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Report No: PAD2523

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED SCALE-UP FACILITY CREDIT

IN THE AMOUNT OF EUR 376 MILLION

(US\$450.64 MILLION EQUIVALENT)

TO THE

PEOPLE'S REPUBLIC OF BANGLADESH

FOR THE

ENHANCEMENT AND STRENGTHENING OF POWER TRANSMISSION NETWORK IN EASTERN
REGION PROJECT

January 29, 2018

Energy and Extractives Global Practice
South Asia Region

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CURRENCY EQUIVALENTS

(Exchange Rate Effective December 31, 2017)

Currency Unit = Bangladeshi Taka (BDT)

BDT 82.81 = US\$1

US\$1.19870000 = EUR 1

FISCAL YEAR

July 1 – June 30

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AIS	Air Insulated Substation
BERC	Bangladesh Energy Regulatory Commission
BEZA	Bangladesh Economic Zone Authority
BPDB	Bangladesh Power Development Board
CAGR	Cumulative Average Growth Rate
CPF	Country Partnership Framework
DC	Direct Current
DSCR	Debt Service Coverage Ratio
EA	Environment Assessment
EMP	Environmental Management Plan
EPZ	Export Processing Zone
ERP	Enterprise Resource Planning
ERR	Economic Rate of Return
ESIA	Environmental and Social Impact Assessment
EZ	Economic Zone
FM	Financial Management
GC	Global Competitiveness
GDP	Gross Domestic Product
GIS	Gas Insulated Substation
GOB	Government of Bangladesh
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
HVDC	High Voltage Direct Current
IDC	Interest During Construction
IPP	Independent Power Producer
IUFR	Interim Unaudited Financial Report
JICA	Japan International Cooperation Agency
LMIC	Lower-middle-income Country
MVA	Mega Volt Ampere
O&M	Operation and Maintenance
P&D	Planning and Designing

PD	Project Director
PGCB	Power Grid Company of Bangladesh
PMU	Project Management Unit
PPE	Property, Plant, and Equipment
PPSD	Project Procurement Strategy for Development
PSMP	Power System Master Plan
PSP	Private Sector Participation
RAP	Resettlement Action Plan
ROW	Right-of-Way
STEP	Systematic Tracking of Exchanges in Procurement
SUF	Scale-up Facility
T&D	Transmission and Distribution
TA	Technical Assistance
VAT	Value Added Tax

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Country Director: Qimiao Fan

Senior Global Practice Director: Riccardo Puliti

Practice Manager: Demetrios Papathanasiou

Task Team Leader(s): Mohammad Anis, Issa Diaw



BASIC INFORMATION

Is this a regionally tagged project? No	Country(ies)	Financing Instrument Investment Project Financing
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- Situations of Urgent Need of Assistance or Capacity Constraints
- Financial Intermediaries
- Series of Projects

Approval Date 27-Feb-2018	Closing Date 31-Dec-2022	Environmental Assessment Category B - Partial Assessment
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Bank/IFC Collaboration No	
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Proposed Development Objective(s)

The proposed project aims to increase the transmission capacity and reliability of the electricity network in the eastern region and strengthen the institutional capacity of the Power Grid Company of Bangladesh Limited (PGCB).

Components

Component Name	Cost (US\$, millions)
Enhancement and Strengthening of Power Network	686.60
Institutional Development and Implementation Support	31.46

Organizations

Borrower : People's Republic of Bangladesh

Implementing Agency : Power Grid Company of Bangladesh Limited (PGCB)



PROJECT FINANCING DATA (US\$, Millions)

<input checked="" type="checkbox"/> Counterpart Funding	<input type="checkbox"/> IBRD	<input checked="" type="checkbox"/> IDA Credit	<input type="checkbox"/> IDA Grant	<input type="checkbox"/> Trust Funds	<input type="checkbox"/> Parallel Financing
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Total Project Cost:
718.06

Total Financing:
718.06

Of Which Bank Financing (IBRD/IDA):
450.64

Financing Gap:
0.00

Financing (in US\$, millions)

Financing Source	Amount
Borrower	267.42
IDA-61770	450.64
Total	718.06

Expected Disbursements (in US\$, millions)

Fiscal Year	2018	2019	2020	2021	2022	2023
Annual	2.00	18.00	120.00	130.00	150.00	30.64
Cumulative	2.00	20.00	140.00	270.00	420.00	450.64

INSTITUTIONAL DATA

Practice Area (Lead)

Energy & Extractives



Contributing Practice Areas

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag

Does the project plan to undertake any of the following?

a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF

Yes

b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment

Yes

c. Include Indicators in results framework to monitor outcomes from actions identified in (b)

Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	● Substantial
2. Macroeconomic	● Moderate
3. Sector Strategies and Policies	● Moderate
4. Technical Design of Project or Program	● Low
5. Institutional Capacity for Implementation and Sustainability	● Moderate
6. Fiduciary	● High
7. Environment and Social	● Moderate
8. Stakeholders	● Moderate
9. Other	
10. Overall	● Substantial



COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

Yes No

Does the project require any waivers of Bank policies?

Yes No

Safeguard Policies Triggered by the Project

Yes No

Environmental Assessment OP/BP 4.01

✓

Natural Habitats OP/BP 4.04

✓

Forests OP/BP 4.36

✓

Pest Management OP 4.09

✓

Physical Cultural Resources OP/BP 4.11

✓

Indigenous Peoples OP/BP 4.10

✓

Involuntary Resettlement OP/BP 4.12

✓

Safety of Dams OP/BP 4.37

✓

Projects on International Waterways OP/BP 7.50

✓

Projects in Disputed Areas OP/BP 7.60

✓

Legal Covenants

Sections and Description

Financing Agreement (FA), Schedule 2, Section I.D

Description: GoB shall ensure that the following expenditures are financed exclusively out of its own resources or the resources of the PGCB and not out of the proceeds of the IDA financing: (i) all land required for the purposes of the Project; (ii) all resettlement and rehabilitation compensation and other assistance to Affected Persons, in accordance with the RAPs; (iii) operational costs of the PMU including purchase of vehicles; (iv) consultancy costs including for the compiling of a fixed asset register for PGCB; (v) consultancy costs for the developing of the computerized financial management system for PGCB; (vi) interest during construction; (vii) recurrent expenditures such as workshop allowances, sitting allowances, cash per diems, honoraria and fuel; (viii) import and supplementary duties and value-added taxes at import stage; and (ix) value-added taxes on contracts.



Sections and Description

FA, Schedule 2, Section I.A

Description: GOB shall cause the PGCB to maintain until the completion of the Project, a project management unit (PMU) headed by an appropriately qualified project director, and comprised of competent staff including, inter alia, one (1) procurement specialist, one (1) financial management specialist, and one (1) monitoring and evaluation specialist.

Sections and Description

FA, Schedule 2, Section I.A.2

Description: GoB shall cause PGCB to maintain until the completion of the Project, the audit committee comprising of staff, with experience and qualification, in numbers and under terms of reference acceptable to the Association; which committee shall be responsible for overseeing and settling any audit issues during the implementation of the Project.

Sections and Description

FA, Schedule 2, Section I.A.3

Description: GoB shall cause PGCB to maintain until the completion of the Project, a bid/proposal evaluation committee with composition and terms of reference acceptable to the Association, which shall include an international procurement specialist. The Association's concurrence shall be required for the formation and modification in the constitution of the committee.

Sections and Description

FA, Schedule 2, Section I.C

Description: GoB shall, and shall cause PGCB to, ensure that the activities under the Project are carried out in accordance with the provisions of the ESIA (including the EMPs and the RAPs).

Sections and Description

Project Agreement (PA), Section I.C.(iii)

Description: Before commencing any civil works for any transmission line, substation or distribution network under the Project, PGCB to ensure that (i) all necessary governmental permits and clearances for such civil works shall have been obtained from the competent governmental authority/ies and submitted to the Association; and (b) all the pre-construction conditions imposed by the governmental authorities under such permit(s) or clearances shall have been complied with.



Sections and Description

PA, Section III (a)

Description: PGCB shall fill the vacancy for the position of General Manager, Finance and Executive Director, Finance in PGCB and appoint experienced and professionally qualified accountant(s) to the said positions by December 31, 2018.

Sections and Description

PA, Section III (b) and (c)

Description: PGCB shall hire, by December 31, 2018, the relevant consultants/consulting firm (i) for assisting PGCB in compiling a fixed asset register and (ii) for supporting PGCB in developing a computerized financial management system in accordance with the terms of reference agreed to with the Association.

PGCB shall hire, by no later than December 31, 2018, the relevant consultants/consulting firm for the carrying out of Component 2 (TA) activities in accordance with the terms of reference agreed to with the Association.

Sections and Description

PA, Section III (d)

Description: PGCB shall enter into a subsidiary loan agreement, and shall exercise its rights and carry out its obligations under such agreement in such manner as to protect the interests of the Association and to accomplish the purposes of the financing, including to identify the allocation of expenditures between PGCB and the GoB and the role of GoB as the default financier. Except as the Association shall otherwise agree, GoB shall not assign, amend, abrogate or waive the subsidiary loan agreement or any of its provisions. In the event of any conflict between the provisions of the subsidiary loan agreement and the legal agreements, the provisions of the legal agreements shall prevail.

