ECONOMIC AND FINANCIAL ANALYSES

I. ECONOMIC ANALYSIS

A. Background

1. The Bangladesh–India Electrical Grid Interconnection Project will allow an exchange of power between the two countries. It will initially facilitate the transmission of 500 megawatt (MW) of power from India to meet existing and future demand in Bangladesh. The economic analysis of the investment proposal for the cross-border transmission network was carried out in accordance with the Guidelines for Economic Analysis of Projects of the Asian Development Bank (ADB).

B. Economic Rationale of the Project

2. Energy cooperation among South Asian Association for Regional Cooperation (SAARC) countries was first discussed at the fifth SAARC summit in 1990. The concept of an "energy ring" was agreed at the 13th summit in 2005 in Dhaka to promote trading in electricity, gas, and oil between SAARC member countries. The economic rationale for this initiative was the efficient use of energy resources and the provision of a platform for power trading. The SAARC countries are net importers of fossil fuels such as coal, oil, and oil products from outside the region, and considerable benefits could be derived from tapping hydropower potential in Bhutan, India, and Nepal and from utilizing the differing seasonal load characteristics of the countries in the region. Regional interconnectivity could help countries manage power shortages, avoid power outages, and improve system-wide efficiency. Currently, India imports power from Bhutan and exports power to Nepal. Technical studies are under way on the feasibility of grid interconnections between India and Sri Lanka. The electrical grid interconnection project between India and Bangladesh when implemented will provide a successful example of power trading between two countries in the region, contribute to meeting the goal of providing power to all, and bring economic benefits to the region.

C. Demand–Supply Situation in Bangladesh

3. The Bangladesh economy has grown by nearly 6% a year since 2005, and the country faces rapidly growing energy needs to sustain its growth, particularly in the industry sector. Inadequate generation capacity addition and fuel shortages have resulted in electricity sales in Bangladesh not matching demand. A peak deficit of over 1,000 MW was recorded in 2012. The government has attempted different approaches to minimize power shortages—by adding significant capacity from rapidly deployable but expensive rental power plants that use imported oil and diesel; by preparing projects based on imported coal; and by improving the efficiency of large public sector projects to generate additional output, in some cases with ADB assistance. Sourcing power from the South Asia region is another option that can provide a fast and efficient mechanism to offset shortages, and it is being supported under this project. The electrical grid interconnection facility between India and Bangladesh will partially alleviate the current power crisis by providing 500 MW of power from India. The project will facilitate imports of cheap and reliable power from India for use in Bangladesh. A significant part of the demand in Bangladesh can be attributed to industrial and residential activities.

D. Least-Cost Analysis

4. Over 80% of electricity in Bangladesh is produced from gas-based power plants. Coal, hydropower, heavy fuel oil (HFO), and diesel are the other sources of energy for power generation. Inadequate investment in upstream gas field development since the early 2000's has resulted in a shortage of gas for industrial use and for electricity generation. This has forced electricity utilities to resort to load shedding while industrial consumers have been using captive generation facilities that require diesel. As an immediate measure to reduce the shortage of gas, the government has

decided not to provide assured gas supply to several new power projects and has asked promoters to develop these projects on a dual-fuel basis (to be run on diesel or HFO).

5. Table 1 indicates the cost of generating electricity in Bangladesh using various fuels.[1]

Table 1: Least-Cost Analysis of Electricity Generation in Bangladesh

Fuel Source	**Economic Generation Cost Per Unit** (Tk/kilowatt-hour)
Gas	4.2
Coal (local)	3.7
Coal (imported)	5.4
Heavy fuel oil	12.1
Diesel	25.2
Hydropower	1.4

Source(s): ADB estimates

6. While hydropower is the most economic source of electricity in Bangladesh, its potential is limited to a few small scale hydropower projects. The next low-cost source of electricity is coal followed by gas, HFO, and finally diesel. As indicated above, a significant expansion of gas-based power generation is not feasible in the near future given inadequate gas production. Gas is also being used for transportation, industries (mainly fertilizers), and domestic purposes. Given the severity of power shortages, the government has decided to cut down the gas supply to some industries, such as fertilizer production, and has limited the supply of gas to the power sector. Under such circumstances, local gas, although the least-cost option, will not provide an immediate solution to the power crisis. While Bangladesh has sizable coal reserves in the northwest region, there are constraints in coal production. The development of domestic coalfields will take time and will require significant investment. Imported coal-based power would cost at least Tk5.4 per kilowatt-hour (kWh) at current coal prices, according to estimates from projects planned in Bangladesh.[2] In the current situation, power imports from India are expected to be the most feasible least-cost way of overcoming power shortages in Bangladesh.

