

**Japanese ODA Loan****Ex-Ante Evaluation(for Japanese ODA Loan)****South Asia Division 4, South Asia Department****Japan International Cooperation Agency****1. Name of the Project**

Country: The People's Republic of Bangladesh

Project: Matarbari Ultra Super Critical Coal-Fired Power Project (VI)

Loan Agreement: November 22, 2021

**2. Background and Necessity of the Project****(1) Current State and Issues of the Power Sector and the Priority of the Project in Bangladesh**

Demand for electricity has risen steeply in Bangladesh in recent years due to factors such as stable economic growth and the progression of industrialization, and is expected to increase roughly 7.9% per year over the next decade from 2020 (Ministry of Power, Energy and Mineral Resources, 2016). Meanwhile, the production volume of domestically produced natural gas—the fuel for gas-fired power generation, which the country relies on for roughly 70% of total power generation—has topped out; to meet rapidly increasing demand for energy, the country began importing liquefied natural gas (LNG), which is roughly five times more expensive than domestically produced natural gas, in 2018. The country's overdependence on a single source of energy has prompted concerns that any problems with the fuel supply or relevant facilities could result in energy security problems such as disruptions to the energy supply or rises in the cost thereof. Therefore, the country faces the critical task of diversifying its energy supply structure. Bangladesh has limited potential for hydraulic power generation because most of its territory lies at or below an elevation of 9 m above sea level. The country also has limited land suitable for introducing renewable energy, such as land for large-scale photovoltaic power generation, because its high population density makes land acquisition difficult. As a means of realizing the diversification of energy sources and providing a stable supply of energy to respond to increasingly robust demand for electricity underpinned by factors such as sustained economic growth, the Government of Bangladesh plans to increase the portion of facility capacity dedicated to coal-fired power generation, which is more economically efficient than imported LNG, from roughly 1.5% (2016) to roughly 32% (2041) (Ministry of Power, Energy and Mineral Resources, 2018).

The Eighth Five Year Plan (FY2021-FY2025) sets a goal to enhance the power generation capacity to ensure supply of unhindered quality power from the grid, with 100% population connected to quality electricity supply, and highlights the need to establish a power system capable of providing a stable availability of electricity regardless of time of day or weather through the establishment of multiple energy hubs, including the Matarbari Ultra Super Critical Coal-Fired Power Plant. The Revisiting Power System Master Plan (PSMP) 2016 (Ministry of Power, Energy and Mineral Resources, 2018) also indicates policies for using imported LNG, imported coal, and nuclear power as energy sources for responding to increases in demand for electricity that cannot be met by domestically produced natural gas. Additionally, the Government of Bangladesh formulated Nationally Determined Contributions (NDCs) 2021 (Updated) in 2021 that set out targets (e.g. using ultra supercritical technology in coal-fired power generation) on the condition that it receives additional support from the global community.

Under the Matarbari Ultra Super Critical Coal-Fired Power Project (“the Project”), a highly efficient ultra supercritical coal-fired power plant and other facilities that run on imported coal will be constructed to meet rapidly increasing demand for electricity in Bangladesh while concurrently striving to diversify its energy sources. The Project has been identified as one of Bangladesh’s high-priority infrastructure improvement projects being carried out under the direct supervision of the Prime Minister of Bangladesh, and in the Japan-Bangladesh Leaders Telephone Talk (August 2020), the Japanese and Bangladeshi prime ministers affirmed that Japan and Bangladesh would continue collaborating to work toward development in the Southern Chattogram area, including the highly efficient coal-fired power station.

## (2) Japan’s and JICA’s Cooperation Policy and Operations in Power and Energy sector

The Country Development Cooperation Policy for the People’s Republic of Bangladesh (February 2018) lists the acceleration of economic growth as one of the focus areas, and JICA Country Analytical Work for the People’s Republic of Bangladesh (March 2019) found the stable supply of electricity and energy to be a key issue. Accordingly, it is necessary to diversify energy sources in addition to establishing infrastructure for generating, transmitting, and distributing electricity. The Project is, therefore, aligned with the policy and analysis. Additionally, in terms of realizing energy security in Bangladesh, the Project will contribute to the

pursuit of economic prosperity under the Japanese government's vision of a "Free and Open Indo-Pacific".