Conditions

Type

Effectiveness

Description

The Subsidiary Loan Agreement has been executed on behalf of the Recipient and PGCB and all conditions precedent to its effectiveness or to the right of the Recipient to make withdrawals under it (other than the effectiveness of this Agreement) have been fulfilled.

**PROJECT TEAM****Bank Staff**

Name	Role	Specialization	Unit
Mohammad Anis	Team Leader(ADM Responsible)	Task Team Leader	GEE06
Issa Diaw	Team Leader	Technical and Co-TTL	AFCC1
Ishtiak Siddique	Procurement Specialist(ADM Responsible)	Procurement	GGOPZ
Mohammed Atikuzzaman	Financial Management Specialist	Financial Management	GGOES
Iqbal Ahmed	Environmental Safeguards Specialist	Environment Safeguard	GEN06
Jari Vayrynen	Team Member	Co-TTL	GEE06
Md. Iqbal	Team Member	Technical	GEE06
Md. Tafazzal Hossain	Team Member	Program Assistant	SACBD
Mohammad Saqib	Team Member	Economic and Financial Analysis	GEE06
Sabah Moyeen	Social Safeguards Specialist	Social Safeguard	GSU06
Satish Kumar Shivakumar	Team Member	Finance	WFACS
Shaukat Javed	Team Member	Program Assistant	GEE06
Vidya Venugopal	Counsel	Legal	LEGES

Extended Team

Name	Title	Organization	Location
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BANGLADESH

ENHANCEMENT AND STRENGTHENING OF POWER TRANSMISSION NETWORK IN EASTERN REGION

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I. STRATEGIC CONTEXT

A. Country Context

1. Bangladesh's economy has performed well over the past decade. The country's gross domestic product (GDP) has grown at an average of 6 percent per year since 2010. In FY14, the country moved up to a lower-middle-income country (LMIC) status as per capita gross national income of US\$1,080 crossed the LMIC threshold of US\$1,046. The country's per capita income rose further to US\$1,480 at the end of FY17. This sustained growth was achieved despite the adverse impacts of the global recession, oil price increases, unrest in the Middle East (an important source of healthy remittance inflow), and natural disasters. Bangladesh's economy could have performed better if the energy infrastructure had developed in line with the economic demands.

2. The Government of Bangladesh (GOB) has targeted GDP growth of 7.4 percent per year between 2016 and 2020 in its Seventh Five Year Plan. Solid performance by the power sector is considered necessary to achieve this target. The current Power System Master Plan (PSMP) notes that if Bangladesh were to follow Thailand's growth trajectory as desired by the Government, it would have to sustain a per capita GDP growth rate of 5.2 percent per year between 2016 and 2041. This would require the development of new export-oriented industries and a significant increase in power generation capacity, along with a quadrupling of the total energy used.¹ The Government has also set the goal of achieving universal access to electricity by 2021, when Bangladesh completes 50 years of independence.

3. The availability and reliability of power is a key constraint to job creation and poverty reduction, hampering the competitiveness of Bangladesh's economy.² The supply of power in Bangladesh has not been able to keep pace with the rapid growth in demand and consumers experience frequent power outages. In addition to shortfalls in power generation, Bangladesh's aging and inadequate transmission and distribution (T&D) systems impose severe constraints on power delivery to consumers. Due to lack of investment and inadequate maintenance, the reliability of the system has deteriorated substantially, resulting in several instances of major system collapse. As in other countries of South Asia, a majority of manufacturing and service firms in Bangladesh identify a shortage of reliable electricity as the most important constraint they face to smooth operations and expansion. Outages result in about 2–3 percent loss of GDP per year, with significant sums spent on diesel generators for backup.

4. Bangladesh's energy sector has become increasingly vulnerable to external shocks in energy supply. National reserves of natural gas, which accounts for about 67 percent of power generation, are estimated to diminish substantially from 2020 if no new gas reserves are discovered or if technology does not allow a higher rate of extraction from existing gas fields. Declining indigenous resources and growing electricity demand have resulted in an increasing reliance on imported fuel oil for power generation. From 2009 to 2017, the share of oil-fired electricity increased from 5 percent to 27 percent. This increase in oil-fired electricity contributed to the fuel cost per kWh generated rising from BDT 1.1 per kWh to BDT 3.42

¹ The Power System Master Plan 2015. JICA/TEPCO. "PSMP2015 High-Level Discussion SUMMARY PART." April 2016.

² Bangladesh is ranked 107th out of 140 countries on the Global Competitiveness (GC) Index and 120th on quality of electricity supply. The GC Survey identified inadequate supply of infrastructure as the most problematic factor for doing business along with corruption.



per kWh (US\$0.014 per kWh to US\$0.04 per kWh) over the same period.

5. Bangladesh is also one of the countries that is most vulnerable to climate change. Two-thirds of the country is located at less than five meters above sea level and more than 700 rivers run through its borders. Consequently, infrastructure investments in Bangladesh are highly exposed to various climate risks, including extreme precipitation and flooding, sea level rise, storm surge, strong winds, and landslide. The need to address climate risks in infrastructure projects is becoming increasingly urgent to ensure sustainable economic development of the country.

B. Sectoral and Institutional Context

6. The power sector in Bangladesh has grown rapidly over the last decade—maximum generation increased from a little over 3,000 MW in 2009 to more than 9,000 MW in 2016, but there is significant unserved demand. The Government’s electrification efforts brought electricity access to 80 percent of the population. While current name-plate installed generation capacity in Bangladesh is 15,379 MW (that includes 600 MW import from India and 2,200 MW from captive power generation), available capacity is only about 9,000 MW due to a range of sector challenges including fuel constraints and insufficient infrastructure. However, there is considerable headroom for electricity demand growth. The per capita consumption of electricity in Bangladesh is only 407 kWh per year, which is one of the lowest in the world and lower than other large South Asian countries (1,010 kWh for India, 2,600 kWh for China, and 13,246 kWh for the United States). Driven by socio-economic development objectives, electricity demand is projected to grow by more than 10 percent per year over the medium term.

7. Bangladesh’s power sector is making significant efforts to meet fast growing demand. The Government plans to increase the existing installed capacity to 24 GW by 2021 and reach 50 GW by 2041 using private and public funding. Fifty-five percent of the installed capacity is generated by public sector plants run by Bangladesh Power Development Board (BPDB) and by its subsidiary corporatized generation companies, and the rest by independent power producers (IPPs) and rental units (smaller in scale and with different contractual structures than IPPs, many running on liquid fuel although some use gas) owned by the private sector. The Government is also working on improving the energy mix (including imports from India, Bhutan, and Nepal) considering the depleting indigenous natural gas reserves.

8. Among the sector’s considerable challenges, alleviating Bangladesh’s transmission system bottlenecks is critical to ensuring that the increasing numbers of consumers connected to the grid receive reliable, good quality electricity supply. Investments in power generation will not have the intended benefits to consumers without an adequate and timely upgrade of electricity transmission and distribution (T&D) systems. Investment of about US\$4.8 billion in enhancing and strengthening the network is currently under implementation, while another US\$7.1 billion of investment is under consideration to increase the network’s wheeling capacity and reliability.

9. Bangladesh’s transmission system mainly consists of 230 kilo-Vol (kV) and 132 kV systems, while one 400 kV High Voltage Direct Current (HVDC) system has recently been implemented. The country has about 10,635 circuit km of transmission lines and about 46,413 million kWh wheeled through the transmission network during FY15–16. Transmission losses have come down to 2.38 percent in 2015–16 from 4.24 percent in 2000–01. The country is vertically divided by the rivers Jamuna and Padma; and the western and eastern part of Bangladesh’s transmission network is interconnected by two 230 kV double



circuit lines. A summary of the country's transmission system is presented in Table 1.

Table 1. Transmission Lines and Substations by Voltage, Length/Quantity (as of December, 2017)

Transmission Lines		Substations	
Voltage level (kV)	Circuit Km	Voltage Level (kV)	No of Substations (MVA)
400	560	400 (HVDC)	1 (500MW)
230	3,325	400/230	3 (2,210 MVA)
132	6,750	230/132	24 (11,485 MVA)
		132/33	117 (18,145 MVA)
Total	10,635		32,340 MVA

10. Power Grid Company of Bangladesh (PGCB) is the sole authority responsible for the transmission network in the country. The network is currently under pressure due to the rapid growth of demand for electricity. Bangladesh's growing power system will require the wheeling of 50 GW capacity through the transmission network by 2041. PGCB has already undertaken several development projects to improve the network and plans to add 3,098 km of new transmission lines and 106 new substations by 2020 and an additional 3,005 km and 90 substations by 2025. However, a considerable number of grid substations and transmission lines are overloaded, contributing to the unreliable electricity supply in major load centers. The system also faces growing physical constraints to expand due to lack of right-of-way (ROW) for the lines and land for substations in densely populated areas.

11. PGCB not only needs to expand its transmission system but also significantly improve its operation and maintenance (O&M) practices to ensure reliability and quality of supply of a significantly expanded asset base. More than 2,000 staff are already involved in O&M (including 1,141 engineers and 709 technical staff). The total expenditure³ for maintenance almost doubled between FY11/12 and FY15/16 from BDT 4.2 billion to BDT 7.2 billion (that is, US\$54 million to US\$90.3 million). The current O&M practices in PGCB are mainly focused on time-based and breakdown maintenance. Handling the expanded system with current maintenance practices and tools will lead to low level of reliability and unmanageable level of staffing, resulting in major challenges to ensuring the sustainability of transmission assets.

