Performance Evaluation Report

Reference Number: PPE:BAN 2009-43
Project Number: 26451
Loan Number: 1293-BAN(SF)
December 2009

Bangladesh: Third Natural Gas Development Project

Independent Evaluation Department

Asian Development Bank

CURRENCY EQUIVALENTS
(as of November 2009)

Currency Unit – taka (Tk)

		At Appraisal (September 1993)	At Project Completion (October 2003)	At Independent Evaluation (November 2009)
Tk1.00	=	$0.0251	$0.0171	$0.0145
$1.00	=	Tk39.90	Tk58.40	Tk69.09

ABBREVIATIONS

ADB	–	Asian Development Bank
BAPEX	–	Bangladesh Petroleum Exploration and Production Company Limited
BERC	–	Bangladesh Energy Regulatory Commission
BFA	–	Bakhrabad franchise area
BGFCL	–	Bangladesh Gas Fields Company Limited
BGSL	–	Bakhrabad Gas Systems Limited
EA	–	executing agency
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
HCU	–	Hydro Carbon Unit, a branch within the Ministry of Power, Energy and Mineral Resources
IED	–	Independent Evaluation Department
IEM	–	independent evaluation mission
JBIC	–	Japan Bank for International Cooperation
JFA	–	Jalalabad franchise area
JGTDSL	–	Jalalabad Gas Transmission and Distribution Systems Limited
MPEMR	–	Ministry of Power, Energy and Mineral Resources
MRS	–	metering and regulating station
PCR	–	project completion report
PDF	–	price deficit fund
PIO	–	project implementation office
PPER	–	project performance evaluation report
RRP	–	report and recommendation of the President
SARD	–	South Asia Regional Department
TA	–	technical assistance
TFA	–	Titas franchise area
TGTDCL	–	Titas Gas Transmission and Distribution Company Limited
UNDP	–	United Nations Development Programme
VAT	–	value-added tax
WACC	–	weighted average cost of capital

WEIGHTS AND MEASURES

bbl	–	barrel
km	–	kilometer
MCF	–	thousand cubic feet
MMCF	–	million cubic feet
psig	–	pounds per square inch gauge
TCF	–	trillion cubic feet

NOTES

(i) The fiscal year (FY) of the Government of Bangladesh and its agencies ends on 30 June. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2008 ends on 30 June 2008.

(ii) In this report, "$" refers to US dollars.

KEYWORDS

adb, asian development bank, bangladesh, dhaka, energy, evaluation, gas, reform, tariff, third natural gas development project

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The guidelines formally adopted by the Independent Evaluation Department (IED) on avoiding conflict of interest in its independent evaluations were observed in the preparation of this report. C. Pappas and D. Bakht were the consultants. To the knowledge of the management of IED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

BASIC DATA
Loan 1293-BAN(SF): Third Natural Gas Development Project in Bangladesh

Project Preparatory/Institution Building

TA No.	Technical Assistance Name	Type	Person-Months	Amount ($)	Approval Date
849	Technical Assistance to the People's Republic of Bangladesh for the Third Natural Gas Development Project (Funded by UNDP, administered by ADB)	Project preparatory TA		230,000	22 Jan1987
1962	Preparation of Power System Master Plan	Advisory TA	34	600,000	11 Oct 1993
2024	Preparation of a Gas System Development Plan and the Strengthening of the Organizational and Regulatory Framework for the Oil and Gas Sector	Advisory TA		565,000	21 Dec 1993
2025	Safety and Efficiency Improvements in the Gas Sector	Advisory TA		480,000	21 Dec 1993

ADB = Asian Development Bank, TA = technical assistance, UNDP = United Nations Development Programme.

Key Project Data ($ million)	Per ADB Loan Documents	Actual
Total Project Cost	198.58	156.81
Foreign Exchange Cost	117.10	85.46
ADB Loan Amount/Utilization	107.00	71.48
ADB Loan Amount/Cancellation[a]		
Amount of Cofinancing	10.10	15.23

ADB = Asian Development Bank.
[a] Actual loan amount and cancellation will not add up because of fluctuations in the exchange rate of the US dollar and special drawing rights.

Key Dates	Expected	Actual
Fact-Finding Mission		24 April–7 May 1993
Appraisal Mission		9–27 Sept 1993
Loan Negotiations		19–24 Nov 1993
Board Approval		21 Dec 1993
Loan Agreement		23 Dec 1993
Loan Effectiveness	23 Mar 1994	23 Mar 1994
First Disbursement		29 Nov 1995
Project Completion		30 June 2003
Loan Closing	31 Dec 1999	23 Oct 2003
Months (Effectiveness to Completion)		93

Internal Rates of Return (%)	**Appraisal**	**PCR**	**PPER**
Economic Internal Rate of Return BGFCL	81.4	168.2	229.91
Economic Internal Rate of Return BGSL	27.9	22.9	26.45
Economic Internal Rate of Return TGTDCL	47.1	104.1	76.50
Economic Internal Rate of Return JGTDSL	127.0	22.0	30.41
Financial Internal Rate of Return BGFCL	17.9	8.2	26.18
Financial Internal Rate of Return BGSL	8.5	<0.0	<0.00
Financial Internal Rate of Return TGTDCL	10.0	11.9	<0.00
Financial Internal Rate of Return JGTDSL	33.1	1.9	<0.00

BGFCL = Bangladesh Gas Fields Company Limited, BGSL = Bakhrabad Gas Systems Limited, JGTDSL = Jalalabad Gas Transmission and Distribution Systems Limited, PCR = project completion report, PPER = project performance evaluation report, TGTDCL = Titas Gas Transmission and Distribution Company Limited.

Borrower	People's Republic of Bangladesh
Executing Agencies	Bangladesh Gas Fields Company Limited (BGFCL) Bakhrabad Gas Systems Limited (BGSL) Titas Gas Transmission and Distribution Company Limited (TGTDCL) Jalalabad Gas Transmission and Distribution System Limited (JGTDSL)

MISSION DATA

Type of Mission	**No. of Missions**	**No. of Person-Days**
Fact-Finding/Pre-Appraisal (upgraded to Appraisal)	2	60
Inception	1	18
Review	9	87
Project Completion Review Mission	1	30
Independent Evaluation Mission	1	28

EXECUTIVE SUMMARY

The main energy resource in Bangladesh is natural gas. The Third Natural Gas Development Project was aimed at developing this resource to meet the increasing demand for primary commercial energy in the country. At the time of project appraisal, the gas distribution networks in all three gas franchise areas of Bangladesh—Bakhrabad franchise area, Titas franchise area, and Jalalabad franchise area—had grown in an unplanned manner and were experiencing severe constraints during peak periods of demand. In January 1986, through the country programming mission, the government requested Asian Development Bank (ADB) assistance for the Third Natural Gas Development Project.

The objectives of the Project were to (i) promote sector reforms; (ii) expand the gas production and treatment facilities at Titas, Habiganj, and Bakhrabad gas fields; (iii) upgrade, rehabilitate, and expand the gas transmission and distribution network in Bangladesh; and (iv) improve the efficiency and safety of the operations of the gas transmission and distribution companies.

The total project cost estimated at appraisal was $198.58 million. ADB provided $107 million out of its Special Funds resources to finance 91% of the foreign exchange cost of the project. The then Overseas Economic Cooperation Fund of Japan cofinanced the remaining 9% of the foreign exchange cost (or about $10 million) on a parallel basis. The Overseas Economic Cooperation Fund subsequently became part of the then Japan Bank for International Cooperation, which disbursed funds for the distribution networks under part C of the Project. The government provided $81.48 million in counterpart funding to cover the entire local currency cost of the Project. At completion, the actual cost of the project works was $156.81 million equivalent, primarily because of the lower than estimated bid prices for the procurement of goods, services, and turnkey contracts.

The Project was set up in four parts:

(i) **Part A:** (i) drilling of seven new development wells, (ii) workover of six wells (workover activities include a variety of remedial operations on a producing well to try to increase production), (iii) installation of two gas treatment plants and two dehydration units, (iv) installation of a telecommunication system, and (v) training for personnel of Bangladesh Gas Fields Company.

(ii) **Part B:** (i) rehabilitation of the gas distribution networks in Chittagong and Comilla, (ii) expansion of the gas distribution system to Feni Industrial Estate and other areas, and (iii) provision of training for personnel of Bakhrabad Gas Systems.

(iii) **Part C:** (i) upgrading and expansion of the gas distribution network in Dhaka, (ii) installation of five metering and regulating stations in Dhaka and the upgrading/replacement of 11 metering and regulating stations in other locations, (iii) establishment of a centralized data acquisition and monitoring system, (iv) installation of household gas meters, and (v) provision of training for staff of Titas Gas Transmission and Distribution Company.

(iv) **Part D:** (i) upgrading and expansion of the distribution network in Sylhet; (ii) construction of transmission pipelines from Kailashtilla gas field to Chhatak, and from Chowdhuribazar to Kuchai; and (iii) provision of training for staff of Jalalabad Gas Transmission and Distribution System.

There were no major changes to the original design of the project. However, there were some changes to the scope of the project, which was expanded to include repair and

rehabilitation of road and railway infrastructure damaged during the flood of 1998. These were funded by utilizing $10.00 million of loan savings. The government also requested ADB to allocate $10.00 million of the unutilized loan balance to settle a disputed payment to Spie Capag of France, which arose from a previous ADB loan project. Project implementation followed the arrangements envisaged at appraisal, with some minor changes that mainly related to the upgrading of metering and regulating stations. Several additional upgrades were undertaken while other planned upgrades did not proceed because of a lack of expected growth in demand.

The project is rated “successful.” All components were consistent with government priorities as well as ADB’s strategy for the sector. Institutional reforms were initiated as a consequence of the project, and the availability and utilization of gas has improved significantly in the project target areas.

The project is rated “relevant.” The project design was in line with ADB’s gas sector strategy and its country operational strategy of 1993. At the time of loan appraisal, there was increasing demand for natural gas that could not be met with the existing gas infrastructure, there were unacceptable levels of losses, and the sector was in need of reform. All components of the project were fully consistent with the government’s priorities—to increase exploration activities and restructure the gas sector. After loan effectiveness the project's administration was managed by the Bangladesh Resident Mission which enabled frequent communication between ADB, EAs, consultants, contractors and development partners.

The project is rated “effective.” In assessing effectiveness, the evaluation examined if outcomes were achieved and the effect of project implementation on the expected outcomes, including delays in outcome. The project’s major targets have been met. The project was successful in (i) expanding the availability and utilization of gas throughout project target areas, (ii) collecting adequate revenue for sustainable operations and maintenance, (iii) establishing a mechanism for minimizing system losses, (iv) introducing sector reforms for commercial orientation of the executing agencies (EAs), and (v) segregating regulatory functions.

The project is rated “efficient.” Despite a 4-year delay in loan closure, the project achieved its objectives of expanding gas production, and improving the gas transmission and distribution networks. Efficiency in reaching these objectives was substantial and the time delay did not result in a cost overrun. Without the project, Bangladesh would need to import petroleum products at world prices, use more coal, and increase wood burning. The increased availability of gas has encouraged energy consumers from all categories to switch to the generally cheaper, cleaner, and more convenient gas. The recalculated economic internal rates of return (EIRRs) for the four project components yielded values greater than the 12% threshold (Appendix 3), indicating that these subprojects deliver significant economic benefits as a result of the high economic cost of alternative fuels.

The project is rated “likely to be sustainable.” The recalculated financial internal rate of return (FIRR) for part A was well above the weighted average cost of capital while the FIRRs for parts B, C, and D were all less than zero. The negative FIRRs indicated that the project facilities do not yield enough revenue to recover the cost of gas and the transfer payments that have to be made. However, the overall operations of the EAs remain profitable and they continue to have sufficient financial and technical capability to keep the facilities in good condition. The ongoing financial sustainability of these key institutions will depend on their ability to remain profitable. The EAs will remain sustainable as long as tariffs are maintained at a level sufficient to cover costs, service debts, and provide maintenance. The finances of the gas distribution companies are currently healthy, and on 1 August 2009, the Bangladesh Energy Regulatory Commission approved an 11.22% overall increase in the price of gas. In response to the

Independent Evaluation Department's recent report on Bangladesh's energy sector[1] ADB's management has agreed to continue policy dialogue with the Government to encourage action addressing price subsidies in the energy sector.

ADB's performance is rated "satisfactory." Project formulation, design, and implementation arrangements were generally satisfactory. Project administration was delegated to the Bangladesh Resident Mission immediately after loan effectiveness. This facilitated frequent communication between ADB, EAs, consultants, and contractors. ADB fielded eight project review missions, and interacted regularly with the borrower and EAs. Offsetting these achievements by ADB, project cost estimates could have been more accurate and implementation delays could have been managed better.

The performance of the borrower and EAs is rated "partly satisfactory." The borrower complied with all conditions for loan effectiveness expeditiously, and the loan became effective as stipulated in the loan agreement. The four EAs successfully implemented their components but with time overruns ranging from 1.0 year to 4.5 years. Delays in completing field development works by Bangladesh Gas Fields Company contributed to gas supply shortages in Bangladesh during 1998–2000. The Titas gas field has also experienced problems with gas seepage and BGFCL is currently taking action to address this problem.

The performance of the borrower and EAs in complying with the reform agenda could have been better. At the time of the independent evaluation mission, six of the 20 loan covenants were still not fully complied with. Progress has been particularly slow with regard to meeting the targets for (i) installation of household gas meters; (ii) privatizing meter reading, billing, and collection; (iii) charging consumers the full economic price of natural gas; (iv) collecting accounts receivable; and (v) ensuring that at least 20% of the shares of each project EA are owned by the private sector.

While the project has been rated "successful," several outstanding issues still need to be addressed. There are 35,916 household gas meters still in storage out of the 60,000 procured under the project. The government has decided that household consumers with stoves of only one or two burners would not be metered but instead would be charged on a flat rate basis. This is not an efficient way of determining with any accuracy the use of an important national resource. Under the project, the Greater Dhaka Area was to be divided into gas management zones, each with a known gas consumption that can be monitored. This did not occur as additional funds were required for the necessary equipment and these costs were not covered under the local financing of the loan. Loan covenant 7(a) requires that the full economic price of natural gas be recovered progressively from consumers by 30 June 1998. In practice, there have been long periods between price reviews, which places additional financial pressure on the national gas companies. Bangladesh Energy Regulatory Commission will need to review all gas pricing on a more regular, perhaps annual, basis.

Finally, Bangladesh is experiencing a significant shortfall in gas supplies, which the government is attempting to address via exploration incentives and through appraisal, development, and workover of existing wells. To supplement these actions, the government should consider introducing disincentives to discourage any new captive power plants that are inefficient consumers of a significant proportion of Bangladesh's gas. Similarly, government-owned power plant utilities should be establishing time-bound plans to replace inefficient generation units with more efficient ones.

[1] ADB. 2009. *Sector Assistance Program Evaluation: Energy Sector in Bangladesh*. Manila.

The evaluation identifies several lessons from the project, including the following:

(i) Cost underruns were experienced for parts C and D of the project. This was partly because equipment cost estimates were based on tied loan prices. In the future, project preparatory technical assistance consultants should obtain prices on the open market, and should undertake cross-checks with more than one supplier.

(ii) The delays in procurement of materials under the project necessitated the resident mission to perform more rigorous and detailed follow-up of EA procurement action. Monthly estimate sheets were provided by the EAs to ADB to show progress and pinpoint where delays were taking place. This should become a fixture in future loans to the Bangladesh gas sector, and should be incorporated in project administration memorandums.

(iii) Whenever possible, implementation consultants should be selected prior to project approval. All too often, ADB approves advance selection of consultants but EAs do not take advantage of this opportunity. In future loans to the gas sector in Bangladesh, ADB missions should encourage the EAs more strongly to select consultants in time for project implementation and to take advantage of ADB's permission for advance recruitment of consultants.

(iv) It is always difficult to change individual consultants, especially when the consultants are employed on an intermittent basis on a long project. It is more practical to hire a consulting firm rather than individual consultants (consultants were hired individually under the project) and thus gain the flexibility of changing consultants as and when needed.

(v) As Titas Gas Transmission and Distribution Company annual system losses have still not been reduced to below 2%, monthly reporting of losses (that was so successful in providing mass awareness among stakeholders) should be continued under the Gas Sector Reform Road Map.

The evaluation identified two issues that require follow-up actions.

Actions	**Responsible Department**	**Time Frame**
SARD should initiate discussions with the government regarding its policy of not metering all consumers. A concerted effort should be made together with other development partners to bring this about, as non-metering of household consumption can encourage inefficient and unlawful usage of gas. Gas meters remaining under the project for installation in households using one or two burner stoves should also be fitted as originally intended by project covenant 6(b) (paras. 34, 41, 69, 76).	SARD	2010
Consistent with project covenant 6(e), the government should be encouraged to privatize/outsource meter reading, billing, and collection. This would assist with improving revenue collection and limiting corruption (para. 41).	SARD	2010

ADB = Asian Development Bank, SARD = South Asia Regional Department.

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I. INTRODUCTION

A. Evaluation Purpose and Process

1. The Independent Evaluation Department (IED) of the Asian Development Bank (ADB) included the Third Natural Gas Development Project in Bangladesh[1] in its annual work program for 2009 (the design and monitoring framework is in Appendix 1). The main reasons for selecting the project for evaluation were (i) IED planned to conduct a sector assessment program evaluation in 2009 for the energy sector in Bangladesh; and (ii) to undertake a more in-depth assessment following on from ADB's 2005 project completion report.[2] The Third Natural Gas Development Project was approved in December 1993 to assist the Government of Bangladesh in progressing sectoral reforms and expanding gas production and treatment facilities. Almost 5.5 years after the loan's closure (October 2003), IED fielded an independent evaluation mission (IEM) to Bangladesh from 10 to 23 May 2009 to evaluate the project in terms of its relevance, effectiveness, efficiency, sustainability, and other impacts.[3]

2. The IEM prepared this report in accordance with IED guidelines.[4] This evaluation draws on a review of project documents, other relevant studies, and discussions with ADB staff. Discussions were also held with (i) the Ministry of Power, Energy and Mineral Resources (MPEMR); (ii) Bangladesh Oil, Gas and Mineral Corporation (Petrobangla); (iii) Gas Transmission Company Limited; (iv) relevant loan executing agencies (EAs): Bangladesh Gas Fields Company Limited (BGFCL), Bakhrabad Gas Systems Limited (BGSL), Jalalabad Gas Transmission and Distribution Systems Limited (JGTDSL), and Titas Gas Transmission and Distribution Company Limited (TGTDCL); and (v) Bangladesh Energy Regulatory Commission (BERC). A copy of the draft evaluation report was shared with ADB's South Asia Regional Department and the government through the Ministry of Finance. Their views were incorporated where relevant.

B. Expected Results and Program Objectives

3. As stated in the 1993 report and recommendation to the President (RRP), the objectives of the project were to (i) promote sector reforms; (ii) expand the gas production and treatment facilities at Titas, Habiganj, and Bakhrabad gas fields; (iii) upgrade, rehabilitate, and expand the gas transmission and distribution network in Bangladesh; and (iv) improve the efficiency and safety of the operations of the gas transmission and distribution companies.