E. Economic Feasibility

7. All costs are expressed in constant 2013 prices. The domestic price numeraire has been used and tradable inputs were valued at their border price equivalent value and converted using an estimated shadow exchange rate factor of Tk1.34 per Indian rupee. For the Bangladesh part of the interconnection facility, an economic conversion factor for labor cost (0.97) was considered. The capital costs include physical contingencies but exclude taxes, price contingencies, and financial charges during construction. For the Indian part, a standard conversion factor of 0.97 has been used to convert financial costs and benefits into economic values.

[1] Except for imported coal, the unit costs are based on actual data for Bangladesh in 2010.

[2] Price estimates available for imported coal-based power in Bangladesh in 2013 indicate a delivered price of around Tk7.0/kWh. For the base-case calculations, imported coal at Tk5.4/kWh is retained from the economic analysis for the original Project to maintain a similar level of estimation of benefits while Tk 7.0/kWh was used for sensitivity analysis.

8. A period of 30 years was assumed for the economic analysis and a standard 12% discount rate was used to calculate the net present value (NPV). Capital costs were spread over the first 4 years based on progress. Capacity utilization of the transmission lines was assumed to be 80% in estimating the quantity of power transmitted.

9. The incremental costs and benefits of the cross-border transmission proposal were estimated by comparing the "with project" and the "without project" scenarios. Under the without-project scenario, it is assumed that an amount of electricity is generated within Bangladesh. The most likely source of energy for power generation in the base case was taken to be imported coal, given shortfalls in gas and domestic coal for power production. During sensitivity analysis, replacement with HFO or imported coal at current prices was considered for the without-project scenario. The interconnection's feasibility was assessed from the perspective of both Bangladesh and the region. Generally, a system or time-slice approach is used in estimating the economic internal rate of return (EIRR) of transmission projects. However, in this case, since the interconnection is similar to a dedicated line to evacuate power from a designated plant, the project was analyzed as a single project, avoiding the system or time-slice approach.

F. Economic Feasibility – Bangladesh Project

10. The project costs include investment and maintenance costs of the Bangladesh transmission line, cost of other associated facilities, and annual payments made to the Indian authorities for delivery of power to Bangladesh. The data used for analysis were extracted from publicly available sources. No environmental or social benefits or costs were quantified or used in the economic feasibility analysis.

11. There are two approaches to estimating benefits. The first is to consider resource cost savings and the second is to use avoided outage costs and other parameters. In the base case, the resource cost savings were used to estimate the benefits. The resource cost savings were based on the assumption that imported coal would be used to generate power in the absence of the project. The cost of imported coal was conservatively estimated at Tk5.4 per kWh with a 2% annual escalation for the base-case calculation.

12. With the Bangladesh–India transmission network in place, Bangladesh will be in a position to import power from India at a relatively cheaper cost. The tariff for the power from NVVN in India is set by the country's Central Electricity Regulatory Commission (CERC) using a published methodology. The trading margin and wheeling costs for delivery of power are also set based on the CERC-approved tariff methodology. In 2013, the total cost works out to about Rs2.8 per kWh (about Tk3.7 per kWh). A 3% annual escalation rate is considered. A bidding process is ongoing to select suppliers from the Indian market for 250 MW in short-term and long-term procurement. Market-based power purchase costs for long- and short-term power supply are considered. An escalation rate of 3% per annum is considered. Standard power sector returns on investment margins are considered in the power tariff used for the economic analysis.