12. The proposed project will expand the network in the eastern region of the country, which is an important economic and industrial hub. The region covers the Greater Comilla and Noakhali areas and part of the Greater Chittagong area. An aged and low capacity grid network in this region is one of the major problems that PGCB is facing and a key priority. The Greater Comilla region, which has more than 1,000 people per square km, and Noakhali area together are the second largest load centers of Bangladesh after the capital city of Dhaka. The Greater Chittagong area is a major commercial and industrial hub with the Government taking initiatives to set up multiple economic zones (EZs) and upgrade port facility and transportation network. Due to lack of electricity supply, economic growth of this area is stagnant. Operational bottlenecks of the region were identified during a network analysis performed by PGCB and the feasibility study carried out by a consulting firm. The project will also assist PGCB to introduce reactive, predictive, and proactive O&M approaches.

13. Institutionally, the Ministry of Power, Energy, and Mineral Resource in Bangladesh has the

³ Including repair and maintenance, salaries and benefits of O&M staff, depreciation, and so on.



responsibility for the power sector. The structure of the sector has evolved from a single vertically integrated utility to a partially unbundled sector with private entry and competition in generation and, to a lesser extent, in distribution. Until 1996 when PGCB and Dhaka Electric Supply Company were established, the Bangladesh Power Development Board (BPDB) was the single vertically integrated utility. The sector now comprises BPDB – which retained a large portion of public generation assets, a share of distribution assets, and is acting as the single buyer – plus several generation companies, one transmission company (PGCB), several distribution companies as well as a regulatory body (Bangladesh Energy Regulatory Commission [BERC]). Unlike in power generation with significant private sector participation, there have been recent but limited developments on private sector participation (PSP) in the transmission network. A Government committee evaluated the technical, financial, and security aspects of PSP in the transmission sector but has not identified any particular investments that may be undertaken in the medium term.

C. Higher Level Objectives to which the Project Contributes

14. The proposed project directly contributes to the priorities set under the Country Partnership Framework (CPF) for FY16–20 (Report No. 103723-BD), which identifies shortages of grid-connected electricity as a key constraint to growth and reaffirms a commitment to address climate change risks in Bangladesh. The CPF is anchored in Bangladesh’s Seventh Five Year Plan and recognizes the need for additions to generation capacity while ensuring adequate supply of electricity through the development of infrastructure. Enhancing transmission capacity to limit congestion and ensure efficient evacuation of power and improving the operation of the grid are key priorities for World Bank support.

15. The Government aims to increase power generation to 24 GW by 2021. However, investments in power generation will not have the intended benefits to consumers without an adequate and timely upgrade of electricity T&D systems. Investment of about US\$4.8 billion in enhancing and strengthening the network is currently under implementation, while another US\$7.1 billion of investment is under consideration to increase the network’s wheeling capacity and reliability. The proposed project is part of this investment plan. It would expand the 230 kV transmission system and strengthen the 132 kV transmission systems in the grid network of the eastern region.

16. The project is well aligned with the objectives of the IDA18 Scale-up Facility (SUF). Network investments under the proposed project are expected to maximize leverage of public finance for further development by unlocking private sector growth and bringing a transformational economic impact in the eastern region. The Government is considering developing the Mirsharai area as a key private economic zone (EZ). Based on the forecasted load demand, Mirsharai EZ will require 500 MW power by 2025 according to the plan of Bangladesh Economic Zone Authority (BEZA). The upgrade of substations at Mirsharai to 400/230 kV and the associated 400 kV double circuit line will create basic capacity of more than 2,000 MW of power supply for the Mirsharai EZ, which will enable the private sector to invest in productive facilities in the area. The upgraded substation at Mirsharai and another three new substations at Lakhshmipur, Choumuhani, and Maijdee under this project are expected to facilitate the integration of renewable energy of significant capacities (about 550 MW of proposed solar PV projects in the private sector and 300 MW in the public sector) into the grid. BPDB’s generation plan (2017–2030) also includes several private sector projects (about 900 MW capacity) in the eastern region, which would be benefitted by the proposed project and are expected to be added to the grid by 2020. The Korerhat substation under this project will be connected to the 400 kV Meghnaghat-Madunaghat line and would draw power from



the Maheskhali power hub where both private and public sector plants are expected to operate in the future and would support the load demand of several heavy industry facilities operated by the private sector. Replacement of the aging Haliashahar substation will support many key economic facilities such as the Chittagong Sea Port, the Chittagong Airport, the Chittagong Eastern Refinery, the Chittagong Export Processing Zone (EPZ), and so on that receive power from the existing substation, which has a high interruption rate. The proposed project is also expected to enable import of electricity after the establishment of an HVDC interconnection at Comilla with Tripura (importing 500 MW of power). Furthermore, the technical designs for the investments will incorporate features that will enhance the climate resilience of the constructed transmission lines.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

17. The proposed project aims to increase the transmission capacity and reliability of the electricity network in the eastern region and strengthen the institutional capacity of the Power Grid Company of Bangladesh Limited (PGCB).

B. Project Beneficiaries

18. The primary beneficiaries of the project will be the population of the eastern region and PGCB. The company will benefit from improved management and O&M practices, including an improvement of staff skills. The population of the eastern region will benefit from improved availability of the power supply, which will result in reduction of unserved demand and the number and duration of power outages. About 275,000 new residential consumers and about 16,000 new agricultural consumers can be supplied through this project. This would improve living standards and strengthen the agricultural sector by supplying reliable quality power. Further, about 6,000 small-scale industries and 3 large-scale industries could be supplied with power through this. Assuming employment of about 20 persons per small industry and 500 persons per large industry, total employment for about 121,500 persons could be generated.

C. PDO-Level Results Indicators

19. Key expected results from the project are (a) increase in transformation capacity (MVA) in the project area, (b) average interruption frequency per year in the project area, (c) number of people provided with new or improved electricity, and (d) improvements in maintenance and financial management (FM) practices.

III. PROJECT DESCRIPTION

A. Project Components

20. The proposed project will have two components with the following estimated cost: (a) Enhancement and Strengthening of Power Network (US\$686.6 million) and (b) Institutional Development and Implementation Support (US\$31.46 million). The technical assistance (TA) activities under Component 2 amount to US\$5.39 million. Detailed descriptions of the components are given in the following sections.



Component 1: Enhancement and Strengthening of Power Network (US\$686.6 million, IDA SUF US\$426.25 million)

21. This component will cover the following activities:

- (a) **New Substations.** Thirteen new gas insulated substations (GISs) (one upgrade to 400/230/33 kV substation from 230/33 kV substation, one new 400/230/132 kV substation, two new 230/132 kV substations, and nine new 132/33kV substations);
- (b) **Transmission Lines.** One 230 kV high-capacity four circuit backbone transmission line (with twin Finch conductor per phase) through greater the Comilla region and four short distance 132 kV double circuit lines to connect the new 400/230 kV, 230/132 kV, and 132/33 kV substations to the existing ones in Comilla and Noakhali areas;
- (c) **Replacement of substation and reconductoring.** Replacement of the Hlishahar 132/33 kV air insulated substation (AIS) by an advanced GIS and reconductoring of existing Sikalbaha-Cox's Bazar 132 kV line and Korerhat-Feni 132 kV line with higher capacity conductor.

22. A new 400/230/132 kV substation will be installed at Korerhat and one 230/33 kV substation will be upgraded to 400/230/33 kV substations at Mirsharai. Substations of 230/132 kV are planned for Chowmuhoni and Kachua, while 132/33 kV substations are to be installed in Kosba, Muradnagar, Chandina, Laksham, Laxmipur, Bashurhat, Maijdee, Patiya, and New Mooring. Because of the scarcity of land in the project areas (due to high population density), all these substations are planned with GIS configuration. The 132/33 kV New Mooring substation to be built on the western side of Chittagong City will become a 400/230/132/33 kV power hub in future. The 132/33 kV part will be built by this project, but the land acquisition and layout planning will incorporate the future 400/230/132 kV design. Some other 132/33 kV substations will also be designed keeping provisions for upgrades to 230 kV in future.

23. To strengthen the Dhaka-Chittagong transmission backbone system, one 400/230/132 kV substation at Korerhat will be established through the Madunaghat-Meghnaghat 400 kV double circuit line⁴. This will improve system stability and reduce losses. In the Chittagong region, the Government has planned to build Mirsharai area as the largest EZ of Bangladesh. Development of this EZ is expected to result in high electricity demand. This proposed project will help upgrade the Mirsharai 230 kV substation to higher capacity at the 400 kV level and will directly connect it to Korerhat substation (through extension of Mirsharai-Bangladesh Steel Re-Rolling Mill (BSRM) 400 kV line up to Korerhat substation) to enhance the power supply capability of the Mirsharai EZ. A few additional 230 kV substations within and around this EZ are also expected to be fed directly from the 230 kV bus of Mirsharai 400/230 kV substation. To meet the growing demand in the Chittagong area, 132/33 kV substations at New Mooring/Anand Bazaar and Patiya will be established along with the reconductoring of the Sikalbaha-Patiya-Dohazari-Cox's Bazaar 132 kV DC line with a high-capacity conductor.