4. The project completion report (PCR), which was circulated to ADB's Board of Directors in December 2005, assessed the project as "highly relevant," "efficacious," "efficient," and "most likely to be sustainable."[5] Overall, the PCR rated the Project "successful." The PCR assessed the project design as highly relevant to the government's development strategy to promote economic development through improved gas infrastructure. The project was also highly relevant to ADB's 1993 country operations strategy for Bangladesh,[6] which sought to reduce

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1 ADB. 1993. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Technical Assistance Grant to the People's Republic of Bangladesh for the Third Natural Gas Development Project*. Manila (Loan 1293-BAN[SF], approved for $107.0 million on 21 December).

2 ADB. 2005. *Completion Report: Third Natural Gas Development Project in Bangladesh.* Manila.

3 The IEM comprised S. Bayley, evaluation specialist/team leader; B. Palacios, senior evaluation officer; C. Pappas, international consultant; and D. Bakht, national consultant.

4 ADB. 2006. *Guidelines for Preparing Performance Evaluation Reports for Public Sector Operations*. Manila.

5 For an explanation of rating descriptions used in ADB evaluation reports, see: ADB. 2006. *Guidelines for Preparing Performance Evaluation Reports for Public Sector Operations.* Manila.

6 ADB. 1993. *Country Operational Strategy for Bangladesh.* Manila.

poverty through economic development. It was efficacious (i.e., effective), as it achieved its objectives by proving 4.6 trillion cubic feet (TCF) of additional gas supplies, improving transmission bottlenecks, and contributed indirectly to reducing poverty in the project area through economic growth. The PCR calculated financial internal rates of return (FIRR) for the project and found the rates at completion to be less than at appraisal for three of the project's four components. The economic internal rates of return (EIRRs) for the project at completion were less than the rates at appraisal for two components, but higher for two other components. (Appendix 3). The PCR rated the project most likely to be sustainable as the four EAs were profitable and have adequate budgets for the maintenance of project assets.

II. DESIGN AND IMPLEMENTATION

A. Formulation

5. At the time of project appraisal, the gas distribution networks in all three gas franchise areas of Bangladesh—Bakhrabad franchise area (BFA), Titas franchise area (TFA), and Jalalabad franchise area (JFA)—had grown in an unplanned manner and were experiencing severe constraints during peak periods of demand. In TFA, which served Dhaka, the rapid expansion of Dhaka city had led to a sharp increase in gas demand and the need to expand the gas distribution system, including provision of gas regulating stations. In the other two franchise areas, BFA and JFA, the gas distribution network needed rehabilitation and expansion. New production wells and new surface facilities for processing the gas were also needed. In January 1986, through the country programming mission, the government requested ADB assistance for establishing the Third Natural Gas Development Project. The government also approached the United Nations Development Programme (UNDP) for project preparatory technical assistance (TA), which UNDP agreed to finance as a grant on the condition that ADB administered the TA. In 1987, ADB approved the project preparatory TA funded by the UNDP. The outputs of the project preparatory TA included (i) preparation of a scheme for the Titas gas field for the reconfiguration of gas gathering, processing, and dehydration facilities to increase condensate recovery and for setting up a fractionation plant at Titas gas field; (ii) estimation of demand for gas in the Dhaka area for the 10-year period fiscal year (FY) 1987 to FY1996; (iii) formulation of proposals for expansion and improvement of the Titas gas distribution system to meet projected demand; and (iv) preparation of a scheme for the supply of natural gas to various subdistricts of BFA and for expansion of the distribution system. The project preparatory TA was completed in 1993 and formed the basis for the project.

B. Rationale and Scope

1. Rationale

6. The main energy resource in Bangladesh is natural gas. The project was aimed at developing this resource to meet the increasing demand for primary commercial energy in the country. The project sought to promote sectoral reforms, improve the gas infrastructure in Bangladesh, and increase the supply of commercial energy in Bangladesh. It increased the number of gas producing wells and gas treatment facilities, and expanded the gas transmission and distribution network. The project financed drilling and other specialized services for development of new wells, gas treatment plants, pipelines and related facilities, equipment and materials, overseas training, and consulting services. The policy dialogue sought to facilitate a commitment to an improved pricing structure for natural gas, and led to the adoption of modern distribution practices that will result in promoting energy conservation and expanding the effectiveness of the sector. The increased supply of natural gas would also help reduce the

demand for fuelwood and coal, thereby reducing deforestation and air pollution. This rationale was sound and appropriate given the conditions of the gas sector at this time.

2. Scope

7. The EAs for the project were BGFCL, BGSL, TGTDCL, and JGTDSL. The project components and the EAs responsible for them are described below.

a. Part A: Bangladesh Gas Fields Company Limited

8. BGFCL was responsible for (i) drilling of three new development wells at Titas gas field and four new development wells at Habiganj gas field; (ii) workover of five wells at Titas gas field and one well at Bakhrabad gas field (workover activities include a variety of remedial operations on a producing well to try to increase production); (iii) installation of two gas treatment plants (low temperature separator), each with a capacity of 60 million cubic feet (MMCF) per day, at the Titas gas field; and two dehydration units, each with a capacity of 75 MMCF per day, at Habiganj gas field; (iv) installation of a telecommunication system connecting the fields operated by BGFCL with its head office; (v) provision of consulting services for project implementation; and (vi) provision of training for BGFCL personnel.

b. Part B: Bakhrabad Gas Systems

9. BGSL was responsible for (i) rehabilitation of the gas distribution networks in Chittagong and Comilla; (ii) expansion of the gas distribution system to Feni Industrial Estate, Matlab, Kaptai, Rangunia, Lakshmipur, and Barura; and (iii) provision of training for BGSL personnel.

c. Part C: Titas Gas Transmission and Distribution Company

10. TGTDCL was responsible for (i) upgrading and expansion of the gas distribution network in Dhaka and extension of the gas distribution networks of Manikganj, Narshingdi, Tangail, and Munshiganj to cover new growth centers; (ii) installation of five metering and regulating stations in Dhaka and upgrading/modification/replacement of 11 metering and regulating stations at Joydevpur (1), Ghorasal (1), Demra (1), Ashuganj (1), and Dhaka (7); (iii) establishment of a centralized data acquisition and monitoring system and computerized network analysis system for TGTDCL's gas distribution network; (iv) construction of a 20-inch diameter, 32 kilometer (km) gas transmission pipeline from Monohardi to Narshingdi; (v) installation of household gas meters and setting up a metering workshop; (vi) provision of consulting services for project implementation; and (vii) provision of training for TGTDCL staff.

d. Part D: Jalalabad Gas Transmission and Distribution Systems

11. JGTDSL was responsible for (i) upgrading and expansion of the distribution network in Sylhet, including installation of two metering and regulating stations; (ii) construction of an 8-inch diameter, 42 km gas transmission pipeline from Kailashtilla gas field to Chhatak, including installation of five metering and regulating stations; (iii) construction of a 10-inch diameter, 15 km gas transmission pipeline from Chowdhuribazar to Kuchai; (iv) establishment of a pipeline communication network and instrumentation workshop; and (v) provision of training for JGTDSL staff.

C. Cost, Financing, and Executing Arrangements

12. The total project cost estimated at appraisal was $198.58 million. ADB was to provide $107 million out of its Special Funds resources to finance 91% of the foreign exchange cost of the project. The then Overseas Economic Cooperation Fund of Japan was to cofinance the remaining 9% of the foreign exchange cost (or about $10 million) on a parallel basis. The Overseas Economic Cooperation Fund subsequently became part of the then Japan Bank for International Cooperation (JBIC), which disbursed funds for the distribution networks under part C of the project. The government provided $81.48 million in counterpart funding to cover the entire local currency cost of the project.

13. The estimated project cost at appraisal was $198.58 while the actual cost of at completion was $156.81 million equivalent. This was primarily because of lower than estimated bid prices for the procurement of goods, services, and turnkey contracts. This excludes costs related to flood damage restoration, as well as the amount disbursed for payment to Spie Capag,[7] as these costs were separate from the project. Table 1 shows a summary of project costs by component, at appraisal and at completion.

Table 1: Project Cost by Component
($ million)

Component	Cost as Appraised			Cost at Completion		
	Foreign	Local	Total	Foreign	Local	Total
Part A: BGFCL	68.11	22.33	90.44	38.52	8.73	47.25
Part B: BGSL	3.90	4.29	8.19	3.54	5.47	9.01
Part C: TGTDCL	35.30[a]	45.31	80.60	36.10[b]	48.86	84.96
Part D: JGTDSL	9.79	9.56	19.35	7.30	8.29	15.59
Total	**117.10**	**81.48**	**198.58**	**85.46**	**71.35**	**156.81**

BGFCL = Bangladesh Gas Fields Company Limited, BGSL = Bakhrabad Gas Systems Limited, JGTDSL = Jalalabad Gas Transmission and Distribution System Limited, TGTDCL = Titas Gas Transmission and Distribution Company Limited.

[a] Includes $10.1 million cofinancing from the Japan Bank for International Cooperation.

[b] Includes $15.2 million disbursed by the Japan Bank for International Cooperation.

Sources: Executing agencies' project completion reports and the Loan Financial Information System of the Asian Development Bank.

14. The cost underrun of 46.4% for part A was primarily due to (i) lower than estimated prices of goods and services for drilling; (ii) judicious use of services of the drilling contractor and six third-party service contractors; (iii) fielding of six individual consultants according to field needs, instead of retaining them in the field continuously; and (iv) efficient utilization of loan funds, which reduced the service charge and interest during construction.

15. The cost overrun of 10.00% for part B was primarily due to taxes and duties during project implementation being higher than estimated.

16. The cost overrun of 5.4% for part C was due to (i) increased costs of goods from importing higher diameter line pipes using JBIC funding, (ii) higher costs for fabrication of pipes using imported strips, and (iii) higher than estimated costs for taxes and duties.

[7] The Government of Bangladesh requested ADB to allocate $10.00 million of the unutilized loan balance to settle a disputed payment to Spie Capag of France arising from a previous ADB project. See para. 24 for further information.

17. The cost underrun of 19.43% for part D was due to international competition lowering the costs of imported goods and services. JGTDSL, however, paid 196.80% more in taxes and duties than the appraisal estimate.

D. Procurement, Construction, and Scheduling

18. While the loan was declared effective within the time stipulated in the loan agreement, the engagement of consultants, as well as the awarding of construction and turnkey contracts by BGFCL and TGTDCL, was delayed substantially. The following time overruns in implementing components were experienced: 4.0 years for BGFCL, 1.0 years for BGSL, 4.5 years for TGTDCL, and 2.0 years for JGTDSL. BGSL, TGTDCL, and JGTDSL completed most of the revenue generating components without significant delay, enabling them to start connecting new consumers as planned. However, BGFCL's delay in completing field development works contributed to Bangladesh's gas supply shortages during 1998–2000.

19. Works by BGFCL under part A were completed in June 2003, 4 years after the target for completion in June 1999. This overrun was caused by (i) an initial delay of more than a year in engaging consultants; (ii) spending more than 2 years to engage a drilling contractor, resulting from the government's complex procurement procedures; and (iii) a longer than contracted period required for turnkey contractors to install telecommunication facilities and construct gas treatment facilities at Habiganj gas field. In addition, BGFCL was allowed to use surplus loan funds to (i) modernize metering systems for gas and liquid products; (ii) procure goods and services to isolate the water producing zone of one well in the Titas gas field drilled under the project; and (iii) procure additional materials to workover another well drilled under the project in Titas gas field, which was in production but with minor technical faults.

20. BGFCL started procuring goods for drilling new wells and workover producing wells before fielding consultants. BGFCL signed contracts with six individual consultants, engaged through two firms, in February 1996. It also signed six third-party services contracts during October 1997–February 1998. The contract for drilling services was signed in May 1998. At the request of the government, BGFCL was allowed to engage Bangladesh Petroleum Exploration and Production Company Limited (BAPEX) to drill one well at Habiganj gas field, using goods and services of third-party services contractors and consultants engaged under the project. This well, which started production in July 1998, was to address the delay in engaging a drilling contractor through international competitive bidding, and the acute gas shortage in 1997. The other six wells that the international contractor drilled were commissioned during February 1999–March 2000. Contracts for installation of gas processing plants at Titas and Habiganj gas fields were signed in January 1999, and commissioned in July 2000 (Titas) and November 2000 (Habiganj). The processing plant at Habiganj gas field had design flaws that required additional time to remedy. The final acceptance certificate was issued in January 2002. The contract for the telecommunication system was signed in November 1998 and was commissioned in July 2001, 8 months behind schedule.

21. BGSL's completion of project works under part B, scheduled for March 1997, was delayed by about 1 year. This was the result of the need for re-tendering of one subcomponent. However, its training component was completed by mid-1998 as scheduled.

22. Project works by TGTDCL under part C were completed in June 2003, 4.5 years after the completion target of December 1998. TGTDCL's schedule overrun was caused by (i) an initial delay of more than 2 years in engaging consultants which delayed design and procurement of contract services for metering and regulating stations (MRSs), the data

acquisition and monitoring system, as well as the telecommunications component of the project; (ii) construction of gas distribution facilities through local contractors under government funding, which required more time than planned; (iii) the unusually long time taken by TGTDCL to process three turnkey contracts for MRSs, the data acquisition and monitoring system, and the telecommunications component; (iv) frequent changes of project manager; and (v) a longer than contracted period for the turnkey contractor to install the telecommunications equipment. However, TGTDCL was able to commission the transmission pipeline in December 1999. The distribution network was built and commissioned in phases between September 1997 and June 2003.

23. All project works by JGTDSL under part D were completed in June 1998, 2 years later than the completion target of June 1996. JGTDSL's schedule delay was caused by (i) the contractor for the telecommunications system leaving the project without a proper handover, which led to delays in making the system fully operational; (ii) delays in land acquisition for installation of a transmission pipeline; (iii) the need for international re-tendering on one subcomponent; and (iv) JGTDSL lending 28 km of pipe to BGSL to assist its high priority project, which delayed completion of JGTDSL's own works.

E. Design Changes

24. There were no major changes to the original design of the project. However, there were some changes to the scope of the project, which was expanded to include repair and rehabilitation of road and railway infrastructure damaged during the flood of 1998. These were funded by utilizing $10 million of loan savings. Loan savings were also used for an out of court settlement on a previous ADB loan. The government requested ADB to allocate $10.00 million of the unutilized loan balance to settle a disputed payment to Spie Capag of France. In the early 1990s, Spie Capag was engaged as contractor by TGTDCL for construction of a 24-inch transmission pipeline from Ashuganj to Elenga under the Brahmaputra Basin Gas Transmission and Distribution Project.[8] The dispute was taken to arbitration and the International Court of Arbitration and Conciliation awarded Spie Capag $25 million in damages. However, it was resolved without further recourse to the courts and the parties finally agreed on a settlement of $8.85 million. ADB agreed to fund the payment and $8.85 million was disbursed from the loan.

25. Implementation followed the arrangements envisaged at appraisal, with some minor changes: (i) TGTDCL upgraded three additional MRSs, making a total of 19; (ii) TGTDCL did not upgrade distribution networks in smaller townships because of lack of expected growth in demand; (iii) JGTDSL deleted four MRSs as a result of delay in the construction of a cement plant as well as load growth in other areas; (iv) BGSL built three additional MRSs, bringing the total of MRSs installed under the project to 25; (v) workover of one well at Bakhrabad gas field was deleted based on discouraging results of workover of another well with JBIC funding; and (vi) JGTDSL increased the diameter of the transmission line from 8–10 inches to 10 inches.

[8] ADB. 1987. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bangladesh for the Brahmaputra Basin Gas Transmission and Distribution Project*. Manila (Loan 0868-BAN[SF], approved for $74.0 million on 26 November).

F. Outputs

1. Part A: Bangladesh Gas Fields Company Limited Component

a. Drilling of Wells

26. Under part A of the project, 7 new wells (3 at Titas gas field and 4 at Habiganj gas field) were to be drilled. BGFCL expanded gas supply by drilling new wells at Titas gas field (numbers 12, 13, and 14) and Habiganj gas field (numbers 7, 8, 9, and 10). In addition, five wells at Titas were worked over (numbers 2, 7, 8, 9, and 10). One additional well at Bakhrabad gas field was to be worked over but production at the well was suspended soon after the loan was signed.

27. As of May 2009, production was suspended at Titas gas well 14 and Habiganj wells 8 and 9. In September 2009 well number 14 was placed back in production after reworking but wells 8 and 9 at Habiganj will not be reworked as they are located at the flanks of the gas field. The Titas field has also experienced problems with gas seepage and BGFCL is taking action to address this problem. Cumulative production since 1999 at Titas and Habiganj gas fields as a result of the project is 0.958 TCF, with the wells supplying 251 MMCF per day as of December 2008 (the incremental outputs due to the project are shown in Table 2 below in the columns titled "As a result of the project"). This compares favorably with the target at appraisal of 1.36 TCF and 200 MMCF per day over the life of the project. As the remaining project wells have an estimated life expectancy of production for another 10 years, total output will exceed the appraisal targets. Notwithstanding these good production records, BGFCL encountered consultant recruitment difficulties at the start of part A and this led to a delay in drilling of 1 year. This delay contributed to Bangladesh's gas shortages during 1999–2000 (para. 18).

Table 2: Increase in Production in Titas and Habiganj Gas Fields as a Result of the Project

Well Number	Date of Initial Commissioning	Rate of Production at Commissioning (MMCF per day)	Date of Commissioning after Workover	Present Production Rate (MMCF per day)	Cumulative Production			
					Gas (TCF)		Condensate (bbl)	
					Since Inception	As a Result of the Project	Since Inception	As a Result of the Project
Titas Well No. 2	May 1968[a]	30	Mar 1999	32	0.314917	0.106530	484,199	118,814
Titas Well No. 7	Jul 1985[a]	30	July 1999	32	0.217982	0.103631	273,222	114,674
Titas Well No. 8	Feb 1985[a]	30	Apr 1999	19	0.200727	0.085060	247,997	94,907
Titas Well No. 9	Mar 1989[a]	30	May 1999	27	0.191524	0.098316	236,450	108,807
Titas Well No. 10	Sep 1990[a]	30	Jul 1999	12	0.151694	0.070617	192,924	79,034
Titas Well No. 12	July 2002[a] Aug 1999[b]	25	Remedial works completed by BGFCL using own finance Jun 2002	22	0.052878	0.052878	66,391	66,391

Well Number	Date of Initial Commissioning	Rate of Production at Commissioning (MMCF per day)	Date of Commissioning after Workover	Present Production Rate (MMCF per day)	Cumulative Production			
					Gas (TCF)		Condensate (bbl)	
					Since Inception	As a Result of the Project	Since Inception	As a Result of the Project
Titas Well No. 13	Jun 2000[a] Dec 1999[b]	30		30	0.089649	0.089649	152,511	152,511
Titas Well No. 14	Jun 2000[a] Mar 2000[b]	30	Sept 2009	20	0.070472	0.070472	125,608	125,608
HBJ Well No. 7	Apr 2000[a] Apr 1999[b]	20		39	0.108603	0.108603	5,991	5,991
HBJ Well No. 8	May 2000[a] Jan 1999[b]	8		0 (Production ceased on 19 Jun 2004)	0.011023	0.011023	632	632
HBJ Well-9	Jul 1998[a] Jul 1998[b]	17		0 (Production ceased on 22 Apr 2008)	0.052651	0.052651	2,924	2,924
HBJ Well-10	Apr 2000[a] Aug 1999[b]	27		38	0.108462	0.108462	5,991	5,991
Total				**251**	**1.570582**	**0.957893**	**1,794,840**	**876,284**

bbl = barrel, BGFCL = Bangladesh Gas Fields Company Limited, HBJ = Habiganj, MMCF = million cubic feet, TCF = trillion cubic feet.