Table 2: Cost benefit stream for economic analysis

(Tk million)

Year	Capital and Operating Costs	Cost of Power Purchase	Total Cost	Gross Benefit	Net Benefit
2011	2,834	0	2,834	0	(2,834)
2012	453	0	453	0	(453)
2013	6,610	0	6,610	0	(6,610)
2014	2,484	11,962	14,446	14,457	12
2015	128	16,615	16,743	19,662	2,919
2016	134	17,311	17,445	20,055	2,611
2017	141	15,972	16,112	20,456	4,344
2018	148	16,451	16,599	20,866	4,267
2019	155	16,944	17,099	21,283	4,183
2020	163	17,453	17,616	21,709	4,093
2021	171	17,976	18,147	22,143	3,995
2022	180	18,515	18,695	22,586	3,890
2023	189	19,071	19,260	23,037	3,778
2024	198	19,643	19,841	23,498	3,657
2025	208	20,232	20,440	23,968	3,528
2026	218	20,839	21,058	24,447	3,390
2027	229	21,464	21,694	24,936	3,243
2028	241	22,108	22,349	25,435	3,086
2029	253	22,772	23,024	25,944	2,919
2030	265	23,455	23,720	26,463	2,742
2031	279	24,158	24,437	26,992	2,555
2032	293	24,883	25,176	27,532	2,356
2033	307	25,630	25,937	28,082	2,145
2034	323	26,399	26,721	28,644	1,923
2035	339	27,190	27,529	29,217	1,688
2036	356	28,006	28,362	29,801	1,439
2037	374	28,846	29,220	30,397	1,177
2038	392	29,712	30,104	31,005	901
2039	412	30,603	31,015	31,625	610
2040	432	31,521	31,954	32,258	304
				EIRR	24%

( ) = negative, EIRR = economic internal rate of return.

13. The economic cost–benefit analysis indicates that the base case results in an EIRR of 24%, along with an NPV of Tk 9,300 million. The project is economically viable in the base case.

14. A sensitivity analysis indicates that when computing benefits based on HFO -based generation, the use of outage costs and willingness to pay (WTP) in economic analysis yields a significantly higher EIRR. For the sensitivity analysis, an outage cost of $0.34 per kWh for the industrial sector was used while the existing tariff for household, agriculture, and commercial sectors was considered the lower bound of the willingness to pay (WTP). A weighted average WTP in western Bangladesh is Tk5.78 per kWh, based on the weighted average usage by consumer

segments. The project is sensitive to cost escalations and low levels of utilization; a 15% cost increase over the project life (both transmission costs and power generation costs) would yield a negative NPV while 50% utilization over the life of the project would result in a low EIRR when using the resource cost savings approach with the conservative base-case assumption of imported coal at Tk5.4 per kWh. To reduce this risk, the Bangladesh Power Development Board (BPDB), the single buyer of electricity in Bangladesh, has entered into power purchase agreements at regulated tariffs for 250 MW and is tying up contracts for another 250 MW through competitive bidding in 2013. Sensitivity analysis of the 15% cost increase in the transmission and power generation costs or 50% project utilization over its life at the market-based price of imported coal at Tk7.0 per kWh in Bangladesh or 50% utilization for a period of five years (footnote 2) indicates the project remains economically viable. Given the development of the trading market in India and participation of BPDB in the power pool, as well as the level of marginal cost of electricity in Bangladesh, it is not expected that the line will remain unutilized over its life once built. Overall, the analysis shows that the project is economically viable and provides stable benefits under various scenarios.

G. Economic Feasibility – Regional Project

15. A regional analysis was also undertaken and considered the cost of the transmission line investment and operation as well as the recurrent generation costs. If India or the eastern grid of India faces power cuts, the export of power to Bangladesh has an opportunity cost for India. However, given the surplus power situation in the eastern grid, demand variations, and the relative size of the power systems in Bangladesh and India, this was considered low. Further, since India is adding capacity of over 100,000 MW by 2017 under the 12th five year plan, this was not considered an issue. The regional project is also economically stable for most risk factors. The base case of the regional project provides a slightly higher EIRR than that of the Bangladesh project due to trading margins and losses.