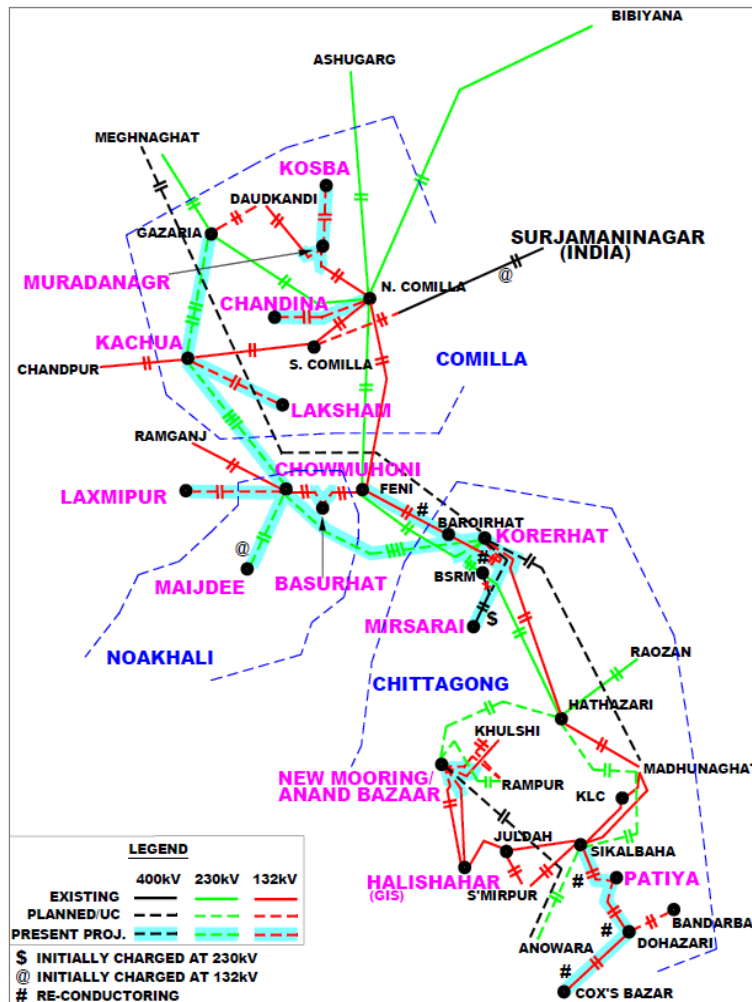
24. To strengthen the transmission system in the Noakhali and Comilla areas, the Korerhat-Chowmuhoni-Kachua-Gazaria 230 kV high-capacity corridor will be built, along with 230/132 kV substations at Chowmuhoni and Kachua. Establishment of 132/33 kV substations have been planned at

⁴ Currently under implementation with JICA assistance.



Basurhat, Maijdee, and Laxmipur for transfer of reliable power from the Chowmuhoni 230 kV substation to these areas. Another 132/33 kV substation at Laksham has been planned to supply power in this area. For dispersal of power from the existing Comilla (N) 230/132 kV substation, 132/33 kV substations have been planned at Chandina, Muradnagar, and Kosba, which would also facilitate supply of reliable power to these areas.

Figure 1. Diagrammatic View of the Project Areas and Scope



Source: Final feasibility study

25. The proposed project will also replace the existing 132/33 kV Haliashahar substation in Chittagong area. This aged substation supplies power to several important establishments like Chittagong Sea Port, Chittagong Airport, Chittagong Eastern Refinery, and Chittagong EPZ. Thus, renovation of the Haliashahar substation along with augmentation of transformation capacity and upgrading from AIS to GIS has been planned to improve the reliability of power supply near Haliashahar. This will require modification and extension of the local 33 kV and 11 kV network so that the load at Haliashahar can be fed from the New Mooring substation during replacement works at Haliashahar. A summary of the proposed scope of works under this project is given in Table 2.

**Table 2. Summary of Proposed Scope of Works**

Transmission Lines		Substations	
Voltage Level (kV)	Circuit (Km)	Voltage Level (kV)	No. of Substations (MVA)
		400/230/33	1 (2,650 MVA)
400	26.8	400/230/132	1 (2,000 MVA)
230	662.9	230/132	2 (1,750 MVA)
132	376.4 ^a	132/33	10 ^b (2,640 MVA)

Source: Final feasibility study.

Note: a. Includes reconductoring of 157 km; b. Includes one replacement of an old substation.

26. Based on the Multilateral Development Bank (MDB) methodology for climate change co-benefits, several of the project activities under this component will generate climate change mitigation co-benefits. The reconductoring of the existing Sikalbaha-Cox's Bazar line and the Korerhat-Feni line (total length is 157 km and the investment amount is US\$15.1 million) with higher capacity conductor will result in a reduction in technical losses, estimated at 1.6 MW power savings annually. In addition, new substations at Lakhshmipur, Choumuhani, and Maijdee are expected to facilitate the integration of renewable energy of significant capacities (about 550 MW of proposed solar PV projects) into the grid. The total cost of these three substations is about US\$40 million. Mirsharai 230 kV substation, that is currently being built under a separate project, will be upgraded to 400 kV under this proposed project (at a cost of US\$25.5 million). The upgraded 400 kV substation will be required to supply about 500 MW power to the Mirsharai EZ (as per BEZA forecast) and evacuate 300 MW of solar PV generation capacity to be built at Feni and integrate into the grid. Interconnecting transmission lines will also be built under this project to allow two (Lakhshmipur and Maijdee) of these three substations to be connected to the grid substation at a cost of US\$13.3 million. The project will also generate adaptation benefits, as explained in paragraph 62.

Component 2: Institutional Development and Implementation Support (US\$31.46 million, IDA SUF US\$24.39 million⁵)

27. The World Bank Group plans to maintain a long-term engagement with PGCB aiming to support the strengthening of its institutional capacities so that it can become a modern transmission company. There are already institutional development activities through ongoing World Bank engagements and other development partners to assist PGCB. Support to PGCB includes activities on investment planning, preparation of its business plan, improvement of operational and FM practices, and technical capacity building.

28. The Government has recently appointed a strategic financial consultant to review sector investment needs, identify financial and management strengths and weaknesses of power sector entities (including PGCB). The consultant will recommend actions to raise funds for future development plans and obligations while keeping the sector financially viable. The Government has also engaged another consulting firm to assess the human resources requirement of each entity and propose an optimized organigram based on international practices. Implementation of an Enterprise Resource Planning (ERP) system across the sector will enable companies to have greater control, insights, and visibility into their

⁵ This IDA SUF amount includes TA support of US\$4.42 million



operations and allow them to make improved critical business decisions. Finally, a full-fledged capacity-building program under a TA program funded by the Asian Development Bank (ADB) will help the regulation of the sector (tariff methodology, tariff filing format and frequency, process of tariff determination, a database, and a data submission procedure).

29. This component will support complementary TA activities to further help PGCB to i) develop a strategy and road map for maintenance, ii) clearly identify its assets and use them to access securitized financing, and ensure well-justified tariff applications, and iii) use computerized accounting and reporting system. This component will also cover project supervision as well as hiring of an independent procurement expert to help in the evaluation of the international competitive bids. The subcomponents that have been agreed are described in the following sections.

Subcomponent 2.1: Definition and Implementation of a New Corporate Maintenance Strategy (IDA SUF US\$20.0 million, including US\$1.0 million TA)

30. The TA activity will allow PGCB to define a new corporate maintenance strategy to address issues raised under paragraphs 10 and 11. As soon as the new strategy and road map for implementation is adopted, PGCB will procure the main equipment, software, and training under this project to cope with the growing asset base and help feed the new strategy process with key data. The TA activity and priority investments identified are described in the following paragraphs.

- (a) **Formulation of a road map for corporate maintenance strategy (US\$1.0 million).** A consultancy firm will be hired to review current policy and procedures, assess organization of the maintenance departments, and establish baseline for cost and performance. It will then propose a new strategy based on an inclusive process involving all relevant departments of PGCB and combining reactive, predictive, and proactive approaches. This will include (i) the introduction of reliability-centered maintenance analysis, (ii) the definition of a new policy framework, (iii) institutional reorganization of the maintenance, and (iv) standard guidelines and procedure during all the equipment/systems' lifetime that would include recommending climate resilient equipment specifications.
- (b) **Computerized maintenance management system (US\$15 million).** It will include an online equipment database, continuous online monitoring of high-value assets, and laser technology for health assessment of aged grid lines.
- (c) **Live line maintenance (US\$4 million).** This practice will allow PGCB to perform major maintenance without disconnecting assets/systems from the power grid. The project will cover the tools and personal protection equipment needed as well as consultancy to establish the required procedures and train selected staff for an initial number of crews.

Subcomponent 2.2: TA for PGCB's Institutional Development and Implementation Support (US\$4.39 million, IDA SUF US\$3.42 million)

31. This subcomponent will help PGCB undertake urgent activities hampering its capacity to access the financial market. It will also support the project supervision activities. Activities are described in the following paragraphs.