The Project will contribute to the stable supply of electricity as well as the diversification of energy sources in Bangladesh. The Project will also contribute to SDGs 7 (access to energy) and 9 (establishing resilient infrastructure).

In the Fifth Strategic Energy Plan (July 2018), the Japanese government committed to providing assistance for introducing ultra supercritical or higher coal-fired power generation facilities if certain requirements are met, only in countries whose only option in terms of energy security and economic efficiency is to use coal as an energy source; the Project is consistent with the Japanese government's assistance policy for coal-fired power generation. Notably, because the Project is already underway, the Japanese government considers it to be outside the scope of requirements for coal-fired power generation exports listed in Infrastructure System Overseas Promotion Strategy 2025 (December 2020).

The following are primary examples of assistance JICA has provided in the power and energy sector.

- Japanese ODA Loans: Matarbari Ultra Super Critical Coal-Fired Power Project (FY2014-FY2019), Dhaka Underground Substation Construction Project (FY2017), Energy Efficiency and Conservation Promotion Financing Project (Phase 2) (FY2019)
- Technical Cooperation: Dispatching of Power Sector Advisors (FY2004–FY2016, FY2019-FY2021), The Project for Gas Network System Digitalization and Improvement of Operational Efficiency in Gas Sector in Bangladesh (FY2019-FY2022), The Integrated Energy and Power Master Plan Project (FY2021-FY2023)
- Private Sector Investment Finance : Sirajganj Combined Cycle Power Plant Project (FY 2017, Co-financing projects with IFC), Moheshkhali Floating Storage and Regasification Unit Operation Project (FY2017, Project Financing), Meghnaghat Combined Cycle Power Project (FY 2020, Leading Asia's Private Infrastructure Fund (LEAP))

### (3) Other Donors' Activities

The World Bank is providing support for the following in the Power and Energy sector of the country: improvement of the core transmission network; provision of development assistance loans for the power sector; formulation of plans for the financial reform and restructuring of the power sector; and construction of gas-fired power plants. The Asian Development Bank is providing support for

the following: improvement of Bangladesh Power Development Board (BPDB) management efficiency; establishment of the Bangladesh Energy Regulatory Commission (BERC); and construction of gas-fired power plants. The Asian Infrastructure Investment Bank is providing support for the development of power distribution networks and the reinforcement of gas distribution networks.

### 3. Project Description

#### (1) Project Objective

The objective of the Project is to increase stable power supply and to diversify energy source in Bangladesh by constructing an ultra super critical coal-fired power plant in Matarbari area, thereby contributing to nationwide economic development.

#### (2) Project Site / Target Area

Matarbari area, Moheshkhali region, Cox's Bazar District, Chattogram Division

#### (3) Project Components

- 1) Ultra super critical coal-fired power plant (600 MW × 2 units), port for coal transport
- 2) Transmission lines (approx. 94 km of 400 kV transmission lines, electric power pylons, etc.)
- 3) Access roads (bridge: approx. 0.8 km; construction of new roads: approx. 7.4 km; repair of existing roads: approx. 5 km; etc.)
- 4) Electrification of the surrounding areas (132 kV transmission lines: approx. 25 km; 132/33 kV and 33/11 kV substations; and 33/11/6.35/0.4 kV distribution facilities)
- 5) Consulting services (basic design/detailed design, tender assistance, construction supervision, organization reinforcement, etc.)

#### (4) Estimated Project Cost

811,048 million Yen (Loan Amount in this tranche: 137,252 million Yen)

#### (5) Project Implementation Schedule

June 2014–January 2027 (152 months in total). The Project will complete upon commencement of operation (July 2024).

