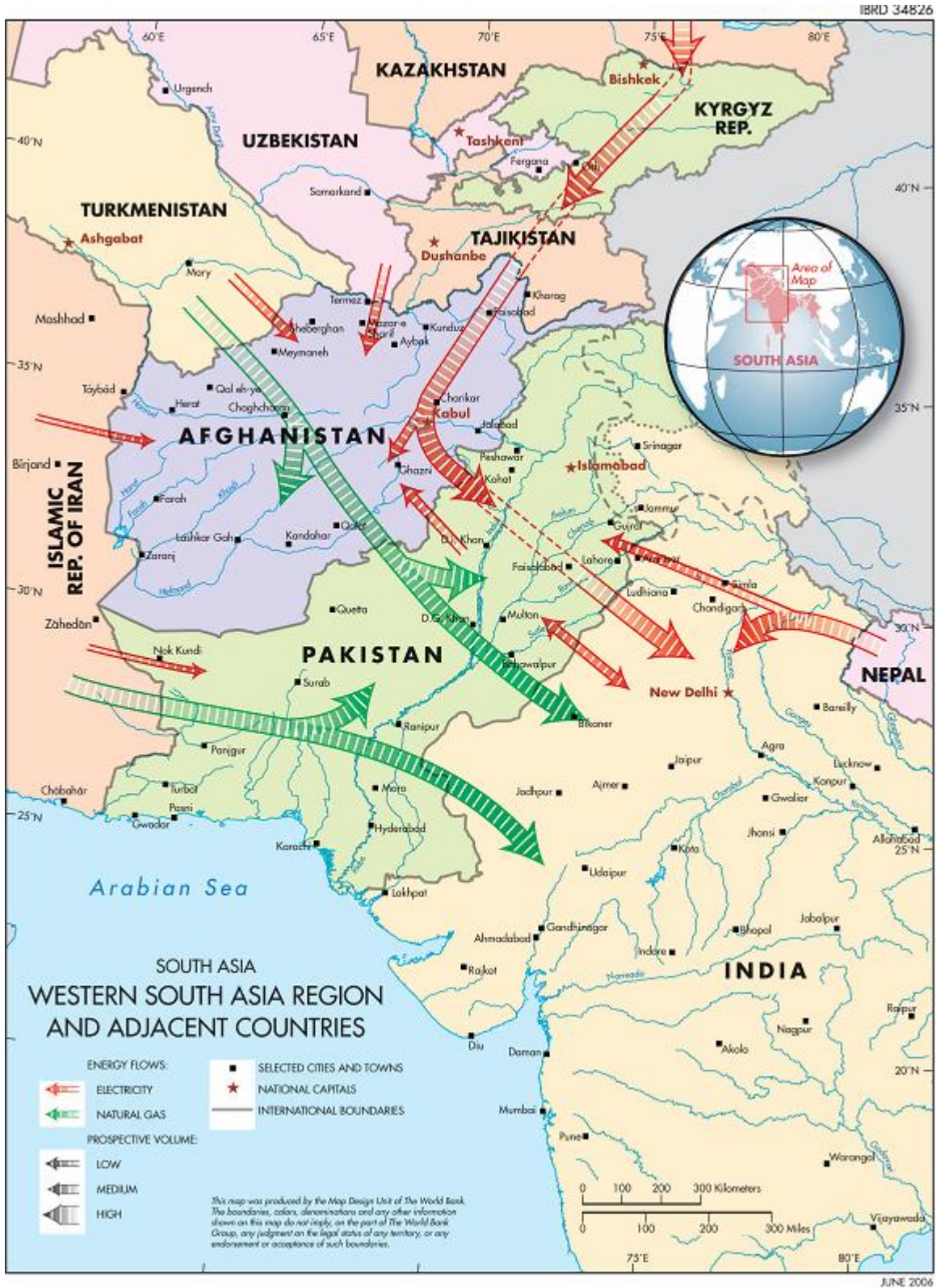


Figure 2: The Directions of the Existing Bilateral Electricity Trade Between Central Asia/Iran and South Asia



AFGHANISTAN POWER SECTOR AND ELECTRICITY IMPORTS

I. POWER SECTOR DIMENSIONS AND STATUS

Afghanistan's present installed capacity is estimated at 475 MW (261 MW of hydro, 151 MW of thermal and 63 MW of Diesel) of which only about 270 MW is considered as available. Only about 70% of its transmission and distribution systems survived the prolonged conflicts the country faced. Utility data show that as of January 2006, the total number of consumers was 404,089 consisting of 365, 221 households, 33,597 commercial establishments and 5,271 government connections.²³ Recent household survey (NRVA 2005) and utility data seem to indicate that approximately 16% of the population has access to public electricity supply and another 10% of the population either has its own captive generation sets or micro-hydroelectric facilities or has access to small communal facilities of the same kind.²⁴ The country's per capita annual electricity consumption, still in very low double digits, is among the lowest in the world.