- (a) **Assist PGCB in compiling a complete fixed asset register and inventory (GOB US\$0.34 million).** PGCB has been receiving qualified audit opinion for incomplete fixed asset register. It was noted that the carrying amount of property, plant, and equipment (PPE) reported in the financial statement of 2016 could not be verified as the PPE register is not maintained with relevant information like original cost, accumulated depreciation, rate of depreciation, year of acquisition, identification number, and so on. Valuation and physical verification of plant and machinery transferred from BPDB and Dhaka Power Distribution Company was not conducted. A consulting firm will be hired to undertake physical verification, valuation, and tagging of fixed assets dispersed across the country and inventory according to international accounting standards. This would be financed using counterpart funds.
- (b) **Support PGCB in developing a computerized FM system (GOB US\$0.63 million).** A consulting firm will be hired to assess (US\$0.2 million) the current financial reporting system and availability of hardware and software that are being used for the reporting system. Based on the assessment, the consultant will develop the technical specifications and bidding documents for the supply, installation, customization, and configuration of software and system (including necessary hardware and accessories) for the automation of the FM systems. PGCB will procure the recommended software (US\$0.43 million) for the implementation of the system. The configuration will be kept open to interface with the planned sector ERP. This would also be financed using counterpart funds.
- (c) **Support for project supervision and bid evaluation (IDA SUF US\$3.42 million).** Despite a good implementation record with other IDA-financed projects, PGCB's staff are overwhelmed by the increasing number of projects from different financing partners. To ensure adequate supervision and timely implementation of the activities under the proposed project, additional supervision resources from the proposed IDA SUF credit will be funded. An Owner's Engineer (OE) will be hired (US\$3.24 million) to support the Project Management Unit (PMU) in the design and preparation of bid documents for 400 kV substations, review of design for other components, procurement, contract management, and field supervision of different contractors and reporting. An independent procurement consultant will also be hired (US\$0.18 million) to be a member of the Bid Evaluation Committee for internationally advertised procurement for supply and installation/works.

B. Project Cost and Financing

32. The proposed project will be supported through Investment Project Financing on IDA SUF terms. The estimated cost of the project is about US\$718.06 million, of which IDA SUF financing is proposed to cover goods, works, and TA support amounting to US\$450.64 million. Counterpart funding of US\$267.42 million will cover PMU costs⁶ (US\$4.83 million), land acquisition cost including all resettlement and rehabilitation compensation in accordance with the Resettlement Action Plans (RAPs) (US\$41 million), import and supplementary duties and value added taxes (VATs) at import stage (US\$159.25 million), VAT on contracts (US\$7.34 million), consultancy costs for the compiling of a fixed asset register and for the developing of the computerized financial management system (including software procurement) for PGCB

⁶ PMU cost will include staff salary and other operating and recurring expenditures such as workshop allowances, sitting allowances, cash per diems, honoraria, fuel, and vehicle.



(US\$0.94 million), interest during construction (IDC) (US\$42.81 million), bank charges (US\$0.97 million) and contingencies (if any, that would be first paid by GOB to the extent of USD 10.29 million). The provision for contingency⁷ in the total project costs is 4 percent to cover both price and physical contingencies. Table 3 provides an overall cost breakdown.

Table 3. Project Costs and Financing (US\$, millions)

Project Components	Project Cost	GOB/PGCB	IDA SUF
Component 1: Enhancement and Strengthening of Power Network	686.60	260.36	426.25
Component 2: Institutional Development and Implementation Support	31.46	7.06	24.39
Total Project Costs	718.06	267.42	450.64
Total Financing Required	—	—	450.64

33. Due to the increasing need of external financing and to access financing beyond regular IDA allocation for Bangladesh, combined with the economic transformation potential of the proposed project, the GOB decided to use IDA SUF for its financing. Funds will be made available to PGCB under a Subsidiary Loan Agreement with the GOB. Use of SUF financing is relevant for Bangladesh as the country's debt distress risk is low and the project will not lead to a deterioration of the risk of debt distress. As explained in paragraph 17, the project is well aligned with the objectives of IDA18 SUF by allowing crowding-in of private resources for development, enabling electricity import, and incorporating resilience in technical design of the project. The TA activities under this project would also help the implementing agency access commercial financing in future.

34. **Rationale for public financing.** Although some generation projects of the public sector have been able to attract private capital against the backdrop of a Government guarantee, transmission projects with PGCB have not applied for commercial financing, although PGCB is listed in the Bangladesh capital market. About 5 percent of PGCB's shares are held by general investors and despite erratic cashflows and a decline in net income, PGCB regularly pays dividends, maintaining the investors' confidence. In 2011, the Government had decided to off-load more shares of a number of state-owned enterprises (that includes PGCB) in the capital market to meet funding requirements but has not implemented the program due to market conditions and a lack of enthusiasm among enterprises. Recently, the Government has been considering a 'Power Bond' through which entities like PGCB may raise funds from the local as well as international market. The World Bank plans to assist the Government in such efforts through its ongoing dialogue in the sector.

35. Commercial lenders in Bangladesh are risk averse and expect predictability and stability of cashflows and a safe regulatory regime. Nevertheless, PGCB's revenues are linked to electricity wheeling charges with no fixed capacity charge component, which exposes the company to various risks of generation and distribution companies. It may suffer financial losses if the power plants are commissioned with delays, or not available, and/or if power cannot be transmitted because of the constrained distribution network. Therefore, given the uncertain conditions associated with the timing and amount of revenues, commercial lenders are unlikely to lend to PGCB for longer maturities without Government

⁷ Front-end Fee of \$1.2m is included in the project cost as GOB decided to capitalize the fee as per the credit choice worksheet. This amount is based on the foreign exchange rate calculations and has been rounded off to conform to the credit amount.



guarantees. Similarly, under these uncertain conditions, PGCB also will be reluctant to borrow directly from commercial banks. When it borrows through/from the Government, it can manage its liquidity risks due to delayed tariffs by adjusting the timing of its payments to the Government. Currently, funding for its planned investments of US\$7.1 billion has largely been identified with development partners, so PGCB is not actively pursuing the commercial borrowing as an immediate option.

36. Some commercial financing, particularly for urgent needs, may be possible but will not become a major source of funding for PGCB unless the underlying issues associated with tariff and regulatory processes, human capital needs, and corporate governance are addressed. In addition to the ongoing activities through other financing sources as mentioned in paragraph 28, several institutional strengthening activities planned for PGCB under this project are steps in the right direction and may address binding constraints for attracting sustainable commercial financing.

C. Lessons Learned and Reflected in the Project Design

37. The design and development of this project have benefited from lessons learned from ongoing projects in Bangladesh and other World Bank-financed operations in South Asia and beyond.

38. **Use of a long-term programmatic approach as an instrument to establish a strong transmission system and stronger utility corporation.** This is a lesson learned from the long-term engagement of the World Bank with the India Central Transmission Utility, which underwent a substantial transformation to become one of the leading transmission companies in the world with state-of-the-art tools and world-class practices (India Fourth Power System Development Project [PSDP] [P101653]). Following the IDA investment in the optimization of dispatch operation, this project will continue to provide both the knowledge and investment required to upgrade the infrastructure but also management and system operations tools and practices.

39. **A dedicated PMU, within PGCB with clear authority to undertake all fiduciary functions, as well as strong support from an owner's engineer are essential for successful implementation.** This is a lesson learned for ongoing projects in Bangladesh in particular with PGCB staff being more and more overstretched by the implementation of an ambitious investment plan. The Project Director (PD) and the other required staff are expected to be on board as soon as the project's Development Project Proposal (DPP) is approved.

40. **Advance preparation of procurement packages is a must for fast-track implementation.** It is generally agreed that such advance preparation up to draft bidding documents before project approval is good for project implementation. PGCB has already committed to define standard specifications for major transmission equipment to be posted on the PGCB website under an ongoing World Bank-financed operation which will be adopted systematically in all procurement packages in future.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

41. PGCB will be the implementing entity of the project. It will set up a dedicated PMU to implement the project, which will work closely with the corporate units at PGCB. All procurement will be carried out



by a newly formed 'contract' unit under its Planning and Design (P&D) department. FM activities will also be led by the corporate finance team. Although the TA activities will be managed by the relevant internal departments, the initiation of the consultants' hiring and coordination among the internal stakeholders (including the central management) will be carried out by the PMU. PGCB has demonstrated good implementation performance in procurement, safeguards, and construction management with two earlier World Bank-funded projects: the power evacuation component under the Siddhirganj Power Project (P095965) and the Rural Electricity Transmission and Distribution Project (P129920). Despite its good performance, PGCB is now under pressure with the increasing number of projects supported by different financing partners. To cope with the increasing load and to enable PGCB to adequately manage development projects, PGCB is ensuring that a single PD would not manage more than one project.

42. The PMU staffing will include

- (a) **A full-time PD.**
- (b) **Dedicated design and supervision engineers.** PGCB will depute senior P&D engineers from its corporate units for both substations and transmission lines. They will be supported by qualified junior P&D engineers in the PMU; Adequate number of engineers will also be engaged during supervision;
- (c) **Procurement experts.** PGCB will strengthen the Corporate Procurement Team with engineers having knowledge/experience in public procurement and implementation of infrastructure projects;
- (d) **FM experts.** PGCB shall depute two FM experts, not below the rank of a manager, to handle all FM matters of the project; and two accountants to manage FM related activities under the project; and
- (e) **Safeguard experts.** Two recent permanent hires in its Environment and Social Unit would need to be trained and engaged for monitoring the safeguard compliance requirement of the project.

43. Given the large volume of activities in the project that are concentrated in and around Comilla, Noakhali, and Chittagong, the project will require a robust supervision plan. PGCB has agreed full-time field presence to supervise the works and give day-to-day decisions to the various contracts. A firm to act as OE will be hired to ensure adequate supervision and timely implementation of the project. PGCB is also evaluating options for closer supervision including establishing a post of deputy PD, located in the region.