[a] Date of production starting.

[b] Date of completion.

Source: Bangladesh Gas Fields Company Ltd.

b. Gas Treatment Plants

28. Two 60 MMCF per day capacity low temperature separator processing plants at location 5 in Titas gas field were commissioned on 30 July 2000. These units processed gas from Titas well numbers 12, 13, and 14. Two dehydration units of 75 MMCF per day capacity (glycol processing plants) were commissioned at Habiganj on 4 November 2000. As of May 2009, all four gas treatment plants are operating successfully. In 2007–2008, the Titas field low temperature separator treatment plants were processing a total of 470 barrels of condensate per day. At appraisal, the envisaged incremental rate of processing for Titas gas field as a result of the project was estimated at 225 barrels of condensate per day whereas the actual incremental rate has only been 80 barrels of condensate per day. This was due to a gradual decrease in well gas pressure.

c. Telecommunications, Consulting Services, Training

29. The telecommunications system was installed in 2000. A total of 23 BGFCL staff completed overseas training—17 received training in Canada and 6 in the United States. Consulting services for implementation of part A of the project were completed satisfactorily.

2. Part B: Bakhrabad Gas Systems Component

a. Rehabilitation and Expansion of Distribution System and Training

30. Rehabilitation of the gas distribution network in Chittagong and Comilla was completed, and was in operation since 1999. Expansion of the gas distribution network to Feni industrial estate, Matlab, Rangunia, Kaptai, Lakshimpur, and Barura districts was completed. A total of 278 km of distribution pipelines was installed; and three MRSs were installed at Kaptai, Lakshimpur, and Chittagong. The pipes ranged in size from 1 inch to 6 inches, with pressures of 4 bar and 10 bar. Out of the total pipes laid, 27 km were 10 bar and 251 km were 4 bar. The facilities in BFA are delivering 290 MMCF per day of gas but demand has reached 360 MMCF per day. The number of new customers connected at project completion reached 7,390 against a target of 8,669.

31. A total of 20 BGSL staff completed overseas training—17 received training in Canada and 3 attended a seminar in the United States.

3. Part C: Titas Gas Transmission and Distribution Company Component

a. Transmission, Distribution Network Expansion, and Provision and Upgrading of Metering and Regulating Stations

32. TGTDCL completed construction of 25 km of a 20-inch transmission pipeline from Monohardy to Narshingdhi in 1997, which has since been operating at full capacity. The same line was extended a further 39.5 km from Narshingdhi to Siddhirganj under the project, with cofinancing from JBIC. By June 2000, the distribution network was extended to Manikganj, Narshingdi, Tangail, and Munshiganj, with a total of 481 km of distribution pipeline being installed. A total of 19 MRSs were installed, replaced, or upgraded—4 were new, 11 were replaced, and 4 upgraded. The target of 16 MRSs was exceeded, with 3 additional MRSs upgraded, and all 19 MRSs were commissioned by June 2003.

b. Network Analysis and Supervisory Control and Data Acquisition Systems, Consulting Services and Training

33. The telecommunications and Supervisory Control and Data Acquisition (SCADA) systems were installed and commissioned by June 2001. TGTDCL accepted the computerized network analysis and design system for its distribution network in 2002. Consulting services for implementation of part C of the project were completed satisfactorily. Overseas training in Canada for 30 staff was completed successfully. The courses covered included measurement and control, environmental engineering, gas utilization engineering, safety engineering, computer-aided design, corrosion control and cathodic protection, and telecommunications engineering. In addition, two staff attended a seminar on regulatory framework for natural gas in Canada and four senior staff attended courses in the United States. Overall, 36 staff received training.

c. Installation of Gas Meters and Meter Workshop

34. The meter workshop was completed in March 2003. However, 35,916 out of the 60,000 meters procured under the project were still in TGTDCL stores as of May 2009. TGTDCL has explained that this was due to the government's 2002 policy decision to collect a flat rate tariff for households using stoves with one or two burners, so meters are only installed

for households with higher usage (e.g., 3-burner stoves, stoves with ovens, hot water heaters, etc). This is a most inefficient way of keeping track of the amount of gas a distribution company uses and is open to abuse of a scarce and valuable resource. The government's policy on meters is inconsistent with the loan agreement.

4. Part D: Jalalabad Gas Transmission and Distribution Systems Component

a. Transmission and Distribution Network Expansion

35. JGTDSL completed all construction work on the pipelines by June 1998. Under the project, JGTDSL constructed a total of 57 km of new 6–10 inch, 100 pounds per square inch gauge (psig) transmission pipeline; an 8-inch, 42 km long pipeline from Kuchai to Chhatak to supply the cement plant at Chhatak; and a 10-inch, 15 km pipeline from Kailashtila to Chhatak to Khadim, including crossing the Suma river at Sylhet. In addition, JGTDSL rehabilitated 25 km of existing transmission pipeline from Haripur to the Fenchuganj Natural Gas Fertilizer Factory at Sylhet. JGTDSL constructed 55 km of new 6 inch and 2–4 inch 60 psig distribution pipeline, and installed 3 MRSs around Sylhet town. However, given the delayed construction of the new cement plant at Chhatak, JGTDSL dropped the metering and regulating station required for supplying gas to the plant. The Chhatak cement plant is now operational but still not working at maximum capacity. The pipeline feeding it has a maximum transmission capacity of 80 MMCF per day but is currently transmitting only 30 MMCF per day. It is expected that by the end of 2010 the pipeline will be operating at 70 MMCF per day, as another power plant at Kumargong is expected to come online and the cement plant will be working at increased capacity.

b. Telecommunications Network and Training

36. JGTDSL attempted to establish a sophisticated telecommunications network that included interoffice voice and fax communication links and a mobile localized network. The contract for the network was on a design, build, and turnkey basis. Bidding was based on a VHF communication system but JGTDSL negotiated the contract on a UHF-VHF system. After installation, the contractor failed to conduct performance testing of the integrated system and JGTDSL withheld the acceptance certificate. In spite of repeated requests by JGTDSL, the contractor failed to complete the job. JGTDSL terminated the contract, blacklisted the contractor, withheld the balance payment, and cashed the contractor's performance bank guarantee. JGTDSL subsequently tried to make the system operable but was unsuccessful. It has decided to abandon the new system and is continuing to use its previous system.

37. A total of 19 JGTDSL staff received overseas training—11 in Canada, 6 in the United Kingdom, and 2 in the United States.

G. Consultants

38. Loan funds utilized for consulting services totaled $1.29 million equivalent, compared with an appraisal estimate of $2.10 million equivalent. The delay in recruiting consultants by BGFCL and TGTDCL was one of the causes of the time overrun in implementing the project components.

39. The scope of consulting services for the ADB-financed component included assisting BGFCL in preparing the prequalification and tender documents for the well drilling and workover services, supervision of drilling, and basic design of the gas processing plants and telecommunication system. The BGFCL component provided for 72 person-months of

consulting services from five individual consultants. BGFCL engaged six individual consultants, instead of five, through two firms, using international competitive bidding. ADB accepted BGFCL's proposal to engage two petroleum engineers (one for drilling and completion, the other for workover and re-completion), instead of one. BGFCL fielded the consultants in March 1996, and used their services intermittently according to field requirements through June 2002 for 49.7 person-months.

40. The ADB-financed component also helped TGTDCL design and prepare tender documents for the procurement of the MRSs, data acquisition and monitoring system, and telecommunication system. The TGTDCL component provided for 13 person-months of consulting services from two individual consultants. TGTDCL engaged two individual consultants through a firm, using international competitive bidding. TGTDCL fielded the consultants in March 1997 and utilized their services for 13 person-months.

H. Loan Covenants

41. Out of 20 loan covenants, the eight given below were either not complied with or were partially complied with at project completion (PCR serial numbers 5, 6, 7[a], 8, 11, 14, 16, and 17). At the time of the IEM, only covenants 11 and 16 had been fully complied with during recent years (Appendix 2).

> 5. "The Borrower shall ensure that BGSL and JGTDSL maintain system losses in their respective franchise areas at 2% or less throughout the Project." The IEM found that this covenant was partially complied with. Although they have improved over time, the levels of system losses are variable and not always below the 2% target since project completion. For FY2008, system losses were +0.84% for BGSL and -1.07% for JGTDSL.
>
> 6. "The Borrower shall ensure that TGTDCL, with advice of the consultants appointed under the Safety and Efficiency TA, shall implement the system loss reduction plan agreed with ADB to reduce the level of system losses in its franchise area to 2% or less by 30 June 1995, and maintain such level thereafter." The IEM found that this covenant was not complied with. TGTDCL's losses have been consistently above target, although improving over time. TGTDCL's losses were 3.4% in FY2008.
>
> 6(c) "gradually install meters, as agreed with ADB, under Part C of the Project beginning with households with more than one appliance, or which share the use of their kitchen with other households, subject to any other prioritization for installation of gas meters determined by the consultants under the Safety and Efficiency TA." The IEM found that this covenant was partially complied with. Out of the 60,000 meters procured, 35,916 meters are still in TGTDCL stores (para. 34).
>
> 6(d) "divide Greater Dhaka area into gas management zones, each with known gas consumption that can be monitored." The IEM found that this covenant was partially complied with. Greater Dhaka was divided into 12 zones for administrative purposes but the division could not be operationally implemented due to a lack of funds. A budget of Tk300 million was needed to cut pipes, install monitoring valves, and provide M&R stations. This task was not foreseen in the government budget for the project, and it was not pursued as funds could not be provided. ADB should have addressed this issue in its subsequent loans to the sector.

6(e) “privatize meter reading, billing, and collection for metered consumers and gas consumption assessment for nonmetered consumers in accordance with a scheme acceptable to ADB, with privatization of two gas management zones each, on a pilot basis, in 1994 and 1995, respectively, and commencement in 1996 of privatization of gas management zones in Dhaka City with assistance of the consultants appointed under the Safety and Efficiency TA.” The IEM found that this covenant was not complied with. Tenders were floated for two areas but TGTDCL did not finalize contracts as it found the conditions imposed by the contractors unacceptable. TGTDCL floated two more tenders but subsequently abandoned trying to privatize meter reading under pressure from trade unions. A more concerted effort is needed by the government in privatizing bill collection activities.

7(a) “full economic price of natural gas (i.e., the international price of fuel oil on a heating value parity basis) is recovered progressively from consumers by 30 June 1998, as agreed by the Borrower and ADB.” The IEM found that this covenant was partially complied with. The tariff was revised four times during 1998–2002, increasing to 80% of the international price of fuel oil. In 2003, the government adopted a pricing policy aligning the wellhead price of gas produced by national companies to 7% of the international price of fuel oil on heating value parity, with provisions for periodic review. Since the formation of the Bangladesh Energy Regulatory Commission (BERC), there was an increase in gas tariffs on 1 January 2005 whereas the price of international oil and gas has increased substantially during 2005–2009. In 2008, Petrobangla requested an increase of 35% in its bulk gas price and 65% in its domestic price but BERC rejected this. BERC was prepared to consider a 10%–15% increase on conditions to be agreed by Petrobangla and adjourned its review pending further information from Petrobangla. On 1 August 2009, BERC approved an overall 11.2% increase in gas prices on condition that Petrobangla create a gas development fund that would be used solely for exploration, production, transmission, and distribution of gas.

8. “The Borrower shall ensure that BGSL, BGFCL, JGTDSL, and TGTDCL take all necessary steps to improve the collection of accounts receivable to achieve a level of 3 months of gas sales or less by 30 June 1994, and maintain such level thereafter.” The IEM found that this covenant was partially complied with. Levels of accounts receivables have not been consistently below the 3-month target since project completion. Average accounts receivable as of June 2008 were 2.28 months for BGSL, 2.93 months for BGFCL, 3.0 months for JGTDSL, and 3.1 months for TGTDCL. As of April 2009, TGTDCL’s collections from government-owned entities (such as textile and jute mills) had accounts receivable of 5.1 months whereas the accounts of private sector clients were 2.6 months.

11(a) “Except as ADB might otherwise agree, the Borrower shall ensure that an annual rate of return on average net fixed assets, valued on a historical cost basis, of not less than 12% is maintained by BGFCL and JGTDSL throughout the Project.” The IEM found that this covenant was partially complied with since project completion although fully met in recent years. The return on average net fixed assets for FY2008 was 26.4% for BGFCL and 23% for JGTDSL.

11(b) “Except as ADB might otherwise agree, the Borrower shall ensure that an annual rate of return on average net fixed assets, valued on a historical cost basis, of not less than 12% is achieved by BGSL for the FY1997, and maintained in each fiscal year thereafter.” The IEM found that the 12% target had not been achieved in each year since

project completion (5.4% in FY2000 for example) although the target had been well exceeded in recent years (211.9% in FY2008).

11(c) “Except as ADB might otherwise agree, the Borrower shall ensure that an annual rate of return on average net fixed assets, valued on a historical cost basis, of not less than 12% is achieved by TGTDCL for the FY1994 and FY1995, and 15% for the Fiscal Year FY1996 and in each fiscal year thereafter.” The IEM found that this covenant was partially complied with since project completion although fully met in recent years. The return on average net fixed assets for FY2008 was 48.4%.

14. “The Borrower, by 30 June 1994, shall introduce legislation containing provisions for: (a) expeditious recovery of unpaid gas bills; (b) empowerment of gas transmission and distribution companies to expeditiously disconnect nonpaying or delinquent consumers, and removal or limitation of jurisdiction of civil courts to issue injunctions preventing disconnection in such cases; (c) police assistance for disconnecting delinquent/ nonpaying consumers; (d) criminalization of pilferage of gas and tampering with gas meters, including punishment of abettors; and empowerment of personnel and companies involved in privatized meter reading, assessment, billing, and collection to effectively discharge their functions, including powers to disconnect delinquent/nonpaying consumers.” The IEM found that this covenant was partially complied with. The borrower enacted the Energy Regulatory Commission Act in March 2003, which addressed some of these requirements. The draft Gas Act 2009 which has been approved by Cabinet and placed in Parliament for enactment will further empower the distribution companies to take more stringent legal action against fraud, theft, and malpractices by delinquent customers.

16. “To confer greater autonomy on the project executing agencies all financial powers enjoyed by Petrobangla for procurement of goods and services are transferred to the project executing agencies, and that adequate steps satisfactory to ADB have been initiated to allow greater financial powers to the project executing agencies.” At project completion, this covenant was partly complied with as Petrobangla had only relinquished 50% authority to the EAs. The EAs have since been given full financial authority so this covenant is now fully complied with.

17. “As a step towards eventual privatization of the project executing agencies, the Borrower shall ensure that at least 20% of the shares of each project executing agency are owned by the private sector by 30 June 1999, and that at least 5% of such private sector ownership is achieved by 30 June 1996.” The IEM found that this covenant was not complied with. TGTDCL placed 25% of its shares on the market in June 2008 but offloading of shares for JGTDSL and BGSL has been halted. The government has decided to redefine the areas of BGSL and TGTDCL to create a new company to be named Karnapuli Gas Distribution Company. BGFCL and JGTDSL are engaging consulting firms to assist them in off-loading shares once Karnapuli Gas Distribution Company has been established.

I. Policy Framework

42. ADB, together with other development partner agencies, has been in continuous dialogue with the government regarding improving governance in the sector, as well as harnessing the sector as an engine for accelerating economic growth. The policy dialogue of the project involved a range of issues such as (i) enactment of a new gas law to allow the

distribution companies to take more stringent legal actions against fraud, theft, and malpractices by delinquent customers; (ii) private sector participation in gas exploration and production; (iii) planning for optimized development of the gas sector and use of natural gas resources; and (iv) improvement in the corporate governance of the sector entities, including reconstitution of the boards of directors, delegation of authority, and revision of the conditions of service of employees. The project experienced both successes and setbacks with respect to its policy dialogue.

43. One of the successes was the establishment of the Hydrocarbon Unit. Under the government's petroleum policy, Petrobangla was to become a joint venture partner in oil and gas exploration and production, so there was a need to transfer its functions in the areas of policy implementation and supervision of the oil and gas sector to MPEMR to avoid any possible conflict of interest. In response to project covenant no. 15, the government agreed to establish a hydrocarbon sector unit in MPEMR. The Hydrocarbon Unit was established in June 1994.

44. Another success was the creation of BERC. Although ADB, the World Bank, and other development partners had initially recommended independent regulators for each of the gas and power sectors, the government decided to create a single independent regulator for both the gas and power sectors. The legal framework for establishing BERC was enacted on 13 March 2003 and BERC became fully operational in 2007 with the appointment of all members.

45. Policy dialogue successes also include (i) the establishment of private sector participation in oil and gas exploration; (ii) introduction of the Gas System Loss Reduction Plan, which reduced the losses of TGTDCL from around 9.0% prior to its introduction to 3.39% by FY2008; and (iii) TGTDCL, Gas Transmission Company Limited, and JGTDSL all now having private sector members on their boards.

46. Policy setbacks include (i) the government's failure to align the gas price with the international fuel oil price and the continuing subsidy it provides for the users of gas in the country, (ii) the government's slow progress in enacting the Gas Act (the draft Gas Act 2009 is currently in Parliament for enactment), (iii) the government policy of not metering all gas consumers, and (iv) slow progress in further corporatization/breakup of the existing gas distribution companies.

47. Notwithstanding these setbacks, the government has embarked on addressing some of these issues through the Gas Sector Reform Road Map, 2009–2012. The road map, which forms part of the Gas Transmission and Development Project,[9] envisages (i) institutional and financial restructuring of gas sector companies to ensure long-term financial sustainability; (ii) strengthening public–private partnership in the gas sector, aimed at creating an environment for private sector-led growth; (iii) transformation of gas companies to diversify ownership involving private investors; (iv) restructuring and unbundling gas sector institutions and enterprises; and (v) market-oriented energy pricing reflecting energy parity, eliminating noneconomic factors and levies, and equating gas prices from the state-owned gas-producing companies with those from international oil companies.

48. As stated in the road map Petrobangla's legislation will be reviewed to redefine the role of Petrobangla to suit the changing business environment. Gas sector entities will continue to

[9] ADB. 2005. *Report and Recommendation of the President to the Board of Directors: Proposed Loans to Bangladesh for the Gas Transmission and Development Project*. Manila (Loan 2188/2189-BAN[SF], approved for $225.0 million on 25 October).

implement the Gas System Loss Reduction Plan, under which gas theft and meter-reading malpractices will become illegal in accordance with the proposed Gas Act. The government is preparing a Revised Energy Policy Statement that is to provide the broad framework for development of Bangladesh's energy sector. The statement is expected to be submitted to Parliament in the second half of 2009.