#### (6) Project Implementation Structure

- 1) Borrower: The Government of the People's Republic of Bangladesh
- 2) Guarantor: N/A
- 3) Executing Agency: Coal Power Generation Company Bangladesh Limited (CPGCBL), Power Grid Company of Bangladesh Limited (PGCB), Roads

and Highways Department (RHD)

- 4) Operation and Maintenance System: CPGCBL will operate and maintain the power plant and the port for coal transport, PGCB will operate and maintain the power transmission lines, and RHD will operate and maintain the access roads. Additionally, Chittagong Port Authority (CPA) will operate and maintain the access channel, basin, and breakwaters. The Bangladesh Water Development Board will be in charge of the embankments that form part of the access roads.

(7) Collaboration and Sharing of Roles with Other Donors

1) Japan's Activity

A coal-fired power plant to be constructed in the Project will be connected to the substation (expected to be completed in June 2022) to be constructed in the Japanese ODA Loan project called the Dhaka-Chittagong Main Power Grid Strengthening Project (FY2015) and will supply electricity to the Dhaka metropolitan area. After the completion of the commercial port which is planned to be constructed in the Japanese ODA Loan project called the Matarbari Port Development Project (I) (FY2019), a part of the port facilities (access channel, basin, and revetment) to be developed in the Project will be used jointly with the commercial port. Plans also call for the formulation of a master plan for realizing a low-carbon/ decarbonized society and achieving sustained growth through a technical cooperation for development planning titled "Integrated Energy and Power Master Plan Formulation Project" (FY2021–FY2023).

2) Other Donors' Activity: N/A

(8) Environmental and Social Consideration/Cross-Sectoral Issues/Gender Category

1) Environmental and Social Consideration

- ① Category: A
- ② Reason for Categorization: The Project falls into the thermal power sector under the JICA Guidelines for Environmental and Social Considerations (published in April 2010).
- ③ Environmental Permit: The Environmental Impact Assessment (hereinafter referred to as "EIA") Report on the construction and maintenance of the power plant and port was approved by the

Department of Environment (hereinafter referred to as “DOE”) in October 2013, and the EIA Report on the construction and maintenance of transmission lines and access roads was approved by DOE in November 2013. The EIA Report on rural electrification (i.e., construction of a transmission line network) was approved by the DOE in October 2015. The need of an additional scope of the construction and maintenance of the power plant and port, including the construction of a breakwater, expansion of the shipping channel, and construction of berths, arose later, but an EIA report was prepared as part of the Matarbari Port Development Project, and it was approved by the DOE in November 2018. Similarly, although the routes of the power transmission lines were changed, an EIA report was prepared as part of the Dhaka-Chittagong Main Power Grid Strengthening Project, and it was approved by the DOE in September 2016. Additionally, because the routes of the access roads were changed, the EIA for the construction and maintenance of the access roads was revised, and then approved by the DOE in January 2016.

- ④ Anti-Pollution Measures: The Project will incorporate seawater-based flue gas desulfurization equipment and a low-NO<sub>x</sub> combustion system, so it is expected to meet the criteria for both sulfur oxide (SO<sub>x</sub>) and nitrogen oxide (NO<sub>x</sub>) exhausts from power stations in accordance with applicable domestic and international regulations (IFC Environmental, Health, and Safety Guidelines. Hereinafter referred to as “EHS Quidelines”). The power station to be constructed in the Project is expected to meet both national standards and EHS Guidelines for atmospheric concentrations. Furthermore, the estimated (annual) PM<sub>10</sub> concentration level (42.4 to 62.4 µg/m<sup>3</sup> ) for the power station’s emissions exceeded the upper limit of Bangladesh's prescribed range, but this was the only instance in which the plant missed a threshold. This most likely reflected the impact of the pre-implementation concentration level (42 to 62 µg/m<sup>3</sup> ) and the Project presumably contributed an insignificant amount of 0.4 µg/m<sup>3</sup> . The effects of PM will be minimized by adopting a high stack (275 m) and electric dust collectors. Plans also call for preventing coal dust from scattering by sprinkling water mainly during the dry season once the plant is in service. Seawater will be used for cooling in the Project, but no

negative impact on the ecosystem is expected. By controlling the temperature of the water at discharge to within 7°C above the temperature at intake, the plant will comply with the national standard (less than 40°C). The noise impact is expected to meet the standard for Bangladeshi or EHS guidelines during the construction and after the commencement of service.