B. Results Monitoring and Evaluation

44. The PMU will be responsible for monitoring and evaluation (M&E) of the project. The PMU will submit quarterly progress reports which will include achievements in terms of intermediate indicators and provide an annual update of the PDO indicators. The monitoring of the project will be done in two phases. In the first phase, the focus will be on efficient, timely implementation of project components. In the second phase, the focus will be expanded to improved reliability. The PMU will monitor physical output and the National Load Dispatch Center will monitor the improved reliability of the upgraded network in eastern region, both reported through regular project/operational reporting. Reports shall



include the various indicators of the Results Framework and Monitoring table in Annex 1.

45. The specific results indicators for the project have been agreed with PGCB and the design of the different substations will include needed data acquisition devices⁸ to allow monitoring of the electric network performance in the project areas. The M&E capacity of PGCB will be strengthened during project implementation.

46. Overall, PGCB has existing capacity to collect and process data required for the M&E system. In addition, the World Bank team will provide continuous implementation support throughout the year, including monitoring the results indicators defined in annex 1, as well as additional FM and procurement aspects of project implementation. A comprehensive evaluation of project results will be conducted during the project's midterm review.

C. Sustainability

47. The long-term sustainability of the transmission investments supported by the project will depend on good quality implementation and on PGCB's O&M capacity that would ensure sustained performance and efficiency of its assets. The capacity-building and institutional development activities under Component 2 will complement ongoing TA activities to build stronger procurement, financial management and operations systems. Among these activities, the project will provide needed support and tools for improved O&M and to anticipate major risks associated with premature degradation of the equipment and therefore help PGCB manage the risks better.

48. Environmental and social sustainability will be ensured by a full implementation of the safeguards instruments and the agreed Environmental and Social Management Plan, which was derived from a due consultative process.

D. Role of Partners

49. In addition to World Bank Group support, the Government is mobilizing financial resources to invest in transmission lines and substations expansion from the Government of China and India (through a bilateral arrangement), ADB, Japan International Cooperation Agency (JICA), German *Kreditanstalt für Wiederaufbau (KfW)*, Korea Economic Cooperation Development Fund, and Islamic Development Bank. Asian Infrastructure Investment Bank has also shown keen interest to invest in the transmission projects.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

50. The overall risk rating for the project is 'Substantial' because of high fiduciary risk and substantial sector strategies and policy risk. The 'High' rating for fiduciary risk is due to concerns about the adequacy of staffing at PGCB, which has led to delays with decision making in other World Bank-financed projects, lack of qualified leadership in the financial department, low FM capacity especially on fixed asset management, liability recognition, and inadequate financial reporting standards. Nevertheless, the World Bank's project team notes the progress with ongoing operations and has identified activities for

⁸ Compatible with PGCB's Supervisory Control and Data Acquisition (SCADA) system



institutional strengthening. The fiduciary risks and mitigation measures are explained in the following paragraphs.

51. Until recently, PGCB has not had a dedicated Procurement Unit supporting the P&D department. All logistics of the bidding process are handled by the design team. This certainly will become problematic with the anticipated volume of projects of about US\$7 billion. Recognizing the growing volume of work, the PGCB Board has recently approved the establishment of a Contract Unit under the P&D department, which will evolve to a separate department eventually.

52. PGCB's leadership in the Finance Department lacks professionally qualified staff. The position of the executive director (Finance) at PGCB has been vacant for more than 4.5 years with the executive director of Human Resources Management bearing the additional responsibility. Recently, the position has been filled with a government nominee from the Ministry of Civil Aviation. The next key position, general manager (Finance), has also been vacant for several years. With significant investments to be managed by PGCB in the coming years, and to streamline the FM system (fixed asset registry, automation of the reporting system, and so on), there is a need to appoint qualified professional accountants at the vacant positions both at the senior level as well as junior level to mitigate the fiduciary risks for the project. PGCB management has committed to fill these positions as soon as possible.

53. The Sector Strategies and Policy risk is 'Substantial', as the tariff revisions proposals of the PGCB are subject to political considerations and may not reflect the actual needs and, thus, could impact the financial condition of PGCB. Commensurate with the increase in generation capacity, large-scale investments in transmission infrastructure are needed. The GOB, therefore, needs to adopt an appropriate transmission pricing mechanism to facilitate and equip PGCB with the financial capability to mobilize and service resources. The support through the ADB-funded project (refer to paragraph 29) in filing more informed tariff application and support under Component 2 of this project for compiling complete fixed asset register will help mitigate the risk significantly.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

54. **Project economic analysis.** The proposed project is needed to transmit additional power that will meet the growing demand and improve power reliability. The economic analysis has been carried out to evaluate key risk factors and calculate the economic rate of return (ERR). Economic cost of the project net of taxes (US\$160 million), price contingencies (US\$14 million), and IDC (US\$43 million) is about US\$500 million. Additional investment of about US\$40 million will be required in the distribution network to supply about 13,000 GWh of electricity annually to 297,000⁹ additional residential, agriculture, and industrial consumers. The incremental load is projected to increase from 466 MW for FY21 to a plateau of 1,862 MW by FY23. Sales to end-consumers are estimated assuming a conversion load factor of 90 percent, transmission losses of 2.7 percent, and distribution losses of 9.3 percent. Net benefits of the project are estimated using consumer surplus approach by taking the difference between willingness to pay (using self-generation from diesel as a proxy) and cost of supply through the grid (that is, liquefied natural gas-based combined cycle gas turbine plants, plus T&D cost). The net present value at 12 percent

⁹ Feasibility study



discount rate is estimated to be US\$2,051 million and the ERR is 46 percent. Expected improvement in grid reliability and possible reduction in losses will further increase project returns. A key risk factor and an extreme scenario is if the substations and associated lines are ready but cannot be energized causing delayed benefits. In such a scenario, even if these benefits are delayed by 16 years after all investments have been incurred (which is highly unlikely), the project would still achieve 12 percent ERR to remain economically viable. Another risk factor is cost escalation. Though enough contingencies are built into the project cost, for sensitivity, the project will remain viable even if capital cost increases by 5.9 times.

55. **Historic financial analysis of the entity.** PGCB revenues, directly proportionate to electricity wheeled, increased at a cumulative annual average growth rate (CAGR) of 15 percent from BDT 6,255 million in FY11 to BDT 12,722 million in FY16. PGCB has gradually reduced the transmission losses from 3.4 percent to 2.7 percent over the last ten years. Yet, its profit margin has been shrinking; the return on net fixed assets was 15 percent in FY08 and since then has declined to 3.2 percent in FY15 mainly due to delayed and insufficient increases in transmission tariff, combined with lower capacity utilization of the transmission assets. By FY14, interest payables (mainly to the Government) accumulated to BDT 10 billion, which were almost four times the interest expense during the year. The tariff was last increased by BDT 0.05 per kWh in September 2015, after almost a decade, that increased the return on net fixed assets to 6 percent for FY16.

56. **Implications of current tariff methodology.** Under the current return on asset-based tariff methodology, only 8 percent of the US\$12 billion ongoing and planned investments can be financed through internal cash generation, provided tariffs are adjusted in tandem. However, most of the PGCB's planned investments in the next five years will be funded through multilateral and bilateral sources. The tariff is linked to electricity wheeled (BDT per kWh) with no fixed capacity charges and exposes PGCB to risk from reduced power transmission between generation and the off-taking distribution companies. It may suffer financial losses if the power plants are delayed, or are not available, and/or if power cannot be transmitted because of constraints in the distribution network. Also, the principal repayment is recovered through depreciation spreading over an average asset life of about 30 years, which does not correspond well with commercial financing, generally offered for much shorter maturities.

57. The rate base does not include work in progress, which incentivizes PGCB to complete and capitalize its projects as quickly as possible and start earning the return and recover its costs through depreciation. As work in progress gets capitalized, regular tariff applications by PGCB to BERC (not more than once annually according to the regulations) could ensure that its tariff remains cost-reflective; and it continues to fulfill its financial obligations and maintain its share of equity in the projects.

58. PGCB's optical ground wire network that is being used for its own communication need is also being leased out (spare cables) to local telecom operators. Currently, this fiber optic business is contributing only 2 percent of the total PGCB revenue but this would contribute significantly when expanded further.¹⁰ In the current tariff methodology, this revenue is deducted from the wheeling tariff requirement.

59. **Impact of the project and other investments on the wheeling tariff and PGCB's financial health.** To assess the impact of this project and other investments on PGCB's financial situation, the following

¹⁰ PGCB Board has already approved the business model and is exploring financing sources for its investment.



scenarios were developed: (A) ongoing projects, (B) ‘A’ plus proposed project, and (C) ‘B’ plus future projects. As shown in scenario ‘C’ in Table 4, the PGCB asset base for tariff calculation is projected to increase at CAGR of 24 percent, but required increase in transmission tariff is only 13 percent due to 10 percent expected increase in energy wheeled. On a stand-alone basis, a tariff of BDT 0.49 per kWh in real terms would be required to achieve a 10 percent financial rate of return. The project, however, will not have a standalone tariff but will become part of PGCB’s asset base on which it earns its returns through wheeling charge approved by the regulator. Scenario ‘B’ shows that the impact of this project on wheeling charge when compared to scenario ‘A’ is negligible and for some years is even less. Financial ratios presented in Table 4 show that PGCB can afford the planned investments (scenarios A, B, and C) provided funding is available at concessional terms for longer maturities, throughput is guaranteed, and tariffs are adjusted as needed to reflect changes in costs.