H. Conclusions

19. The economic analysis was updated using reasonable assumptions and follows the same methodology adopted for the original project's economic analysis. The economic feasibility of the project was assessed from the perspective of Bangladesh and the region. Results show that the proposed project is economically viable from both perspectives. India has committed 250 MW of power under a long-term power purchase agreement, while the remaining 250 MW will be purchased based on bidding in 2013. The sensitivity analysis shows that project returns are quite stable with reference to the relevant risks.

II. FINANCIAL ANALYSIS

A. Introduction

20. The financial analysis of the proposed Bangladesh–India Electrical Grid Interconnection Project was carried out in accordance with ADB guidelines.[3] All financial costs and benefits are expressed in constant 2013 prices. Cost streams used to determine the financial internal rate of return (FIRR)—i.e., capital investment, and operation and maintenance costs etc. —reflect the costs of delivering the estimated benefits. The revenue accruing to the executing agency based on transmission tariffs was used to estimate the financial benefits.

[3] ADB. 2005. *Financial Management and Analysis of Projects*. Manila.

B. Methodology and Major Assumptions

21. The weighted average cost of capital (WACC) of the project was compared with the FIRR to ascertain the financial viability of the project. The sensitivity of the FIRR to adverse movements in the underlying assumptions was also assessed. Based on this analysis, the project is assessed to be financially viable.

22. Financial viability was examined by comparing the incremental costs and benefits of the "with project" and "without project" scenarios. Incremental costs include the investment costs and operating costs associated with the project. The investment costs include the civil works, electrical and mechanical work, land acquisition and development, and resettlement under the project in Bangladesh. Interest during construction and price contingencies were excluded. Operating costs have been considered at 2.5% of the capital cost for transmission lines and at 0.7% of the capital cost of high-voltage direct current (HVDC) substations for the first year of operation based on regionally available benchmarks. The transmission tariff to the Power Grid Company of Bangladesh (PGCB) was set by the government and has not been revised in the last 5 years. Non-revision of tariffs will affect the financial feasibility of the project. The Bangladesh Energy Regulatory Commission (BERC) has proposed a new tariff methodology to the government based on a "cost plus rate of return" principle. The rate of return is based on PGCB's cost of long-term debt and the dividend rate. It is expected that the draft regulations would be applicable after notification in 2014, and the impact is estimated to start in 2015. Until such time, the existing transmission tariff is used for computing benefits. A period of 30 years is considered for calculations, and it is expected that BERC will periodically adjust the transmission tariff in accordance with tariff regulations.

23. Energy flows were computed based on an annual project utilization of 80%. Income tax was assumed to be 27.5% (for publicly traded companies). A straight-line depreciation rate of 3.15% was assumed based on the draft regulations on transmission tariffs. A working capital requirement of 2 months of operating costs was assumed in accordance with draft tariff regulations. The free cash-flow stream is converted to real terms by adjusting for domestic inflation for financial analysis.

C. Calculation of Weighted Average Cost of Capital

24. To compute the WACC, the financing sources were assumed to comprise equity and debt contributions to the project and the loans from ADB. The cost of equity was assumed to be 12%, based on the government's long-term bond rate and margin for the sector. The analysis assumed that the ADB loan was extended to the government and re-lent to PGCB in Bangladesh taka at an interest rate of 4%. The loan tenure is taken at 20 years, including a 5-year grace period. The cost of government debt is taken at 5%. The foreign inflation rate is assumed at 1.9% and the domestic inflation rate at 7.8%. The average WACC is 1.8%.

D. Calculation of Financial Internal Rate of Return

25. The FIRR for the transmission project calculated over a period of 30 years was 4.0%, compared with a WACC of 1.8%. The project is financially viable in the base case.

Table 3: Cost benefit stream for financial analysis

(Tk million)

Year	Capital Cost	Revenue	Operating Costs, Taxes, Adjustments	Net cashflow
2011	3,425			(3,425)
2012	664			(664)
2013	9,276			(9,276)
2014	2,251	604	236	(1,883)
2015		1,223	235	988
2016		1,223	152	1,071
2017		1,223	149	1,074
2018		1,223	149	1,074
2019		1,223	149	1,074
2020		1,281	159	1,122
2021		1,281	151	1,130
2022		1,281	151	1,130
2023		1,281	151	1,130
2024		1,281	151	1,130
2025		1,342	358	985
2026		1,342	463	879
2027		1,342	468	874
2028		1,342	472	870
2029		1,342	476	866
2030		1,406	509	897
2031		1,406	502	904
2032		1,406	502	904
2033		1,406	502	904
2034		1,406	502	904
2035		1,473	532	941
2036		1,473	522	951
2037		1,473	522	951
2038		1,473	522	951
2039		1,473	522	951
2040		1,543	553	990
				4.0%

( ) = negative, FIRR = financial internal rate of return.