III. PERFORMANCE ASSESSMENT

A. Overall Assessment

49. The project is rated "successful" (see Table 3). There were no major changes to the design of the project and all components were consistent with government priorities as well as ADB's strategy for the gas sector.[10] After loan effectiveness the project's administration was managed by the Bangladesh Resident Mission which enabled frequent communication between ADB, EAs, consultants, contractors, and development partners. Institutional reforms were initiated as a consequence of the project, and the availability and utilization of gas have improved significantly in the project target areas. While the EIRRs for all four project components were higher than ADB's 12% threshold, the FIRRs for three components were negative. These negative FIRRs indicate that the project facilities do not yield enough revenues to recover the cost of gas and the transfer payments that have to be made. However, the overall operations of the EAs remain profitable and they continue to have sufficient financial capability to keep the facilities in good condition. The EAs also have the necessary engineering and operational human resources to sustain the investments financed by ADB.

Table 3: Overall Assessment of the Project

Criterion	Weight (%)	Assessment	Rating Value	Weighted Rating
Relevance	20	Relevant	2	0.4
Effectiveness	30	Effective	2	0.6
Efficiency	30	Efficient	2	0.6
Sustainability	20	Likely	2	0.4
Overall Rating		**Successful**		**2.0**

Note: Highly successful (weighted average is greater than or equal to 2.7), successful (weighted average is greater than or equal to 1.6 and less than 2.7), partly successful (weighted average is greater than or equal to 0.8 and less than 1.6), unsuccessful (weighted average is less than 0.8).
Source: Independent Evaluation Mission.

B. Relevance

50. The project is rated "relevant." The project design was in line with ADB's gas sector strategy (footnote 10), its country operational strategy of 1993 (footnote 6) and ADB's 1995 energy policy.[11] At the time of loan appraisal, there was increasing demand for natural gas that could not be met with the existing gas infrastructure, there were unacceptable levels of losses, and the sector was in need of reform. All components of the project were fully consistent with the government's priorities—to increase exploration activities and to restructure the gas sector. They were relevant as enhancement of supply, transmission, and distribution of natural gas—the primary source of energy in Bangladesh—were essential to the overall economy of Bangladesh.

[10] ADB's strategy to the gas sector is summarized in IED's Sector Assistance Program Evaluation for Bangladesh Energy Sector. (ADB. 2009. *Sector Assistance Program Evaluation: Energy Sector in Bangladesh.* Manila.)
[11] ADB. 1995. *Bank Policy for the Energy Sector*. Manila.

C. Effectiveness

51. The project is rated "effective," as overall the major targets of the project were met. In assessing effectiveness, the evaluation examined if outcomes were achieved and the effect of project implementation on the expected outcomes, including delays in outcome. The expected outcomes of the project were to (i) expand availability and utilization of gas throughout project target areas, (ii) collect adequate revenue for sustainable operations and maintenance, (iii) establish a mechanism for minimizing system losses, (iv) introduce sector reforms for commercial orientation of the EAs, (v) ensure private sector participation in gas company management, and (vi) segregate regulatory functions.

52. The project was implemented in four parts. Under part A, BGFCL expanded gas supply through drilling of seven appraisal-cum-development wells—three at Titas gas field and four at Habiganj gas field. In addition, five wells at Titas were worked over. Production at Titas and Habiganj gas fields as a result of the project is 0.958 TCF since 1999 and 251 MMCF per day as of December 2008. The total production of gas is expected to exceed the appraisal target of 1.36 TCF, as the Titas and Habiganj wells have in excess of 10 years life expectancy, while the rate of daily production of gas of 200 MMCF per day has already been exceeded.

53. The gas distribution components under parts B, C, and D expanded transmission and distribution system capacity to ensure reliable gas supply to the power plants, particularly in TFA, and connected new industrial consumers in BFA, TFA, and JFA. A total of 107 km of transmission pipeline was laid in TFA and JFA, and 814 km of distribution pipelines were laid in BFA, JFA, and TFA. This distribution expansion was carried out by BGSL, TGTDCL, and JGTDSL in their respective franchise areas. Delays in completion of these components were 2.0 years for BGSL, 4.5 years for TGTDCL, and 4.5 years for JGTDSL. These delays were mainly due to (i) late engagement of consultants, (ii) late completion of gas distribution facilities by government-funded local contractors, and (iii) frequent changes of project managers. Whereas the project target at completion was for 50,000 new consumers to be connected by December 2003, 64,548 had actually been connected. Despite the delays, the project resulted in a total of 183,530 new consumers being connected as of May 2009—24 power plants, 1,333 industrial consumers, and 182,173 domestic consumers.

54. As a result of the project covenants, a proper reporting system was introduced, which helped in monitoring overall loss and distribution loss by area. These measures have been effective in reducing system losses. At project appraisal, TGTDCL's transmission losses were 9.22%. TGTDCL now has 12 teams of inspectors in Dhaka City to monitor gas use. TGTDCL's system losses for FY2008 were 3.39% and for March 2009 were 1.30%.

55. In September 1994, MPEMR issued a notification placing the Hydro Carbon Unit (HCU) in the Energy and Mineral Resources Division. The HCU is now a permanent institutional unit and since July 2008 has been functioning as the technical wing of the Energy and Mineral Resources Division. Staffing levels have yet to be finalized by the government, but this is expected to be resolved during 2009.

56. BERC was established in 2004 and its duties include the setting of gas tariffs. The financial position of the gas distribution companies is sound, with all of them profitable and generating surplus cash from their operations. The finances of the distribution companies show a general pattern of improving profitability, with increasing returns on equity and on fixed assets. Debt–equity ratios show that there is a comfortable cushion of equity in the companies and they

could accommodate additional debt to finance further investment. All EAs now have private sector members on their boards in accordance with the project's loan covenants.

D. Efficiency

57. The efficiency of the project refers to the extent to which ADB resources have been delivered on time and optimally utilized. The project experienced significant time delays and the original loan closing date of 31 December 1999 was extended twice (paras. 18–23), closing on 23 October 2003. Despite the delays, the project achieved its objectives of expanding gas production and improving the gas transmission and distribution networks, and efficiency in reaching this objective was substantial. The delay in project completion did not lead to any major cost over runs.

58. Without the project, Bangladesh would need to import petroleum products at world prices, use more coal, and increase the burning of wood. The increased availability of gas has encouraged energy consumers from all categories to switch to the generally cheaper, cleaner, and more convenient gas. The recalculated EIRRs for the four project components ranged between 30.41% and 229.91%, implying highly efficient investment in terms of economic returns (Appendix 3)., Such high EIRRs are common in natural resource projects like gas projects with relatively low workover investment costs. The project is rated "efficient."

E. Sustainability

59. The sustainability criterion looks at the probability that the human, institutional, financial, and natural resources are sufficient to maintain the outcome achieved over the economic lifetime of the project. The project is rated "likely to be sustainable." The recalculated FIRR for part A was well above the weighted average cost of capital while the FIRRs for parts B, C, and D were all less than zero (see Appendix 3). The negative FIRRs indicated that the project facilities do not yield enough revenues to recover the cost of gas and the transfer payments that have to be made (i.e., to Petrobangla, BAPEX, price deficit fund [PDF], value-added tax [VAT], and supplementary duties). The project facilities in isolation from the overall operations of the EAs do not appear to be financially viable based on the recalculated FIRRs. However, the project facilities are only a component of the overall operations of the EAs. When the total operation of the EAs is considered, they remain profitable and continue to have sufficient financial capability to keep the facilities in good condition.[12] Notwithstanding the overall financial position of the institutions, there is room for improvement especially in the areas of systems loss for TGTDCL and operating costs for BGSL and JGTDCL. BGFCL has had to deal with disruptions in the production of three project wells. Two of these wells have been depleted and the production of the third well has been suspended because of water intrusion. BGFCL has managed to keep the other wells in good condition and production continuous. The physical sustainability of the transmission and distribution lines and equipment purchased under the project is high as BGSL, JGTDSL, and TGTDCL are all experienced in the maintenance of such facilities. The gas companies in Bangladesh have the necessary engineering and operational human resources to sustain the investments financed by ADB. The financial sustainability of these key institutions will depend on their ability to remain profitable. The EAs will remain sustainable as long as tariffs are maintained at a level sufficient to cover costs, service debts, and provide maintenance. The finances of the gas distribution companies are currently healthy, and on 1 August 2009, BERC approved an 11.22% overall increase in the price of gas. Prior to

[12] For further information on the sustainability of gas sector entities see: ADB. 2009. *Sector Assistance Program Evaluation: Energy Sector in Bangladesh.* Manila.

this increase, gas prices had not been adjusted since FY2006 (except enhancement in feed gas and consumer pricing for compressed natural gas [CNG] in FY2008). For as long as the EAs are financially healthy, they will have enough resources to maintain the project facilities.

IV. OTHER ASSESSMENTS

A. Impacts

1. Poverty Impact

60. Although not evaluated directly, the project has contributed indirectly to poverty reduction in Dhaka and surrounding areas by supporting economic growth and spreading of wealth.

2. Consumer Survey

61. As part of this evaluation, a consumer survey was undertaken of household, commercial, and industrial gas consumers in the project area. The survey of 205 households found the following:

(i) Some 63.4% of respondents reported that they had a metered gas connection.
(ii) Respondents were generally satisfied with the quality of gas services for new connections/extensions, repairs, and billing. Consumers were also generally satisfied with the price of gas. The majority of respondents were not willing to pay a higher price to obtain more reliable gas supply.
(iii) One-third of the respondents reported having paid a bribe to avoid harassment in obtaining a new gas connection/extension/meter connection, etc.

62. The survey of 204 commercial consumers (retail shops, beauty salons, hotels, business offices, etc.) found the following:

(i) About 47% of commercial consumers reported being satisfied with the cost of gas and their billing arrangements. Similar to household consumers, most commercial gas users were not willing to pay a higher price for more reliable gas supply.
(ii) One-third of the respondents reported having paid a bribe to avoid harassment in obtaining a new gas connection/extension/meter connection, etc.

63. The survey of 15 small and medium-sized industrial consumers (chemical, packaging, steel, clothing, and rubber manufacturing, etc.) found the following:

(i) About two-thirds of respondents were satisfied with the price they pay for gas and 93% were satisfied with their billing arrangements.
(ii) Some 80% of respondents rated the reliability/quality of their gas supply poor; 0% rated reliability/quality good. However, the majority of the respondents were not willing to pay a higher price for more reliable gas supply.
(iii) About 47% of respondents reported having paid a bribe to avoid harassment in obtaining a new gas connection/extension/meter connection, etc.

64. Further information on the survey's methodology and findings is in Appendix 4.

3. Environmental Impact

65. At appraisal, the initial environment examination report concluded that the project did not produce any substantial adverse environmental impacts. Hence, a full environmental impact assessment was not required. The EAs advise that minor environmental issues were addressed properly during design and implementation of the project. The upgrading of the network has also helped to improve the safety of operations. The EAs currently apply international standards in regard to their operations and maintenance. Although not analyzed quantitatively, the use of gas in cooking has contributed to avoidance of domestic pollution and benefited women folk.

B. ADB Performance

66. ADB's performance is rated "satisfactory." Project formulation, design, and implementation arrangements were generally satisfactory. Project administration was delegated to the Bangladesh Resident Mission immediately after loan effectiveness. This facilitated frequent communication between ADB, EAs, consultants, and contractors. ADB's timely approval of contract awards and disbursements, and active monitoring of progress, contributed to project completion. ADB fielded eight regular project review missions, and interacted regularly with the borrower and EAs. Offsetting these achievements by ADB, project cost estimates could have been more accurate and implementation delays could have been managed better.

C. Borrower Performance

67. The performance of the borrower and EAs is rated "partly satisfactory." This was the first reform-linked project in the gas sector. The borrower complied with all the conditions for loan effectiveness expeditiously, and the loan became effective as stipulated in the loan agreement. BGFCL, BGSL, and TGTDCL continued to operate the project implementation offices (PIOs) established under an ADB-assisted project that closed in November 1993. JGTDSL established a PIO for implementation of its component of the project. The borrower ensured smooth implementation of the project with timely acquisition of land and release of local funds.

68. While the loan was declared effective within the time stipulated in the loan agreement, the engagement of consultants, as well as the awarding of construction and turnkey contracts by BGFCL and TGTDCL, was substantially delayed. The four EAs successfully implemented their components, but with time overruns of 1.0–4.5 years and BGFCL's delay in completing field development works contributed to gas supply shortages in Bangladesh during 1998–2000 (para. 18).

69. The performance of the borrower and EAs in complying with the reform agenda could have been better. At the time of the IEM, six of the 20 loan covenants were still not fully complied with (para. 41). Progress has been particularly slow with regard to meeting the targets for (i) installation of household gas meters; (ii) privatizing meter reading, billing, and collection; (iii) charging consumers the full economic price of natural gas; (iv) the collection of accounts receivable; and (v) ensuring that at least 20% of the shares of each project EA are owned by the private sector.

D. Technical Assistance

70. There were two advisory TA projects attached to the project. The TA on preparing a gas system development plan and the strengthening of the organizational and regulatory framework

for the oil and gas sector[13] is rated "partly successful." The objectives of preparing a gas system development plan were (i) to optimize and balance the operations of the existing gas production, transmission, and distribution systems in Bangladesh taking into account the planned system rehabilitation and expansion of the system in the near future; and (ii) to develop a plan for further development of gas infrastructure in Bangladesh during the next 10 years. The objective of strengthening the organizational and regulatory framework for the oil and gas sector is to rationalize the operations and responsibilities of the government companies and institutions and regulatory mechanisms for the sector to promote private investment.

71. It was envisaged that the TA would enable the government to plan gas infrastructure projects in a timely manner to meet the increase in gas demand projected for the next 10 years. The plan would also include actions that need to be taken to establish an integrated gas transmission network in the near future, and identify alternative development scenarios depending on such factors as the discovery of additional gas reserves, potential for gas exports, producer and consumer pricing of the gas, and planned infrastructure projects. The TA would also make recommendations for developing an appropriate gas pricing system to make gas production, transmission, and distribution more efficient, market-oriented, and financially viable.

72. The TA provided the required outputs by (i) preparing a long-term gas system development plan; and (ii) making recommendations for strengthening regulatory functions of the government, rationalizing gas prices, and defining the role of Petrobangla to meet challenges of the anticipated increase in private sector investment in the gas sector, particularly in gas exploration and production. The TA is rated "partly successful," as the government was very slow to act on the TA's recommendations, particularly in relation to the strengthening of regulation and introducing appropriate gas pricing.

73. The TA on safety and efficiency improvements in the gas sector[14] is rated "partly successful." The objective of the TA was to assist TGTDCL, BGSL, and JGTDSL to (i) carry out safety and efficiency improvements of their gas distribution systems; and (ii) implement a system loss reduction plan, to reduce and/or maintain the unaccounted for gas to below 2% of company purchases.

74. System improvements were to cover areas related to the design, construction, operation, maintenance, testing, protection, and inspection of the gas distribution facilities. The consultants would assist the gas companies in adopting appropriate codes and standards; and prepare procedures for continuing adherence to these codes. The consultants were to train gas company personnel in implementing the findings of their study under the TA. In addition, the consultants would assist the gas companies prepare a plan to set up a training facility to upgrade the skills of their personnel in maintenance procedures. Finally, the consultants were to assist the gas companies to update maps and drawings, and provide practical advice and training to their personnel in work related to reducing gas losses.

75. The TA provided the required outputs by providing (i) expertise to the EAs in making comprehensive safety and efficiency improvements to the gas networks; (ii) assistance to TGTDCL in implementing its system loss reduction plan; and (iii) recommendations for

[13] ADB. 1993. *Technical Assistance to Bangladesh for the Preparation of a Gas System Development Plan and the Strengthening of the Organizational and Regulatory Framework for the Oil and Gas Sector.* Manila (TA 2024-BAN, approved for $565,000 on 21 December; attached to loan 1293-BAN[SF]: *Third Natural Gas Development Project*).

[14] ADB. 1993. *Technical Assistance to Bangladesh for the Safety and Efficiency Improvements in the Gas Sector.* Manila. (TA 2025-BAN, approved for $480,000 on 21 December; piggybacked to Loan 1293-BAN[SF]: *Third Natural Gas Development Project*).

maintaining the system losses of the EAs within acceptable limits. The TA is rated "partly successful" because TGTDCL has not fully implemented some of the TA's recommendations, particularly dividing the Dhaka city distribution network into several gas management zones. Furthermore, while TGTDCL has reduced its system losses, it has not been able to meet the 2% target.

V. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS

A. Issues

76. **Meters**. There are 35,916 household gas meters remaining in TGTDCL's stores out of the 60,000 procured under the project. Loan covenant 6(c) required that all of these meters be installed in accordance with the recommendations of the TA on safety and efficiency improvements in the gas sector. This covenant has only been partially met. The government decided that household consumers with stoves of only one or two burners would not be metered, but charged on a flat rate basis. This is not an efficient way of determining with any accuracy the use of an important national resource. The government should review this policy and continue with the installation of all remaining meters.

77. **Tariffs**. The project's loan covenant 7(a) requires that the full economic price of natural gas be recovered progressively from consumers by 30 June 1998. This covenant has only partially been met. The government revised tariffs four times during 1998–2000, increasing to 80% of the international price of fuel oil. In 2003, the government adopted a pricing policy aligning the wellhead price of gas generated by national production companies to 7% of the international price of fuel oil on heating value parity, with provisions for periodic review. However, during January 2005–July 2009, no significant increases in tariffs have taken place and the price of international oil and gas has increased substantially. In June 2008, Petrobangla requested an increase of 35% in its bulk gas price and a 65% increase in the domestic gas price but BERC rejected this. BERC was prepared to consider a 10%–15% increase on conditions to be agreed to by Petrobangla, and adjourned its review pending receipt of further information from Petrobangla. On 1 August 2009, BERC agreed to an overall increase of 11.2%. Long periods between price reviews places additional financial pressure on the national gas companies. BERC will need to review all gas pricing on a more regular, perhaps annual, basis.[15]

78. **Bangladesh Energy Regulatory Commission**. International oil companies operating in Bangladesh receive world parity prices for their gas whereas national gas production companies do not. Furthermore, BERC's 2003 legislation specifically excludes BERC from regulating the price of gas at the wellhead. This affects the financial position of all the national gas production companies. It is recommended that BERC's legislation be amended to enable BERC to set the price at the wellhead for the national gas production companies.