60. Each of these factors are analyzed next and presented in Table 5: (a) if sales increase by only 8 percent compared to 10 percent assumed in scenario ‘C’, PGCB’s net income will be drastically reduced, if tariffs are not adjusted to reflect changes in energy wheeled, and (b) delays in tariff adjustments could result in huge financial losses exceeding US\$20 billion per year for scenario ‘B’ and are projected to be much higher for scenario ‘C’.

Table 4. Key Inputs, Financial Ratios, and Tariff Projections

	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026
Scenario A: Committed and Under-construction Project										
Energy Wheeled, TWh	51	56	61	65	68	72	74	76	77	77
Asset Base, BDT Billion	96	114	136	170	211	248	271	284	290	290
Net Income, BDT Billion	2	2	4	4	8	14	14	17	18	17
Wheeling Charge, BDT/kWh	0.28	0.37	0.47	0.54	0.63	0.68	0.66	0.67	0.66	0.65
Current Ratio	3.40	2.39	1.26	1.06	1.04	1.47	1.93	2.41	2.82	3.34
DSCR	2.24	2.78	1.88	1.21	1.38	1.51	1.52	1.60	1.60	1.56
Debt Ratio	0.76	0.82	0.86	0.88	0.88	0.86	0.83	0.80	0.76	0.73
Scenario B: 'A' plus World Bank Financed Project										
Energy Wheeled, TWh	51	56	61	65	72	79	88	90	92	92
Asset Base, BDT Billion	96	114	138	177	226	273	304	323	333	335
Net Income, BDT Billion	2	2	3	4	8	14	14	18	20	19
Wheeling Charge, BDT/kWh	0.28	0.37	0.47	0.56	0.64	0.67	0.62	0.64	0.64	0.63
Current Ratio	3.40	2.39	1.22	1.01	1.00	1.42	1.83	2.29	2.69	3.19
DSCR	2.24	2.78	1.86	1.21	1.39	1.52	1.57	1.57	1.58	1.55
Debt Ratio	0.76	0.82	0.86	0.89	0.90	0.88	0.85	0.82	0.79	0.76
Scenario C: 'B' plus Planned Investments										
Energy Wheeled, TWh	51	56	62	68	75	82	90	99	109	120
Asset Base, BDT Billion	96	114	141	196	280	382	485	575	639	677
Net Income, BDT Billion	2	2	3	2	7	10	11	20	29	31
Wheeling Charge, BDT/kWh	0.28	0.37	0.47	0.58	0.73	0.83	0.91	1.00	1.01	0.96
Current Ratio	3.40	2.39	1.23	1.04	1.10	1.75	2.17	2.05	2.33	2.67
DSCR	2.24	2.77	1.82	1.20	1.38	1.49	1.62	1.64	1.55	1.52
Debt Ratio	0.76	0.82	0.88	0.92	0.93	0.94	0.94	0.92	0.90	0.88

Note: Projections for FY2017 are based on actual current wheeling tariff; DSCR = Debt Service Coverage Ratio.



Table 5. Sensitivity Analysis

Sensitivity i: Scenario 'C' with reduction in energy wheeled keeping wheeling charge the same										
Energy Wheeled, TWh	50	53	57	61	65	70	75	80	85	91
Asset Base, BDT Billion	96	114	141	196	280	382	485	575	639	677
Net Income, BDT Billion	1	1	1	-2	0	0	-3	0	4	3
Wheeling Charge, BDT/kWh	0.28	0.37	0.47	0.58	0.73	0.83	0.91	1.00	1.01	0.96
Current Ratio	3.35	2.27	1.10	0.86	0.82	1.01	1.17	1.26	1.28	1.30
DSCR	2.17	2.61	1.66	1.06	1.18	1.24	1.30	1.28	1.18	1.11
Debt Ratio	0.76	0.83	0.88	0.93	0.95	0.96	0.97	0.97	0.96	0.96
Sensitivity ii: Scenario 'B' with no increase in tariff										
Energy Wheeled, TWh	51	56	61	65	72	79	88	90	92	92
Asset Base, BDT Billion	96	114	138	177	226	273	304	323	333	335
Net Income, BDT Billion	2	(3)	(8)	(15)	(20)	(20)	(21)	(21)	(21)	(23)
Wheeling Charge, BDT/kWh	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Current Ratio	3.40	1.68	0.61	0.36	0.25	0.21	0.18	0.16	0.14	0.12
DSCR	2.24	1.96	0.98	0.52	0.50	0.50	0.54	0.49	0.47	0.44
Debt Ratio	0.76	0.84	0.91	0.97	1.02	1.06	1.11	1.16	1.22	1.28

B. Technical

61. Transmission investments are generally selected considering the Bangladesh Power Sector Master Plan. Before undertaking a transmission project, various system studies are undertaken considering the existing system and present and future load flow requirements, and the most optimal transmission system (either associated with generation projects or grid strengthening projects) is identified with bare minimum redundancy. Further, design studies are undertaken for selection of major system and equipment parameters for the transmission system up to 400 kV level. PGCB has developed in-house infrastructure/software capabilities and computer-aided facilities for P&D and O&M of the transmission system.

62. The project has been designed in the most optimal manner based on network studies and a feasibility study. Voltage level, conductor sizes, and basic equipment specifications were selected considering the technical and operational standards in line with the international practices. The project will also address climate change vulnerability and hazards with robust technical design that will consider the exposure to climate change risks and will help limit damage and loss. The transmission lines as well as towers in the northern region of the country, which is less vulnerable to climate hazards, are usually not designed with considerations to withstand high cyclone winds. As the project locations are prone to climate hazards, the transmission lines and towers will be built to make them climate-resilient. Such measures are expected to address structural stability and impact of high temperature, floods, high winds, and earthquakes and will generate climate change adaptation co-benefits. The incremental investments needed for these adaptation/resilience-related design enhancements are currently estimated at US\$20.9 million.

63. PGCB has implemented similar transmission projects with acceptable standards of quality, including previous World Bank-funded projects. It has qualified staff to undertake/supervise the design engineering, planning, and implementation of transmission projects. However, the personnel are stretched given the multiple ongoing large contracts. It was therefore agreed that (a) project implementation will be based mainly on an engineering, procurement, and construction contract to



minimize risks due to lack of coordination and ensure full responsibility by contractors, and (b) an owner's engineer will be hired to oversee project implementation in conjunction with the PGCB team.

C. Financial Management

64. **FM risk.** The overall FM risk is rated as 'High' due to weak FM capacity especially on fixed asset management, liability recognition, inadequate financial reporting standards, and qualified audit opinion on the entity's financial statements in recent years. However, at the project level, the auditors' opinion was 'unqualified' which indicates that the financial statements give a true and fair view of the financial state of the project funded by the World Bank. As of today, there is no pending audit report from PGCB under World Bank projects. The residual FM risk may be rated as 'Moderate' subject to the successful implementation of the following agreed recommendations:

- (a) Engage a professional accountant with relevant experience in the finance leadership team of PGCB.
- (b) Engage an internationally renowned firm for revaluation and updating fixed asset register and inventory.
- (c) Plan and implement an automated FM information system with minimal manual intervention covering all aspects of FM, fixed asset management, and so on.
- (d) Conduct a training need assessment for FM staff and identify the improvement areas to be included under this project.

65. **FM arrangement.** PGCB shall depute/appoint one FM specialist and two accountants for managing FM issues of the project like fund flow, disbursement, accounting, planning and budgeting, financial reporting, and auditing. For managing TA component on revaluation of fixed asset and inventory and updating fixed register, PGCB shall depute another FM specialist and an accountant.

66. The PD of the PMU will have adequate financial control to manage IDA funds and payment of all project-related eligible payments. PGCB will continue to have separate accounting and recording code to track the expenditure and budget of this project with identifiable audit trail. The project will make all payments using the banking system (except for small petty cash payments). Under the project, IDA funds will not finance salaries/operational costs of any nature for the PGCB nor sitting allowances, honoraria, and VAT (VAT on contracts, import, and supplementary duties and VAT at import stages). The project will follow the transaction-based disbursements where PGCB will submit statements of expenditure on a monthly basis to document project expenditures in the client connection. For contractual payments, IDA funds will be transferred directly to the contractors' account or payment will be made through the Special Commitment method. For noncontract payment, if any, the project shall use the Reimbursement method. The project will provide quarterly interim unaudited financial reports (IUFRs) within 45 days from the end of each quarter according to the reporting format acceptable to the World Bank. The IUFR would track the expenditures relating to IDA financing and PGCB financing separately. The annual accounts of PGCB and the project will be audited by private audit firm and audit reports will be submitted to the World Bank by December 31 each year.



D. Procurement

67. All goods, works, non-consulting services, and consulting services required for the project and to be financed out of the proceeds of the financing shall be procured in accordance with the requirements set forth or referred to in the World Bank's 'Procurement Regulations for Borrowers under Investment Project Financing', dated July 1, 2016 (revised November 2017), and the provisions of the Project Procurement Strategy for Development (PPSD) document and Procurement Plan for the project accepted by the World Bank.