- ⑤ Natural Environment: The target area of the Project is not located in or around vulnerable areas, such as national parks. Sonadia Island, designated as an “Ecologically Critical Area” by the Government of Bangladesh, is located approximately 15 km south of the Project site. However, no negative impact on Sonadia Island is expected because the mitigation measures noted in the anti-pollution measures will be taken and the effects of air pollution and water contamination will remain limited. To avoid any harm to the breeding of sea turtles, necessary measures has been taken during their breeding and hatching season, including dimming the intensity of light sources illuminated on the sea surface or the surrounding area during construction and limiting noise and vibration. Project workers has been bunned from gathering, harvesting, or hunting spoon-billed sandpipers and other rare species, or their eggs. In addition, the additional environmental impact on the expansion of the access channel and basin, joint work with the port project, is assumed to be the impact of dredged soil discharged to the sea, but the impact on the surrounding environment will be minor, because mitigation measures will be taken to minimize the impact on benthic organisms, fish, and other organisms. For example, the diffusion of pollution will be minimized by selecting a sea area with a sufficient distance and depth from offshore as a candidate site for ocean disposal, installation of a pollution diffusion prevention film, and other measures.
- ⑥ Social Environment: The size of land acquisition for construction of the power plant and port is approximately 709 ha; a portion of the area was used as a salt field during the dry season and for shrimp cultivation during the rainy season. The construction and maintenance of the power plant and port required the resettlement of non-title holders (44 households); payment of compensation to eligible households is complete. A total of 2,300 residents were affected, although

compensation has not yet been paid to some of them, the executing agency has been continuing activities (e.g. holding meetings, visiting individual residences) toward completing the payments. Additionally, the construction of new access roads and repairs to existing access roads required roughly 41 ha; land acquisition was required for roughly 11 ha of that area. The land acquisition required the resettlement of 580 residents from 102 households (including non-title holders). Although compensation has not yet been paid to all affected residents (including resettled residents), procedures for land acquisition, compensation, and assistance are proceeding according to domestic procedures in Bangladesh and the Resettlement Action Plan (RAP) prepared in line with JICA Guidelines for Environmental and Social Considerations. Land owned by the executing agency and government is being used to construct power transmission lines and electrifying communities in the vicinity; consequently, neither land acquisition nor resident resettlement is required. The payment of compensation to affected residents is essentially complete, and procedures are proceeding according to domestic procedures in Bangladesh and the RAP prepared in line with JICA Guidelines for Environmental and Social Considerations. Notably, discussions with local stakeholders have been held according to the RAP.

- ⑦ Other / Monitoring: For the resettlement of residents and livelihood restoration, the executing agency will conduct internal monitoring and third-party institutions will conduct external monitoring. With regard to the environment, the executing agency and the contractor has been monitoring the air quality, water quality, noise levels, vibrations and ecosystem during construction. After the commencement of service, the executing agency will continue monitoring these factors.
- 2) Cross-Cutting Issues: CPGCBL and the Contractor have and will continue to implement specific measures to prevent COVID-19 infections, including rigorously conducting PCR testing, constructing lodging facilities on the Project site to minimize relevant people's travel into and out of the site, and performing health checks at site entrances.
- 3) Category of Gender [N/A]: GI (Gender Mainstreaming Needs Assessment and Analysis Project)  
Description of Activities/Reason for Categorization: Although gender

mainstreaming needs were investigated and confirmed under the Project, it did not lead to the implementation of specific efforts to contribute to gender equality or empowerment of women. Gender-segregated interviews and gender-balanced stakeholder meetings have been conducted with regard to environmental and social considerations during the preparatory survey.