79. **Shortfall in Gas Supply to Meet Demand**. The current policy of making the country's gas resources available to users at an artificially low price is unsustainable. Costs will rise as increasing quantities of gas are obtained from international oil companies and the present price of gas does not provide sufficient revenues to support increased gas exploration activities by the government-owned companies. As of April 2009, there was a shortfall in the overall gas supply in the country of 202 MMCF per day out of a total demand of 2,120 MMCF per day. Although the government is taking measures to increase production through exploration incentives and

[15] For further information on gas tariffs see: ADB. 2009. *Sector Assistance Program Evaluation: Energy Sector in Bangladesh.* Manila.

through appraisal, development, and workover of existing wells, it is noted that captive power plants account for 13.2% of the overall demand for gas or 280 MMCF per day—this represents 24% of total gas usage for power generation. This is an inappropriately high level, as captive power plants are inefficient consumers of gas, and this inefficiency affects the long-term viability of the power sector. Once the crisis of present lack of supply is over, the government should begin considering disincentives for future captive power plants. At present, the cost of gas for captive power companies is below that of industry and commercial users. The government should raise the cost of gas to captive power producers to bring it to parity with industry use and then slowly raise it to commercial rates.

80. Finally, the efficiency of older government-owned power plants could be significantly improved. Dispatch of generation plant should be based on the most efficient plant available, and a concerted effort is needed to replace old and inefficient plants. The power utilities should be establishing time-bound plans to replace inefficient generation units with more efficient ones. This could involve converting open cycle generation units to combined cycle where possible, and shutting down gas-fired and diesel engine generation units. Additional demand-side measures could also be introduced, addressing the efficiency of household gas appliances and promoting more efficient boilers in the case of commerce and industry.

B. Lessons

81. Cost underruns were experienced for parts C and D of the project. This was partly because equipment cost estimates were based on tied loan prices. In the future, project preparatory technical assistance consultants should obtain prices on the open market, and should undertake cross-checks with more than one supplier. Cross-checking of market prices of equipment should be written into the terms of reference of project preparatory TA consultants for ensuing loans.

82. The delays in procurement of materials under the project necessitated a more rigorous and detailed follow-up by the resident mission of EA procurement action. Monthly estimate sheets were provided by the EAs to ADB to show progress and pinpoint where delays were taking place. This should become a fixture in future loans to the Bangladesh gas sector and should be incorporated in project administration memorandums.

83. Whenever possible, implementation consultants should be selected prior to project approval. All too often, ADB approval for advance selection of consultants is given but the EAs do not take advantage of this opportunity. In the case of future loans to the gas sector of Bangladesh, ADB missions should encourage EAs more strongly to select consultants in time for project implementation and to take advantage of ADB's permission for advance recruitment of consultants.

84. It is always difficult to change individual consultants, especially when the consultants are employed on intermittent basis on a long project. It is more practical to hire a consulting firm rather than individual consultants (consultants were hired individually under the project) and thus gain the flexibility of changing consultants as and when needed.

85. In the case of the power sector, the delegation of authority for procurement action has proven successful in reducing procurement delays. Now that the gas transmission and distribution companies have been given full procurement autonomy, such delays should be less common.

86. As TGTDCL's annual system losses have still not been reduced to below 2%, monthly reporting on the losses of TGTDCL (that was so successful in providing mass awareness among the stakeholders) should be continued under the Gas Sector Reform Road Map.

C. Follow-Up Actions

87. The evaluation identified two issues that require follow-up actions.

(i) ADB's South Asia Department (SARD) should initiate discussions with the government regarding its policy of not metering all consumers. A concerted effort should be made together with other development partners to bring this about, as non-metering of household consumption can encourage inefficient and unlawful usage of gas. Gas meters remaining under the project for installation in households using one or two burner stoves should also be fitted as originally intended by project covenant 6(b). (SARD, 2010)

(ii) Consistent with project covenant 6(e), the government should be encouraged to privatize/outsource meter reading, billing, and collection. This would assist with improving revenue collection and limiting corruption. (SARD, 2010)

PROJECT DESIGN AND MONITORING FRAMEWORK AND ASSESSMENT RESULTS AT PROJECT COMPLETION AND PERFORMANCE EVALUATION

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
Impact Economic growth through increased gas supply for power generation and industrial use	Expand gas supply capacity by providing 1.36 TCF of additional gas in Titas and Habiganj gas fields, and create facilities for producing 200 MMCF of gas per day	Drilling of 7 appraisal-cum-development wells (3 in Titas gas field and 4 in Habiganj gas field), workover of 5 existing gas wells, and expansion of gas processing facilities helped in proving 4.63 TCF of additional gas reserves and supplying 200 MMCF of gas per day	Gas reservoir of Habiganj gas field more or less defined. Further appraisal of Titas gas field is needed to define the reservoir. Drilling of additional wells is needed for optimizing gas production from these fields to sustain the level of production and stimulate further economic growth.	Target of 1.36 TCF expected to be met during the operating life of the gas wells; target of 200 MMCF per day has already been achieved. Production rate of Titas and Habiganj gas fields since 1999 as a result of project is 0.958 TCF and 251 MMCF per day (as of March 2009).
	Expand transmission and distribution systems capacity to ensure reliable gas supply to the power plants, particularly in TFA, and connect new industrial consumers in BFA, TFA, and JFA	Construction of 83 km transmission line in TFA and JFA, and 870 km distribution service mains in BFA, TFA, and JFA helped in supplying gas to four new power stations and 138 industrial consumers by the end of FY2003		The length of transmission lines constructed under the project are as follows: JFA: 82 km TFA: 25 km Total: 107 km The length of distribution lines constructed under the project are as follows: BFA: 278 km JFA: 55 km TFA: 481 km Total: 814 km New consumers since 2003: TFA: 1,171 (industrial), 11 (power plant) BFA: 136 (industrial), 4 (power plant) JFA: 26 (industrial), 9 (power plant)
Outcome 2.1 To expand availability and utilization of gas throughout the target area by the end of the project in December 1999	Network to be able to handle increased demand of gas in project areas	Drilling of additional gas wells, construction of new transmission lines, upgrading of distribution networks, addition of new MRS, and upgrading of existing MRS ensured availability and utilization of more than 200 MMCF per day of gas in the target areas	Project purpose fully realized	Present production rate of 251 MMCF per day exceeds target of 200 MMCF per day. MRS: 10 newly constructed, 11 replaced, and 4 upgraded
2.2 To collect adequate revenue for sustained O&M and further expansion	Return on average net fixed assets > 12% Debt service coverage ratio > 1.2	Return on average net fixed assets for FY2003 was BGFCL: 26.72% BGSL: 24.86% TGTDCL: 15.79% JGTDSL: 11.91% Debt service coverage ratio for FY2003 was	EAs' financial position improved and adequate revenue generated for sustainable O&M of created facilities	2. Return on average net fixed assets for FY2008: BGFCL: 26.4% BGSL: 211.9% TGTDCL: 48.4% JGTDSL: 23% Debt service coverage ratios for FY 2008:

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
		BGFCL: 5.57 BGSL: 9.34 TGTDCL: 1.62 JGTDSL: 1.93		BGFCL: 1.58 BGSL: 102.46 TGTDCL: 10.39 JGTDSL: 5.09
2.3 To establish mechanism for minimizing system loss	Introduction of proper reporting system	Proper reporting system introduced, which helped in monitoring overall loss and distribution loss by area	Created awareness among all stakeholders	Measures taken by the government and gas companies have been effective in reducing system losses. TGTDCL now has 12 teams of inspectors in Dhaka city to monitor gas use. In 2006, a general amnesty produced 24,000 new customers.
	Segregation of TFA into a number of gas management zones	Consultants under TA 2025-BAN[a] provided guidelines for segregation. Segregation of Dhaka city distribution network deferred until installation of large diameter distribution mains to meet the gas demand in segregated zones.	100 km, 16-inch diameter distribution mains are being built under Dhaka Clean Fuel Project,[b] which will enable segregation of Dhaka City distribution network	TGTDCL divided Dhaka into 12 gas management zones for internal administrative purposes but did not carry out the required physical works because of lack of funds.
	Install 60,000 gas meters to households on pilot basis	60,000 gas meters procured in 2003, and being installed in specified areas	The government is also contemplating dividing TGTDCL into three companies, particularly to address system loss through better management.	Out of the 60,000 meters procured, 35,916 meters are still in TGTDCL stores. Meters are not being installed in all households. Government policy is to collect a flat rate tariff for households using stoves with 1 or 2 burners; meters are installed for households with higher usage (e.g., 3-burner stoves, stoves with ovens, hot water heaters, etc).
2.4 To introduce sector reform for commercial orientation of the EAs, ensure private sector participation in management, and segregate regulatory functions	Allowing the gas sector corporate entities full autonomy	In 1994, Petrobangla delegated 50% of its financial authority to the boards of directors of the EAs. Full financial powers and autonomy in most operational matters were granted to the EAs and other gas sector entities in 2003, as a condition of Dhaka Clean Fuel Project.		Regulatory functions are now with the BERC. Boards of all EAs are empowered with full financial and administrative authority in accordance with the Companies Act, 1994. However, companies are following government pay scales as they still do not have their own pay structures.
	At least one outside director with commercial background appointed to the boards of directors of EAs	Introduced in 1998		Members from the private sector are now included on all EA boards. BGSL and JGTDSL each have 1 member, and BGFCL has 2 members.
	20% of the shares of each EA offloaded to the private sector	As a step toward eventual privatization, offloading of shares of the EAs was attempted, and valuation of assets of BGFCL and TGTDCL was done in		TGTDCL placed 25% of its shares on the market in June 2008 but offloading of shares for JGTDSL and BGSL has been halted. The government has decided to

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
		1999. However, further steps were not taken as offloading of shares alone was not expected to produce the desired improvement in management.		redefine the areas of BGSL and TGTDCL to create a new company to be named Karnapuli Gas Distribution Company. BGFCL and JGTDSL are engaging consulting firms to assist them in offloading shares. BGSL will proceed with offloading once Karnapuli Gas Distribution Company has been established.
Outputs 3.1 New institutions established	HCU created	In September 1994, MPEMR issued a notification designating the Energy and Mineral Resources Division as the HCU.	HCU is acting as a project under MPEMR. The government is considering a proposal to make it a permanent institutional unit in MPEMR.	HCU is now a permanent unit and is functioning as the technical wing of the Energy and Mineral Resources Division since July 2008. Staffing level is yet to be finalized by the government.
3.2 New facilities installed	Enhancement of gas production, transmission, and distribution facilities			
	Drilling of 7 new appraisal-cum-development wells (3 in Titas gas field, 4 in Habiganj gas field) to ensure availability of 1.36 TCF of gas for manufacturing cement and fertilizer; power generation; and industrial, commercial, and domestic use.	One well at Habiganj gas field was completed and commissioned in July 1998. The remaining three wells at Habiganj gas field and two wells at Titas gas field were completed and commissioned between April and July 2000. The third well at Titas field was completed in 2000, but commissioning was delayed until July 2002 for required re-completion. These wells produce more than 170 MMCF per day. Drilling of wells proved 4.63 TCF of additional gas reserve in Titas and Habiganj gas fields.	Ensured production and processing of 200 MMCF per day of gas from Titas and Habiganj gas fields	As of December 2008, cumulative production at the Titas and Habiganj gas fields reached 0.958 TCF under the project.
	Workover of 6 wells (5 in Titas and 1 in Bakhrabad gas fields)	Workover of 5 wells of Titas gas field completed in 1999. Workover of the well at Bakhrabad gas field abandoned because of depletion of the gas field and discouraging results from a worked over well under JBIC financing.	Ensured supply of 200 MMCF per day of gas in TFA	As of December 2008, production at the Titas and Habiganj gas fields reached 251 MMCF per day
	Installation of two gas treatment plants at both Titas gas field (120 MMCF per day capacity) and Habiganj gas field (150 MMCF per day)	Installed with 100% standby capacity		All 4 gas treatment plants are operating successfully. In 2008, the Titas field LTS treatment plants were processing a total of 470 barrels of condensate per day and 18 barrels per day at

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
				Habiganj. At appraisal, the envisaged total incremental rate of processing for Titas gas field as a result of the project was estimated at 225 barrels of condensate per day whereas the actual incremental rate has only been 80 barrels of condensate per day. This was due to the gradual decrease of well gas pressure.
	32 km long, 20-inch diameter, 1,000 psi gauge transmission line in TFA	23 km, 20-inch line constructed from Monohordi to Narsingdi in 1997, operating at full capacity	During the project, TGTDCL extended the pipeline from Narsingdi to Demra with additional funding from JBIC.	TGTDCL installed 25 km of 20-inch, 1,000 psi gauge transmission pipeline from Monohardi to Narsingdi and is now operating at full capacity. The same pipeline was extended a further 39.3 km from Narsingdi to Siddhirganj under the project with cofinancing from JBIC, forming a continuous line to feed the Tarabo and Narayanganj industrial areas and Siddhirganj power station.
	57 km long, 8- and 10-inch diameter, 1,000 psi gauge transmission lines in JFA	60 km, 10-inch line constructed and operating at partial capacity since 1998	Will ensure supply of required gas to the cement plant, which is under construction, with a capacity of 1.2 million tons per year	57 km 8 inch and 10 inch new transmission line was laid with rehabilitation of 25 km old transmission line. In addition, 55 km of up to 6-inch diameter distribution line has also been laid under the project and connected to existing 2,000 km JFA system. Lafarge Surma Cement plant at Chattack was completed in 2006. Presently, the line feeding the cement plant, is operating at one-third of its capacity as the cement plant still not at full output. Line expected to reach 90% capacity by 2010 with commissioning of new power plant at Kumargaong.
	849 km, 1-inch through 12-inch diameter 50 and 150 psi gauge distribution and service mains	870 km distribution and service mains constructed	Enabled BGSL, TGTDCL, and JGTDSL to connect new consumers, ensure quality supply to all consumers, and proper monitoring of gas transmission and distribution systems	A total of 814 km of 1–12 inch distribution and service mains were installed under the project.
	Installation of 12 new MRSs and upgrading of 11 existing MRSs	9 new MRSs installed and 16 existing MRSs upgraded		TGTDCL installed 4 new MRSs and upgraded/replaced 15 MRSs. BGSL built 3 district

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
				regulating stations—one at Kaptai, one at Lakshimpur, and one at Chittagong. JGTDSL installed 3 new MRSs. A total of 25 MRSs were installed or upgraded.
	Installation of telecommunication and data acquisition system	Installed and commissioned		JGTDSL did not hand over take-over certificate to contactor for telecommunications system and will now write off the equipment (about $0.64 million). All other telecommunications systems and data acquisition systems installed.
3.3 New consumers connected	50,000 new consumers connected	64,548 new consumers connected by December 2003		As of May 2009, a total of 183,530 new consumers were connected as a result of the project—24 power plants, 1,333 industrial consumers, and 182,173 domestic consumers.
3.4 System loss reduced	System loss reduced below 2%	BGSL and JGTDSL maintained loss below 2%. TGTDCL's system loss is still above 8%.	Close monitoring of implementation of TGTDCL's system loss reduction plan needed	System losses have improved but the 2% target has not always been met after project completion by TGTDCL. For FY2008, system losses (gain) were as follows: BGSL: (0.84%) JGTDSL: 1.07% TGTDCL: 3.39% Adoption of several action plans, both technical and administrative, has helped reduce average system loss of BFA, JFA, and TFA. These actions include upgrading of metering and regulating stations, strengthening cathodic protection, installation of meters, increased vigilance, and severance of unauthorized connections. The enactment of the proposed Gas Act will empower the distribution companies to take more stringent legal action against fraud, theft, and malpractice by delinquent customers.
3.5 Gas system properly maintained	Desired pressure level maintained. Corrosion of gas distribution system controlled.	Supply pressure stabilized and maintained. New corrosion protection installations helped in improving protection level.		The consumer survey in TFA, conducted in June 2009, concluded that the infrastructure built under the project has strengthened the networks and improved the quality of services. However, 80%–90% of respondents in

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
				TFA still regard reliability/ quality of gas supply to be in need of further improvement. Strengthening and improvements in quality of services have also been achieved in BFA and JFA.
3.6 Tariff restructured and raised	Tariff aligned to international fuel oil price on heating value parity basis and gradually raised to the level by 1998	The government revised tariff four times during 1998–2000, rising to more than 80% of the international price of fuel oil. In 2003, the government adopted a pricing policy aligning wellhead price of gas produced by national companies to 7% of international price of fuel oil on heating value parity basis with provisions for periodic review. Two revisions of tariff implemented so far based on the new tariff policy.		On 1 August 2009, BERC approved an 11.22% overall increase in the price of gas. Prior to this increase, gas prices had not been adjusted since FY2006.
3.7 Effective billing and collection	Accounts receivable maintained below 2 months billing amount	Accounts receivable in months billing amount as of 30 June 2003 was as follows: BGFCL: 6.43 BGSL: 2.95 TGTDCL: 4.18 JGTDSL: 6.26	Improvement of BGFCL's position depends on payment from gas marketing companies. Court cases limit TGTDCL's ability to improve collections. Enactment of the proposed Gas Act will help improve this situation.	Average accounts receivable in months as of June 2008: BGFCL: 2.93 BGSL: 2.28 TGTDCL: 3.10 JGTDSL: 3.00
3.8 Human resource development	Training of EA staff	79 technical staff of EAs trained in Canada and other places under structured engineering training program. In addition, 11 management staff of EAs participated in seminars abroad.		Staff trained abroad: BGFCL: 31 BGSL: 20 TGTDCL: 36 JGTDSL: 19 Total: 106
Inputs 4.1 Finance: Foreign: $117.10 million Local: $81.48 million	Source of financing: ADB: 107.00 million JBIC: $10.10 million Government: $81.48 million	Actual project cost on completion: ADB: $71.48 million JBIC: $15.23 million Government: $71.35 million	Actual project costs exclude disbursement of $8.18 million for 1998 flood damage restoration, and $8.85 million for settlement of claim of Spie Capag arising from a previous ADB project. (see para. 24 of the main text for further information)	

Design Summary	Performance Targets/Indicators	PCR Assessment (December 05)	PCR Remarks	PPER Assessment Results and Comments
4.2 Consulting services: 85 person-months	BGFCL: 72 person-months TGTDCL: 13 person-months	Actual utilization: BGFCL: 49.7 person-months TGTDCL: 13 person-months		BGFCL: 49.7 person-months TGTDCL: 11.13 person-months

[a] ADB. 1993. Technical Assistance to Bangladesh for the Safety and Efficiency Improvements in the Gas Sector. Manila. (TA 2025-BAN, approved for $480,000 on 21 December; piggybacked to Loan 1293-BAN[SF]: Third Natural Gas Development Project).

[b] ADB. 2002. *Report and Recommendation of the President to the Board of Directors: Proposed Loans to the People's Republic of Bangladesh for the Dhaka Clean Fuel Project*. Manila (Loan 1942/1943-BAN, approved for $72.6 million on 26 November).

ADB = Asian Development Bank, BGFCL = Bangladesh Gas Fields Company Limited, BFA = Bakhrabad franchise area, BGSL = Bakhrabad Gas Systems Limited, EA = executing agency, HCU = Hydrocarbon Unit, JBIC = Japan Bank for International Cooperation, JFA = Jalalabad franchise area, JGTDSL = Jalalabad Gas Transmission and Distribution System Limited, km = kilometer, MMCF = million cubic feet, MRS = metering and regulating station, PCR = project completion report, PPER = project performance evaluation report, psi = pounds per square inch, TCF = trillion cubic feet, TFA = Titas franchise area, TGTDCL = Titas Gas Transmission and Distribution Company Limited.