68. **Procurement risk and mitigation measures.** PGCB has long experience in implementing similar World Bank-funded procurement under several projects. There has been no major issue except delays in processing procurement activities including preparation of bidding documents and ineffective monitoring of contract implementation due to shortage of officials in PGCB. In view of the country's governance context and the size of the procurement contracts envisaged under this project, the risk of the project is rated as 'Substantial' from the standpoint of procurement operation and contract management. Several risk mitigations measures, including the following, would be put in place as detailed in the PSD document:

- (a) PGCB, in agreement with the World Bank prepared a PSD considering activity-level risks and capacity of PGCB in managing those risks, value of the activities, prevailing market conditions, geographical locations of the activities, and so on. PSD spelled out the appropriate procurement strategy for this project. PSD is a live document and it is to be updated at least annually. As an output of the PSD exercise, the initial Procurement Plan for the project was also prepared. The agreed Procurement Plan contains procurement activities to be financed under the project, the different selection methods for procurement including applicable conditions, market approach, contracting arrangement, estimated costs, World Bank's prior review requirements, applicable standard procurement documents, and time frame.
- (b) PGCB has recently formed a fully staffed unit for procurement/contract activities within its organogram.
- (c) The World Bank's Systematic Tracking of Exchanges in Procurement (STEP) system will be used to manage the Procurement Plan and procurement transactions under the project. The Procurement Plan will be updated semiannually (or as required) using the STEP system.
- (d) World Bank team will provide necessary procurement training to relevant PGCB officials specially on the topic of supply and installation bidding document preparation and bid evaluation, consultant selection following World Bank's procurement regulations, and use of the STEP system.
- (e) PGCB shall ensure that the bid/proposal evaluation committees for this project will be formed in a manner acceptable to the World Bank, and the World Bank's 'no objection' shall be required on the formation as well as alteration of the committee. The Bid Evaluation Committee for internationally advertised supply and installation/works procurements will consist of five members, including one international procurement expert.



E. Social (including Safeguards)

69. The substations under the project will require land acquisition. According to the field survey, no physical displacement is involved in any of the proposed substations' locations. The RoW for transmission lines will mostly pass through agricultural fields and will not require land acquisition. However, temporary losses caused by the transmission line construction will need to be addressed under the social safeguard policy OP 4.12 (Involuntary Resettlement). An Environmental and Social Impact Assessment (ESIA) has been conducted that describes potential social impacts of the project. Thirteen site-specific RAPs for substations have been prepared, approved, and disclosed on the PGCB website on October 18, 2017, and the World Bank's Operations Portal on October 20, 2017. Hard copies of the documents have also been made available in all field offices related to the project's implementation. The RAPs provide the substation-specific (a) social screening, (b) baseline information on social impacts, (c) analysis of alternatives, (d) public consultations, (e) specific mitigation measures detailed in the entitlement matrix, (f) specific assistance to be provided to vulnerable groups including female-headed households, and (g) institutional arrangement for implementation of RAPs along with Grievance Redress Mechanisms (GRMs).

F. Environment (including Safeguards)

70. The proposed project is classified as Category B and the safeguard policies OP/BP 4.01 (Environmental Assessment); OP/BP 4.04 (Natural Habitats); OP/BP 4.36 (Forests); OP/BP 4.11 (Physical Cultural Resources) are triggered. The line routes of transmission lines and the locations of substations under the project are already identified. The subproject-specific Environment Assessments (EAs) were carried out to meet the requirements of Environment Conservation Rules 1997 of Bangladesh; the safeguard policy (OP/BP 4.01); and the Environmental, Health, and Safety Guidelines of the World Bank Group. A key environmental issue would be health and safety during the line installation. The EA also revealed that some tall-growing trees will be cut and the agricultural areas within the ROW may be affected. The expected environmental impacts can be mitigated through implementation of the Environmental Management Plan (EMP) during implementation stage. Also, necessary mitigation measures for overhead transmission lines against accidental fall from elevated height during work and the potential risks from project-induced labor influx need to be considered. The Environment Management Unit of PGCB is functional and the training on environment management for the concerned officials of PGCB is to be arranged at regular intervals. The EA document has been disclosed on October 18, 2017, on the PGCB website and in the World Bank's Operations Portal on October 20, 2017. The Bangla version of the executive summary of the EIA has been disclosed on October 30, 2017. Hard copies of the document will also be made available in all field offices related to the project's implementation. A national level workshop on the draft final EA has been planned in January 2018. PGCB will also be responsible for getting necessary environmental clearance from the Department of Environment. The subproject-specific Environmental Code of Practice and the EMPs with cost and special environmental clauses shall be incorporated in the bid document. Environmental issues will be integrated into the project GRM.

G. Gender and Citizen Engagement

71. In general, there is a gender disparity in the country between men and women in labor force participation, and women are particularly vulnerable in the rural areas. The socioeconomic survey carried out during the RAP preparation considered gender-disaggregated consultations and it was found that no women in the project area are currently engaged in any income-generating activities. As agreed with the implementing agency, the proposed project will continue to be gender informed and implement any



follow-up actions recommended to address the differential needs of male and female project-affected people. Efforts will be made to ensure that compensation for the lost assets under this project that include land, structure, trees, crops, and so on will be paid to actual owners irrespective of gender considerations according to the Land Acquisition law and RAP policy. During the construction phase of the project, separate toilets, shaded rest areas, secluded breastfeeding corners, and so on for the female workers will also be provided in the construction camps.

72. At the implementing agency level, the percentage of women employment is roughly 5 percent of the total workforce and most of the employment is based at the PGCB headquarters. As the works at the field are usually shift based, women's participation in fieldwork is negligible. Although PGCB is interested in hiring more women staff, there is also a shortage of women engineers who are qualified to take up the works at PGCB. PGCB has agreed to undertake an organizational assessment to understand steps that have been taken to address barriers to women's employment and working conditions in the organization. If the assessment suggests that lack of capacity of women workforce is an issue, training will be provided to the targeted women group through the TA part of this project.

73. The project's objective is to improve the transmission infrastructure, which provides limited opportunity for direct engagement with beneficiaries. However, the project will interact with the wider public through focus group discussions to understand the experiences people/business have with power cuts and their expectations about improved service. The specific citizen engagement approaches in the project will also include (a) the consultation process for ESIA and RAP and (b) the GRM with people and communities. The agency will disclose the summary of these discussions on the PGCB website.

H. World Bank Grievance Redress

74. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit <http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service>. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.



VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

COUNTRY : Bangladesh

Enhancement and Strengthening of Power Transmission Network in Eastern Region

Project Development Objectives

The proposed project aims to increase the transmission capacity and reliability of the electricity network in the eastern region and strengthen the institutional capacity of the Power Grid Company of Bangladesh Limited (PGCB).

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Increase in transformation capacity in the project area		Kilovolt-Amphere(K VA)	2775000.0 0	11815000. 00	Annual	Progress report	PGCB
Description: This indicator measures the transmission capacity of the network							
Name: Average interruption frequency per year in the project area		Number	110.00	40.00	Annual	Progress report	PGCB
Description: This indicator will measure the reliability of the transmission system							



Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: People provided with new or improved electricity service	✓	Number	30258000.00	32833000.00	Annual	Progress report	PGCB
Description:							
Name: Improvement in maintenance and financial management practices		Yes/No	N	Y	Annual	Progress Report	PGCB
Description:							
Intermediate Results Indicators							
Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Transmission lines constructed under the project		Kilometers	0.00	290.00	Annual	Progress report	PGCB
Description:							
Name: Transmission lines		Kilometers	0.00	157.00	Annual	Progress report	PGCB



Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
rehabilitated under the project							
Description:							
Name: Substations constructed under the project		Number	0.00	13.00	Annual	Progress report	PGCB
Description:							
Name: Substations rehabilitated under the project		Number	0.00	1.00			
Description:							
Name: Corporate maintenance strategy developed		Yes/No	N	Y	Annual	Progress report	PGCB
Description:							
Name: Live line maintenance implemented		Yes/No	N	Y	Annual	Progress report	PGCB



Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Description:							
Name: Fixed asset registry in place		Yes/No	N	Y	Annual	Progress Report	PGCB
Description:							
Name: Financial Management system implemented		Yes/No	N	Y	Annual	Progress report	PGCB
Description:							
Name: Improved customer (or beneficiary) satisfaction with new or improved electricity service		Yes/No	N	Y	Annual	Progress Report	PGCB
Description:							
Name: Percentage of female staff trained from total staff trained		Percentage	0.00	30.00	Annual	Progress report	PGCB



Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Description:							



Target Values

Project Development Objective Indicators

Indicator Name	Baseline	End Target
Increase in transformation capacity in the project area	2775000.00	11815000.00
Average interruption frequency per year in the project area	110.00	40.00
People provided with new or improved electricity service	30258000.00	32833000.00
Improvement in maintenance and financial management practices	N	Y

Intermediate Results Indicators

Indicator Name	Baseline	End Target
Transmission lines constructed under the project	0.00	290.00
Transmission lines rehabilitated under the project	0.00	157.00
Substations constructed under the project	0.00	13.00
Substations rehabilitated under the project	0.00	1.00
Corporate maintenance strategy developed	N	Y
Live line maintenance implemented	N	Y



Indicator Name	Baseline	End Target
Fixed asset registry in place	N	Y
Financial Management system implemented	N	Y
Improved customer (or beneficiary) satisfaction with new or improved electricity service	N	Y
Percentage of female staff trained from total staff trained	0.00	30.00