(9) Other Important Issues: N/A

#### 4. Targeted Outcomes

(1) Quantitative Effects

Outcomes (Operation and Effect Indicators)

Indicator		Baseline (Actual value in 2013)	Target (2026) (Expected value 2 years after project completion)	
Power Plant	Net electric energy production(GWh/year)	N/A	7,865	
	Utilization ratio(%)	N/A	80	
	Operation rate (%)	N/A	85	
	Auxiliary power ratio (%)	N/A	6.48	
	Gross thermal efficiency (%)	N/A	41.11	
	Unit downtime*	Human errors (hours/year)	N/A	0
		Mechanical troubles (hours/year)	N/A	218
		Regular inspections (hours/year)	N/A	1,096
	Frequency of suspension of operations (times/year)*		N/A	10
Fuel Consumption (1000 tons/year)*		N/A	1,863	
Transmi ssion Lines	Transmission loss rate(%)	N/A	0.4	
Ports and Harbors	Berth occupancy rate (%)	N/A	60	
	Total cargo volume (1000 tons/year)	N/A	4,000	

\* Per unit

(2) Qualitative Effects

Diversification of energy sources and stabilization of electricity supply through the strengthening of supply capacity

(3) Internal Rate of Return

According to the following preconditions, this project's Economic Internal Rate

of Return (EIRR) will be 13.7%. The Financial Internal Rate of Return (FIRR) will be 1.6% for power generation, port and harbor, and road construction and 9.7% for power transmission.

**【EIRR】**

Cost: Project costs, fuel costs, and maintenance/operation costs (excluding tax)

Benefit: The difference between electricity generated by the Project (with case) and the costs of electricity purchased from private power producers (without case) (including maintenance costs)

Project Life: 36 years

**【FIRR】**

(Power generation, port and harbor, and road construction)

Cost: Project costs (for the construction of a power plant, port, harbor, and roads), fuel costs, and maintenance/operation costs

Benefit: Sales revenue for electric power (PPA)

Project Life: 36 years

(Power transmission)

Cost : Project costs (for transmission lines), maintenance/operation costs

Benefit : Revenue from transmission charges

Project Life : 34 years

## **5 . External Factors and Risk Control**

(1) Preconditions: Conclusion of procurement agreements for the imported coal needed to operate the power plant.

(2) External Factors: N/A

## **6 . Lessons Learned from Past Projects**

The results of the ex-post evaluation of the Mombasa Diesel Generating Power Plant Project (evaluated in 2005) in the Republic of Kenya demonstrates that appropriate support from the manufacturers enhances the sustainability of power plant projects. For the Project, a maintenance and operation system will be built and established by means of a technology transfer for operation and maintenance management through consulting services and a Long Term Service Agreement with the manufacturers. Additionally, efforts will be made under the Project to strengthen the management system of the executing agency with organizational strengthening consultants employed separately.

## **7 . Evaluation Results**

Under the Project, a highly efficient coal-fired power plant that runs on imported

coal will be constructed to contribute to the diversification of energy sources and expand the capacity of Bangladesh to supply electricity in response to rapidly increasing demand for electricity; therefore, the Project is consistent with Bangladesh's development issues and policies and with the assistance policies and the analysis of the Government of Japan and JICA. The project will also contribute to Goal 7 ("Ensure access to affordable, reliable, sustainable and modern energy for all") and Goal 9 ("Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation") of SDGs. Thus, the necessity for JICA to support the Project is substantial.

#### **8. Plan for Future Evaluation**

(1) Indicators to be Used

As indicated in Sections 4.

(2) Future Evaluation Schedule

Ex-post evaluation: Two years after the project completion

END