Sources: RRP of the project, Petrobangla, and ADB staff's assessments and estimates.

LOAN COVENANT STATUS
(as of May 2009)

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
Borrower's Obligation 1. The Borrower shall make available to the project executing agencies, promptly as needed, and on terms and conditions acceptable to ADB, the funds, facilities, services, land, and other resources, which are required, in addition to the proceeds of the loan, to carry out the Project.	Section 4.02	Complied with	
Withdrawal of Loan Proceeds 2. Notwithstanding any other provision of this Loan Agreement, and except as ADB might otherwise agree, no loan funds shall be disbursed to finance: (a) the construction of the gas transmission pipeline from Kailashtilla gas field to Chhatak, or installation of metering and regulating stations in respect thereof under Part D of the Project, unless the gas supply agreement has been duly executed, in a form acceptable to ADB, between JGTDSL and the sponsor of the proposed new cement plant at Chhatak; and (b) Part B of the Project, unless satisfactory arrangements acceptable to ADB shall have been made for construction of the Ashuganj–Bakhrabad gas transmission pipeline.	Schedule 3, para. 7	ADB waived this condition on request of JGTDSL to complete the pipeline on time. The metering and regulating station was dropped. JGTDSL signed a gas supply agreement with sponsor of the restructured cement project on 19 January 2003 and secured an interest free loan of $1.0 million for the metering and regulating station. ADB waived this condition on request of BGSL, following the World Bank's commitment to finance the Ashuganj–Bakhrabad line. The line was commissioned in 1998.	
Execution of the Project 3. PIO established under the Second Natural Gas Development Project (Loan No. 714-BAN[SF]) by BGFCL, BGSL, and TGTDCL shall continue to operate in support of Part A, B, and C of the Project, while JGTDSL shall establish a PIO comprising a project manager assisted by a project accountant and a procurement officer for Part D of the Project.	Schedule 6, para. 2	Complied with	
4. The Steering Committee of the Borrower's Ministry of Energy and Mineral Resources shall also monitor the progress of the Project.	Schedule 6, para. 5	Complied with	
Reduction of System Losses 5. The Borrower shall ensure that BGSL and JGTDSL maintain system losses in their respective franchise areas at 2% or less throughout the Project.	Schedule 6, para. 6	Partially complied with BGSL maintained system losses less than 2% up to FY1999. JGTDSL maintained system losses less than 2% throughout the project, except in FY1994.	Partially complied with. Levels of system loss have improved but target has not always been met after project completion. For FY2008, system losses (gain) were BGSL: (0.84%) JGTDSL: 1.07%

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
6. The Borrower shall ensure that TGTDCL, with advice of the consultants appointed under Safety and Efficiency TA, shall implement the system loss reduction plan agreed with ADB to reduce the level of system losses in its franchise area to 2% or less by 30 June 1995, and maintain such level thereafter. Under the plan, TGTDCL shall, among others:	Schedule 6, para. 7	Not complied with TGTDCL failed to contain system losses at 2%.	Not complied with TGTDCL's losses were 3.39% in FY2008.
(a) repair existing meters;		Complied with	
(b) disconnect delinquent/nonpaying consumers;		Complied with	
(c) gradually install meters, as agreed with ADB, under Part C of the Project beginning with households with more than one appliance, or which share the use of their kitchen with other households, subject to any other prioritization for installation of gas meters determined by the consultants under the Safety and Efficiency TA;		Partially complied with 60,000 meters procured for installation in selected areas; contractors are being engaged	Partially complied with Out of the 60,000 meters procured, 35,916 meters are still in TGTDCL stores. Meters are not being installed in all households. Government policy is to collect a flat rate tariff for households using stoves with 1 or 2 burners; meters are installed for households with higher usage (e.g., 3-burner stoves, stoves with ovens, hot water heaters, etc.)
(d) divide Greater Dhaka area into gas management zones, each with known gas consumption that can be monitored; and		Depends on completion of some ongoing works	Partially complied with. Greater Dhaka was divided into 12 zones for administrative purposes but the division could not be operationally implemented due to a lack of funds. Funds were needed to cut pipes, provide monitoring valves, metering and regulating stations, etc. A budget of Tk300 million was needed to

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
(e) privatize meter reading, billing, and collection for metered consumers and gas consumption assessment for nonmetered consumers in accordance with a scheme acceptable to ADB, with privatization of two gas management zones each, on a pilot basis, in 1994 and 1995, respectively, and commencement in 1996 of privatization of gas management zones in Dhaka City with assistance of the consultants appointed under the Safety and Efficiency TA.		Not complied with Contract for two areas finalized. Re-tendered for two more areas. TGTDCL subsequently abandoned the idea under pressure from trade union.	effect the division. Not complied with
Gas tariffs 7. Except as ADB might otherwise agree, the Borrower shall ensure that gas tariffs (including excise duties) are revised periodically so that: a) full economic price of natural gas (i.e., the international price of fuel oil on a heating value parity basis) is recovered progressively from consumers by 30 June 1998, as agreed by the Borrower and ADB; and b) each project executing agency is able to comply with its financial obligations specified in Section 2.16 of its Project Agreement.	Schedule 6, para. 8	Partially complied with Tariff revised four times during 1998–2002. The borrower is developing a policy for aligning domestic gas price with international fuel oil price. Complied with	Partially complied with. On 1 August 2009, BERC approved an 11.22% overall increase in the price of gas. Prior to this increase, gas prices had not been adjusted since FY2006.
Accounts Receivable 8. The Borrower shall ensure that BGSL, BGFCL, JGTDSL, and TGTDCL take all necessary steps to improve the collection of accounts receivable to achieve a level of 3 months of gas sales or less by 30 June 1994, and maintain such level thereafter.	Schedule 6, para. 9	Not complied with	Partially complied with. Levels of accounts receivables have not been consistently below the 3-month target since project completion. Average accounts receivables in months as of June 2008 are as follows: BGSL: 2.28 BGFCL: 2.93 JGTDSL: 3.00 TGTDCL: 3.10
Financial Covenants 9. The Borrower shall ensure that the project executing agencies maintain a debt–equity ratio of not more than 70:30 throughout the Project; and the Borrower, if necessary, shall make appropriate equity contributions to the project executing agencies for this purpose.	Schedule 6, para. 11	Complied with	

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
10. Except as ADB might otherwise agree, the Borrower shall ensure that: a) BGFCL, JGTDSL, and TGTDCL maintain a debt service ratio of not less than 1.2 throughout the Project; and b) BGSL achieves a debt service ratio of not less than 1.2 for the FY1995, and maintains each year thereafter.	Schedule 6, para. 12	Complied with	
11. Except as ADB might otherwise agree, the Borrower shall ensure that an annual rate of return on average net fixed assets, valued on a historical cost basis, of not less than: a) 12% is maintained by BGFCL and JGTDSL throughout the Project; b) 12% is achieved by BGSL for the FY1997, and maintained in each fiscal year thereafter; and c) 12% is achieved by TGTDCL for the FY1994 and FY1995, and 15% for the Fiscal Year FY1996 and in each fiscal year thereafter.	Schedule 6, para. 13	Partially complied with BGFCL maintained since FY1994 JGTDSL maintained since FY1994, except in FY1999 and FY2000 BGSL achieved 12% return in FY2001 TGTDCL achieved a 15% return in FY1997 and maintained up to FY1999 and then dropped. The return in FY2002 was 11.25%.	The IEM found that this covenant was partially complied with since project completion although fully met in recent years. The return on average net fixed assets for FY2008 was BGFCL: 26.4% JGTDSL: 23% The IEM found that this covenant was partially complied with since project completion although fully met in recent years. The return on average net fixed assets for FY2008 was BGSL: 211.9%. The IEM found that this covenant was partially complied with since project completion although fully met in recent years. The return on average net fixed assets for FY2008 was TGTDCL: 48.4%.
12. The Borrower shall ensure that the project executing agencies shall not declare or pay any dividend, or effect any transfer of funds except out of net profit after tax for the year or from other undistributed profits accumulated; and then only if, after payment of such dividend, the project executing agency concerned has complied with all the financial obligations stipulated in this Loan Agreement and the Project Agreement concerned.	Schedule 6, para. 14	Complied with	

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
Transfer of Assets and Liabilities to Project Executing Agencies 13. The Borrower shall ensure that each project executing agency shall: a) inform ADB of any proposed transfer of assets and liabilities to the project executing agency from the project implementation unit established under the World Bank's Second Gas Development Project at least 3 months before any such transfer; and b) meet and fully satisfy any condition required by ADB to ensure that the financial viability of the project executing agency concerned is not adversely affected on transfer of any asset or liabilities under (a) above.	Schedule 6, para. 15	 Complied with Complied with	
Introduction of Legislation 14. The Borrower, by 30 June 1994, shall introduce legislation containing provisions for: a) expeditious recovery of unpaid gas bills; b) empowerment of gas transmission and distribution companies to expeditiously disconnect nonpaying or delinquent consumers, and removal or limitation of jurisdiction of civil courts to issue injunctions preventing disconnection in such cases; c) police assistance for disconnecting delinquent/ nonpaying consumers; d) criminalization of pilferage of gas and tampering with gas meters, including punishment of abettors; and empowerment of personnel and companies involved in privatized meter reading, assessment, billing, and collection to effectively discharge their functions, including powers to disconnect delinquent/nonpaying consumers.	Schedule 6, para. 16	Delayed compliance. The borrower enacted the Energy Regulatory Commission Act in March 2003, which addresses some requirements.	Partial compliance. The borrower enacted the Energy Regulatory Commission Act in March 2003, which addressed some of these requirements. The enactment of the proposed Gas Act will further empower the distribution companies to take more stringent legal actions against fraud, theft, and malpractice by delinquent customers.
Establishment of Hydrocarbon Unit 15. The Borrower, in consultation with ADB, shall establish by 30 June 1994, a hydrocarbon sector unit in the Ministry of Energy and Mineral Resources.	Schedule 6, para. 18	Complied with Established in September 1994	

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
Autonomy and Privatization of Project Executing Agencies 16. To confer greater autonomy on the project executing agencies, the Borrower shall ensure that by 31 March 1994: (a) all financial powers enjoyed by Petrobangla for procurement of goods and services are transferred to the project executing agencies, and that adequate steps satisfactory to ADB have been initiated to allow greater financial powers to the project executing agencies; (b) full autonomy, including financial powers, are granted to the board of directors of each project executing agency; (c) at least one outside director with commercial background is appointed to the board of directors of each project executing agency.	Schedule 6, para. 19	Partially complied with (a) all financial powers enjoyed by Petrobangla for procurement of goods and services are transferred to the project executing agencies, and that adequate steps satisfactory to ADB have been initiated to allow greater financial powers to the project executing agencies; Petrobangla delegated 50% of its financial authority in 1994. Full autonomy was given during February–April 2003. Appointed in 1998	Complied with Full authority has been provided
17. As a step towards eventual privatization of the project executing agencies, the Borrower shall ensure that at least 20% of the shares of each project executing agency are owned by the private sector by 30 June 1999, and that at least 5% of such private sector ownership is achieved by 30 June 1996.	Schedule 6, para. 20	Not complied with Following discussion with ADB, strategy is being developed for offloading of shares of the EAs to a strategic partner.	Not complied with TGTDCL placed 25% of its shares on the market in June 2008 but offloading of shares for BGSL has been halted. The government has decided to redefine the areas of BGSL and TGTDCL to create a new company to be named Karnapuli Gas Distribution Co. BGFCL and JGTDSL are engaging consulting firms to help them offload shares. BGSL will implement offloading once Karnapuli Gas distribution company has been established.

Covenant	Reference in Loan Agreement	PCR Assessment (Dec 05)	PPER Assessment
Environmental Safety 18. Gas fields and pipeline systems operated and maintained in accordance with acceptable international codes and standards. The project executing agencies, in implementing the environmental management plan, shall coordinate their activities with Petrobangla.	Schedule 6, para. 21	Complied with	
Training 19. The Borrower shall ensure that, before any loan funds are used for training under the Project, each project executing agency, in consultation with and approval by ADB, shall: (a) prepare a training program; and (b) make necessary arrangements to ensure that all recipients of overseas training financed under the Project continue their services with the project executing agency concerned for a reasonable period following completion of such training.	Schedule 6, para. 22	Complied with	
Accounts and Auditing 20. (a) EAs shall (i) maintain separate accounts for the Project and for its overall operations; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with sound auditing standards, by independent private auditors acceptable to ADB; and (iii) furnish to ADB, promptly after their preparation, but in any event not later than 6 months after the close of the fiscal year to which they relate, unaudited copies of such accounts and financial statements; and not later than 9 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements, and the report of the auditors relating thereto, all in the English language. EAs shall furnish to ADB such further information concerning such accounts and financial statements, and the audit thereof, as ADB shall from time to time reasonably request. (b) EAs shall enable ADB, upon ADB's request, to discuss EAs' financial statements and their financial affairs from time to time with EAs' auditors, and shall authorize and require any representative of such auditors to participate in any such discussions requested by ADB, provided that any such discussion shall be conducted only in the presence of an authorized officer of the EAs unless the EAs shall agree otherwise.	Project agreement, Section 2.09	Generally complied with by BGFCL, BGSL, and JGTDSL Complied with late by TGTDCL Complied with	

ADB = Asian Development Bank, BERC = Bangladesh Energy Regulatory Commission, BGFCL = Bangladesh Gas Fields Company Limited, BGSL = Bakhrabad Gas Systems Limited, EA = executing agency, IEM = Independent Evaluation Mission, JGTDSL = Jalalabad Gas Transmission and Distribution System Limited, PCR = project completion report, PIO = project implementation office, PPER = project performance evaluation report, TA = technical assistance, TGTDCL = Titas Gas Transmission and Distribution Company Limited.
Sources: EAs' audited financial statements and project completion reports.

REEVALUATION OF THE FINANCIAL AND ECONOMIC INTERNAL RATES OF RETURN

A. Basic Assumptions

1. The main objectives of the Third Natural Gas Development Project were to (i) expand the gas production and treatment facilities at Titas, Habiganj and Bakhrabad gas fields; (ii) upgrade, rehabilitate, and expand the gas transmission and distribution networks of Bakhrabad Gas Systems Limited (BGSL), Titas Gas Transmission and Distribution Company Limited (TGTDCL), and Jalalabad Gas Transmission and Distribution System Limited (JGTDSL); and (iii) improve the efficiency and safety of the operations of BGSL, TGTDCL, and JGTDSL. Natural gas is the primary commercial energy resource of Bangladesh.

2. To expand the gas production, new development wells were drilled, workover of wells was undertaken and gas treatment plants were installed under Part A; Bangladesh Gas Fields Company Limited (BGFCL) was the executing agency (EA) for this part. Gas distribution networks were rehabilitated, expanded, and upgraded for Parts B, C, and D. BGSL was the EA for Part B, TGTDCL for Part C, and JGTDSL for Part D.

3. The financial and economic analysis of the project was carried out on an incremental basis. All prices and costs are expressed in US dollars and adjusted for inflation to second quarter 2009 constant values. The World Bank unit value manufacturing index[1] was used as a proxy for world price movements and was used to convert all prices to a 2009 base.

4. Actual operating costs in US dollars per thousand cubic feet (MCF) were used and held constant at 2009 levels for the remaining life of the project.

5. Actual costs of production, supplementary duties, and value-added tax (VAT) were used from 1999 to 2008. VAT at 13.04% and supplementary duties at 41.96% of sales were added to total costs. These costs were held constant at the estimated 2009 levels for the remaining life of the project.

B. Financial Analysis

6. The Project financial evaluation is carried out with financial cost flows inclusive of taxes, duties, subsidies and physical contingencies, but exclusive of any price contingencies and interest during construction. The following general assumptions have been adopted:

(i) The project is evaluated over a 20-year period with Project benefit and cost streams held constant from 2009 to 2017.
(ii) The financial evaluation considered only the incremental revenues and costs directly associated with each project component. Therefore, the revenues and costs of existing systems are not considered.
(iii) All costs and revenues are expressed in 2009 prices and in US dollars.
(iv) Capital costs include physical contingencies but exclude price contingencies and interest during construction for the project over 1997–2003.
(v) An average exchange rate of Tk68.736 per $1.00 was used to convert foreign exchange costs to their local currency equivalent in May 2009.

[1] Available: http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934112179736353 9/MUV_012809.xls

(vi) Actual average gas purchase prices were used as reported in the various annual reports. These were adjusted for inflation and assumed constant at 2009 levels until 2017.
(vii) Other payments include contributions to the price deficit fund, supplementary duties, VAT, and gas producers' margin.
(viii) Income tax payments were assumed to be 35% of taxable income.

1. Part A: Bangladesh Gas Fields Company Limited

7. BGFCL incremental production was based on production data available as of December 2008 on the workover wells and the appraisal-cum-development wells (Table A3.1). Production from Titas well number 14 was suspended on 6 November 2006 because of water intrusion. Production from Habiganj well number 8 started in May 2000.

8. The operating cost for part A includes management charges from Bangladesh Oil, Gas and Mineral Corporation (Petrobangla).

Table A3.1: Production on Project Wells

Fields	Workover Well Number	New Well Number	Daily Gas MMCF	Cumulative Production	
				Since Inception	From Project
				TCF	
Titas	2		33	0.315	0.106
	7		33	0.218	0.104
	8		19	0.201	0.085
	9		27	0.192	0.098
	10		12	0.152	0.071
		12	23	0.053	0.523
		13	31	0.090	0.090
		14	Suspended	0.070	0.070
Habiganj		7	39	0.109	0.109
		8	Depleted	0.011	0.011
		9	Depleted	0.053	0.053
		10	39	0.108	0.108

MMCF = million cubic feet, TCF = trillion cubic feet.
Source: Various annual reports, and independent evaluation mission.

9. The financial internal rate of return (FIRR) for part A was recalculated at 26.18% higher than the weighted average cost of capital (WACC) estimated to be 4%.[2] The updated gas production estimates from the project wells obtained by the Independent Evaluation Mission (IEM) were used for the estimation of the FIRR and the economic internal rate of return (EIRR). The cumulative production estimates obtained by the IEM are significantly higher than the estimates used by the project completion report (PCR), despite the suspension of production from the three wells which came after completion of PCR.

[2] The weighted average cost of capital at appraisal was estimated to be 5.6% for parts A and C, 4.3% for part B, and 5.9% for part D. These estimates were based on a nominal cost of 11% for borrowed capital and opportunity cost of equity of 11% for part B and 15% for parts A, C and D.

2. Part B: Bakhrabad Gas Systems Limited
Part C: Titas Gas Transmission and Distribution Limited
Part D: Jalalabad Gas Transmission and Distribution Systems Limited

10. Project capital expenditures include taxes and physical contingencies and are the base costs (before adjustment) set out in the economic evaluation. Parts B, C, and D of the project consisted of construction of transmission and distribution pipelines.

