Ex-Ante Evaluation

1. Name of the Project

Country:	Arab Republic of Egypt
Project:	Electricity Sector Rehabilitation and Improvement Project
Loan Agreement:	October 24, 2016
Loan Amount:	41,098 million yen
Borrower:	Egyptian Electricity Holding Company (EEHC)

2. Background and the Necessity of the Project

(1) Current State and Issues of the Electricity Sector in Egypt

The Arab Republic of Egypt (hereinafter Egypt) experienced economic growth averaging 4.3 percent over the ten years from fiscal 2005/06 to fiscal 2014/15, but its peak load for the same period grew even faster, averaging 6.0 percent (as calculated from IMF World Economic Outlooks and EEHC Annual Reports).

With the increase in power demand, installed capacity has risen year by year. That capacity for fiscal 2014/15 reached 35,220 MW (from the EEHC 2014/2015 Annual Report), which is 1.72 times that of the capacity for fiscal 2005/06. However, assuming that peak load continues its growth at 6.0 percent annually, the peak load for fiscal 2017/18 is projected to reach 37,333 MW, which would exceed the supply capacity for fiscal 2014/15.

Further, the average availability of power generation for fiscal 2014/15 reached 83.3 percent (from the EEHC 2014/2015 Annual Report). After accounting for generation facilities not in operation due to regular inspections, the available installed capacity, which was calculated as 29,338 for fiscal 2014/15, is well below installed capacity.

Currently, Egypt is highly dependent upon thermal power. According to the EEHC 2014/15 Annual Report, power resources were 8 percent hydropower, 90 percent thermal power, and 2 percent renewable energy. From the same report, natural gas comprised 73.6 percent of the fuel used for thermal generation. Oil and natural gas development have floundered since the Arab Spring in 2011 due to the worsened investment climate; with a shortage of natural gas, some power plants are turning to diesel fuel and other low-quality alternatives. The existing thermal power plants are steadily falling in efficiency, leaving them unable to generate sufficient power.

Given the circumstances, power shortages in recent years are becoming a social issue and resulting in outages. These outages were particularly frequent in the summer of 2014. Thus, with the power supply slumping, efficiency must be maintained or raised for existing plants, and installed capacity must be further strengthened in order to stabilize power supply so that it can meet the strong power demands.

(2) Development Policies for the Electricity Sector in Egypt and the Priority of the Project

In its Five-Year Macroeconomic Framework and Strategy for FY14/15-FY18/19 announced in March 2015, the Egyptian Government positioned the Electricity Sector, along with the rest of the energy sector, as a sector of importance. The strategy lists strengthening generation facilities as necessary for preventing power outages. In the Energy White Paper also announced in March 2015, the Egyptian government speaks of improving the low efficiency for its thermal power plants as the means to increase generation for existing plants without building any new plants. Also, the draft submitted

in November of the same year for the UN Framework Convention on Climate Change (UNFCCC) stipulates that Egypt strive to reduce greenhouse gas (GHG) emissions by introducing optimized technology from developed countries.
The Electricity Sector Rehabilitation and Improvement Project (hereinafter, the "Project") is a project to help stabilize power supply and reduce GHG emissions by updating, overhauling, and supplying reserve parts for equipment for existing thermal power plants in order to recover their generation capacity, improve plant efficiency, and maintain that efficiency. The Project is aligned with the issues and policy for the Egyptian Electricity Sector.

(3) Japan and JICA's Policy and Operations in the Electricity Sector

Japan's Country Assistance Program for Egypt (June 2008) lists improving the investment and business climates as an important sector target under the heading of "realizing sustainable economic growth and employment creation" for assistance policies for respective priority areas. Further, in the Country Analysis Paper for Egypt (March 2016), JICA gives programs for assisting development of power infrastructure and promoting energy conservation as cooperation programs which will contribute to address important development issues in Egypt. To date, JICA has approved 18 yen loan projects in the Electricity Sector. Also, four projects are currently underway: the Gulf of El Zayt Wind Power Plant Project, the Energy Control System Upgrading Project in Upper Egypt, the Electricity Distribution System Improvement Project, and the Hurghada Photovoltaic Power Plant Project. The Project will recover installed capacity, improve plant efficiency, and help to maintain this capacity and efficiency, and these outcomes are aligned with the above policies and analyses.

(4) Other Donors' Activity

No other donor agencies are actively assisting Egypt in updating or overhauling equipment for existing thermal power plants. There are multiple cases, however, of donor agencies assisting in construction of new thermal power plants. One such example is a 1,800 MW-scale combined-cycle thermal plant being constructed in Damanhur in northern Egypt with assistance from the European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), Arab Fund for Economic and Social Development (AFESD), and African Development Bank (AfDB).

(5) Necessity of the Project

The Project is consistent with the development policy and issues of Egypt, as well as the pillars of priority for Japan and JICA assistance. Since the Project plants are assumed to be ones with relatively large power generation amount where the current equipment was supplied by Japanese companies, the Project is expected to greatly restore installed capacity and use Japanese technology in the interest of maintaining compatibility with existing equipment. Given all this, the need for JICA assistance in the Project is high.

3. Project Description

(1) Project Objective

The Project will help stabilize power supply and reduce GHG emissions in Cairo and the Alexandria areas by updating, overhauling, and supplying reserve parts for equipment for existing thermal power plants in order to recover installed capacity for

the existing plants, improve plant efficiency, and maintain that efficiency. It will contribute to the growth of the Egyptian economy and society and help mitigate climate change.