In 2005 a total supply of 1,162.3 GWh was reported consisting of domestic hydro generation (57%), domestic thermal generation (15.3%) and imports (27.8%). For the first 8 months of 2006 a total supply of 875.2 GWh had been reported consisting of 54.1% hydro, 14.8% of thermal and 31% of imported power.²⁵

Since demand outstrips supply, there is extensive load shedding and the quality of supply is poor. Even as late as in December 2005, most of the consumers in the capital city of Kabul were receiving supply only for few hours a few days a week in the winter with only marginal improvement in the summer. The use of small privately owned diesel generating sets has become extensive. Power from these generators is estimated to cost about 25 cents per kWh based on the high cost of light diesel fuel used.

The power sector facilities are owned and operated by Da Afghanistan Breshna Mossesa (DABM), which is a state-owned vertically integrated power utility reporting to the Ministry of Energy and Water. Electricity tariffs are location specific and the average tariff / kWh varied in FY 2005 from about 4.1 cents in Kabul and 3.3 cents in Kandahar (both with hydroelectric supplies) to 6.9 cents to 7.4 cents in the Kunduz and Mazar-e-sharif (northern system-with some imported supply) and 2.5 cents in Herat area (with inexpensive imports from Iran). The overall average tariff per kWh worked out to about 5.1 cents. These tariff levels were believed to cover less than 50% of the cost of supply²⁶. Technical losses in the transmission and distribution networks are believed to be in the range of 20% to 25%. A further loss of 15% to 20% of energy is believed to be caused by non technical reasons such as theft and poor billing.²⁷ Collections are estimated at around 60% to 70% of the total billed amounts. Some estimates place it even lower at 54%. Most of the arrears, estimated at around \$23 million, were attributed to nonpayment of dues from government entities.

²³ www.afghanenergyinformationcenter.org

²⁴ National Risk Vulnerability Assessment Study covering 1850 villages and 11,200 households

²⁵ Same website as in footnote 22

²⁶ The tariff in Kabul, Kandahar and Lashkahgar (the hydropower supply based areas) is reported to have been raised significantly in August 2006.

²⁷ Asian Development Bank, President's Report: AFG 37078 dated March 2005 for the Afghanistan Power Transmission and Distribution Project.

The Power System Master Plan (PSMP) finalized in 2004 by consultants under World Bank financing estimated that the actual peak demand of Afghan power system was about 215 MW and that, including the suppressed or unmet demand, the true demand was about 363 MW. The base case load forecast made in the study envisaged the growth of this peak demand to 911 MW by 2020 at an average annual rate of 5.7%. In energy terms the demand was forecast to grow from 1,295 GWh to 3,868 GWh at an average annual rate of 6.6%.

II. GROWTH IN POWER IMPORTS AND PROGRESS IN SYSTEM DEVELOPMENT.

The volume and value of imports during the last three years from the existing interconnections to Iran, Turkmenistan, Uzbekistan and Tajikistan are summarized in Table 1-A below.

Table 1-A: Electricity Imports into Afghanistan

Source and Route	FY 2004-05		FY 2005-06		FY 2006-07 (3 months only)	
	Volume GWh	Value US\$ mill	Volume GWh	Value US\$ mill	Volume GWh	Value US\$ million
Tajikistan: Geran (Tajikistan) to Kunduz (Afghan) 110 kV single circuit line, operated at 35 kV on the Afghan side	28.99	0.58	39.22	0.78	23.33	0.47
Uzbekistan: Termez (Uzbek) to Khulum (Afghan) and on to Mazar-e-sharif 220 kV line double circuit operated at 110 kV	118.18	2.36	149.71	2.99	24.18	0.48
Turkmenistan: Gushby (Turkmenistan) to Herat (Afghanistan), 120 km, 220 kV single circuit line completed in May 2004, but operated at 110 kV	49.27	0.99	95.63	1.91	35.39	0.71
Turkmenistan: Turkmenistan to Andkhoy-Jawzjan-Sheberghan, 110kV line in poor condition with high voltage drops	48.57	0.97	69.72	1.39	12.28	0.25
Iran: Torbat-e-jam (Iran) to Herat (Afghanistan) 150 km 132 kV double circuit line commissioned in January 2005. Financed by Iran ----- Iran: Tayyebat (Iran) to Herat 2 x 20 kV single circuit lines. Financed by Iran	26.72	0.65	57.85	1.11	21.48	0.53
Iran: Zabol (Iran) to Zaranj (Afghanistan) 20 kV single circuit opened in March 2004	11.55	0.26	17.99	0.40	9.52	0.21
Total Imports	283.28	5.81	430.12	8.59	126.18	2.65
Average price/kWh in US cents		2.1		2.0		2.1

Source: DABM data

Note: (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.

Key Details of the Import Transactions with Each Country

Tajikistan has hydroelectric potential exceeding 40,000 MW and an installed capacity of about 4,400 MW and annual generation of about 15 to 18 TWh. It 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. Exports were resumed in May 2003. Supplies had been erratic for various reasons but have grown steadily during the last three years. The supplies took place at a price of 2.0 cents/kWh. Major increases in the supply from Tajikistan are envisaged. 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 1-A).²⁸ 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. The possibility of this has to be carefully studied before entering into take or pay type of contracts.