11. Actual system losses until 2009 of BGSL, JGTDSL, and TGTDCL as obtained by the IEM were used. These system losses are in Table A3.2.

Table A3.2: System Losses

Year	System Loss (%)		
	BGSL	JGTDSL	TGTDCL
1996	+2.00	9.25	6.97
1997	0.50	0.00	8.23
1998	2.52	0.19	7.41
1999	+0.86	0.88	7.91
2000	2.81	0.34	8.49
2001	2.33	0.06	8.30
2002	4.08	0.94	8.24
2003	1.28	0.18	6.12
2004	1.18	+0.29	7.08
2005	2.33	+0.06	7.07
2006	2.52	+1.14	6.47
2007	2.12	0.52	5.26
2008	+0.84	1.07	3.39

BGSL = Bakhrabad Gas Systems Limited, JGTDSL = Jalalabad Gas Transmission and Distribution Systems Limited, TGTDCL = Titas Gas Transmission and Distribution Company Limited.
Source: Various annual reports, and independent evaluation mission.

12. The operating costs for parts B, C, and D include price deficit fund (PDF) charges, payments to Bangladesh Petroleum Exploration Company Limited (BAPEX), Petrobangla management charges, payments to the hydrocarbon fund, and depreciation expenses.

13. Project revenues of parts B, C, and D come from gas delivered to end users. Distribution of gas sales by category are presented in Table A3.3. The actual average end-user tariff was used and assumed constant at 2009 levels until 2017.

Table A3.3: Distribution of Gas Sales by Category (%)

Item	BGSL	JGTDCL	TGTDCL
Power	20.60	46.54	41.82
Fertilizer	34.18	17.38	9.05
Industrial	11.85	9.69	17.81
Captive Power	10.16	5.70	15.67
Commercial	1.89	3.97	0.98
Domestic	16.40	12.97	10.99
Compressed Natural Gas	4.92	3.76	3.68

BGSL = Bakhrabad Gas Systems Limited, JGTDCL = Jalalabad Gas Transmission and Distribution Systems Limited, TGTDCL = Titas Gas Transmission and Distribution Company Limited.
Sources: Various annual reports.

14. The FIRRs for parts B, C, and D were less than zero. The revenues generated by the project facilities are not enough to cover the costs in light of the government-approved tariff and the transfer payments in the form of PDF, BAPEX and Petrobangla charges. PPER production estimates differ from the PCR for part B. It is not clear how the PCR estimated the volume sales for TGTDCL. The PPER estimated sales volume. The gas sales volume for each EA that can be attributed to the project was estimated by prorating the total amount of gas sold with the facilities provided by the project in relation to total amount of facilities operated by the EAs.

15. While the three EAs (BGSL, TGTDCL, and JGTDCL) are profitable in their overall operations, the project facilities do not generate enough revenue to cover operating costs and all the transfer payments that have to be made. Moreover, the relatively high systems losses of TGTDCL and high operating costs of JGTDCL put downward pressure on their respective FIRRs. There is room for improvement in their operations to improve the financial performance of the project facilities.

C. Economic Analysis

16. All costs have been expressed at constant 2009 price level. The world price numeraire was used. Traded inputs were valued at their border price equivalent values and non-traded inputs were valued at domestic prices and then adjusted to the world price numeraire by multiplying by the estimated standard conversion factor of 0.97. Capital costs include physical contingencies, but exclude taxes, price contingencies, and financial charges during construction. All taxes and transfer payments were excluded in the computation of operating costs.

17. For the economic analysis, it was assumed that Bangladesh's gas resources would be fully depleted at the end of the 20-year period. The depletion premium was estimated using the following methodology.[3]

Depletion Premium

$$DP_{t=} \quad \frac{(PS_T - CS_t)(1+r)^t}{(1+r)^t}$$

where:

PS_T	=	price of substitute fuel at time of complete exhaustion T.
CS_t	=	extraction cost of present resource, assumed constant for all years.
r	=	discount rate assumed to be 12%.
T	=	time of exhaustion of deposit.

1. Part A: Bangladesh Gas Fields Company Limited

18. For part A, the United States natural gas wellhead prices in dollars per MCF (Table A3.4) were used as proxy for border prices. The reestimated EIRR for part A using the border prices to calculate economic benefit is 229.9% (Table A3.13). To confirm the level of EIRR, it was also reestimated using the prices of alternative fuels in lieu of the border prices. The fuel substitutes for each customer category and their prices were obtained from the Final Report for the technical assistance to *Prepare the Gas Sector Development Program*,[4] and are presented in

[3] Source: ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.
[4] ADB. 2007. *Gas Sector Development Program.* Manila. (TA 4952-BAN, approved for $575,000 on 16 July).

Tables A3.5 and A3.6. BGFCL's sales per customer category used to get the weighted average price of alternative fuels from 1998 to 2009 are in Table A3.7. The resulting EIRR was 255.8%, higher but not significantly different from the estimates using border prices.

Table A3.4: United States Natural Gas Wellhead Price
(annual average in US dollars per thousand cubic feet)

Year	Price
1998	1.954
1999	2.192
2000	3.687
2001	4.013
2002	2.948
2003	4.880
2004	5.454
2005	7.319
2006	6.395
2007	6.377
2008	8.068
2009 (January to September)	3.745

Source: Energy Information Administration. Available: http://tonto.eia.doe.gov/dnav/ng/hist/n9190us3m.htm.

Table A3.5: Fuel Substitutes

Customer Category	Fuel Substitute
Power	50% gas oil; 50% heavy fuel oil
Industrial	10% kerosene; 40% gas oil, 50% heavy fuel oil
Commercial	20% kerosene, 20% gas oil, 30% LPG, 30% wood
Residential	40% kerosene, 10% gas oil, 10% LPG, 40% wood

LPG = liquefied petroleum gas.
Source: Final Report for TA 4952-BAN: *Gas Sector Development Program*. March 2009.

Table A3.6: Economic Fuel Costs of Alternative Fuels
(2009, US dollars per thousand cubic feet equivalent)

Alternative Fuel	Economic Price
Gasoline	23.1
Kerosene	22.0
Gas Oil	18.8
Heavy Fuel Oil	11.2
Liquefied Petroleum Gas	24.4
Coal	5.1
Wood	3.0

Source: Final Report for TA 4952-BAN: *Gas Sector Development Program*. March 2009.

Table A3.7: Sales by Customer Category, Bangladesh Gas Fields Company Limited
(fiscal year 2007–2008)

Category	%
Power	42.56
Fertilizer	11.56
Industrial	15.14
Commercial	1.07

Category	%
Tea-Estate	0.21
Compressed Natural Gas	3.74
Domestic	11.23
Captive Power	14.50

Source: BGFCL. 2008. *Annual Report 2007–2008*. Dhaka.

19. As a last exercise to confirm the EIRR for Part A the capital costs for the wells that were worked over were estimated and made part of the project component's capital cost. The recalculated EIRR was the same at 229.6%. The summary of results for EIRR under different assumptions is given in Table A3.8.

Table A3.8: Economic Internal Rate of Return under Different Assumptions

Assumption	**EIRR** (%)
Using border prices	229.9
Using prices of alternative fuels	255.8
Includes sunk costs of workover wells	229.6

Source: Independent Evaluation Mission.

2. Part B: Bakhrabad Gas Systems Limited
Part C: Titas Gas Transmission and Distribution Limited
Part D: Jalalabad Gas Transmission and Distribution System Limited

20. In the recalculation of the EIRR for part B (BGSL), part C (TGTDCL), and part D (JGTDSL), resource cost savings were used to estimate the economic benefits. The distribution of gas sales by customer category for each of the EA as shown in Table A3.3 was used to compute for the weighted average price of alternative fuels. The life-cycle gas cost (on an average incremental cost basis) of $1.16/MCF, as determined by the technical assistance for preparation of the *Clean Fuel Sector Development Program*,[5] has been taken as a measure of the long run marginal cost (LRMC) of gas production. The cost of gas was valued at LRMC.

21. The recalculated EIRR for part B is 26.4%, for part C 76.5%, and 30.4% for part D. All are above the 12% threshold used by ADB (Tables A3.14 to A3.16).

[5] ADB. 2007. *Gas Sector Development Program.* Manila. (TA 4952-BAN, approved for $575,000 on 16 July).

Table A3.9: Financial Internal Rate of Return
Part A: Bangladesh Gas Fields Company Limited

Fiscal Year	Gas Sales Volume (MMCF)	Average Gas Sales Price ($/MCF)	Revenue ($ million)		Capital Cost ($ million)	Operating Cost ($ million)	VAT + SD ($ million)	Income Tax ($ million)	Net Benefit ($ million)
			Gas	Liquids					
1997					3.54				(3.54)
1998	2,414	0.680	1.64		2.57	0.00	1.31		(2.57)
1999	32,580	0.680	22.15		6.40	0.18	17.72		(2.16)
2000	72,825	0.658	47.92	0.0218	16.43	1.99	38.36		(8.83)
2001	90,089	0.688	61.99	0.8242	4.57	4.10	50.25	1.36	3.90
2002	98,035	0.696	68.23	0.8810	0.88	5.41	55.29	2.64	4.90
2003	103,285	0.796	82.26	1.3699	0.72	5.16	66.90	3.80	7.05
2004	104,245	0.854	89.08	2.1026		4.93	72.94	4.66	8.65
2005	102,397	0.818	83.72	2.2293		5.06	68.76	4.25	7.88
2006	97,191	0.814	79.09	1.9834		4.25	64.86	4.19	7.78
2007	86,925	0.850	73.92	1.8679		5.23	60.63	3.47	6.45
2008	81,940	0.912	74.74	1.7153		8.10	61.17	2.52	4.67
2009	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2010	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2011	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2012	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2013	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2014	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2015	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2016	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2017	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2018	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2019	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2020	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2021	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
2022	81,940	1.001	82.04	1.8828		7.98	67.14	3.08	5.72
								FIRR =	**26.18%**

( ) = negative, FIRR = financial internal rate of return, MCF = thousand cubic feet, MMCF = million cubic feet, SD = supplementary duties, VAT = value-added tax.
Source: Independent evaluation mission.

Table A3.10: Financial Internal Rate of Return
Part B: Bakhrabad Gas Systems Limited

Fiscal Year	Gas Sales Volume (MMCF)	Gas Purchase Volume (MMCF)	Average Gas Sales Price ($/MCF)	Average Gas Purchase Price ($/MCF)	Sales Revenue ($ million)	Capital Cost ($ million)	Operating Cost ($ million)	Cost of Gas ($ million)	Other Payments ($ million)	Cost of Sales ($ million)	Net Cash Flow ($ million)
1995						1.21					(1.211)
1996						2.16					(2.163)
1997	14	14	1.3936	0.600	0.020	3.07	0.0029	0.008	0.011	0.011	(3.060)
1998	76	78	1.4488	0.664	0.110	0.83	0.0145	0.052	0.061	0.066	(0.786)
1999	157	156	1.4123	0.658	0.222	0.03	0.0296	0.102	0.122	0.132	0.061
2000	245	252	1.4449	0.688	0.354		0.0443	0.173	0.195	0.218	0.136
2001	394	403	1.4444	0.696	0.569		0.0626	0.281	0.313	0.343	0.226
2002	560	584	1.6408	0.796	0.920		0.0966	0.465	0.506	0.562	0.358
2003	649	658	1.7287	0.855	1.123		0.0953	0.562	0.617	0.657	0.465
2004	674	682	1.7020	0.818	1.148		0.0972	0.558	0.631	0.655	0.493
2005	689	705	1.6382	0.814	1.128		0.1153	0.574	0.620	0.689	0.439
2006	713	732	1.7287	0.829	1.233		0.1151	0.607	0.678	0.722	0.511
2007	741	757	1.8639	0.912	1.382		0.1583	0.691	0.760	0.849	0.533
2008	792	785	1.8991	0.929	1.504		0.1558	0.730	0.827	0.886	0.618
2009	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2010	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2011	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2012	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2013	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2014	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2015	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2016	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
2017	840	857	1.8991	0.929	1.595		0.1823	0.797	0.877	0.979	0.616
										FIRR =	**<0**

FIRR = financial internal rate of return, FY = fiscal year, MCF = thousand cubic feet, MMCF = million cubic feet.
Note: Without the transfer payments to Bangladesh Petroleum Exploration Company Limited, the Price Deficit Fund, and management charges from Bangladesh Oil, Gas and Mineral Corporation, the FIRR is recalculated to be +2.05%.
Source: Independent evaluation mission.

Table A3.11: Financial Internal Rate of Return
Part C: Titas Gas Transmission and Distribution Company Limited

Fiscal Year	Gas Sales Volume (MMCF)	Gas Purchase Volume (MMCF)	Average Gas Sales Price ($/MCF)	Average Gas Purchase Price ($/MCF)	Sales Revenue ($ million)	Capital Cost ($ million)	Operating Cost ($ million)	Cost of Gas ($ million)	Other Payments ($ million)	Cost of Sales ($ million)	Net Cash Flow ($ million)
1995						0.19					(0.192)
1996						1.85					(1.847)
1997						5.79					(5.790)
1998	164	317	0.94	0.629	0.275	15.59	0.0463	0.199	0.151	0.246	(15.557)
1999	293	2,335	0.97	0.651	2.087	6.92	0.3265	1.521	1.148	1.847	(6.681)
2000	2,150	2,350	0.94	0.643	4.218	8.55	0.5561	1.512	2.320	2.068	2.151
2001	4,487	4,893	0.97	0.657	4.346	0.67	0.5357	3.214	2.390	3.749	0.596
2002	4,236	4,616	0.99	0.662	4.183	4.30	0.4739	3.054	2.300	3.528	0.655
2003	4,639	4,942	1.13	0.755	5.247	15.53	0.5342	3.732	2.886	4.267	0.980
2004	4,816	5,183	1.21	0.812	5.818	3.79	0.5861	4.210	3.200	4.797	1.021
2005	4,901	5,274	1.26	0.796	6.153		0.4749	4.196	3.384	4.671	1.482
2006	5,193	5,552	1.44	0.780	7.486		0.5369	4.329	4.117	4.866	2.620
2007	5,380	5,679	1.60	0.857	8.605		0.5654	4.868	4.733	5.433	3.171
2008	5,778	5,981	1.46	1.000	8.434		0.6822	5.979	4.639	6.661	1.774
2009	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2010	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2011	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2012	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2013	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2014	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2015	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2016	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
2017	5,778	5,896	1.51	1.019	8.740		0.7475	6.005	4.807	6.753	1.987
										FIRR =	**<0**

Without the transfer payments to Bangladesh Petroleum Exploration Company Limited, the Price Deficit Fund, and management charges from Bangladesh Oil, Gas and Mineral Corporation, the FIRR is recalculated to be +0.64%.
FIRR = financial internal rate of return, FY = fiscal year, MCF = thousand cubic feet, MMCF = million cubic feet.
Source: Independent evaluation mission.

Table A3.12: Financial Internal Rate of Return
Part D: Jalalabad Gas Transmission and Distribution Systems Limited

Fiscal Year	Gas Sales Volume (MMCF)	Gas Purchase Volume (MMCF)	Average Gas Sales Price ($/MCF)	Average Gas Purchase Price ($/MCF)	Sales Revenue ($ million)	Capital Cost ($ million)	Operating Cost ($ million)	Cost of Gas ($ million)	Other Payments ($ million)	Cost of Sales ($ million)	Net Cash Flow ($ million)
1995						0.48					(0.476)
1996						3.13					(3.133)
1997						3.59					(3.587)
1998	26	71	0.94	0.608	0.067	4.54	0.0084	0.043	0.037	0.052	(4.524)
1999	71	105	0.97	0.624	0.101	0.11	0.0095	0.066	0.056	0.075	(0.085)
2000	104	104	0.94	0.632	0.120	0.08	0.0126	0.066	0.066	0.078	0.042
2001	128	129	0.97	0.826	0.124	0.05	0.0106	0.106	0.068	0.117	0.007
2002	149	150	0.99	0.936	0.147	0.05	0.0132	0.141	0.081	0.154	(0.007)
2003	1,326	1,328	1.13	0.706	1.499		0.1488	0.937	0.825	1.086	0.413
2004	1,370	1,366	1.21	0.758	1.654		0.1625	1.036	0.910	1.198	0.456
2005	1,397	1,396	1.26	0.734	1.753		0.1848	1.024	0.964	1.209	0.544
2006	1,332	1,313	1.44	0.699	1.920		0.3671	0.918	1.056	1.286	0.634
2007	1,297	1,303	1.60	0.773	2.074		0.4043	1.007	1.141	1.411	0.663
2008	1,545	1,562	1.35	0.834	2.084		0.1944	1.303	1.146	1.497	0.587
2009	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2010	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2011	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2012	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2013	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2014	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2015	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2016	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
2017	1,600	1,633	1.40	0.850	2.236		0.2179	1.388	1.230	1.605	0.631
										FIRR =	**<0**

Without the transfer payments to Bangladesh Petroleum Exploration Company Limited, the Price Deficit Fund, and management charges from Bangladesh Oil, Gas and Mineral Corporation, the FIRR is recalculated to be (1.99%).
FIRR = financial internal rate of return, FY = fiscal year, MCF = thousand cubic feet, MMCF = million cubic feet.
Source: Independent evaluation mission.

Table A3.13: Economic Internal Rate of Return
Part A: Bangladesh Gas Fields Company Limited

Fiscal Year	Gas Sales Volume (MMCF)	Benefits ($/MCF)	Benefits ($ million)	Capital Cost ($ million)	Operating Cost ($ million)	Depletion Premium ($ million)	Net Benefit ($ million)
1997				3.51			(3.51)
1998				2.54		0.79	(3.33)
1999	2,414	1.73	4.18	6.34	0.17	0.99	(3.33)
2000	32,580	2.85	92.88	16.26	1.07	0.77	74.78
2001	72,825	3.01	219.36	4.52	2.75	0.91	211.18
2002	90,089	2.18	196.80	0.87	3.56	0.80	191.57
2003	98,035	3.89	381.16	0.71	3.82	1.16	375.47
2004	103,285	4.65	479.77		3.40	1.79	474.58
2005	104,245	6.23	649.81		3.42	2.19	644.20
2006	102,397	5.53	566.62		2.63	3.07	560.92
2007	97,191	5.82	565.77		3.43	3.20	559.13
2008	86,925	7.92	688.19		6.36	5.52	676.31
2009	81,940	3.75	306.87		6.49	2.59	297.79
2010	81,940	3.75	306.87		6.49	2.93	297.45
2011	81,940	3.75	306.87		6.49	3.29	297.09
2012	81,940	3.75	306.87		6.49	3.69	296.69
2013	81,940	3.75	306.87		6.49	4.15	296.22
2014	81,940	3.75	306.87		6.49	4.68	295.70
2015	81,940	3.75	306.87		6.49	5.26	295.12
2016	81,940	3.75	306.87		6.49	5.93	294.45
2017	81,940	3.75	306.87		6.49	6.67	293.71
2018	81,940	3.75	306.87		6.49	7.51	292.87
2019	81,940	3.75	306.87		6.49	8.45	291.93
2020	81,940	3.75	306.87		6.49	9.51	290.87
2021	81,940	3.75	306.87		6.49	9.50	290.88
2022	81,940	3.75	306.87		6.49	10.69	289.69
						EIRR =	**229.91%**

EIRR = economic internal rate of return, MCF = thousand cubic feet, MMCF = million cubic feet.
Source: Independent evaluation mission.