(2) Project Site/Target Area

Cairo and Alexandria areas

(3) Project Components

1) Upgrade and overhaul existing thermal power plant equipment, and provide reserve parts (target plants are currently expected to be the Cairo North Power Station, Sidi Krir Power Plant, and El Atf Power Station)
2) Consulting services (tender assistance, construction management, training, etc.)

(4) Estimated Project Cost

50,129 million yen (including the yen loan of 41,098 million yen)

(5) Project Implementation Schedule

From October 2016 to May 2024 (total of 92 months). Project completion is defined as the start of the actual operation at all prospective Project plants (May 2021).

(6) Project Implementation Structure

1) Borrower: Egyptian Electricity Holding Company (EEHC)
2) Guarantor: Government of the Arab Republic of Egypt
3) Executing agency:
   EEHC
   Cairo Electricity Production Company (CEPC)
   Middle Delta Electricity Production Company (MDEPC)
   West Delta Electricity Production Company (WDEPC)
4) Operation/Maintenance/Management Structure
   The plants are operated, maintained, and managed by CEPC, MDEPC, and WDEPC.

(7) Environmental and Social Considerations/Poverty Reduction/Social Development

1) Environmental Social Consideration

a) Category: B
b) Reason for Categorization: The Project does not qualify as a large-scale thermal Electricity Sector project as given in the JICA Guidelines for Environmental and Social Consideration (April 2010). It also is not judged to have a major adverse impact on the environment, has no environmentally sensitive features, and is not in an environmentally sensitive region as given in the Guidelines.
c) Environmental Permit: No Environmental Impact Assessment (EIA) concerning the Project is mandated by Egyptian law.
d) Pollution Measures: During the work, the appropriate pollution preventive measures will be taken according to Egyptian construction guidelines and other

resources to prevent construction materials from scattering and prevent paint and oil/grease from polluting soil in the area. Also, water will be leached appropriately, and work hours will be limited to control noise and vibrations. After handover, emissions are expected to comply with Egyptian and IFC air quality standards. Wastewater will first be treated at existing wastewater treatment plants, and then discharged at a water quality compliant with Egyptian standards.

e) Natural Environment: The target area for the Project is not in a sensitive area such as a national park, nor in the surrounding area of such; therefore, adverse impact on the environment should be minimal.

f) Social Environment: Since the Project will be conducted within the grounds of existing power plants, no land acquisition or resettlement is necessary.

g) Other/Monitoring: During the work, the implementing bodies and construction contractor will monitor for noise, vibration, water quality, soil quality, and other factors. After handoff, the implementing bodies will monitor air quality, water quality, and other factors.

2) Promotion of Poverty Reduction: None
3) Promotion of Social Development: None

(8) Possibility of Coordination with Other Donors: None
(9) Other Considerations:

1) The Project is expected to use Japanese technology in the interest of maintaining compatibility with existing equipment.
2) Upgrading the existing thermal plant equipment will improve plant efficiency and help to reduce GHG emissions. Assuming the current plant candidates are selected for the Project, the Project would reduce GHG emissions by an estimated 68,469 tons/year in CO2 equivalence. Once plant selections are made official, the mitigated effects will be recalculated.

4. Targeted outcomes

(1) Quantitative Effects

1) Outcomes (performance indicators)
The baselines and targets for these indicators will be set for each Project plant once the sub-projects are decided.

Indicators	Baseline (Actual figures for 2018)*1	Target (2023) (Expected value 2 years after project completion)
Plant Load Factor (%)	—	—
Availability Factor (%)	—	—
Outage Hours for Every Cause (hrs/yr)	—	—
Maximum Output (MW)	—	—
Net Electric Energy Production(MWh/yr)	—	—
GHG Reduction (t/yr)	—	—

*1: 2015 figures will be used for the baseline for the Cairo North Power Station.

(2) Qualitative Effects

Promoting economic growth, stimulating industry, helping to stabilize resident life with a stable power supply, mitigating climate change

(3) Internal Rate of Return

Based on the following preconditions, the Economic Internal Rate of Return (EIRR) and Financial Internal Rate of Return (FIRR) will be calculated for each Project plant once the sub-projects are decided. Note that preconditions may change when sub-projects are decided.

[EIRR]
Cost: Project cost, operation and maintenance expenses (all excluding tax)
Benefit: Consumers' willingness to pay for additionally supplied power due to recovered generation capacity, electricity sale income which would be lost due to outages if the Project is not performed
Project Life: 15 years

[FIRR]
Cost: Project cost, operation and maintenance expenses
Benefit: Electricity sale income
Project Life: 15 years

5. External Factors and Risk Control

None

6. Lessons Learned from Past Projects and Application to This Project

(1) Lessons Learned from Similar Projects

In the ex-post evaluation and other reports for the Mombasa Diesel Generating Power Plant Project in Kenya, generation figures did drop temporarily due to generator and equipment failures after exceeding their manufacturer service periods, but then plant O&M capacity was improved by building and precisely managing a system for technical cooperation with the manufacturer.
From the ex-post evaluation and other reports for the Rades Combined Cycle Power Plant Construction Project in Tunisia, the lesson learned is that full consideration should be given to increasing project sustainability in terms of the implementing bodies securing maintenance personnel and how personnel are trained.

(2) Application of Lessons to This Project

This Project is scheduled to improve the knowledge and skill of Egyptian engineers and enhance O&M capacity for facilities by including manufacturer training in the project content and assisting in human resource development for thermal power plant O&M through technical cooperation.

7. Plan for Future Evaluation

(1) Indicators to be Used for Future Evaluation

Plant load factor, availability factor, outage hours for every cause, maximum output, net electric energy production, greenhouse gas reduction, EIRR, and FIRR

(2) Time of Future Evaluation

Two years after the completion of the Project