Uzbekistan has an installed capacity exceeding 11,500 MW and an annual generation exceeding 49 TWh and yet faced difficulties to meet its peak demand of about 7,700 MW on account of the poor availability of its aging generating units. However 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.²⁹ Uzbekistan has considerable natural gas and coal resources and its generation mix is predominantly 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.³⁰ 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 that using the present facilities, it could not supply more than 85 MW until 2010 and that the Afghan side should approach the Uzbek government to improve the infrastructure to enable supply of 300 MW.

To enable the import of Uzbek power in a reliable manner, ADB is financing the construction of a 220 kV double circuit line from Hairatan at the Uzbek border to Pul-e-Khumri via Naibabad. ADB is also financing the Naibabad to Mazar-e-Sharif double circuit 220 kV link. Government of India is financing

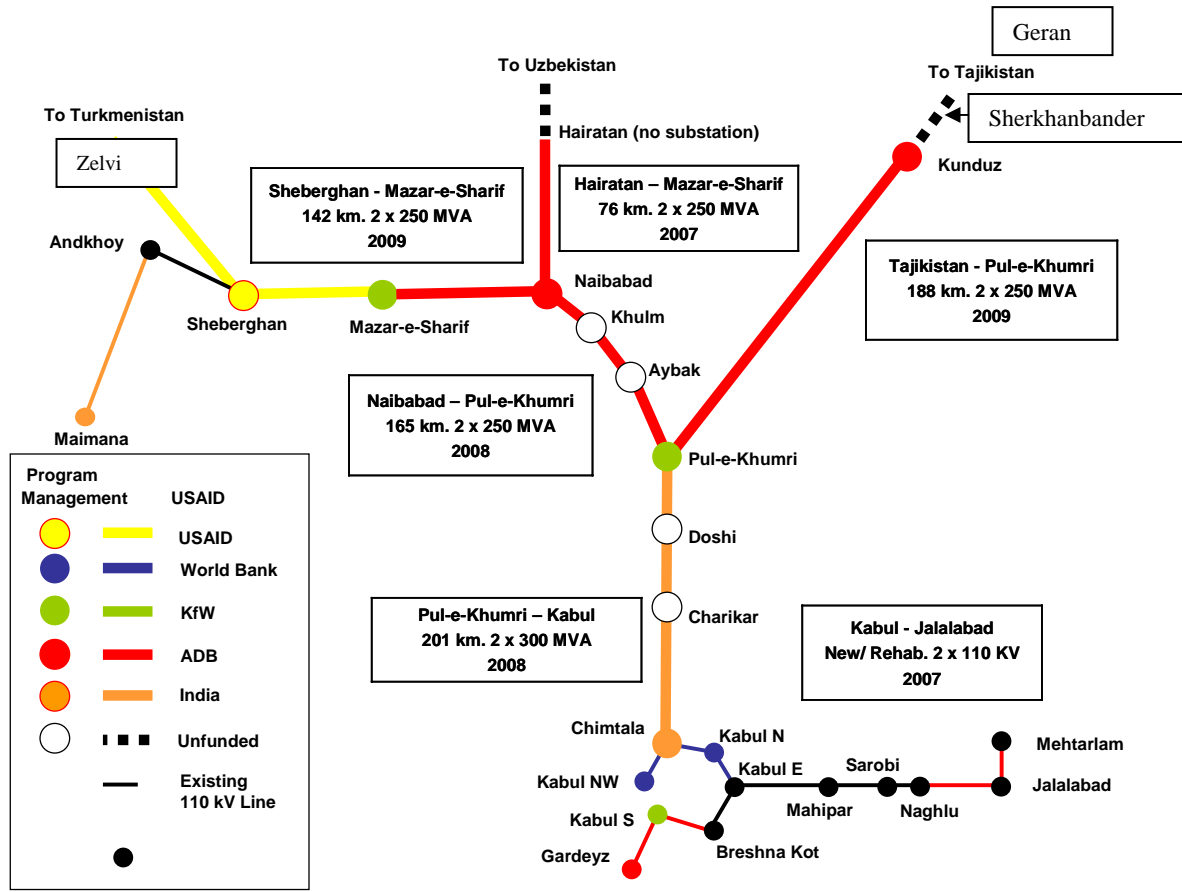
²⁸ ADB is also financing a dedicated 220 kV line from a substation near Sangtuda I to connect to the line in Afghanistan at Sherkhanbander.

²⁹ There are some concerns about the need to verify the natural gas reserves to ensure that they are adequate to support the country's ambitious generation capacity expansion plans.

³⁰ Price was increased to 2.3 US cents the following year and currently is 2.65 US cents per kWh.

the 220 kV double circuit line from Pul-e-Khumri to Chimtala near Kabul and the link between Chimtala and Kabul ring is financed by the World Bank. These lines will form the backbone of the NEPS. These are expected to be operational by 2008-09 or earlier.

Figure 1-A: Evolution of the North East Power System (NEPS)



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. 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.³¹ 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. Feasibility Study 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 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.

³¹ The financial year of Afghanistan government ends on March 20.