E. Risk Assessment and Sensitivity Analyses

26. **External risks.** BERC announced its draft transmission tariff regulations in 2008 after consultations with various stakeholders. However, unlike gas transmission and electricity generation regulations that follow a similar methodology, the regulations for transmission tariffs have not yet been notified by the Government. The tariff-related risk for the project will be mitigated once BERC's tariff regulations are notified and PGCB is in a position to recover its operating costs and earn a return on capital. Notification is expected on or before 30 June 2014.

27. **Project-specific risks.** Financial risks for the project typically include the following: (i) an increase in the price of civil works and equipment, (ii) delays in project implementation, and (iii) lack of access to necessary counterpart funds. These risks are considered low given the advanced stage of the project and the expected commissioning in late 2013. PGCB's implementation capacity has been demonstrated in project implementation of prior ADB loans, and the government has released funds for the project in a timely manner. Actuarial valuation for gratuity schemes has not been conducted and there are legacy issues from the restructuring period. PGCB's audited financial statements indicate fixed asset register and physical verification of assets as concerns and PGCB is conducting studies in 2013 to address these issues.

28. **Sensitivity analysis**. Analysis was carried out to examine the sensitivity of the FIRR and the financial NPV to adverse changes in key variables. The variables considered for the sensitivity analyses are a 10% increase in capital costs, a 10% increase in operation and maintenance costs, and a 10% reduction in power flow over the line. The project is most sensitive to a reduction in power flows that would have a detrimental impact on the FIRR. Bangladesh is entering into power purchase agreements with suppliers in India to utilize the full capacity of the interconnection. Demand is expected to grow and power shortages in Bangladesh are expected to continue, and given the differential in the cost of electricity between the two countries, it is unlikely that the interconnection once created would not continue to be utilized. Also, there are ongoing discussions with the Government on a transition from the existing energy based tariff structure to a capacity based tariff structure that is more aligned to PGCB's underlying cost structure and will reduce PGCB's risk related to under-loading of the transmission line. If a capital cost overrun occurs, BERC could be expected to consider the cost overrun for inclusion in PGCB tariff determination if the costs were prudently incurred or were the result of factors outside PGCB's control.

F. Financial Viability

29. PGCB was incorporated in 1996 and is responsible for the transmission of electricity in Bangladesh. PGCB's revenue increased from Tk5.9 billion in 2010 to over Tk7.0 billion in 2012, while profit after tax marginally decreased from Tk1.6billion to Tk1.2 billion over the same period. The debt–equity ratio is at 2.6 in 2012. The notification of BERC transmission tariff regulations based on cost plus regulated rate of return principles is delayed. PGCB's profits, return on equity, and other ratios are expected to improve once the draft transmission tariff regulations are notified in 2014 and tariff for PGCB are periodically reviewed and reset by BERC based on the tariff regulations.

Table 4: Financial Performance and Projections for PGCB

Item	2010(A)	2011(A)	2012(A)	2013(F)	2014(F)	2015(F)	2016(F)
Revenue (Billion Taka)	5.9	6.2	7.1	7.7	9.2	16.6	17.6
Profit after Tax (Billion Taka)	1.6	0.9	1.2	0.9	1.0	5.8	5.9
Return on Equity (%)	10.7%	4.7%	5.3%	3.6%	2.9%	14.1%	12.0%
Current Ratio (%)	3.7	2.1	1.6	1.2	1.6	2.5	3.3
Debt Equity Ratio (%)	2.7	2.4	2.6	2.3	2.0	1.6	1.3

Source: PGCB accounts for 2010-2012 and ADB estimates for 2013-2016