Table A3.14: Economic Internal Rate of Return
Part B: Bakhrabad Gas Systems Limited

Fiscal Year	Gas Sales Volume (MMCF)	Gas Purchase Volume (MMCF)	Economic Benefit ($ million)	Economic Cost of Gas Purchases ($ million)	Capital Cost ($ million)	Operating Cost ($/MCF)	Operating Cost ($ million)	Depletion Premium ($ million)	Net Benefit ($ million)
1995					0.925				(0.925)
1996					1.653				(1.653)
1997	14	14	0.16	0.016	2.344	0.2054	0.0029	1.041	(3.240)
1998	76	78	0.90	0.090	0.634	0.1901	0.0145	1.166	(1.007)
1999	157	156	1.84	0.181	0.022	0.1888	0.0296	1.306	0.306
2000	245	252	2.88	0.292		0.1809	0.0443	1.462	1.079
2001	394	403	4.62	0.468		0.1588	0.0626	1.638	2.448
2002	560	584	6.56	0.678		0.1724	0.0966	1.834	3.954
2003	649	658	7.54	0.763		0.1467	0.0953	2.054	4.626
2004	674	682	7.79	0.792		0.1442	0.0972	2.301	4.600
2005	689	705	7.98	0.818		0.1675	0.1153	2.577	4.469
2006	713	732	8.27	0.849		0.1614	0.1151	2.886	4.418
2007	741	757	8.58	0.879		0.2135	0.1583	3.233	4.312
2008	792	785	9.10	0.911		0.1968	0.1558	3.621	4.412
2009	840	857	9.63	0.994		0.2170	0.1823	4.055	4.395
2010	840	857	9.63	0.994		0.2170	0.1823	4.542	3.908
2011	840	857	9.63	0.994		0.2170	0.1823	5.087	3.363
2012	840	857	9.63	0.994		0.2170	0.1823	5.697	2.753
2013	840	857	9.63	0.994		0.2170	0.1823	6.381	2.069
2014	840	857	9.63	0.994		0.2170	0.1823	7.146	1.303
2015	840	857	9.63	0.994		0.2170	0.1823	8.004	0.446
2016	840	857	9.63	0.994		0.2170	0.1823	8.964	(0.515)
2017	840	857	9.63	0.994		0.2170	0.1823	10.040	(1.590)
								EIRR =	**26.45%**

EIRR = economic internal rate of return, FY = fiscal year, MCF = thousand cubic feet, MMCF = million cubic feet.
Source: Independent evaluation mission

Table A3.15: Economic Internal Rate of Return
Part C: Titas Gas Transmission and Distribution Company Limited

Fiscal Year	Gas Sales Volume (MMCF)	Gas Purchase Volume (MMCF)	Economic Benefit ($ million)	Economic Cost of Gas Purchases ($ million)	Capital Cost ($ million)	Operating Cost ($/MCF)	Operating Cost ($ million)	Depletion Premium ($ million)	Net Benefit ($ million)
1995					0.13				(0.127)
1996					1.22				(1.216)
1997					3.81				(3.810)
1998	164	168	1.89	0.195	10.26	0.1518	0.0249	1.041	(9.631)
1999	293	291	3.37	0.337	4.55	0.1239	0.0364	1.166	(2.720)
2000	2,150	2,213	24.75	2.567	5.63	0.1194	0.2567	1.306	14.994
2001	4,487	4,594	51.59	5.329	0.44	0.1119	0.5020	1.462	43.853
2002	4,236	4,416	48.67	5.122	2.83	0.1151	0.4877	1.638	38.600
2003	4,639	4,699	52.88	5.451	10.22	0.1217	0.5645	1.834	34.810
2004	4,816	4,873	54.62	5.653	2.49	0.0969	0.4667	2.054	43.947
2005	4,901	5,018	55.66	5.821		0.1034	0.5067	2.301	47.035
2006	5,193	5,327	59.06	6.180		0.1051	0.5458	2.577	49.760
2007	5,380	5,496	60.77	6.376		0.1181	0.6352	2.886	50.873
2008	5,778	5,730	64.44	6.647		0.1294	0.7475	3.233	53.818
2009	5,778	5,896	64.24	6.839		0.1400	0.8087	3.621	52.967
2010	5,778	5,896	64.24	6.839		0.1400	0.8087	4.055	52.532
2011	5,778	5,896	64.24	6.839		0.1400	0.8087	4.542	52.046
2012	5,778	5,896	64.24	6.839		0.1400	0.8087	5.087	51.501
2013	5,778	5,896	64.24	6.839		0.1400	0.8087	5.697	50.890
2014	5,778	5,896	64.24	6.839		0.1400	0.8087	6.381	50.206
2015	5,778	5,896	64.24	6.839		0.1400	0.8087	7.146	49.441
2016	5,778	5,896	64.24	6.839		0.1400	0.8087	8.004	48.583
2017	5,778	5,896	64.24	6.839		0.1400	0.8087	8.964	47.623
								EIRR =	**76.50%**

EIRR = economic internal rate of return, FY = fiscal year, MCF = thousand cubic feet, MMCF = million cubic feet.
Source: Independent evaluation mission.

Table A3.16: Economic Internal Rate of Return
Part D: Jalalabad Gas Transmission and Distribution Systems Limited

Fiscal Year	Gas Sales Volume (MMCF)	Gas Purchase Volume (MMCF)	Economic Benefit ($ million)	Economic Cost of Gas Purchases ($ million)	Capital Cost ($ million)	Operating Cost ($/MCF)	Operating Cost ($ million)	Depletion Premium ($ million)	Net Benefit ($ million)
1995					0.35				(0.347)
1996					2.28				(2.284)
1997					2.62				(2.615)
1998	26	26	0.30	0.030	3.31	0.1204	0.0031	1.041	(4.081)
1999	71	72	0.82	0.083	0.08	0.1181	0.0084	1.166	(0.514)
2000	104	104	1.21	0.121	0.06	0.0916	0.0095	1.306	(0.285)
2001	128	129	1.46	0.149	0.03	0.0981	0.0126	1.462	(0.199)
2002	149	150	1.68	0.174	0.03	0.0825	0.0123	1.638	(0.176)
2003	1,326	1,328	15.28	1.541		0.0883	0.1170	1.834	11.784
2004	1,370	1,366	15.71	1.584		0.1123	0.1537	2.054	11.917
2005	1,397	1,396	16.05	1.619		0.1186	0.1657	2.301	11.968
2006	1,332	1,313	15.35	1.523		0.1323	0.1762	2.577	11.077
2007	1,297	1,303	14.85	1.512		0.2757	0.3574	2.886	10.099
2008	1,545	1,562	17.60	1.812		0.3118	0.4817	3.233	12.078
2009	1,600	1,633	18.18	1.894		0.1258	0.2014	3.621	12.467
2010	1,600	1,633	18.18	1.894		0.1362	0.2179	4.055	12.016
2011	1,600	1,633	18.18	1.894		0.1362	0.2179	4.542	11.529
2012	1,600	1,633	18.18	1.894		0.1362	0.2179	5.087	10.984
2013	1,600	1,633	18.18	1.894		0.1362	0.2179	5.697	10.374
2014	1,600	1,633	18.18	1.894		0.1362	0.2179	6.381	9.690
2015	1,600	1,633	18.18	1.894		0.1362	0.2179	7.146	8.924
2016	1,600	1,633	18.18	1.894		0.1362	0.2179	8.004	8.067
2017	1,600	1,633	18.18	1.894		0.1362	0.2179	8.964	7.106
								EIRR =	**30.41%**

EIRR = economic internal rate of return, FY = fiscal year, MCF = thousand cubic feet, MMCF = million cubic feet.
Source: Independent evaluation mission.

CONSUMER SURVEY

A. Methodology

1. With a view to obtaining representative data for household, commercial, and industrial consumers covered by the Third Natural Gas Development Project, areas of the Titas Gas Transmission and Distribution Company Limited (TGTDCL) gas distribution system were selected for inclusion in the survey—Banashree, Rampura main road, Ullon, Uttara (sector 10–14), Dhaka–Tongi road (Uttara), Mirpur (section 1–10 and 10–11.5), Tongi, and Shaympur.

2. Fifteen enumerators were recruited to complete the field survey for household, commercial, and industrial consumers from the identified areas. Survey teams were divided into two groups and two supervisors were engaged to oversee daily survey works at the field. Orientation and training was arranged for the enumerators and supervisors—describing the objectives, importance, and methodology of the survey and study. The training also covered identification; collection, verification and recording of data on questionnaire; approach, attitude, and dealings with the respondents. Prior to undertaking the surveys, the three draft questionnaires were pretested with a small sample of respondents.

B. Results for Household Consumers

Table A4.1: Home Ownership

Ownership	Frequency	Percent
Owned	98	47.8
Rented	107	52.2
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.2: Type of Dwelling House

Type of Dwelling House	Frequency	Percent
Pucca	180	87.8
Semi pucca	17	8.3
Tin shed	6	2.9
Nonresponse	2	1.0
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.3: Monthly Average Family Income (Tk)

Number	Valid	191
	Missing	14
	Mean	40,497.38
	Median	25,000.00
	Mode	20,000
	Minimum	4,000
	Maximum	600,000
Percentiles	10	15,000.00
	20	16,000.00
	30	20,000.00
	40	20,000.00
	50	25,000.00
	60	30,000.00
	70	35,000.00
	80	45,000.00
	90	68,000.00

Source: Independent Evaluation Department survey.

Table A4.4: Number of Family Members

Number	Frequency	Percent
1	1	0.5
2	10	4.9
3	27	13.2
4	48	23.4
5	57	27.8
6	28	13.7
7	9	4.4
8	12	5.9
9	2	1.0
10	3	1.5
11	2	1.0
12	1	0.5
14	1	0.5
15	1	0.5
Subtotal	202	98.5
Missing	3	1.5
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.5: Monthly Average Gas Expenditure

Monthly Average Expenditure (Tk)	Frequency	Percent
350	11	5.4
400	172	83.9
600	1	0.5
700	1	0.5
800	11	5.4
900	1	0.5
1,400	1	0.5
Nonresponse	7	3.4
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.6: Daily Gas Usage

Daily Use (Hours)	Frequency	Percent
2	13	6.3
3	33	16.1
4	62	30.2
5	50	24.4
6	44	21.5
8	2	1.0
10	1	0.5
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.7: Preference for Shifting Present Gas Connection to LPG

Preference	Frequency	Percent
Yes	28	13.7
No	177	86.3
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.8: Preference to Have a Metered Natural Gas Connection

Preference	Frequency	Percent
Yes	130	63.4
No	74	36.1
Total	204	99.5
Nonresponse	1	0.5
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.9: Satisfaction with New Gas Connection and Extension

Rating	Frequency	Percent
Very Satisfied	13	6.3
Satisfied	51	24.9
Neither Satisfied nor Dissatisfied	59	28.8
Dissatisfied	37	18.0
Very Dissatisfied	22	10.7
Nonresponse	23	11.2
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.10: Satisfaction with Gas Repairs

Rating	Frequency	Percent
Very Satisfied	19	9.3
Satisfied	38	18.5
Neither Satisfied nor Dissatisfied	63	30.7
Dissatisfied	48	23.4
Very Dissatisfied	19	9.3
Nonresponse	18	8.8
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.11: Satisfaction with Gas Billing

Rating	Frequency	Percent
Very Satisfied	38	18.5
Satisfied	102	49.8
Neither Satisfied nor Dissatisfied	14	6.8
Dissatisfied	21	10.2
Very Dissatisfied	14	6.8
Nonresponse	16	7.8
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.12: Satisfaction with the Cost of Gas

Rating	Frequency	Percent
Very Satisfied	38	18.5
Satisfied	130	63.4
Neither Satisfied nor Dissatisfied	7	3.4
Dissatisfied	22	10.7
Very Dissatisfied	3	1.5
Nonresponse	5	2.4
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.13: Willingness to Pay for More Reliable Gas Supply

Willingness	Frequency	Percent
Yes	60	29.3
No	141	68.8
Total	201	98.0
Nonresponse	4	2.0
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.14: Affordability of Paying a Higher Price for a More Reliable Gas Supply

Percentage More	Frequency	Percent
5	22	10.7
6	1	0.5
10	26	12.7
12	1	0.5
15	3	1.5
20	2	1.0
50	1	0.5
100	2	1.0
Subtotal	**58**	**28.3**
Nonresponse	147	71.7
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.15: Paying Bribes to Avoid Harassment

Bribery	Frequency	Percent
Yes	48	23.4
No	152	74.1
Nonresponse	5	2.4
Total	**205**	**100.0**

Source: Independent Evaluation Department survey.

C. Results for Commercial Consumers

Table A4.16: Type of Business

Type	Frequency	Percent
Shop	116	56.9
Community Center	4	2.0
Hotel	28	13.7
Saloon	13	6.4
Business House/Office	16	7.8
Others	24	11.8
Nonresponse	3	1.5
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.17: Monthly Turnover (Tk)

Number	Valid	200
	Missing	4
	Mean	353,115.01
	Median	150,000.00
	Mode	150,000.00
	Minimum	8,000.00
	Maximum	6,000,000.00
Percentiles	10	25,000.00
	20	35,200.00
	30	60,000.00
	40	105,000.00
	50	150,000.00
	60	180,000.00
	70	300,000.00
	80	490,000.00
	90	885,000.00

Source: Independent Evaluation Department survey.

Table A4.18: Number of Employees

Number of Employees	Frequency	Percent
1–5	158	77.5
6–10	24	11.8
11–15	11	5.4
16–20	4	2.0
21–25	2	1.0
26–30	3	1.5
36–40	2	1.0
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.19: Satisfaction with New Gas Connection/Extension

Rating	Frequency	Percent
Very Satisfied	6	2.9
Satisfied	42	20.6
Neither Satisfied nor Dissatisfied	17	8.3
Dissatisfied	46	22.5
Very Dissatisfied	3	1.5
Nonresponse	90	44.1
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.20: Satisfaction with Gas Repairs

Rating	Frequency	Percent
Very Satisfied	4	2.0
Satisfied	37	18.1
Neither Satisfied nor Dissatisfied	24	11.8
Dissatisfied	44	21.6
Very Dissatisfied	2	1.0
Nonresponse	93	45.6
Total	204	100.0

Source: Independent Evaluation Department survey.

Table A4.21: Satisfaction with Gas Billing

Rating	Frequency	Percent
Very Satisfied	4	2.0
Satisfied	93	45.6
Neither Satisfied nor Dissatisfied	8	3.9
Dissatisfied	10	4.9
Very Dissatisfied	89	43.6
Nonresponse	204	100.0
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.22: Satisfaction with the Cost of Gas

Rating	Frequency	Percent
Very Satisfied	4	2.0
Satisfied	92	45.1
Neither Satisfied nor Dissatisfied	7	3.4
Dissatisfied	12	5.9
Nonresponse	89	43.6
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.23: Willingness to Pay for More Reliable Gas Supply

Willingness	Frequency	Percent
Yes	26	12.7
No	95	46.6
Nonresponse	83	40.7
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.24: Affordability of Paying a Higher Price for a More Reliable Gas Supply

Percentage More	Frequency	Percent
0	1	0.5
5	14	6.9
10	5	2.5
20	2	1.0
25	1	0.5
50	1	0.5
Nonresponse	180	88.2
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.25: Paying Bribes to Avoid Harassment

Bribery	Frequency	Percent
Yes	33	16.2
No	88	43.1
Nonresponse	83	40.7
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.26: Reason for Paying a Bribe to Avoid Harassment

Reasons	Frequency	Percent
Getting new gas connection	26	12.7
Getting meter connection	7	3.4
Nonresponse	171	83.8
Total	**204**	**100.0**

Source: Independent Evaluation Department survey.

D. Results for Industrial Consumers

Table A4.27: Industry Type

Types	Frequency	Percent
Textile	9	60.0
Ready-Made Garment	3	20.0
Washing	2	13.3
Packaging	1	6.7
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.28: Monthly Average Turnover (Tk)

Number	Valid	15
	Mean	12,376,000.00
	Median	4,500,000.00
	Minimum	650,000.00
	Maximum	70,000,000.00
Percentiles	20	1,730,000.00
	40	3,900,000.00
	60	5,840,000.00
	80	14,200,000.00

Source: Independent Evaluation Department survey.

Table A4.29: Average Monthly Consumption and Expenditure

Month	**Average Consumption** (cm)	**Average Expenditure** (Tk)
January	19,959.50	90,746.71
February	15,251.27	93,146.37
March	19,168.91	110,591.70
April	17,110.27	105,566.10
May	18,348.90	107,258.90
June	20,243.67	114,452.30
July	19,913.04	120,800.10
August	20,176.33	122,526.10
September	18,192.75	108,558.90
October	16,891.75	171,832.80
November	30,339.58	181,093.40
December	18,478.92	98,496.07
Total	234,074.90	1,425,069.00
Monthly Average	19,506.24	118,755.75

cm = cubic meter.
Source: Independent Evaluation Department survey.

Table A4.30: Ratings of Reliability and Quality of Gas Supply

Rating	**Frequency**	**Percent**
Fair	2	13.3
Poor	12	80.0
Non Response	1	6.7
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.31: Satisfaction with New Gas Connection and Extension

Rating	**Frequency**	**Percent**
Satisfied	6	40.0
Neither Satisfied nor Dissatisfied	1	6.7
Dissatisfied	7	46.7
Very Dissatisfied	1	6.7
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.32: Satisfaction with Gas Repairs

Rating	**Frequency**	**Percent**
Very Satisfied	2	13.3
Satisfied	8	53.3
Neither Satisfied nor Dissatisfied	1	6.7
Dissatisfied	4	26.7
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.33: Satisfaction with Gas Billing

Rating	Frequency	Percent
Very Satisfied	1	6.7
Satisfied	13	86.7
Dissatisfied	1	6.7
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.34: Satisfaction with Cost of Gas

Rating	Frequency	Percent
Satisfied	10	66.7
Dissatisfied	5	33.3
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.35: Willingness to Pay for More Reliable Gas Supply

Willingness	Frequency	Percent
Yes	4	26.7
No	11	73.3
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.36: Affordability of Paying a Higher Price for a More Reliable Gas Supply

Percentage More	Frequency	Percent
2	1	6.7
5	1	6.7
10	1	6.7
Non-Response	12	80.0
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.37: Paying Bribes to Avoid harassment

Bribery	Frequency	Percent
Yes	7	46.7
No	8	53.3
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.

Table A4.38: Reason for Paying a Bribe to Avoid Harassment

Reasons	Frequency	Percent
Getting New Connection	5	33.3
Getting Meter Connection	1	6.7
Billing	1	6.7
Non-Response	8	53.3
Total	**15**	**100.0**

Source: Independent Evaluation Department survey.